Understanding Brownfield Regeneration in Iran through the Lens of International Experience

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In ever loving memory of Arash, my brother.

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List of Abbreviations

BBC	Building Better Cities (Australia)
CABERNET	Concerted Action on Brownfields and Economic Regeneration Network (EU)
CDP	Comprehensive Development Plan (Iran)
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (US)
CF	Cohesion Fund (EU)
CLARINET	Contaminated Land Rehabilitation Network for Environmental Technologies (EU)
DoE	Department of Environment (Iran)
DP	Detailed Plans (Iran)
DUF	Deteriorated Urban Fabric (Iran)
EEA	European Environment Agency
ELD	Environmental Liability Directive (EU)
EPA	Environmental Protection Agency (US)
EPI	Environmental Policy Integration
EPIB	Environmental Policy Integration for Brownfields
EPPI	Environmental Protection and Planning Institute (China)
ERDF	European Regional Development Fund
ESIF	European Structural and Investment Funds
EU	European Union
GFC	Global Financial Crisis
HEPI	Horizontal Environmental Policy Integration
HEPIB	Horizontal Environmental Policy Integration for Brownfields
ICHTO	Iran Cultural Heritage, Handcraft and Tourism Organization
MEP	Ministry of Environmental Protection (China)
MLIT	Ministry of Land, Infrastructure and Transport (Japan)
MoE	Ministry of Environment (Japan)
MoI	Ministry of Interior (Iran)
MRUD	Ministry of Roads and Urban Development (Iran)
NEC	Nippon Electric Company (Japan)
PDL	Previously Developed Land
PPP	Polluter Pays Principles
RCRA	Resource Conservation and Recovery Act (US)

SARA	Superfund Amendments and Reauthorization Act (US)
SCCA	Soil Contamination Countermeasures Act (Japan)
SCUPA	Supreme Council of Urban Planning and Architecture (Iran)
SQSG	Soil Quality Standards and Guidelines (Iran)
TKS	Tokyo Kikai Seisakusho (Japan)
UDRO	Urban Development and Revitalization Organization (Iran)
UDUF	Underutilised and Deteriorated Urban Fabric (Iran)
UK	United Kingdom
US	United States
VCP	Voluntary Clean-up Program (US)
VEPI	Vertical Environmental Policy Integration
VEPIB	Vertical Environmental Policy Integration for Brownfields
WWII	World War II

Thesis Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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Armin Mehdipour

02 January 2020

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Abstract

The rapid growth of urban areas arising from the economic and geopolitical trends of the last century has resulted in an increasing volume of underutilized land within cities across the developed and developing world. To pursue the ideal of efficient use of natural resources and to contain the far-reaching implications of urban sprawl, brownfield recycling and reuse has been adopted as a pragmatic policy approach over recent decades. Even though the systematic regeneration of brownfield land has become an important policy agenda in many nations, the phenomenon of brownfield is still unexplored within the current statutory framework of Iran. This research aims to provide an inclusive explanation of 'brownfield regeneration' in Iran. It seeks answers to fundamental questions about how brownfield sites have emerged, and how they could be effectively responded to in policy and action. Using a multiple-case study approach, the research examines how countries in different regional and political contexts have understood and practiced land recycling and reuse. Considering four international cases, including the US, Europe, Japan and China, this study analyses the brownfield formation process and legislative response. Such analysis helps to set some findings suited to the scope for brownfield regeneration and policy development in Iran.

To shed light on brownfield-related issues in Iran, this research is structured in three major phases. The first phase is based on data collection and analysis of international case studies, investigating the rooted causes of brownfield generation and key characteristics of the policy-making process across these different examples. Drawing on the findings from international case study analysis, the second phase of this study develops an analytical tool, namely Environmental Policy Integration for Brownfields (EPIB). Through the lens of the EPIB tool, multiple development factors in brownfield policies and practices are comparatively analysed. Finally, the third phase applies this analytical tool to the Iranian context. Using several case study site visits and interviews with different stakeholder groups in Iran, the study explains how brownfield sites have been formed within Iranian cities, and to what extent development agencies and actors have understood the concept of brownfield regeneration to date. This thesis highlights the key challenges, opportunities and shortcomings arising from the current state of brownfield-related policies in Iran. These findings are relevant to all levels of government and provide a foundation to future policy development in relation to brownfield sites in Iran.

PART I

CHAPTER 01

Introduction

1.1 Preamble

Urbanization is one of the most important global trends of the last 200 years and as we progress into the 21st century it continues to be the subject of ongoing debate across the world. Cities are a reflection of economic opportunities as they generate more than 80 per cent of global GDP (UN-HABITAT 2011). Although cities act as engines of economic development mainly driven by industry and services, they are a big part of the environmental problem facing humanity (Newman 2006; Young et al. 2015; Tietenberg & Lewis 2016; Chen et al. 2016; Behera & Dash 2017; Alvarado & Toledo 2017). The widespread phenomena of environmental pollution, carbon emissions, climate change, and natural resource depletion are driving policy across different nations and political regimes worldwide to promote sustainable development, as emphasized by the Brundtland Report (WCED 1987). The idea of urban regeneration contributes to the bigger sustainability argument about efficient use of natural resources (Weinberg et al. 2000; Newton 2010). Since the 1990s, regeneration of urban brownfields has become an integral part of city policy and action in the developed world. In other places, such as China, brownfield regeneration is still emerging (Xie & Li 2010) and in many countries, such as Iran, it has not been recognised yet as a necessary urban policy (Zekavat & Motamedi 2015).

This research predominantly intends to reflect on the brownfield emergence process and set this in the broader context of urban change. In particular, the present study attempts to address brownfield issues in the context of Iran, setting these within the broader international perspective. Given its inherent environmental, physical and socio-economic complexities, regeneration of brownfields often presents a series of challenges across various phases of decision-making and practice. The study also aims to address these challenges and explain the development of policy and practice in respect of brownfields, with particular attention to urban development and policy in the context of Iran. This chapter begins by elaborating on the statement of the research problem in Section 1.2 and highlighting the scope of the research in Section 1.3. Building on this narrative, the aims and objectives underlying the study are outlined in Sections 1.4. Section 1.5 describes the significance of the study, and the chapter concludes with a brief discussion outlining the structure of the thesis.

1.2 Statement of the problem

Over the last century, cities around the world have grown both in population and in size. The rapid process of urbanization and spatial distribution of population have occurred in different time periods and forms in different parts of the world. Concurrent with uneven expansion of urban areas has been the outward migration of industrial activities ways from central cities towards outer suburbs, regional areas and overseas (Breheny 1987; Champion 2001). The relocation or closure of factories has been commonly driven by factors such as constraints on the supply of land in inner-city areas, the increasing value of urban land and more importantly structural change resulting from international competition (Zhu 2004; Evans 2008; Gereffi 2011). In addition to post-industrial sites, cities in many countries have witnessed an increasing volume of underutilized land, commercial properties, older housing and military sites due to a series of structural, socio-economic and geopolitical driving forces.

The steady expansion of urban areas causes many forms of socio-economic, and environmental-physical costs, such as increased pressure on undeveloped land, increased air pollution and emission of greenhouse gases, increased charges for local communities and taxpayers as well as negative impacts on public health (Squires 2002b; Ewing 2003; Bruegmann 2005; Galster et al. 2001). In response to widespread problems caused by uncontrolled growth of cities, several anti-sprawl movements have been reformed since the second half of the twentieth century in order to map out coherent urban containment strategies. Although the incentives of these strategies vary in different countries, there can be little doubt that all are driven by two dominant motives; first, reduction of pollution and second, protection of undeveloped lands and open countryside (Breheny 1996). In the words of Sherlock (1990),*"instead of frittering away valuable urban land as a palliative to those who suffer a poor environment, we would be better off using our resources to improve the appearance and safety of the whole urban environment while, at the same time, maintaining the concentrated form of the city."*

Over and above the urbanization trend, since the mid-1970s, many cities across the developed world have experienced a strong wave of industrial restructuring as a result of economic globalization and emergence of new service-based industries often located in inner cities. There has been a marked shift of manufacturing away from the developed to the developing world as a result of high labour costs and the replacement of many secondary by tertiary jobs. The land vacated by former manufacturing industries has often lain derelict for long periods in many cities, as result of low demand, high costs of remediation and safety issues resulting from contamination. In the period since 1990, many large urban areas in developed economies have come to be viewed as development opportunities with residential, cultural or economic potential. In the course of time cities have won back the ground they have lost in terms of population and employment initiating a new round of urban change (Klaassen & Scimeni 1981). This back-to-the-city stage of urban dynamic is often referred to as re-urbanization and represents an integrated approach towards strengthening urban communities and promoting the viability of central cities (Brotchie et al. 1995; Champion 2001; Glaeser & Gottlieb 2006; Brotchie et al. 2017).

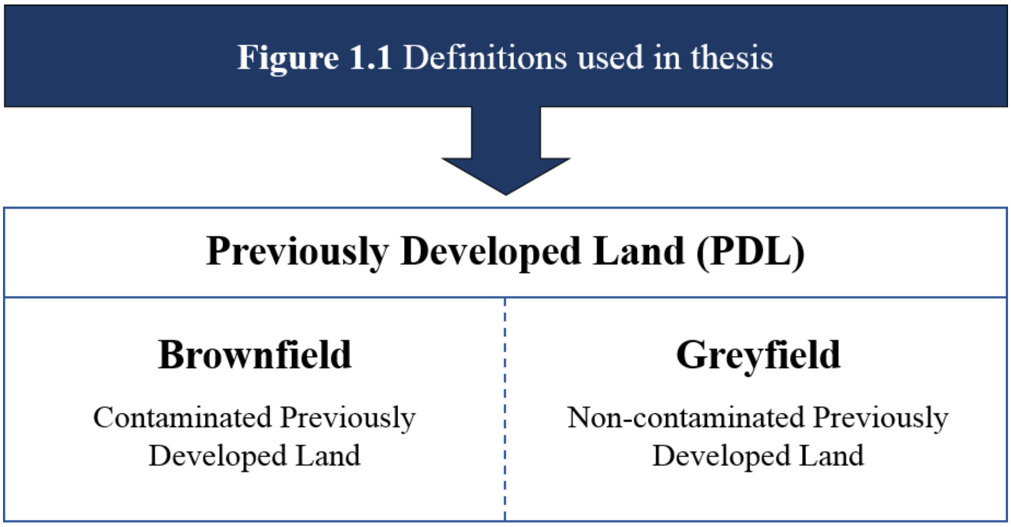
The agglomeration of inner-city services and amenities has stimulated the population and employment inflow to urban core areas in many countries, in particular in the context of European cities (Cheshire 2006; Haase et al. 2010). Growing inner-city residential and occupational preferences have reinforced trends in both public policy and the market towards the reuse of old buildings, and the rejuvenation of derelict land and infrastructure, such as canals and railways. This regeneration process has gone through a number of transformations in strategy, orientation and approach to intervention (Roberts 2017). For example, in the UK, during the 1980s the idea of urban reinvestment using public funds to leverage private funds was paramount, whereas in the 1990's the government policy's focus was placed more on community development.

With the agglomeration of informational, cultural and knowledge-intensive industries in many twenty-first-century cities, the nexus between liveability and sustainability has become an important subject of urban development discussion and policy agenda (Florida 2005; Newton 2012). As part of this big picture, the concepts of *'urban regeneration'* (Roberts 2000; Garcia 2004) and, more recently, *'regenerative cities'* (Girardet 2010; Du Plessis 2012; Thomson & Newman 2018) have emerged as key parts of the sustainable development discussion and policy debate. Roberts (2000) identifies urban regeneration as *a "comprehensive and integrated vision and action which leads to the resolution of urban problems and which seeks to bring about a lasting improvement in the economic, physical, social and environmental condition of an area that has been subject to change or offers opportunities for improvement"*. Based on such vision and action, Girardet (2014) suggests that the idea of creating regenerative cities goes further than just urban regeneration, as *"it focuses on the linkage between city people and nature, between urban systems and ecosystems"*. He argues regeneration of cities and sustainability under the broader context of urban growth and future development. Building on this narrative, there is scope for further discussion of 'brownfield regeneration' within the bigger picture of urbanization. While there are various attempts to develop policy approaches to brownfield regeneration, there is less discussion of the relationship between brownfields and urban structural change. This study seeks to explore this issue further.

1.2.1 *What is Brownfield?*

The term brownfield has been widely used in academic literature and policy documents since the 1990s. At present, there are different interpretations of the brownfield concept worldwide. Given a wide variety of terminologies, different stakeholder groups involved with brownfield regeneration may favour interpretations of the terminology that reflect their own perspectives (Alker et al. 2000). The United States first introduced the term brownfield as *"abandoned, idled, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination"* (USEPA 1995). In a similar vein, in Australia, brownfields are defined as abandoned or under-used industrial and commercial sites that are contaminated to some degree, depending upon the nature of prior use (Newton 2010). To distinguish non-contaminated land from contaminated, the term greyfield has been used to describe non-contaminated precincts, including ageing and occupied residential sites in Australia (Newton 2010), or outdated retail and commercial sites in North America (Adams et al. 2010). However, several countries, e.g. the UK, Germany, France and Belgium, have labelled brownfield more broadly as a Previously Developed Land (PDL) that represents both contaminated and non-contaminated derelict land.

In the light of this variation in definitions, for the purpose of this research, brownfield is discussed as *"previously developed land (excluding agricultural land) that is currently unoccupied or not in productive use, and is known or suspected to be contaminated"*. Brownfields are physically deteriorated, economically distressed, and environmentally degraded areas that have emerged as a result of a range of economic and structural changes. The most notable examples are former industrial, mining and military urban sites that are often subject to soil and groundwater contamination issues. Having said that, greyfields are referred to as non-contaminated derelict lands, such as outdated residential, retail and commercial sites. In addition, Previously Developed Land (PDL) is a term used to describe a combination of both contaminated derelict land (brownfield) and non-contaminated derelict land (greyfield). Figure 1.1 shows the definitions used in thesis.



1.2.2 Brownfield policy and practice

Over the past few decades, the phenomenon of brownfield has attracted the attention of decision-makers and practitioners in many regions around the world. Many countries and political regimes to date have underpinned policy approaches to promoting brownfield regeneration. For instance, between 1995 and 2003, the United States federal government for environmental protection made an investment of over US$700 million in the Brownfields Program (USEPA 2003). In the UK, the recycling and reuse of PDL (i.e. brownfield and greyfield) has been a policy of central government as more than 60 per cent of new housing developments are established on such land (Tang & Nathanail 2012). Generally, brownfield regeneration policies aim at making available resources that can be utilized for sustainable development pursuant to three strategic targets; (1) to promote socio-economic regeneration of surrounding areas, (2) to improve the environmental conditions of the sites themselves, and (3) to reduce the development pressure on undeveloped lands (Dixon 2006). However, legislative decisions and actions vary strongly in different countries on account of great disparities in spatial-industrial development, their institutional structures and policy drivers and priorities. As the thesis will show, different nations are at different stages of policy development in addressing brownfield issues and Iran is an example of one that has just started this journey.

1.3 Scope of the research

This study contributes to the rigorous analysis of urban brownfield phenomenon from several nation-specific perspectives and examines how different states have characterized and practiced brownfield regeneration. Findings from this international analysis provide significant references for understanding the structural formation and policy-making procedure associated with brownfields in Iran. Using an analytical tool, such references are tailored to meet the specific requirements of the Iranian context.

Unlike the growing awareness about the significance of land recycling and reuse particularly across advanced economies, there is a lack of adequate understanding of brownfield-related issues in Iran. Generally, the significance of brownfield regeneration in inner-city areas attracts scant attention within the Iranian urban management and planning system, because its potential is mostly unexplored by the government, developers, and other stakeholder groups involved. The phenomenon of brownfield is still unknown in the existing legal and regulatory framework in Iran, and thus, no structural support system has been, to date, framed for regeneration of such sites. In Iranian urban vocabulary, the term brownfield has not yet been officially defined and there is no consensus to address the extent of brownfield lands. According to a report from the Urban Development and Revitalization Organization of Iran (UDRO 2018), there are over 140,000 hectares of old and deteriorated urban areas within nearly 500 cities which include almost 30 per cent of the total urban area in Iran. However, it is unclear to what extent this figure encompasses brownfields as there is no explicit terminology for such sites to be used in land-use planning and for legislative purposes.

The UDRO's report seems to only reflect the extent of greyfields in Iran, whereas contaminated post-industrial sites or brownfields, tend to gradually appear in the fabric of several large, medium-sized and small Iranian cities. Over the past two decades, Iran has witnessed a drastic decline in manufacturing activities, particularly in the light manufacturing sectors. Owing to the economic sanctions and geopolitical condition of the country, the hollowing-out process of industries has been further intensified over the past years. The result is the emergence of vast tracts of former factory sites that, in some cases, suffer from environmental contamination in the soil and groundwater system. Such environmental risks pose serious obstacles to the regeneration process of brownfields in Iran, as elsewhere in the world. Sustainable regeneration of brownfields relies heavily upon overcoming these environmental obstacles. To date, neither the Iranian environmental protection organization nor land-use planning organization has recognized the importance of regenerating such contaminated sites. Meanwhile, no research has been undertaken to date to reflect interests of the full range of stakeholder groups involved and unravel possible challenges they may encounter in dealing with such sites. The existing level of conception and policy response to brownfield issues in Iran call for an empirical analysis to explore how different nations around the world have conceived and applied land remediation and redevelopment mechanisms. Such analysis will greatly help to enrich an operational understanding of brownfield regeneration in both policy and practice in Iran.

1.4 Research aims and objectives

This research aims to develop in-depth understanding of brownfield (re)generation in Iran. Through an exploration of experiences across various world regions, it examines the current state of the urban brownfield process in Iran and related policy responses to date. In doing so, the study seeks to achieve a number of objectives, including:

- To explain the process of brownfield emergence and frame it in the context of urban change
- To highlight and examine international examples of brownfield regeneration
- To examine the scope for brownfield land recycling and reuse in Iran
- To construct a tool that analyses and explains the legislative and policy situation in respect of brownfields in Iran

1.5 Significance of this study

This research is significant from two major perspectives. It firstly enriches the subject area of brownfield emergence in a broad urban development context. What marks this research out and makes it different from the other investigations on brownfield is its commitment to develop an understanding of the ingrained linkage between the broad process of urban development and the formation of brownfields. Secondly, the study integrates a range of factors which influence brownfield policy and governance from different regimes to provide insights into brownfield regeneration in Iran. It sheds light on different aspects of brownfield activity across relevant sectors of government and administration in Iran.

As discussed in the previous section, Iran faces a significant challenge to regeneration of brownfield, particularly in respect of contaminated former industrial sites. This study is important in fully comprehending the lessons learned from researchers, policy makers and developers in tackling brownfield activities. The research offers important practical references for relevant stakeholders in regenerating brownfield sites in Iran. It aims to highlight the scope for the integration of brownfield regeneration into environmental and spatial structures and examine how such regeneration insight could be applied in policy and practice.

The study is expected to have a significant effect on future policy development regarding brownfield sites in Iran. By investigating the key drivers and barriers, it analyses the current level of understanding and policy response to brownfield issues in the Iranian context. To assist the development and enhancement of this operational understanding, the study draws on four international case studies, namely the US, Europe, Japan and China. The contextual, political, environmental and urban development trends in each international case are documented and the findings analysed by adopting a guiding framework, namely Environmental Policy Integration (EPI). EPI was originally developed by the European Union in the 1980s in order to increase environmental awareness across policy development and implementation process (further discussed in Chapters 3 and 8). Building on EPI, the research develops an analytical tool namely, Environmental Policy Integration for Brownfields (EPIB). EPIB offers a way of understanding the brownfield phenomenon from both policy and practice perspectives, capable of being operationalized in different political or regional contexts. This comprehensive analysis helps to explain the brownfield situation in Iran and may prove useful in future policy development in that nation.

1.6 Structure of the thesis

The thesis is structured in twelve chapters. Chapters are grouped into three parts (see Figure 1.2). Part I (Chapters 1-3) presents an introduction to this research, a broad-ranging review of relevant literature coupled with a detailed methodology. Part II (Chapters 4-8) comprises a rigorous analysis of multiple international case studies followed by the development of a theoretical framework in the light of the selected international cases. Part III (Chapters 5-12) focuses on brownfield emergence and policy issues in Iran, along with the conclusion and recommendations to the thesis as a whole. A brief description of the content of each chapter is given below:

Part I:

- **Chapter 1** presents the background to the study, and expounds the research problems, aims, and objectives underlying the study
- **Chapter 2** outlines broad concepts set out in the literature on the changing context of urban change. It summarizes existing knowledge about brownfield formation, conceptualization and policy response in the global context. It also identifies the research gaps in this field.
- **Chapter 3** discusses the methodology for the research undertaken, the theoretical framework on which the research approach and methods are based. It explains why and how a multiple-case study approach has been employed to address research gaps.

Part II:

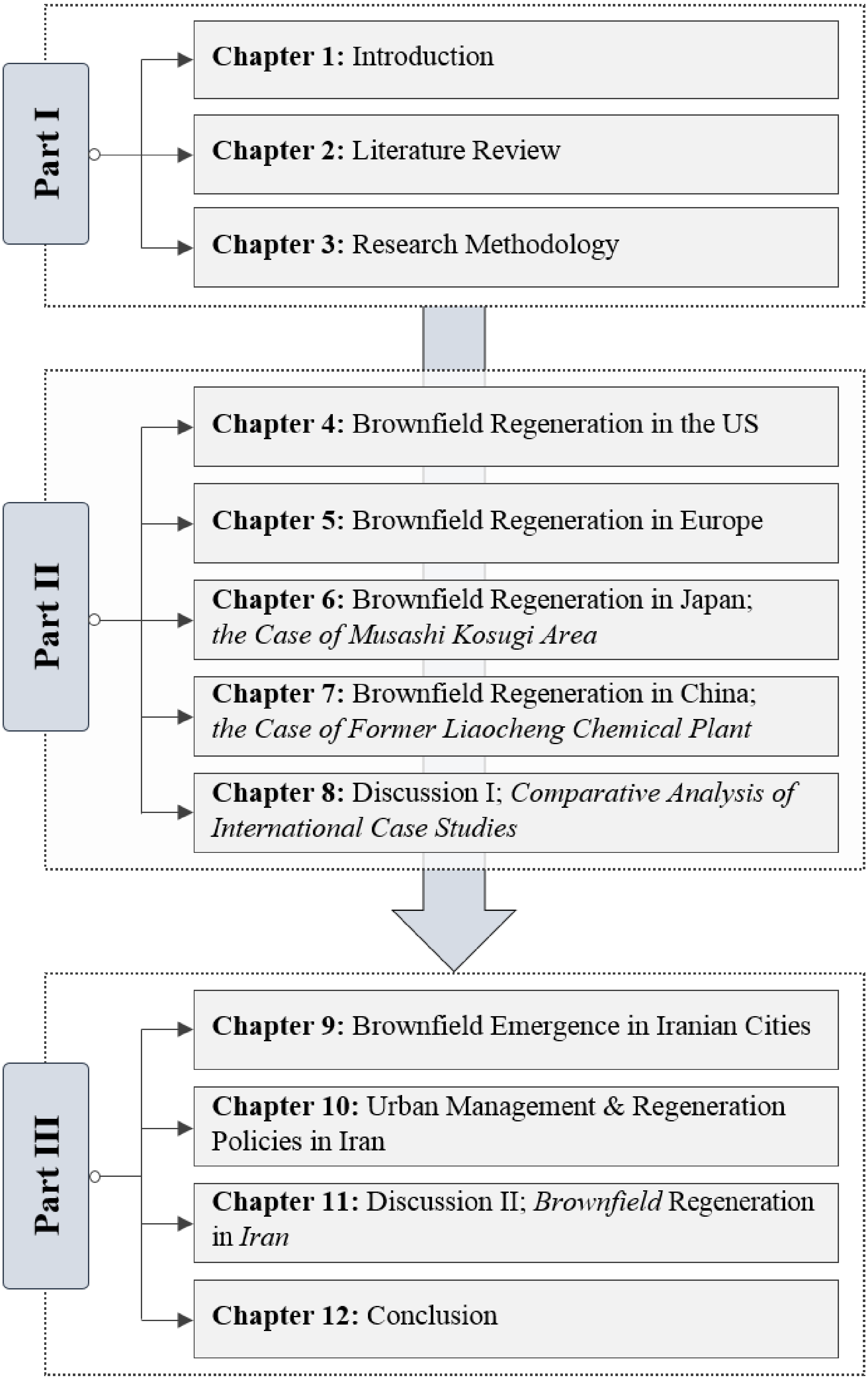
- **Chapters 4 and 5** provide an overview of brownfield emergence and development policy in the US and Europe respectively. The US/EU case studies are essentially literature based.
- **Chapters 6 and 7** present the findings of the field-surveys conducted in Japan and China, respectively, to explore the existing contexts of brownfield emergence, policy and practice in these countries. It is important to note that the approach adopted in these two chapters is different from Chapters 4 and 5. As there is not a lot of easily accessible English language literature on Japan and China, Chapters 6 and 7 primarily focus on a comprehensive site case study analysis. Data for these case studies was obtained through interviews and site visits. Such analysis helps to provide insights into a broader picture of brownfield regeneration activity in the Japanese and Chinese contexts.
- **Chapter 8** provides a discussion of the findings from the analysis of multiple-case studies considered in this study. It pulls out the critical factors in each case and examines them through the lens of an analytical tool, namely EPIB.

Part III:

- **Chapter 9** provides an overview of the urbanization process, industrial transformation and brownfield formation in the context of Iran.
- **Chapter 10** outlines the existing structure of urban management and regeneration policy frameworks in Iran.
- **Chapter 11** draws on the lessons from Chapters 8, 9, and 10 to achieve the primary aim of this study which is to develop a thorough understanding of brownfield regeneration from both policy and practice perspectives in Iran. This is the second discussion chapter of this thesis.
- **Chapter 12** concludes the thesis with a summary of key findings, original contributions to knowledge and recommendations for further research.

The Appendices and References are listed after Chapter 12. The Appendices include the ethics approval letters, consent form, participant information sheet, semi-structured interview questions and the list of interview participants used in the field-surveys.

Figure 1.2 The structure of thesis *(author's construct)*



CHAPTER 02

Literature Review

2.1 Introduction

There is currently a substantial body of literature analysing different aspects of brownfield regeneration. In attempting to grasp brownfield-related issues and develop appropriate policy responses, this research presents a broad-ranging literature review from two major perspectives. The first perspective addresses the scope of this thesis which examines brownfield formation and regeneration in the context of large-scale spatial urban change at the regional level. The second perspective consists of a chronological and contextual approach that looks at brownfield regeneration and how this process has become an issue moving up the urban agenda over the past few decades. The former is discussed in this chapter, and the latter is analysed comprehensively in a series of international case studies in Chapters 4, 5, and 6.

Through a review of relevant literature, this chapter provides a terminological, contextual and chronological account of factors that have led to the concept of brownfield regeneration. The chapter is structured in four sections. The first section, Section 2.2., presents a historical overview of urban-industrial transformation and its profound implications for the structure of cities. Highlighting the trend of re-urbanization, this section also discusses the concepts of urban regeneration and regenerative cities. The next section, Section 2.3, explains the reasons behind the formation of urban brownfields. Section 2.4 discusses the brownfield concept and policy response. It reflects the historical recognition of the brownfield problem and the development of policies over the past half-century. Building on this narrative, Section 2.5 reviews the scope of existing literature on brownfield issues within three strategic aspects, namely ‘definitional and conceptual aspect’, ‘policy and regulatory aspect’, and ‘technical and environmental engineering aspect’. Based on a rigorous analysis of theoretical and empirical brownfield studies, the final section of this chapter presents the research gaps identified and addressed by this thesis.

2.2 Urban and industrial change

In the wake of industrialization in the 18th century, urban communities experienced a wide range of economic, social, physical and also environmental changes, characterized by Rees (1966) as *"the shock of the new into societies"*. The essence of modernization and industrialization and its impact on the basic structure of urban places can be traced historically from the "industrial revolution" as a global process in Western Europe and the United States, beginning around 1760 and continuing to the mid-nineteenth century. It is, however, well known that urban transformation is not limited to this period of time. But rather, associated with changing social and economic relationships as well as the changing proportion of manufacturing, cities have been constantly taking new forms and scales. Recent rapid urbanization in China is a case in point.

The profound effects of industrialization on urban life and redistribution of population can be explained from an economic standpoint. The vigorous economy and labour markets, stimulated by the creation of new urban industries and factories, have encouraged large numbers of people to move and work in large cities (Mehdipour & Rashidi Nia 2013a). This migration trend from rural to urban areas characterizes the history of urbanization during the last two centuries. For instance, in the pre-industrial period, only 20 per cent of the British population used to live and work in urban areas, while this number rose to 75 per cent within the following century (Bairoch et al. 1988).

In retrospect, the social and economic transformation of the Industrial Revolution was characterized and driven by production and transportation of material, predominantly in steel, coal and textile industries. British cities are good examples in this regard, as they are viewed as being the centre of industrialization. Such industrial towns as Birmingham, Liverpool, Manchester, and London were important cities during the Industrial Revolution in terms of factory industry and manufacturing. Among these fastest-growing cities, some port towns like London and Liverpool became important due to their key role in transporting and exchanging products and raw materials (Hall 1982). The great technological advances of the 18th and 19th centuries in material production and transportation system may be regarded as the principal drivers of industrialization. Industrial achievement and major changes in local communities during the Industrial Revolution in the UK is presented in Table 2.1.

Table 2.1 The Industrial Revolution and urban change in Britain		
Time frame	*Industrial Achievement*	*Population Change*
Between 1700 and 1780	New innovations into iron-making and textile industries	Great dominant of rural population
From the 1780s onwards	The emergence of coal as the major raw materials of industries for producing energy	Surge in urban population growth
From the 1830s onwards	Steam-powered transport, mainly in railway system	Urban population exceeds rural population
(Sources: Law 1967; Rostow 1975; Hall 1982; Lawless & Brown 1986)		

Prior to the onset of the Industrial Revolution, small towns and rural areas with predominantly agricultural economies had dominated the spatial structure (Berg & Hudson 1992; Meyer 2003). However, as a result of rapid population growth and mass movement from the countryside in search of work and other opportunities, the population of rural and agricultural districts continued to shrink and small towns changed to overcrowded metropolitan areas in the nineteenth century. The urban environment was overwhelmed to a great extent by labour-intensive industries and high-density settlements through absorbing nearby communities. During industrialization, cities experienced a great transformation *"from a society relatively untouched by industrialism to one almost transformed by it"* (Hays 1995). The compact, polluted and densely-settled industrial cities inexorably established a new social structure.

2.2.1 Post-industrial city change

As Hall (1988) states, *"twentieth-century planning as an intellectual and professional movement, essentially presents a reaction to the evils of the nineteenth-century city"*. From the end the nineteenth century through the first half of twentieth century, several propositions were mapped out by architects and urban planners in response to dense, overcrowded and polluted city centres. Post-World War II, according to Breheny (1996), has played the most important role in the history of the debate about urban form. Suburban communities and small towns have redeveloped in different directions and many of them became the centres of production, manufacturing, retail and commercial activities, previously performed in cities (Stanback 1991). From the prospective of many urban analysts, this process of industrial, social and economic decentralization from the major metropolitan centres has been attributed to the concept of suburbanization. This phenomenon came to dominate the process of urban restructuring and population redistribution during the post-WWII in the 20th century, as a mass departure of population from the older urban areas accelerated (Champion 2001). The congested town centre distributed many of its services and amenities to a fastest-growing suburban periphery, resulting in deglomoration of urban cores which extended to the 1970s - the decade of counterurbanization. According to the four-stage model of Hall (1971), a modern phenomenon of suburbanization began with the decentralization of population and service employment in urban cores and extended to distribution of these within urban rings. The final stage of metropolitan-area development is known as counterurbanization or de-urbanization that is characterized by the relocation of population away from large metropolitan to small non-metropolitan areas (Berry 1976; Mitchell 2004). This trend became the strongest growing force across the developed world for about two decades, in the 1970s and 1980s.

Although the extreme wave of population dispersal ceased by the late 1980s in many countries, the evidence shows that the decentralization trend is still underway (Couch et al. 2008; Bhatta 2010). During the past three decades, the term 'urban sprawl' has replaced what had been previously described as suburbanization and counterurbanization. Ewing (2008) has carried out a comprehensive study in order to analyse this urban trend. Through an extensive review of literature (e.g. Lessinger 1962; Harvey & Clark 1965; Mills 1981; Hekkila & Peiser 1992), he associated the concept of sprawl with various development perceptions, such as "low-density development", "strip development", "scattered development" or "leapfrog development". All these perceptions share a common view of development characterized by a discontiguous urban growth coupled with distribution of services, infrastructures and population. According to Clawson (1962), *"sprawl is a pattern of development on the fringe of expanding urban areas"*. It reflects an outward extension of development, whether as an urban-to-suburban population shift (suburbanization) or metropolitan-to-nonmetropolitan movement (counterurbanization).

In most cases, urban sprawl is identified as unplanned and uneven growth (Bhatta 2010). There are numerous reasons why sprawl occurs. One reason is associated with increasing affluence and a desire for more amenity which is often seen as being related to space (Squires 2002b; Ewing 2003). Rising incomes as well as falling transportation costs have enabled households to afford long-distance commuting cost (Nechyba & Walsh 2004). Families choose to move from the central city to suburbs to escape the environmental and social problems they formerly confronted in cities. Less traffic and pollution, availability of more green space and parks as well as housing flexibility due to more spacious living arrangements in countryside and suburbs play substantial roles in the outward expansion of the urban areas.

Furthermore, technological innovation in public transportation and highway systems is an important driving force behind the urban sprawl in many industrialised countries. Historical evidence shows that changes in transport technology have been important in structural and spatial transformation of cities (Cheyney 1935; Hall 1982; Lawless & Brown 1986; Hays 1995). Transportation development encourages internal migration significantly so that people are freer to commute within the country in search of a higher quality of life. Suburban railways and trams followed by buses allowed cheap mass transit, which stimulated suburban development. The decentralization of urban structure and low-density development of neighbourhoods have been reformed by car-oriented growth in many major cities in North America, Europe, Asia and Australia (Newman & Kenworthy 1989; Brueckner 2000; Glaeser & Kahn 2004).

Last but not least, it is widely accepted that urban sprawl is directly or indirectly driven by a series of policies at the local, state, and national levels of governance (Squires 2002b; Kahn 2006; Lawrence 2005). Subsidies and taxation policies are important market-based forces that can fuel further ex-urban development, although they have the potential to reverse sprawl if framed differently. In many instances, state governments or local jurisdictions impose higher taxes on land, housing and public services in the core city compared to surrounding communities. Therefore, families are encouraged to live on the periphery to avoid higher living costs in inner-city areas. On the other hand, landowners and developers are confronted with more benefits in urban-fringe development, because of less competition for suburban land (Archer 1973). The result is a fast-growing suburban periphery with a low-density development pattern.

2.2.2 Re-urbanization and sustainable development

Since the period of widespread population exodus in the 1970s, many cities in developed economies as well as key cities in developing countries show evidence of re-urbanization or recentralization of population in urban centres (Cheshire 1995; Champion 2001; Seo 2002; Whittaker et al. 2010; Mulligan et al. 2012; Rink et al. 2012). According to Champion (2001), *"the re-urbanization stage is associated with the slowing of urban-region decline, which is initiated by the core and followed by the ring and thus involves a process of renewed centralization".* Re-urbanization has manifested itself in different countries at different time periods and different scale. In many large cities in Europe, for example, central area population loss has slowed since the 1980s, and inner cities gained a large number of residents following the introduction of urban regeneration projects and large-scale schemes of house-building within and on the edge of the city centre (Cheshire 1995; Seo 2002). In Japan, re-urbanization began to occur in the mid-1990s in major metropolitan cities, e.g. Tokyo, Osaka and Nagoya, due to several factors, such as the increasing high-rise housing development and declining land value in central cities (Sorensen 2011).

As briefly discussed in Chapter 1, in the wake of globalization and international competition, many cities around the world have witnessed a significant turnaround in living and working arrangements. With the growth of consumption amenities and services, people have become more attracted to live and work in inner cities (Glaeser et al. 2001b). As described by Glaeser and Gottlieb (2006), there are two main explanations for this turnaround:

> *"First, over the past 20 years, there has been a remarkable increase in the importance of knowledge in the economy and the biggest, densest cities appear to have a comparative advantage in facilitating the flow of knowledge. Secondly, over the past 20 years, the desire of consumers to live in these cities has increased enormously as a result of changes in style of government, improvements in law enforcement technology and rising incomes that have raised demand for high-end urban amenities"*

The agglomeration of service-based and knowledge-intensive activities in urban cores has attracted people back to the city. Workforce residential and locational preferences for inner cities have stimulated government policies and spending aimed at strengthening urban communities and furthering the sustainable development of cities. Over the past three decades, many countries and political regimes around the world have policy strategies for promoting higher urban densities and sustainable use of compact inner-city areas. Debates surrounding urban containment and densification can be epitomized by 'slow-growth initiatives' and 'new urbanism' in the US (Katz et al. 1994; Nelson et al. 2004), and the urban renaissance agenda promoted by Richard Rodger's Urban Task Force (1999) in the UK. Such sustainable city policies have been promulgated based on two common objectives; (1) to lower per capita energy consumption particularly for commuting; and (2) to reduce the loss of agricultural land to urban development (Cheshire 2006).

2.2.2.1 From 'urban regeneration' to 'regenerative cities'

Part of the broad discussion about sustainability is associated with the 'regeneration' of urban land. Regeneration is a metaphor for the types of intervention and revival initiatives observed over the past few decades, but it is losing its metaphorical meaning and purpose (Southern 2013). Since the early 1990s, the concept of 'urban regeneration' has emerged as an important element of urban policy to reflect the broad environmental objectives of sustainable development. There is a substantial literature over this period to articulate the definition of urban regeneration and its contribution to sustainable development (e.g. Couch 1990; Couch & Dennemann 2000; Rosemary et al. 2005; Jones & Evans 2008; Tallon 2013; Southern 2013; Newton 2013; Roberts 2017). Jones and Evans (2008), for example, refer to urban regeneration as *"the large- scale process of adapting the existing built environment, with varying degrees of direction from the state"*. As suggested by Couch and Dennemann (2000), "*urban regeneration contributes to sustainable development through the recycling of derelict land and buildings, reducing demand for peripheral development and facilitating the development of more compact cities"*.

Urban regeneration and its allied terms (e.g. renewal, revitalization, redevelopment, reconstruction, rehabilitation and reinvestment) have been used interchangeably in the existing literature due to varied scope, ownership and governance (Newton 2013). Originating from efforts at post-war reconstruction and physical replacement of outworn inner-urban areas, urban regeneration has evolved over time as a broad interventionist activity aimed at improving urban sustainability. The seminal contribution to the rigorous analysis of this phenomenon was made by Roberts (2017). He affirms that *"urban regeneration moves beyond the aims, aspirations, and achievements of urban renewal, which is seen as a process of essentially physical change, urban development (or redevelopment) with its general mission and less well-defined purpose, and urban revitalization (or rehabilitation) which, whilst suggesting the need for action, fails to specify a precise method of approach"*.

Bridging together the evidence gathered from the other works of literature (Stöhr 1989; Lichfield 1992; Southern 2013; Pugalis & Liddle 2013), Roberts (2017) traces some of the major stages in the development of the theory and practice since the mid-twentieth century in relation to the evolution of urban regeneration (see Table 2.2). He argues that a new wave of change is taking place, referred to as *"urban regeneration in recession"*, which reflects a change in the domains of social and urban policy in response to the Great Recession of the 21st century. With the advent of the Global Financial Crisis (GFC) of 2007-2009, the fall in property values and restrictions on credit availability have had a major impact upon property development and, thus, urban regeneration policy and practice (Parkinson et al. 2009). As Roberts (2017) emphasises, *"the restrictions imposed on public and private sources of funding have caused both the reconsideration of regeneration policy and adjustment of practice: public funding and public agency support have changed dramatically; private lending is generally only available if capital assets exist and communities have increasingly taken responsibility for regeneration".* Crucially, urban regeneration of post the 2008 recession is tied into broader socio-economic processes with greater emphasis on partnership between different branches of government, the private sectors and communities (Jones & Evans 2013). This private-public paradigm, with more active involvement from the private sector, has been the most dramatic difference between urban regeneration in the 2010s and previous interventions.

It is also important to recognize that, since the 1980s, a number of explanations have been advanced to reflect the trends for reinvestment back into urban cores (Bradway Laska et al. 1982; Ley 1986; Zukin 1987; Squires & O'Connor 2001; Newman & Ashton 2004; Lees 2008; Kromer 2009; Podagrosi et al. 2011; Immergluck 2015). These works of literature have used the term 'urban reinvestment' to explain both economic development and human capital development, such as gentrification and social polarisation, neighbourhood displacement along with the form and degrees of government intervention in reinvesting inner cities. The emphasis within urban reinvestment studies and policies has tended to be on economic and social regeneration rather than on environmental regeneration.

Table 2.2 The evolution of urban regeneration
(Source: Author's elaboration on a table from Roberts 2017)*

Period	1950s	1960s	1970s	1980s	1990s	2000s
Policy Type	**Reconstruction**	**Revitalization**	**Renewal**	**Redevelopment**	**Regeneration**	
Major strategy and orientation	Reconstruction and extension of older areas of towns and cities often based on a 'masterplan'; suburban growth	Continuation from 1950s; suburban growth with some early attempts at rehabilitation	Focus on in-situ renewal schemes; still development at periphery	Major schemes of development and redevelopment; flagship projects; out of town projects	A more comprehensive form of policy and practice; emphasis on integrated policy and interventions	Restrictions on all activities with some easing in the areas of growth
Key actors and stakeholders	National and local government private sector developers and contractors	Move towards a greater balance between public and private sectors	decentralization in local government and growing role of private sector	Emphasis on private sector and special agencies; growth of partnerships	Dominant approach of partnership with a growing number of government agencies	More emphasis on private sector funding and voluntary effort
Spatial level of activity	Emphasis on local and site levels	Regional level of activity merged	Regional and local levels initially; later more local emphasis	Initial emphasis on site; later on local level	Reintroduction of strategic perspective; growth of regional interventions	More localist initially with developing sub-regional activity
Economic focus	Public sector investment with limited involvement of private sector	Growing influence of private investment	Resource constrains in public sector and growth of private investment	Private sector dominant with selective public funds	Greater balance between public, private and voluntary funding	Private sector dominant with selective government funding
Social content	Improvement of housing and living standards	Social and welfare improvement	Community-based action and greater empowerment	Community self-help with very selective state support	Emphasis on the role of community	Local initiatives and encouragement of third sector
Physical emphasis	Replacement of inner areas and peripheral development	Some continuation from 1950s with parallel rehabilitation of existing areas	More extensive renewal of older urban areas	Major schemes of replacement and new development; 'flagship schemes'	Initially more modest than 1980s, then increasing scale; heritage emphasised	Generally smaller scale schemes, but larger projects returning
Environmental approach	Landscaping and some greening	Selective improvements	Environmental improvement with some innovations	Growth of concern for wider approach to environment	Broader environmental approach in the context of sustainable development	General acceptance of sustainable development model

** Building on the works of Stöhr (1989), Lichfield (1992) and Pugalis & Liddle (2013).*

Over the past decade, a new concept of sustainable urban development has entered the academic discourse, namely the *Regenerative City*, with the primary aim of enhancing sustainability performance within urban systems. The notion of the Regenerative City was first outlined by the World Future Council in 2010, as a city that regenerates its ecological footprint not just minimizes it (Girardet 2010). Girardet suggests that regenerative urbanization goes beyond the concept of urban regeneration or sustainable urban development; *"regenerative development is about a proactive relationship between humanity and the world's ecosystems, and about nurturing nature's dynamism and abundance whilst drawing on its income"* (Girardet 2010). He explains the relationship between urban systems and ecosystems and places it under the broader context of urban growth as a seemingly unstoppable worldwide process (Girardet 2014). Flavoured by insights from the works of Girardet, the regenerative city concept has received considerable attention in academic discourse (Du Plessis 2012; Pedersen Zari 2012; Woo et al. 2014; Newman et al. 2017; Thomson & Newman 2018). Du Plessis (2012), for example, outlines the concept of regenerative design and development within the broader context of sustainability. Woo et al. (2014) discuss the benefits of regenerative urban development and the challenges faced in decision-making and implementation processes. Moreover, a study by Thomson and Newman (2018) demonstrates metabolic variations in different urban form and infrastructure (i.e. walking, transit and automobile urban fabrics), applying this knowledge in a practical manner toward the delivery of a regenerative city. This study shows that "*city planning decisions are highly influential in delivering sustainable cities because different urban fabrics have different urban metabolisms"* (Thomson & Newman 2018).

To address the great urban-environmental interconnectivity established by the concept of the Regenerative Cities, this research explains brownfield land regeneration and examines this phenomenon under the broader picture of urban change across different regional and political contexts. For the purpose of this research, the concept of 'regeneration' is viewed as a general approach to sustainable policy development and implementation, as suggested by Roberts (2017) and reflected in Table 2.2. Depending upon the performance targets assigned, the term 'redevelopment' is also referred to as an interventional activity at the scale of a single site or project. Meanwhile, 'recycling and reuse' is another term used in this thesis to describe the regeneration of derelict land or PDL, whilst setting it under the broader sustainability argument about efficient use of natural resources.

2.3 Formation of brownfields

As emphasized in Chapter 1, this research discusses brownfields from a perspective of contaminated previously developed land, such as former industrial, mining and military sites. Amongst such urban sites, industrial brownfields appear to have emerged within the fabric of cities as a result of complex structural and spatial changes occurring over decades. This section examines the literature which discusses these changes in two respects, firstly at the broad scale of globalization and industrial restructuring, and secondly, nationally and locally specific urban growth and change, as discussed below.

2.3.1 Globalization and brownfield formation

At the small site scale level, the dereliction of brownfields can be associated with government policies or as a result of trends within the regional or national economy. However, underlying these phenomena are big drivers like globalization and industrial restructuring particularly in advanced economies. Since the mid-1970s, there has been a global shift in the type and location of industry, largely as a result of high labour costs in the developed world and growth of competitive industries in global emerging economies (Alderson 1999; Iversen & Cusack 2000; Bluestone 2003; Häusermann & Schwander 2012). This long-term industrial restructuring, driven by differential labour costs, has played out differently in different regions of the world, with knock-on effects on the global economy. In Britain, for example, industrial restructuring beginning after WWI was a constant presence throughout the next fifty years and was particularly marked during the 1970-80s. During this period, increasing globalization and changes to government policy accelerated the decline particularly of heavy manufacturing industries (Rowthorn & Wells 1987; Gregory & Greenhalgh 1997). In Japan, by contrast, manufacturing employment was still peaking in 1970s, and industrial restructuring started later in the 1990s (Rowthorn & Ramaswamy 1997; Guelle 2001). Lower labour costs and more relaxed environmental regulation in the developing world, particularly in China and much of East Asia, attracted key industries from Europe and the US (Rodrik 2016; Van Neuss 2018).

As part of industrial restructuring parallel with the decline of manufacturing industry, there has been an increasing market for services (e.g. producer service, information, knowledge and creative industries) in the last five decades, known as tertiarization of the economy. Tertiarization is characterized by a marked shift in terms of both employment and production away from the manufacturing sector towards the service sector, mainly due to increased demand for services (Miles 2002; Maroto-Sánchez & Cuadrado-Roura 2009). This strong wave of change with the agglomeration of service demand has washed over the world in the post-WWII period, and accelerated in the 21st century. According to the World Bank (2019a), service industries contributed 70 per cent of GDP in the UK, 77 per cent in the US, 70 per cent in France, 69 per cent in Japan, and 67 per cent Australia in 2018. This shift from a production-based economy to a service-based one has influenced the type and location of industry and, has thus been instrumental in creating inner-city industrial brownfields. This phenomenon will be explored in detail in Chapters 4-8 of this thesis.

2.3.2 Urbanization and brownfield formation

The formation of brownfield sites can be explained in the light of the steady growth of urban areas. As discussed in Section 2.2, after perhaps 100 years of concentration and growth, cities across the developed world began to experience radical outward-oriented low-density expansion. During the 1950s-90s, cities in Europe and the US grew considerably in both size and population. In many developing nations, most notably in China, urban growth has occurred more recently, albeit at high density. With the spread of sprawl in various stages of growth, the extent of land required for development in a full range of activities and services including housing, recreation, employment and infrastructures significantly increased.

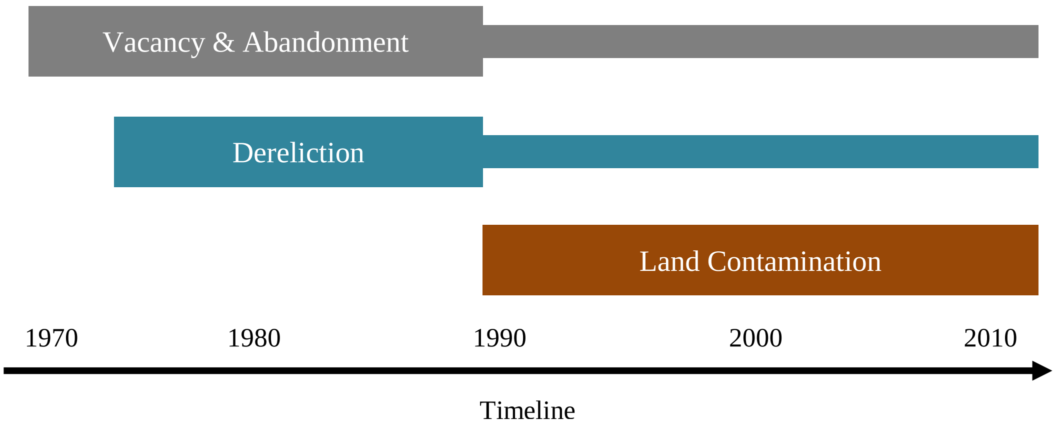
Essentially caused by changes to land values and policies, cities across several industrialized nations witnessed the migration of industries and factories from the central locations to the suburban and greenfield locations (Bluestone 1984; Champion 2001). Many firms moved out of big cities because of the constraints on the supply of land in inner-city locations. The cities became physically compact and, therefore, industries could not find enough space for further development. On the other hand, financial problems of several urban industries and the increasing value of inner-city land encouraged several industrial sites to move out of the city boundaries where cheaper land was available. Additionally, many enterprises went into decline and eventually closed down as a result of external pressures (Tucker 1991). These large-scale physical displacements have left voids within the fabric of the city. As a result of the rapid expansion of cities and the associated closure or relocation of industries, brownfields, unused or ineffectively used urban spaces, have emerged.

2.4 Brownfield concept and policy response

The term 'brownfield' was first used by the United States Environmental Protection Agency (USEPA), when it formally launched the Brownfields Action Agenda in 1995 (Adams et al. 2010). The USEPA defined brownfields initially as *"abandoned, idled, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination"* (USEPA 1995). However, different counties have considered brownfield lands from different perspectives according to their geographical conditions as well as institutional structures and policies (Mehdipour & Rashidi Nia 2013b). A more detailed discussion on the conceptual dimension of brownfields is presented below and in Chapters 4, 5, 6, 7 and 8.

The history of conceptualization of brownfield with its equivalent terms (e.g. Previously Developed Land (PDL) in the UK) has come a long way since the late 1970s and early 1980s, particularly in the developed world. The conceptual term of 'brownfield' would generally appear to have two main derivations, i.e. the previously developed land (originated in the UK) and contaminated land (originated in the US) (Alker et al. 2000; Roberts et al. 2002). This two-sided dimension of the concept can be justified on the grounds that brownfield problems arose in different countries in particular periods. During the 1970s-80s, the brownfield problem became increasingly aligned with urban blight and functional obsolescence (Evans 2003). In response to this pressing and pervasive problem faced by many cities, urban regeneration policy-makers placed their emphasis firmly on framing a pragmatic approach to redevelop or facilitate the redevelopment of distressed urban areas, i.e. disused, vacant, derelict and abandoned pieces of land. Originating from UK planning policy debates in the 1990s, brownfield appeared to signify the opposite of greenfield, as land which had previously been subject to development, was usually industrial in nature and often located in inner-city areas (Syms 1999; Alker et al. 2000). Indeed, the brownfield-related discussion at this time was mostly located in the context of the physical restoration of sites, notably for housing development.

Figure 2.1 Brownfield concept and policy response timeline
(Source: the author)



Until the 1990s, policy-makers around the world had not definitively associated the term brownfield with contaminated land (Figure 2.1). The discussion over soil and ground water contamination and environmental regeneration of brownfield land emerged after the 1990s, following the idea of recycling of natural resources and public health protection which had come along some years earlier. The Superfund Law in 1980 in the US and the Environmental Protection Act in 1990 in the UK are viewed as important policy initiatives aimed at bringing derelict and contaminated land back into productive use. It was after 1990s that 'brownfield' was first introduced as an official term at a US congressional field for the environmental management of land pollution from industrial processes. In early 2000s, the Small Business Liability and Brownfields Revitalization Act (or The Brownfield Law) was regulated by the US government as one of most important legislative attempts at evaluation and clean-up of contaminated sites. Such environmentally driven consideration of brownfields tied in with the concept of the Polluter-Pays Principle (PPP) which had become a key component in international environmental policy since the 1970s. The PPP concerns the identification of the party or operator, e.g. landowner, manager and occupant, who caused or contributed to environmental damage (Gaines 1991; Nash 2000). According to this principle, to ensure the protection of non-responsible landowners or developers, the original polluter is obliged to bear the cost of contamination removal and remediation. The PPP and legal liability issues will be explored further in this thesis.

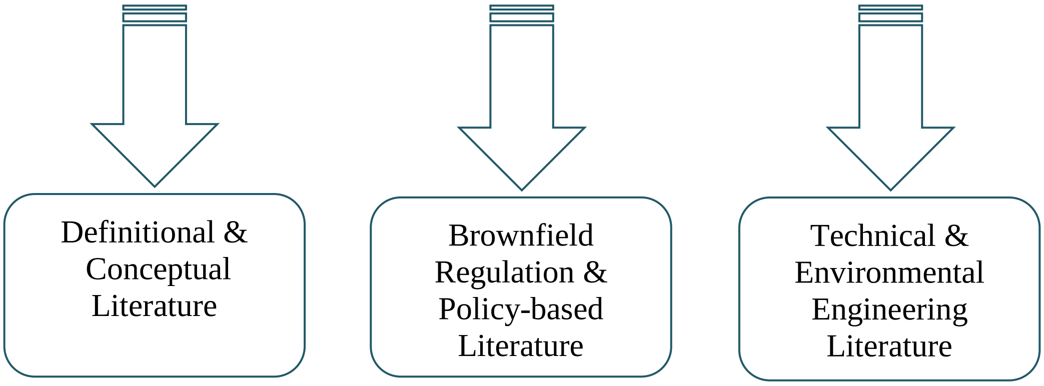
Similar to many countries' conceptualization of brownfields as contaminated industrial sites, e.g. factories, scrap yards, railroad corridors and petrol service stations, there have been significant advances in the area of brownfield policy and practice since the early 1990s in Australia (Newton 2010). The Building Better Cities (BBC) program, in particular, established a new model for intervention in urban brownfields (Newton & Glackin 2014). Launched in 1991 through arrangements between government agencies and private industry, BBC is credited with leading the revival of Australian inner cities; the most significant change in urban Australia during the post-World War II period (Neilson 2008). Following the BBC's long-term and large-scale strategic planning goals, the Australian government has published several policy documents in an attempt to establish overarching frameworks and funding arrangements for delivering new housing and infrastructure. Placing greater focus on delivering infill development in large cities, a recent report (i.e. Infrastructure Australia 2018) provides a definition for the development of brownfield precincts as; *"regeneration of large pieces of former industrial land, including public sites"*.

It is important to take a note of the fact that brownfield regeneration has retained its broader land-use planning significance in a handful of European countries, e.g. the UK, Germany and France (Alker et al. 2000). In such European countries, brownfields are referred to as derelict or underutilized sites, and therefore the related policy emphasis is predominantly placed on the regeneration of physically distressed urban areas regardless of their environmental conditions. This variability in the brownfield concept across the globe has led to misunderstandings and conflicts amongst the academics and various stakeholders involved, including community groups, decision-makers, and practitioners. This critical dimension of brownfield studies will be further explored later in this thesis.

2.5 The scope of existing literature on brownfield issues

This section aims to develop a clear understanding of brownfield-related issues through content analysis of the existing theoretical literature over the last few decades. To achieve this, the existing works of literature are classified into three major groups (see Figure 2.2), each of which are presented in the following sub-sections.

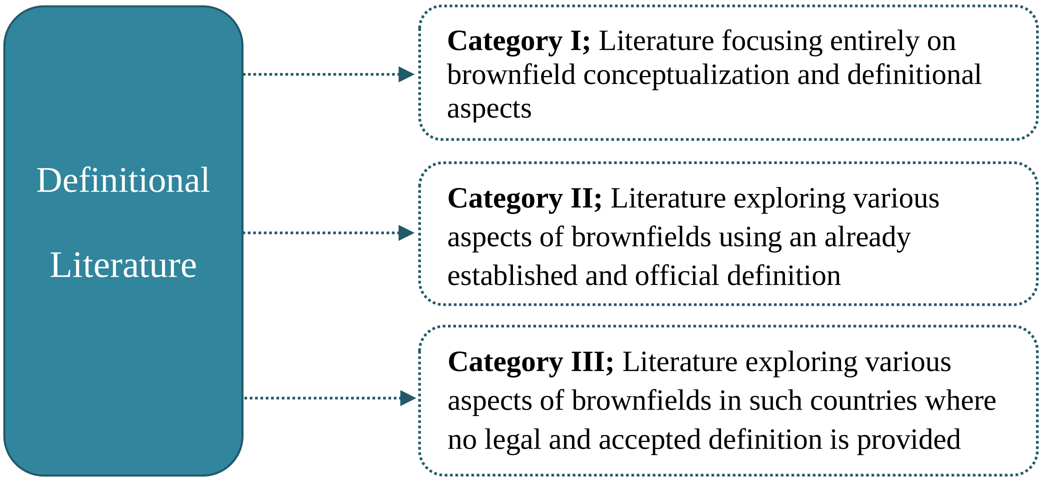
Figure 2.2 The Scope of Existing Brownfield Literature



2.5.1 Definitional and conceptual literature

The existing literature on brownfield definition and terminology can be divided into three general groups, including as follows (see Figure 2.3);

Figure 2.3 Categorization of literature on brownfield definition and concept *(Source: the author)*



The first category consists of studies that explore the interpretations of terminology to be used in both environmental and land-use management disciplines. There is a small amount of literature that has comprehensively investigated the definition and classification of brownfields (i.e. Alker et al. 2000; Roberts et al. 2002; Yount 2003; Oliver et al. 2005). The seminal contribution to the rigorous conceptualization of brownfield sites was made by Alker et al. (2000). Having considered and incorporated all related statutory definitions as well as the views of different stakeholder groups, their research presents a detailed examination of the issues involved in constructing an agreed definition and its significance in relation to UK government policy. Another influential work, in this respect, was done by Oliver et al. (2005) in the context of the European Union. Supported by the European Commission, this research carries out a rigorous analysis of the scale and nature of brownfields across Europe. Drawing primarily on a number of network-based surveys and the responses of member states, it elaborates on the characterization and classification of European brownfields, either on the basis of their original use or otherwise.

The second category is associated with those studies within the context of which brownfields have acquired political significance and, thus, are legally identified. This is the common scenario for a large number of studies in the US, EU and more recently Japan, where the authors are provided with a clear official definition of brownfield sites. Using an already established definition, the authors in this category of literature does not elaborate on definitional components of brownfield sites. In fact, based on the legal terminologies provided, this category explores broader concepts, comprising a wide range of scientific disciplines such as the environmental assessment and management, land-use planning policy, soil remediation technologies, and site-specific analysis and design. The oft-quoted examples in this regard are Davis (2002)'s work which sought to provide a thorough guide to redeveloping brownfield sites in all related disciplines, or a study by Dixon et al. (2008) which presents a comprehensive account of the UK policies and practices in sustainable brownfield regeneration. Meanwhile, relying upon the EPA's Glossary definition, several authors (e.g. Eisen 1996; Abrams 1997; Davis 2002; Reisch & Bearden 2003; Whitney 2003) have carried out an in-depth analysis of the brownfield regeneration programs and strategies in the US. Such works of literature often discuss brownfield terminology as part of their broad-ranging analytical studies.

The last category of definitional literature belongs to several authors who researched aspects of brownfields in those countries in the world where there is (or there was) not a clear legal and accepted definition of brownfields. Such authors have had to produce their own definitions. This can be justified on the grounds of the need for a robust interpretation of the term brownfield from a multidisciplinary perspective across different regimes, as suggested by Alker et al. (2000). Similar to the second category, this category encompasses a wide range of interdisciplinary studies, but conversely does not benefit from an official definition existed at the time of research. The literature works by Syms (1994) and Gwilliam (1997) in context of the UK, Murayama et al. (2006), and Yasutaka et al. (2007) in Japan, as well as WU and Chen (2012) in Australia provide some examples of this research category.

2.5.2 Brownfield regulation and policy-based literature

Over the past two decades or so, a great deal of importance has been placed on the development of brownfield policy across different countries. As regards inner-city revitalization and/or environmental protection, there is currently a voluminous literature investigating and analysing various aspects of brownfield planning and policy (Keeble 1976; Syms 1999; McCarthy 2002; Adams 2004; De Sousa 2005; Nathanail & Bardos 2005; Wernstedt et al. 2006a; Thornton et al. 2007; Hollander et al. 2010). Such views on the significance of legislative activities concerning brownfield regeneration have been replicated in a wider range of academic studies and reports of debates that discuss jurisdictional dimension of soil remediation, land-use planning, environmental technology, economic policy, public health and community development. To reflect a proper understanding of this dimension, some of the seminal works of literature and archival documents on brownfield planning policy in a variety of contexts are highlighted.

One of the earliest and strongest attempts at reflecting an understanding of the extent of the brownfield problem and policy response was made in context of the UK. There are several urban scholars originating from different disciplines, e.g. Syms, Bardos, Nathanail, Dixon and Adams, who have made a considerable contribution to the regulatory-based analysis of brownfield redevelopment in Britain. For example, Syms (1999) underlines the decision-making process concerning both the redevelopment phase of brownfield property and its proposed end use, based on a survey of surveyors, developers and other professionals carried out in the UK in 1998. Having conducted a statistical analysis of a survey of 230 practitioners, further research work by Syms (2001) provides a considerable amount of information regarding the problem of releasing land for development and associated environmental and local community's concerns in the UK. From an environmental-economic perspective, he also gives an invaluable guide to the type of contamination likely to be present by different industrial activities (Syms 2004), and examines the constraints affecting the redevelopment of contaminated and derelict sites with particular reference to funding issues (Syms 1994). In the same vein, but with greater focus on engineering disciplines, Nathanail and Bardos (2005) provide an in-depth overview of UK government policy on contaminated land and investigate the knowledge required for environmental management of such urban areas. Having highlighted practical experience and studies, they present various environmental aspects of reclamation of contaminated land in regulatory planning and practice. Additionally, Dixon, Tiesdell and Adams are amongst the notable urban scholars who have actively explored brownfield planning policy in the UK with particular attention to the regulatory environment of housing supply and the property development industry (Adams 2004; Dixon & Adams 2008; Dixon 2008), land ownership constraints (Adams et al. 2001; Adams et al. 2002), as well as the associated design challenge for house builders (Tiesdell & Adams 2004).

At the broader scale of Europe, brownfield regulation and planning policy has attracted the attention of a large number of scholars, e.g. Oliver et al. 2005; Grimski & Feber 2001; Thornton et al. 2007; Franz et al. 2006; Nathanail et al. 2007. One of the important studies in this regard was conducted by Grimski and Feber (2001) that outlines the major findings on the extent of brownfield problems and summarises challenges to national and regional policy-makers across Europe. Such studies with direct relevance to brownfield redevelopment in Europe are pronounced from the mid-2000s onwards following the establishment of the EC-driven sustainable brownfield regeneration networks (e.g. CABERNET, CLARINET, RESCUE, and NICOLE). The seminal works of Oliver et al. (2005), Franz et al. (2006), Nathanail et al. (2007), and Thornton et al. (2007) represent those studies that explore various aspects of brownfield regeneration policy and the regulatory framework in Europe. Thornton et al. (2007), as an example, analyse the benefits and deficiencies of existing financial, fiscal, legal, regulatory and policy incentives for brownfield regeneration. Having analysed the deficits of financial incentives in Germany, France, and the UK, they argue the implications of current policy framework and bring forward proposals for more effective instruments for the promotion of sustainable brownfield regeneration at both EU and state levels.

In the US, brownfield regulatory-based discussion has been increasingly set in the context of environmental aspects of land development and environmental justice issues. This can be justified on the grounds of environmental-driven recognition of brownfield issues amongst the various stakeholder groups involved in the regeneration of brownfield sites in the US. Since the mid-1990s, most noticeably, a wide range of studies has been conducted to introduce the brownfield policy framework and examine its overall effectiveness in both decontamination and marketability of land at different levels (e.g. Eisen 1996; Simons 1998; Geltman 2000; Davis 2002; Simons et al. 2003; Collins 2003; McMorrow 2004; Alberini et al. 2005; De Sousa 2005; Wernstedt & Heberle 2006, Wernstedt et al. 2006a; Wernstedt et al. 2006b; Guignet & Alberini 2010; Jones & Welsh 2012). For example, Eisen (1996) generates a comprehensive discussion about the US brownfield programs at the federal and state levels of governance. De Sousa (2002) examines brownfield policy performance at the local level of Milwaukee Country. Alberini et al. 2005 underline the role of liability and economic incentives in remediation of contaminated sites, based on the evidence from surveys of developers. Wernstedt et al. (2006b) points at the vagueness of US legislative or regulatory language in acknowledging the value of public interventions in recycling and reuse of contaminated properties. McCarthy 2002 examines the progress by US local, state and federal agencies at the time in addressing the dual land-use policy challenge presented by brownfield regeneration, namely "reducing barriers to private redevelopment" and "connecting reuse to broader community goals". In addition, Thomas (2002) represents a GIS-based support system for decision-makers and policy analysts at all levels of government in the US.

In addition to extensive research studies on brownfield policy in the US and Europe, there is a growing literature focusing on this issue in some other countries, such as Canada (De Sousa 2003; 2006), Australia (Newton 2010; Wu 2012), China (Cao & Guan 2007; Xie & Li 2010), and Japan (Miyagawa & Nakayama 2003). In many of these countries, particularly in Japan, China and Australia, the legal and regulatory framework associated with brownfield remediation and redevelopment is still in its infancy. Therefore, these studies sought to develop an understanding of the situation and construct a conceptual model for brownfield decision-making process. Moreover, a number of research studies (e.g. Miyagawa & Nakayama 2001; Kurose & Han 2007; Otsuka & Abe 2008; Dixon et al. 2011; Adams et al. 2010) contemplate brownfield regeneration policies through a comparative analysis of conditions in different countries. For example, Miyagawa & Nakayama (2001) make a comparison of national Acts on treating land contamination in Japan, the Netherlands, Germany, and the UK, and Adams et al. (2010) evaluate how brownfield policy has developed in Canada, the US, England and Scotland.

Table 2.3 presents a summary of the literature on brownfield regulation and planning policy.

Table 2.3 Summary of the brownfield regulation and policy-based literature *(Source: the author)*		
Context	Scope of studies	Notable studies
UK	- Broad dimensions of land recycling and reuse policy and planning approach, e.g. housing supply, property development and land ownership issues - Overview of the government policy on contaminated land and knowledge required for environmental management	- Syms 1994, 2001, 2004; Adams 2004; Adams et al. 2001, 2002; Dixon & Adams 2008; Dixon 2008; Nathanail & Bardos 2005; Tiesdell & Adams 2004.
EU	- The analysis of the EU-wide brownfield regeneration networks (e.g. CABERNET, CLARINET, and NICOLE) - The operational implication and application of the EU policy framework in member states	- Oliver et al. 2005; Franz et al. 2006; Nathanail et al. 2007; Thornton et al. 2007; Grimski & Feber 2001.
US	- Decision support system for remediation of contaminated land and environmental justice issues - Marketability of land at different levels - Superfund and its serial state expansion	- Eisen 1996; Davis 2002; Thomas 2002; Whitney 2003; Alberini et al. 2005; De Sousa 2005; Wernstedt & Heberle 2006, Wernstedt et al. 2006a, 2006b.
Others*	- Overview of the current brownfield decision-making process and analysis of the condition - Development of a new legislative or regulatory language in the light of international experience	- Miyagawa & Nakayama 2001, 2003; De Sousa 2003, 2006; Xie & Li 2010; Kurose & Han 2007; Dixon et al. 2011; Adams et al. 2010.
** Such countries as Australia, Canada, Japan and China, where brownfields have acquired recent political significance.*		

2.5.3 Technical and environmental engineering literature

One of the key dimensions of sustainable brownfield regeneration is concerned with challenges posed by the risk assessment and remediation of contaminated soil and groundwater. Over the last few decades, the technical and environmental engineering dimension of brownfield remediation has developed largely across the developed and developing world. To date, a great deal of research has been done to explore this dimension (e.g. Wilson & Jones 1993; Brown et al. 1994; Acar et al. 1995; Cunningham et al. 1993; Cunningham et al. 1995; Cunningham et al. 1996; Ma & Rao 1997; Lasat 1999; Mulligan et al. 2001; Mulligan 2005; Wang & Mulligan 2006; Gray et al. 2006; Wuana & Okieimen 2011; Beesley et al. 2011; Tang et al. 2013).

This category of literature essentially focuses on the nature and chemistry of contaminants as well as the available techniques to risk assessment, investigations and treatment of polluted soil and groundwater system. Several authors (e.g. Ma & Rao 1997; Wang & Mulligan 2006;

Wuana & Okieimen 2011) have comprehensively researched the characteristics and chemical fractionation of contamination. Meanwhile, there is currently a large body of literature outlining environmental, economic and technical aspects of various soil remediation techniques. Such techniques as in-situ remediation (Acar et al. 1995; Gray et al. 2006), encapsulation (Aelion et al. 2009; Mbhele 2008), soil washing clean-up (Mulligan et al. 2001; Mulligan 2005), and bioremediation (Wilson & Jones 1993; Brown et al. 1994; Cunningham et al. 1993; Cunningham et al. 1995; Cunningham et al. 1996; Lasat 1999). It is important to recognise the strong relationship between the types of techniques used and the development of policy standards and particularly clean-up costs. Each remediation approach involves different levels of knowledge and technical expertise as well as different costs which relate to the policy stand-point that each country takes. The choices certainly depend on the policy stance and the resource available.

2.6 Gaps in the research

From the results of this literature review, a number of gaps can be identified within the existing international studies on brownfield issues, as follows:

1. *Brownfield emergence in an urban context;*

There is a need to better understand the historical process of brownfield emergence, with particular attention to the relationship of brownfield regeneration with strategic city planning and growth issues. This study aims to address this knowledge gap by bringing to light the international experience and framing critical issues relating to brownfield regeneration in the broader context of urban change. To achieve this, the research examines how the identification of brownfields and their regeneration fit in with the large-scale urban change that has taken place over the last 30 years or so.

2. *Brownfield governance;*

Another gap identified within the current brownfield-related knowledge is related to the broad analysis of the organizational structure of government bureaucracy involved in various phases of decision-making process. Given the nature of brownfield sites, there is a special need to understand the location of power and responsibility across disparate environmental and non-environmental policy sectors and actors in responding to brownfield regeneration challenges (this will be further discussed in the next chapter). At present, the literature has largely focused on brownfield-related issues and policy responses from the environmental protection and economic development perspectives. This research aims to address these critical perspectives and associate them with the larger land-use planning dimension of brownfield regeneration process.

3. *Understanding of brownfield regeneration concept and process in Iran;*

Having set the current state of brownfield knowledge and policy in the broader international context, this thesis represents an attempt to explore important aspects of brownfield regeneration in Iran. It is far from clear how brownfield sites have appeared in Iranian cities; and whether and how the current land-use planning and environmental policy frameworks encourage the regeneration of such sites. In fact, there is currently limited understanding of the processes of effective brownfield regeneration within the Iranian context.

To date, the majority of the literature in brownfield discussion in Iran has exclusively focused on the environmental engineering dimension of soil and groundwater contamination and remediation which is beyond the scope of this study (e.g. Vosoughi 2002; Arbabi et al. 2004; Kalantari et al. 2006; Karimi et al. 2009; Shirdam et al. 2009; Lorestani et al. 2011; Karimi et al. 2013; Pourang & Noori 2014; Asiabadi et al. 2014; Yousefi et al. 2015; Mohaghegh et al. 2016; Zand 2017; Ghoreishi et al. 2017; Alighardashi & Mehrani 2017; Vesali Naseh et al. 2018). Most recently, a few studies have focussed on the conceptual, legislative and design dimensions of brownfields (i.e. Mirmoghtadaee 2010; Laghai et al. 2012; Shemirani & Mofrad 2015; Zekavat & Motamedi 2015). Despite recent research efforts, there is a pressing need to carry out a theoretical and empirical analysis of ‘brownfield (re)generation’ in Iran. Hence, this research study aims to analyse the current level of understanding and policy response to brownfield issues in Iran by setting it within the broader international perspective.

CHAPTER 03

Research Methodology

3.1 Research purpose and questions

The purpose of research is to answer research questions through the application of scientific procedures (Kothari 2004). Research methodology defines the researcher's overarching approach to identifying the purpose of the research and constructing a conceptual framework towards achieving it. While the purpose of the study was broadly outlined in the aims and objectives in Chapter 1, the literature review has identified gaps in current knowledge (see section 2.5 in Chapter 2) resulting in the development of two general research questions, namely *(1) How have brownfield sites appeared in an urban context?,* and *(2) How have they been dealt with from both policy and practice perspectives?*

The primary purpose of this thesis is to develop an understanding of brownfields in Iran. Essentially, the study aims to shed light on the key issues pertinent to brownfield emergence and policy aspects of development in the context of Iran. In order to achieve this aim, the current study firstly identifies a series of case studies around the world to gain a better understanding of how different nations and political regimes, at different stages of urban development and with different socio-economic characteristics, have addressed brownfield emergence and built policy responses to it. The key objective is to pull out the essentials of how brownfields are understood and dealt with in policy terms across various world regions. Having done that, the study seeks to establish an analytical tool in the light of these multiple-case studies for analysing brownfield-related issues in Iran.

3.2 Case study research

In order to answer the key research questions, this study adopts a multiple-case design approach. The evidence from multiple cases is often more compelling than from a single case, and the overall study is therefore regarded more robust (Herriot & Firestone 1983). Multiple cases strengthen the validity of the research process by producing unbiased results, especially when there is uncertainty about the external factors affected by different case studies (Leonard-Barton 1990; Yin 2003). As each case represents multiple experiences, perspectives and sources of evidence, the study requires a strong logic to undertake case selection and analysis. According to Yin (2003), multiple-case studies may follow one of two replication logics, namely literal replication (cases predicts similar results); or theoretical replication (cases predicts different results but for predictable reasons). This study essentially draws on the theoretical replication logic to understand how the concept of brownfield regeneration is applied in different cases. These results are then used to inform an analysis of the brownfield situation in Iran.

Building on a comprehensive review of the literature, this research takes four regional case studies from the US, Europe, Japan and China. The variables and critical development factors of each case are collected, and different perspectives on assessing brownfield regeneration are taken into account. This allows a comparative analysis of how different countries characterize, formulate and practice brownfield redevelopment. Relying upon themes emerging from this international analysis, the study develops an analytical tool that is used to examine how the critical factors can be understood in Iran.

The selection of case studies for this research has been largely based upon an analytical framework using the representative method (Seawright & Gerring 2008). For the purpose of this study, the representative method is useful to collect vital pieces of information through a comprehensive and critical analysis of brownfield emergence and development in different countries. Using this method, the study considers four distinct cases, each of which represents distinct features of brownfield issues (see Figure 3.1). The literature review conducted in the previous chapter serves as a basis to determine which cases were appropriate. In an attempt to fully comprehend the historical process of brownfield emergence within the city areas, the case studies were selected with particular diversities of strategic city planning and growth issues presented by each case. Such diversity in form and structure of cities across different countries helps to establish the replication logic for the analysis of the relationship between the development of urban regions and the formation of brownfield sites.

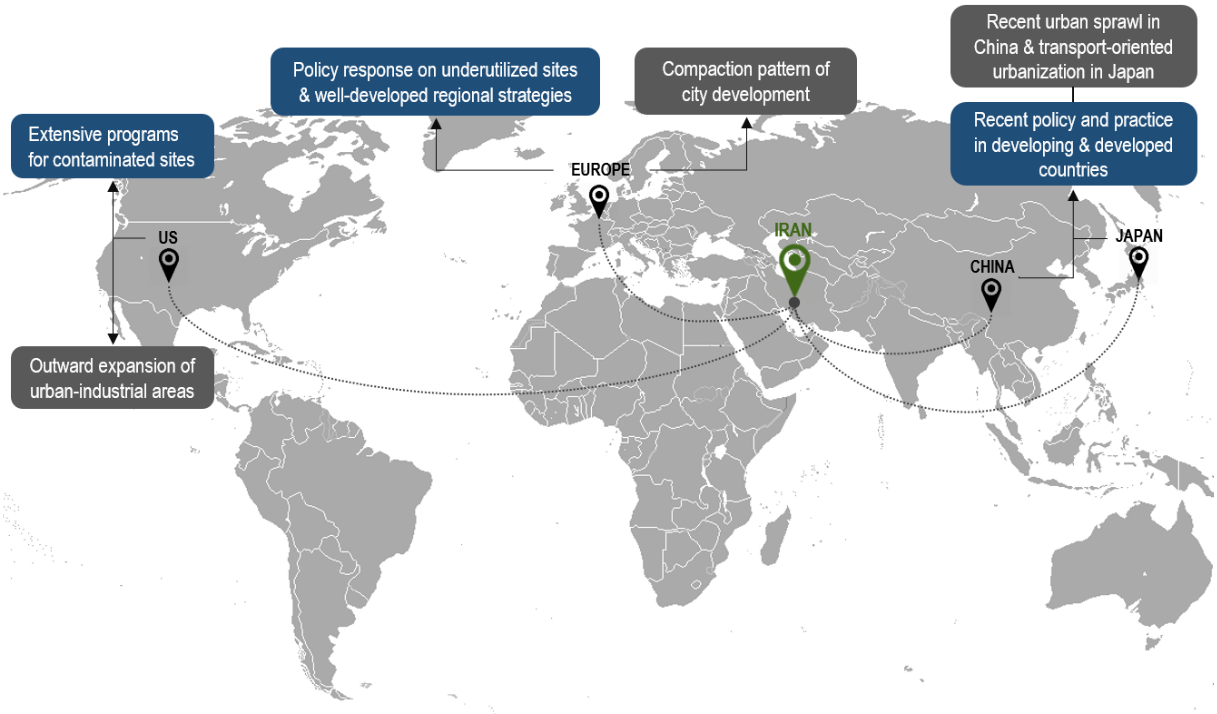


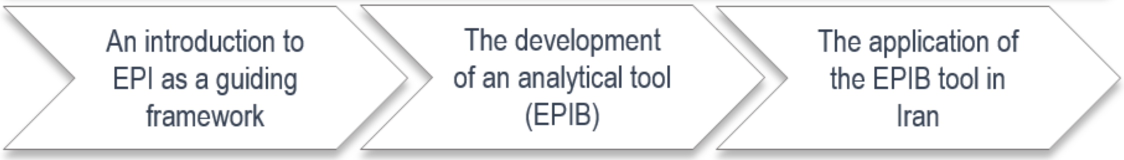
Figure 3.1 Case studies selected for this study *(author's construct)*

The selected cases are also useful in critically addressing the second research question namely, how brownfields have been dealt with across different countries. Each case has come through a unique experience pertinent to development of brownfields in both policy and practice (see Figure 3.1). As suggested by the evidence from the literature review, the US experience in brownfield policy reflects extensive pioneering initiatives and programs for contaminated lands and properties. On the other hand, the European case represents well-developed regional strategies associated with brownfield redevelopment under the broad scope of regeneration underutilized urban areas. The selection of Chinese and Japanese cases was largely motivated by the desire to examine the legal and regulatory framework in developing and developed countries with low level of maturity regarding brownfield redevelopment. The infancy of the existing brownfield policy framework in Japan and China necessitated a comprehensive and critical analysis using practical site case studies (further discussed in section 3.4.2).

3.3 Theoretical framework of the research

As concluded in the previous chapter, one of the key research problems (or gaps) uncovered in the existing literature relates to the disconnect between urban change and policy response to brownfield issues. In an attempt to address this gap, the study aims to examine the broader environmental and non-environmental policy aspects of brownfield redevelopment, using Environmental Policy Integration (EPI). This study adopts EPI as the guiding framework to explain the phenomenon of brownfield redevelopment from both policy and practice perspectives. EPI contributes and applies to this study in three stages, including *'an introduction to EPI', 'the development of the EPIB tool*, and *'the application of the tool'* (see Figure 3.2). The following sub-sections of this chapter (Section 3.3.1) provides an introduction to the concept of EPI and its relevance to land use planning issues. In Chapter 8, the study examines EPI in the light of the outcome of international case study analysis in order to develop an analytical tool, namely Environmental Policy Integration for Brownfields (EPIB). The EPIB tool is employed to provide thorough understanding of policy development and application in relation to brownfield regeneration. In the final stage of theoretical contribution, the study attempts to operationalize EPIB by addressing its analytical framework in the context of Iran and elsewhere, as presented in Chapter 11.

Figure 3.2 **Contribution of Theoretical Framework to Research**



3.3.1 Environmental Policy Integration (EPI); an Introduction

The organizational structure of government bureaucracy often creates boundaries that focus decision makers' attention and assist them in coping with complexity and pressures from wide-ranging interests (Egeberg 2003). Hence, the location of power and responsibility across multiple sectors of government and administrative levels is of great significance (Leiren & Jacobsen 2018). Whilst this organizational framework can assist in problem definition and resolution, it can also be a source of difficulties. A classic problem of governance is associated with the existence of single policy-making silos resulting from such distinct departments and responsibilities. These isolated government silos operate individually and autonomously, so that they often do not share information or work together (Lægreid & Rykkja 2014). The multiplicity and fragmentation of policy decisions made by de-coupled organisational silos often poses formidable obstacles to the implementation of policy. In order to break down vertical silos in governance and enable co-ordinated responses, it is essential to establish a cooperative interaction between disparate administrative functions and levels. This issue is strongly pronounced in managing such cross-sector issues as finance and environment.

Given the growing concerns over environmental issues, e.g. pollution and climate change, the necessity for organizational change is becoming more prominent within each stage of policy generation and application. In response to environmental concerns and natural hazards, Environmental Policy Integration (EPI) was introduced, first in Europe, as an effective approach to heighten environmental awareness across policy development and implementation process. The principle of EPI has been a focus of attention at the international level since the late 1980s. The idea of sustainable development and environmental consideration, e.g. polluter-pays principle, was promoted even earlier under the European Community's first Environmental Action Plan in 1973 (Lafferty & Hovden 2003). The European Union is regarded as the major driving force behind the formulation of EPI (Lafferty & Hovden 2003). This is mainly justified on the grounds of pressing necessity for joined-up policy delivery not only across disparate actors and sectors, but also across the EU Member States, as a whole. Since the late 1990s and early 2000s, the EU has further developed mechanisms and policy-making tools offering an evaluation framework and administrative process for application of EPI. In 2005, the European Environment Agency (EEA) published two important technical reports, namely *"Environmental Policy Integration in Europe; State of Play and an Evaluation Framework"* (EEA 2005a) and *"Environmental Policy Integration in Europe; Administrative Culture and Practices"* (EEA 2005b). These reports have comprehensively addressed policy and practice instruments to deliver EPI within and across European legislation, such as market-based, spatial planning, and environmental management instruments. In fact, the main objective was to set up a series of budgetary, planning and assessment processes that ensure environmental issues are reflected within all non-environmental policy sectors.

EPI has received widespread scientific backing, especially during the early 2000s (e.g. Collier 1997; Lenschow 2002; Lafferty 2002; Hertin & Berkhout 2003; Nilsson & Persson 2003; Lafferty & Hovden 2003; Persson 2004; Jordan & Lenschow 2010; Runhaar et al. 2014). These research studies have comprehensively framed the concept and analysed how it can be evaluated in practice. In defining EPI, existing studies have unanimously agreed upon strong intra-governmental relationships across disparate actors and sectors. Runhaar et al. (2014), for example, refers EPI *"to the incorporation of environmental concerns in non-environmental policy sectors"*. Collier (1997) defines EPI as aiming at *"achieving sustainable development and preventing environmental damage; removing contradictions between policies as well as internal inconstancies; and realizing mutual benefits and making policies mutually supportive".* Articulating an organizational understanding of the term, Collier offers a four-point methodological framework as pertinent ingredients for achieving EPI, including:

(i) *"Consideration of environmental concerns a major policy aim from the earliest stages;*
(ii) *Creation of appropriate political and administrative procedures and structures;*
(iii) *Promotion of appropriate institutional and regulatory framework; and*
(iv) *Use of policy instruments suitable for meeting multiple objectives".*

In much the same vein, Lafferty (2002) has acknowledged EPI not only as an effective approach in removing organizational contradictions, but also in establishing overarching primacy for environmental goals at different levels of policy making. He defines EPI as implying:

(i) *"the incorporation of environmental objectives into all stages of policy making in non-environmental policy sectors, with a specific recognition of this goal as a guiding principle for the planning and execution of policy;*
(ii) *accompanied by an attempt to aggregate presumed environmental consequences into an overall evaluation of policy, and a commitment to minimize contradictions between environmental and sectoral policies by giving priority to the former over the latter."*

Moreover, Lafferty (2002) has made a seminal contribution to the establishment of an analytical mechanism for achieving EPI. To foster potential relationship between departments and between levels of governance, he has developed the idea of EPI along two governmental dimensions, one horizontal and one vertical. This analysis was elaborated further in his subsequent research studies. According to these studies (Lafferty 2002; Lafferty & Hovden

2003; Lafferty 2004), Vertical Environmental Policy Integration (VEPI) refers to "the extent to which a particular governmental sector has taken on board and implemented environmental objectives as central in the portfolio of objectives that the sector continuously pursues". Horizontal Environmental Policy Integration (HEPI), on the other hand, stands for "the extent to which a central authority has developed a comprehensive cross-sectoral strategy for EPI". In fact, VEPI dimension involves various governmental axes- i.e. ministerial sectors-, whereas HEPI signifies the sustainability responsibility for one central authority- i.e. central government (cabinet) or particular legal body or commission- (Figure 3.3).

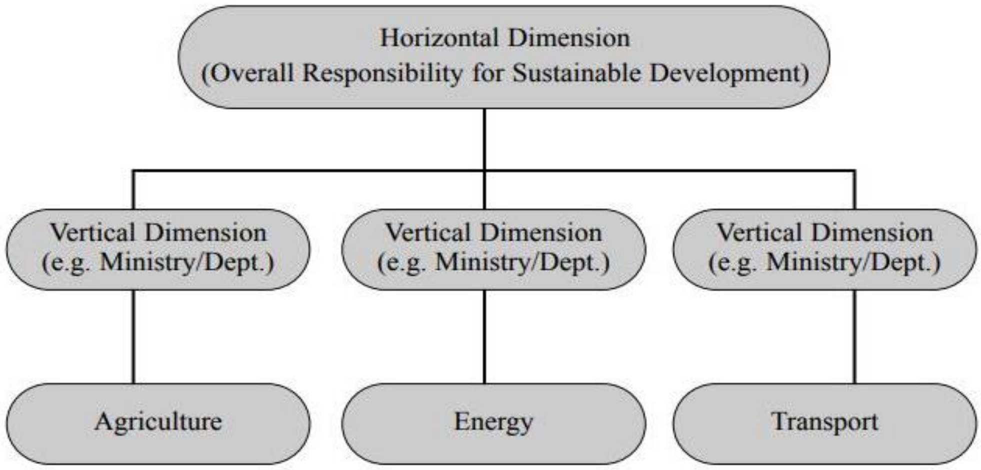


Figure 3.3 Horizontal and vertical dimensions of EPI
(Source: Lafferty & Hovden 2003)

3.3.2 EPI in land-use planning and policy

The application of EPI in respect of land-use policy can be justified on the grounds of the importance of environmental factors in the sustainable urban development process. To make the environmental objectives spatially achievable, it is essential to integrate a series of process-oriented and hybrid environmental tools in different phases of urban land-use planning process. The central objective is, indeed, to seek a common language and mutual understanding amongst environmentalists and urban planners in pursuing the triple principles of sustainability (Simeonova & Van der Valk 2009). In other words, the integration of environmental policies in urban spatial planning aims at reducing environmental damage, while ensuring economic viability and high quality of life in cities (Berke 2002).

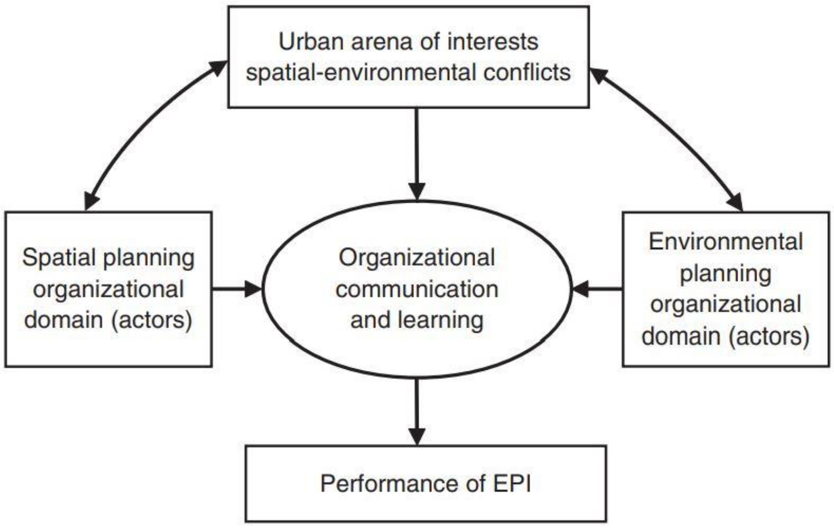


Figure 3.4 Structure of the Communicative Approach to EPI in urban land-use planning *(Source: Simeonova & Van der Valk 2009)*

Following growing environmental concerns, the need for integration of sectoral and environmental issues is becoming more significant within the framework of urban land-use policymaking. This can be observed in scientific debates since the early 2000s. There is a large body of literature that argues in favour of environmental policy integration in the spatial planning process (Flipse 2007; Simeonova & Van der Valk 2009; Runhaar et al. 2009; Pelzer et al. 2013). The seminal contribution to the rigorous analysis of spatial-environmental policy integration was made by Simeonova and Van der Valk (2009). They argued EPI be implemented in the urban planning process by constructing consensus-building and interactive dialogues between the relevant spatial and environmental actors with minimal hierarchical relations (Figure 3.4). Drawing primarily on their comprehensive analysis of various approaches, they conclude that a *"Communicative Approach"* is most likely to achieve EPI in the context of urban land-use planning. It is, however, emphasized by this study that the communicative approach is *"not all-inclusive"* and *"likely to work best…in combination with a procedural and strategic approach"*. They state that (Simeonova & Van der Valk, 2009):

> *"Communicative approach is likely to provide conditions to improve EPI in the field of urban land use planning because it is concerned with establishment of joint decision making between specialized governmental structures. A communicative approach to EPI may be favoured because of the conceptual view it promotes that efficient*

communication and learning between diverse sectoral actors is needed together with a shift from traditional bureaucratic organizational culture in governance to more interactive ones… Actors can join forces in multidisciplinary ad hoc teams or actor networks that offer the conditions for a mutual adjustment process to take place."

Since the early 2000s, spatial-environmental integration policy has drawn increasing attention in several countries in Europe. The Netherlands is one of the leading European countries that has taken a pragmatic approach in applying EPI's principles in local planning practice and urban governance. Several supporting environmental tools have been developed and integrated in the land-use planning and policy system in the Netherlands. The most important tools, in this regard, are MILO (a Dutch acronym for "Environmental Quality in the Physical Environment") and LOGO (a Dutch acronym for "Guidance for Local Area Typology and Environmental Quality") that were introduced in the early 2000s (Pelzer et al. 2013). These two methods, along with other tools such as MIRUP (a Dutch acronym for "Environmental Tool in Spatial Plans") and MMM (a Dutch acronym for "Environmental Maximization Method"), were all developed and propagated on the basis of accommodating environmental and urban planning concerns (Runhaar et al. 2009).

Within the Dutch spatial-environmental planning framework, LOGO and MILO are concerned with local circumstances offering environmental quality criteria and assessment tools for a specific locality at the provincial and local level of land-use planning governance (Pelzer et al. 2013). LOGO is used as a process-oriented tool, mainly for local municipalities, aiming at choosing appropriate environmental standards for each part of the city (Simeonova & Van der Valk 2010). This method focuses on broader aspects of quality-of-life through identifying a clear set of environmental indicators to be used as a vision for urban development process (DCMR & Provincie Zuid-Holland 2004). Whereas LOGO provides a comprehensive framework for an integrated planning policy (De Roo & Visser 2004), MILO guide sets out area-specific environmental quality parameters, such as soil, air, noise and water quality, in different phases of the land-use planning process. MILO is designed for horizontal integration of environmental policies into operational plans at the local and provincial levels (Flipse 2007). It aims at improvement of environmental quality of certain urban and rural areas on different geographic scales where the environmental burdens are limited (Weber & Driessen 2010). Table 3.1 highlights the basic information in respect of content and process of MILO and LOGO planning tools.

Table 3.1 Content and process of MILO and LOGO *(Source: Flipse 2007)*		
Content	**MILO**	**LOGO**
Purpose	Determine differentiated environmental ambitions, with recommendations how to integrate these ambitions into operational plans	Determine quality of life ambitions, with recommendations how to integrate these ambitions into operational plans
Type of Indicators	Objective indicators (physical environmental attributes)	Both objective and subjective indicators (perception of the surroundings)
Scope of Indicators	Environmental quality, a set includes soil, water, noise, odour, external safety, air and water quality	Set of indicators is quality of life set; both objective and subjective indicators (thermometers)
Reference values	Examples are provided for all area types of MILO	For all indicators (parameters) of 27 area types the reference values are given
Area typology	Area typology of 8 different types, within which several types can be distinguished by municipalities, e.g. 'city centre' or 'urban-green'	Area typology of 27 different types, grouped into 4 categories of Centre, working areas, Residential areas, and Recreational, waters or 'greens' areas
Layer approach	The layer approach is recommended	The layer approach is recommended
Process		
Process tool	Recommendations on the process are profound	Rather limited recommendations on the process.
Participation	Participation is recommended	Actual participation is recommended, focus on more openness of the process
Integration	MILO stops were the actual integration starts	LOGO stops were the actual integration starts
Support	MILO project bureau of VNG (The Association of Netherlands Municipalities) offering support throughout the Netherlands.	DCMR, the regional environmental services in the Rijnmond region, in close cooperation with the province South Holland.

3.4 Research approach

As discussed in Section 3.1, the prime objective of this study is to understand where Iran is in the urban brownfield process and what its policy and practice response has been to date. To achieve this, the study employs a case study research approach and constructs a theoretical model through the lens of which the outcome of the case studies are analysed. General questions, then, are how brownfield sites have appeared in cities and how they have been dealt with in both policy and practice. Narrowing down such broad questions, this study frames five sub-questions, namely *(1) what are the rooted cause of brownfield emergence in different countries?, (2) what different types of regulatory framework have been used to encourage brownfield redevelopment?, (3) how effective have different policies been in regenerating* *brownfields?, (4) can policies from other countries be translated to Iran?, and (5) what is the current level of understanding and policy response to brownfield issues in Iran?* The study attempts to address these sub-questions within three successive phases (see Figure 3.5). The following sub-sections elaborate on these three phases and describe how they are applied in this study.

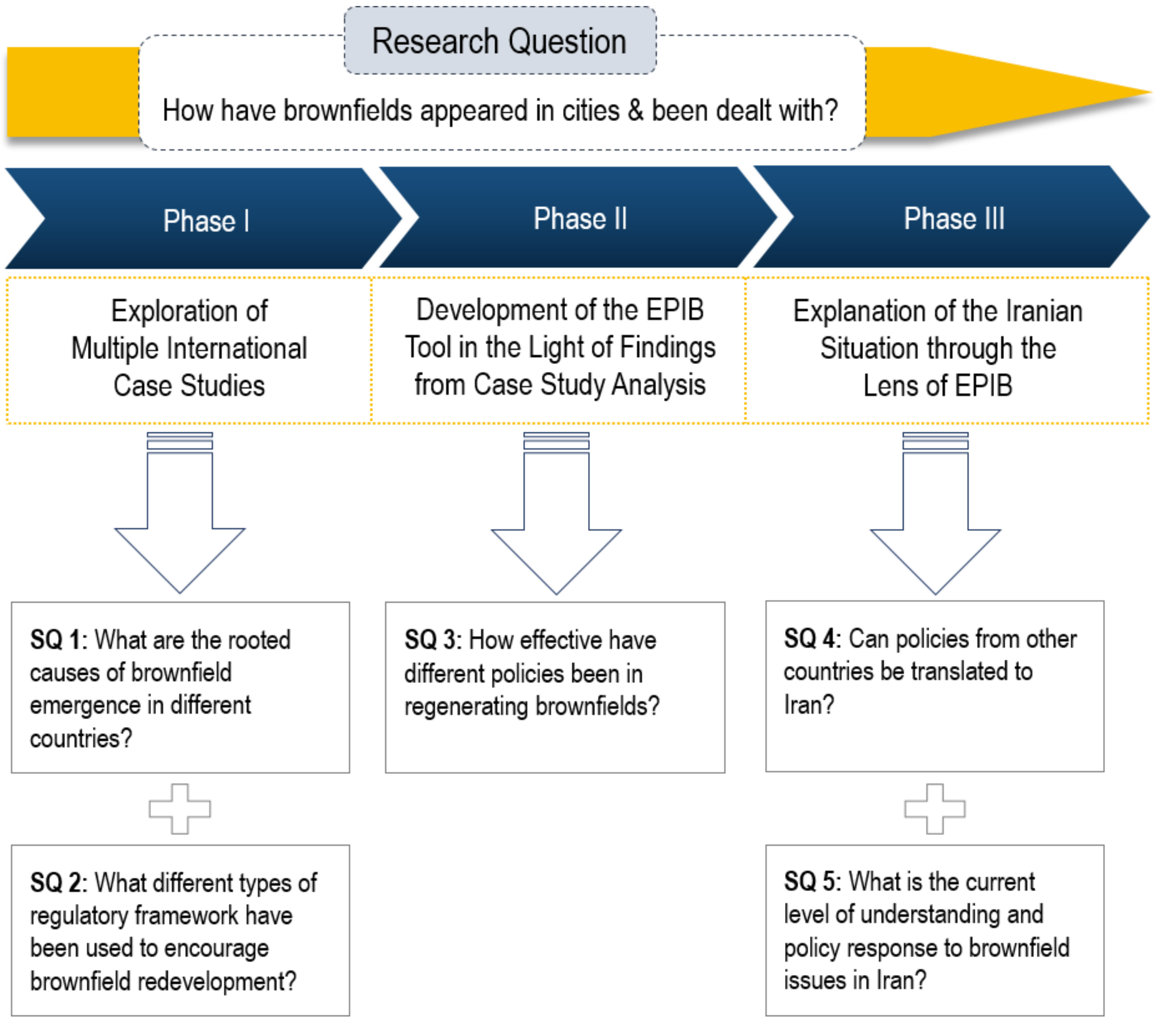


Figure 3.5 Different phases of the study *(author's construct)*

3.4.1 Phase I; Exploration of multiple case studies

One of the key objectives of this research is to frame brownfield issues in the broader context of industrial and, particularly, urban change. The first phase of the study is dedicated to the formulation and clarification of this objective, informing a fundamental sub-question, namely *what are the rooted causes of brownfield emergence in different countries?* In other words, this phase of the research attempts to broaden the current understanding of brownfield emergence and discuss its rooted causes in different contexts. This important research question is posed and examined across four regional case studies (i.e. the US, EU, Japan, and China) (see Figure 3.2).

To answer the first sub-question raised in this phase, the study employs a methodology approach comprising various qualitative strategies, including the comprehensive review of academic literature and reports, coupled with field-survey and interviews. A narrative literature review is undertaken as an extension of broad literature review presented in Chapter 2. It explores the process of spatial-industrial transformation in different contexts and carries out a critical analysis of existing knowledge in the subject area. Both secondary and primary data are used in this analysis. The data for the literature review in the context of US and Europe are entirely secondary, retrieved from resources such as books, journal articles, conference papers, dissertations, and unpublished online articles. These scholarly resources are identified for review based on their comprehensiveness and relevance to the subject matter. In the cases of Japan, China and Iran, along with the secondary data, some primary data have been collected through a range of semi-structured interviews as well as personal site visits in these three countries (further discussed in section 3.5). To ensure the credibility of qualitative research, the collected data from the literature review and field-surveys are supported by a series of statistical data in relation to the spatial, demographic and industrial transformation patterns throughout the country case studies. Policy reports and census data, maps, and newspaper databases serve as the main sources of data collection here.

Furthermore, the first phase of the study explores the international experiences in relation to the formulation of legislative framework on brownfield redevelopment. It attempts to acquire the current knowledge of relevant issues in both policy and practice. To enable the critical analysis of how different regimes have faced the brownfield redevelopment challenges, another sub-question is brought up here, namely *what different types of regulatory framework have been used to encourage brownfield redevelopment?* Based on case study analysis, the study elaborates on the legal conceptualization, quantification and policy agendas employing a qualitative approach. Qualitative secondary data in this phase are collected through a comprehensive review of academic literature, and official government reports and policies in the contexts of all four international country cases selected for this research (i.e. US, EU, Japan, and China). Primary data were collected through several semi-structured interviews with relevant stakeholders in Japan and China (further discussed in section 3.5.1). Meanwhile, two case study site visits (i.e. ongoing and finished brownfield redevelopment projects) have been conducted in Japan and China to examine how typical practices in these countries relate to the formulated policy framework (further discussed in section 3.5.2).

3.4.2 Phase II; Development of the EPIB tool in the light of findings from international case study analysis

Having outlined and compared the driving factors to brownfield occurrence in different country contexts, the second phase attempts to address a key sub-question; *how effective have different policies been towards regeneration of brownfields?* The prime objective is to enhance operational understanding of observed phenomena and provide a lens through which this might be examined. The second phase analyses the findings from international cases through the lens of an analytical tool discussed in section 3.3. In this phase, the study benefits from an established approach and further develops it as a tool for evaluating the brownfield situation in different countries, namely EPIB. In doing so, the study critically analyses the success and failure factors associated with the brownfield redevelopment process in the selected case studies. This presents an analysis of factors that demonstrate existing strength, challenges and barriers to brownfield redevelopment from both policy and practice perspectives.

3.4.3 Phase III; Explanation of the Iranian situation through the lens of EPIB

Building on the EPIB's framework, the final phase of the research involves a detailed reflection on the existing brownfield redevelopment situation in Iran. The sub-question posed here is; *what is the current level of understanding and policy response to brownfield issues in Iran?* To answer this question, the study examines the spatial planning and environmental protection regulatory systems in Iran. It discusses how these systems operate, and to what extent brownfield regeneration policies are developed and implemented within each system. The ultimate objective of this phase is to determine the existing scope for brownfield redevelopment across various levels of Iranian urban and environmental governance. As in the previous phase, the data are collected from both primary and secondary sources. With regards to secondary data, this phase interrogates both scholarly literature and policy documents. The policy data were derived from national, state and local government reports, electronic media and official websites of Iranian governments' institutions. The main medium for collecting primary data is a field-survey in Iran which includes semi-structured interviews and case study site observations across several Iranian cities (i.e. Tehran, Shiraz, Sari and Qaemshahr) (further discussed in section 3.5). The findings from field-survey illustrate how development agencies and actors in Iran comprehend the phenomenon of brownfield regeneration.

3.5 Research methods

To assist in the collection of primary data in different phases, intensive field-surveys are used in three countries, namely Japan, China and Iran. These field-surveys were conducted using a combination of two qualitative approaches including semi-structured interviews and empirical case study site visits, each of which is discussed further in the following sub-sections.

3.5.1 Semi-structured interviews

Semi-structured interviews are employed across different phases of this research as one of the major approaches for investigating the concept, emergence process and policy framework of brownfield sites in different regimes. Through extensive consultation with a range of experts in relevant subject areas, the study attempts to examine how the concept of brownfield is understood; how brownfield sites have emerged in an urban context; and how they are recycled and reused from both policy and practice perspectives. In total, 50 interviews were undertaken with different stakeholders in Japan, China and Iran (see Appendices A-5; A-6; A-7). To fulfil the objectives of the research, three groups of participants were considered for the interview investigation, as follows:

- *Group I:* Academics and urban researchers.
- *Group II:* Public development agencies including both urban development and environmental protection bureaucrats at different levels of governance.

- *Group III:* Professional experts in relevant brownfield redevelopment projects which includes urban planners, architects, landscape architects, environmental engineers, project managers and real-estate developers.

The study employed a 'Snowball Sampling Method' (also known as chain sampling, chain-referral sampling or referral sampling) for identifying interview participants and case study sites in Japan, China and Iran. This method has been extensively used in qualitative sociological research, especially when the focus of study is on a sensitive issue (Biernacki & Waldorf 1981). Snowball Sampling Method "*yields a study sample through referrals made among people who share or know of others who possess some characteristics that are of research interest"* (Biernacki & Waldorf 1981). To access hard-to-reach people and data, this method is useful by *"asking participants for recommendations of acquaintances who might qualify for participation"* (Miller 2003). For the field studies in Japan and China, the host supervisors from Tsukuba University (Japan) and Shandong University (China), who were experts in the field and well connected with industry and academia, directed the researcher to particular people for both interviews and case study site visits. In the case of Iran, the interview arrangements for obtaining the data or any formal arrangements required for site visits were facilitated by an Iranian academic and researcher who was on secondment in South Australia.

The interview participants were identified based on their expertise, experiences and affiliations of different development agencies. Preferably participants had more than ten years of experience. Selected participants were directly or indirectly related to brownfield (re)development and sub-study areas. For participants from government, senior officials of the organisations were selected for interview. The interviewees were mostly selected through personal contacts of the researcher in Australia, Japan, China and Iran, and then contacted through their publicly available email addresses. Interviews were undertaken in conducive public venues or their offices agreed upon between the researcher and interview respondents. In some cases, however, interviews via skype were determined to be the main medium for collecting primary data, in particular for the field-survey in Japan. In addition, interviews would be audiotaped with the consent of interview participants for transcription purpose only (details of other ethical issues considered in the study are provided in Section 3.5.3). As the interviews were semi-structured and informal in nature, only those data relevant to addressing the research objectives have been considered for this study.

The questions for interviews were transcribed by the researcher and refined through several discussions with the supervisory panel. For the field-surveys in Japan and China, the interview questions were meant to address the key issues regarding the brownfield emergence process, as well as policy aspects of development. Similar to the Chinese and Japanese field interviews, in the case of Iran, the questions were essentially framed in an attempt to investigate the underlying stimuli to brownfield occurrence within the fabric of cities. However, in policy terms, the interview questions were rephrased for the Iranian field-survey. This necessary change to the questions was mainly justified on the grounds of limited understanding of the brownfield concept amongst most interview participants and, particularly, the lack of policy framework for brownfield redevelopment in Iran. Hence, the policy-related questions in Iran aimed at explaining the existing structure of urban management and regeneration jurisdiction as well as the environmental protection sector in Iran. Such questions allowed for a deeper understanding of the current scope for brownfield regeneration across various levels of spatial-environmental governance systems in the context of Iran.

3.5.2 Case study site visits

In addition to semi-structured interviews, visits were conducted to several brownfield sites and redevelopment projects in Japan, China and Iran. In the cases of Japan and China, two post-industrial sites, namely the Musashi Kosugi Area in Japan and the former site of Liaocheng Chemical Plant in China, were personally observed and different aspects of their development processes were critically analysed. These two firsthand cases enabled the researcher to examine the application of existing Japanese/Chinese policy, regulatory and technical frameworks for site remediation and reuse. Both cases exemplify the process of brownfield (re)generation in these two countries.

In Iran, a few underutilised and/or abandoned urban sites with former industrial and institutional uses (e.g. post-military sites and prisons), accompanied by a handful of brownfield redevelopment projects were visited across four cities (i.e. Tehran, Shiraz, Sari and Qaemshahr). These site visits in Iran provided good insights into the formation process of brownfields in the local urban context. Furthermore, the site visits have proven useful in reflecting the challenges and shortcomings of policy system in dealing with brownfield issues in Iran.

3.5.3 *Ethical consideration*

Having met the requirements for the Australian Code for the Responsible Conduct of Research and the National Statement on Ethical Conduct in Human Research (2007), this study has undergone the appropriate level of ethical review before the commencement of field-surveys in Japan, China, and Iran. For the Japanese and Chinese field-surveys, a low risk human ethics application was submitted to the Human Research Ethics Committee (HREC) of the University of Adelaide in December 2016 which received an approval in February 2017 (approval number: H-2016-288) (see Appendix A-1). This ethics application was amended for the field-survey in Iran and reapproved by the HREC in March 2018 (see Appendix A-2).

The study followed several protocols for recruiting participants. Participants in all three countries were informed of the purpose of the research and their rights and responsibilities in participating in the study. Those who agreed to participate in the study were given a participant information sheet (providing an overview of the study), a consent form, and a draft of the semi-structured interview questions via email or in person (see Appendices A-3; A-4; A-5; A-6). To enable participants to accurately understand the meaning of the questions, the interview questions were translated to Japanese, Chinese and Persian. For interviews in Japan and China, some bilingual interpreters were identified to assist the researcher when conducting interviews. The interpreters were university students with prior knowledge in research methods and data collection who were living in the study area. The researcher organized a training and discussion session with the interpreters before the administration of the surveys. For interviews in Iran, interviews have been conducted in native language (Persian) by the researcher.

This is a low-risk research project. Therefore, no significant risk has been present to the researcher's health or safety when conducting the field studies. However, there were possible risks to respondents as they might divulge some sensitive information contrary to government policies. A consent form was signed by the respondents prior to commencing the interview, stating that their personal results and sensitive information would not be divulged. The privacy and confidentiality of participant data and samples were protected throughout the different stages of the research. In the reporting of the interview findings, personal identifiers (names) have been removed and replaced by a code (see Appendices A-7; A-8; A-9). For example, 'Participant 01-CN' for interviewees in China, 'Participant 01-JP' for interviewees in Japan, and 'Participant 01-IR' for interviewees in Iran. Meanwhile, personal safety precautions have been followed by the researcher when visiting case study sites. For example, the researcher considered the ground conditions at the site, and used suitable control measures for each site visit. Moreover, some formal arrangements were required for access to brownfield sites in China, Japan and Iran.

3.5.4 Limitations of the data

The current study has encountered a range of limitations in relation to the access to data, and the assessment and interpretation of data. A different set of challenges with data collection were risen during two field-surveys in Japan and China. Such challenges were mostly related to language barriers, accessibility to data as well as unanticipated incidents that affected the process of data collection. Most of the relevant official government documents and policy reports were written in Chinese and Japanese. Nevertheless, language translation applications accompanied by the assistance from host research institutions in Japan and China proved helpful in interpreting some of the non-English language text and providing supplementary information for the detailed analysis respectively.

The study encountered some challenges in terms of the selection of site case studies in China. A brownfield site (shut-down steel factory) in Jinan had been selected and accordingly several interviews had been pre-arranged before the field-survey. However, because of the factory workers' strike, the researcher was not given the permission to enter the factory site and all interviews with authorities were rejected. The case study had to be then replaced during the short period the researcher was staying in China.

Furthermore, during the field-survey in Iran, major challenges were encountered regarding the management of interviews in several Iranian cities. Due to the limited time spent in each city, many interviews with relevant stakeholders, particularly government officials, were cancelled. Therefore, the researcher had to promptly re-arrange new interviews in order to ensure the accuracy of collected primary data and, thus, the credibility of qualitative research in Iran.

PART II

CHAPTER 04

Brownfield Regeneration in the US

4.1 Introduction

Over the past half-century, many US cities have displayed significant socio-economic and physical changes, resulting from a disproportionate flow of population and industries from central cities to suburbs. Coupled with broader shifting global economic factors, this trend of industrial suburbanization, along with lingering infrastructure disinvestment and diminishing support for public services in inner-city areas have put several US cities in pervasive structural predicaments (Beauregard 2009). One of the serious consequences of gradual, but steady, industrial shift and suburban growth has been the disorderly appearance of vacant lots and, in particular, brownfield sites within the fabric of cities. Although the US policy makers and planners have been highly proactive in inner-city recovery and redeveloping brownfields, policy solution to these economically and functionally obsolete sites is still a key concern. This study seeks to provide in-depth insights into different aspects of brownfield activities in the US context and unfold the key issues in this regard.

This chapter is comprised of four major sections. The first section sets the stage by triggering a discussion of urban decentralization and industrial suburbanization in an attempt to gain a better understanding of widespread transformation of US metropolitan areas. It also outlines the scale of the environmental, socio-economic and physical problems in inner-city areas posed by the suburban sprawl in the United States. Section 4.3 discusses the root causes of brownfield generation in US cities, followed by the legal definition and nationwide quantification of brownfields. Section 4.4 is dedicated to the legislative framework on brownfield regeneration, investigating the recent federal and state initiatives and programs. In section 4.5, the status of non-contaminated and vacant urban lands on a nationwide scale is discovered. The case of Detroit, as a widely-known example representing the vacancy of US central cities, is illustrated to frame the examination of US brownfield regulatory baselines and their longtime side-effects on non-contaminated previously developed sites or greyfields.

4.2 Sprawl of the US cities

For several decades, the US population has been disproportionately out-migrating to suburbs, where purchasing land, renting houses and running business are found to be relatively less costly than in central cities (Garreau 1991; Glaeser & Kahn 2001; Squires 2002a). Since the mid-twentieth century, the US governments, developers and business communities have largely focused on development in greenfield locations, on the basis of consumption of new houses and new cars (Brueckner 2000). The result has been a low-density and car-oriented pattern of urban development, namely 'suburban sprawl'. The economic and legal transformations of residential and commercial activities toward greater spatial dispersion that occurred over time have made the suburban fringe independent from the central city locations. The paradigm of the exploding metropolis has become the dominant trend of urbanization in the United States over many decades and frequently segregating suburbs from the central cities economically, socially and physically. While the suburbs boomed, inner-city industries and manufacturing sectors have often declined, resulting in further population loss. This population and industrial flight from the city to the nearby suburbs and smaller towns occurred in many major metropolitan areas in the United States, and is exemplified by the case of Columbus and Detroit since the 1950s. Between 1950 and 2000, the population of Detroit metropolitan area, for example, declined from over 1.8 million to less than 951,270, whereas from 1900 to 1950 this city had experienced strong population growth from under 285,700 to over 1.8 million (Daskalakis et al. 2001).

In many countries, suburban sprawl is predominantly interpreted as a realization of the market-oriented land use planning system and tax revenue regulations (Zhang 2000; McFarland 2013). However, outward expansion of boundaries in the US cities is more than just the product of market forces. Several researchers have listed 'US culture' and 'individual choices of citizens, developers and governments' as the leading factors that facilitated the decentralization of industries and housing (Johnston 1982; Kibel 1998; Young 1995). For example, as Kibel (1998) suggests, *"Americans have been less tied to geographic place, and therefore when confronted regional problems, were more likely to move than to seek place-specific solution"*. In much the same vein, Young (1995) considers the sprawl *"as the natural product of an inherent trait in the American character"*. In fact, the concepts of suburbs and suburbanization have been the centre of US identity in the last hundred years. Population and job loss of central cities to new low-density settlements is rooted in certain persistent social trends.

Furthermore, federal and state governments have supported development on suburban lands because of greater returns on investment and greater appeal to the public. The suburbs were attractive for the US citizens for several reasons. People moved from cities into the decentralized but growing suburban areas largely in search of privacy, mobility, ownership and a sense of security (Calthorpe 1993). Availability of cheap land has always been a draw for development at the periphery. Plus, the geographic characteristic of the US was an important factor that made it possible for further outward-growth of cities. For the nation as a whole, a large quantity of open and fertile suburban land was available for development (Kahn 2000). According to Garreau (1991) *"If you housed every household in the United States in that beloved suburban 'sprawl' density of a quarter acre lot each, that would still take only about 23 million acres, 1.222 per cent of all the land in the United States, even if Alaska were excluded".*

Suburban lands represented tremendous opportunities for a healthier, less congested life and less socially stratified regions that often existed in many large industrial cities. Furthermore, transportation technology, e.g. railroads, automobile and trucks, encouraged US families to move away from their old locations on urban cores to new residence on growing suburban rings. Transportation advances and new communication technologies have been always essential to suburban growth. These could benefit first the middle-class families who were not satisfied with their economic conditions, and also higher-income groups who chose to relocate to suburbs where they could be provided with higher environmental and social prospects. The emergence and adoption of new omnibus lines and modern railroad commuter services, for example in New York and Boston in the 19th century, helped drive early suburbs across the United States. However, with the rise of the US automotive industry in the immediate years after World War II, the growth of cities became predominately car-oriented. Increasing private car ownership and accordingly highway construction were the key to accelerating development leapfrogging to distant communities as they offer unpreceded speed and flexibility in transporting residents, workers and goods (Glaeser et al. 1991). According to the Bureau of Transportation Statistics (BTS 2016), in the 1960 US citizens owned 60 million passenger cars, or about one car for every three people; by 1980 the number had almost doubled to 121 million, more than one car for every two people.

As discussed earlier, it has been always a dream for the US citizens to own a private detached home in the suburbs with good access by private car. As Johnston (1982) suggests, *"although* *suburbanization may be interpreted as a realization of the US dream, in terms of residential preference and the most efficient solution to locational problems for most manufacturing and other business establishments, it could not have occurred without a great deal of investment, both private and public."* Enormous sums of federal monies were invested to build up new production facilities for industries and new plants in suburbs which increasingly promoted a lower density development pattern. A notable example of federal investment in suburban development was the expanding operation of new factories and manufacturing industries outside the city of Detroit during the post-war reconstruction period, during the 1950s and 1960s (Ross & Levine 2011). Meanwhile, federal policies contributed to suburban sprawl by subsidizing highway spending and mortgage tax incentives as two important programs that made the urban-suburban commute easier. Another federal program that influenced the suburbanization of America was the former Title II program of the Clean Water Act, which assisted municipalities in creating or expanding the suburban sewer system and water supply infrastructure (Tarlock 1993). This federal subsidy program significantly reduced the development costs of growth areas in suburbs and accordingly accelerated the suburbanization process across metropolitan areas in the US. The percentage share of total US population between 1950 and 1975 shows that the suburban population increased by approximately 15 per cent, whereas the population of central cities decreased by 5 per cent (Muller 1981).

In contemporary US cities, the revival of exurban population growth has been fuelled by widespread advances in technology and industry, especially toward high-amenity suburban locations. The growth of population and employment centres, particularly in suburban locations, was significant in several US cities- such as San Francisco, Portland, Tacoma, and Las Vegas- throughout the 1990s (Glaeser et al. 2001a). The population of Las Vegas, for example, increased by 14.4 per cent from 1990 to 1992, with much of this increase concentrated one the suburban fringe (Clayton 1995). Las Vegas's rapid growth of population and, thus, sprawling and decentralized urban development have continued apace in the 21st century (Balsas 2017) (see Figure 4.1). Amongst the 51 largest metropolitan areas in 2013, only in 18 of them was urban growth faster than suburban growth (Sanburn 2014). The population growth pace in suburban counties in the US is still faster than population growth in urban counties. In short, the suburbanization trend is ongoing at a rapid pace in the US. Helbock (1968)'s anticipation remains true today: *"The United States is an urbanized nation which is rapidly becoming more suburban than urban"*. Nowadays, the US modern cities have become *"more* *like sprawling suburbs, with a uniform distribution of people and jobs"* (Glaeser & Kahn 2001).

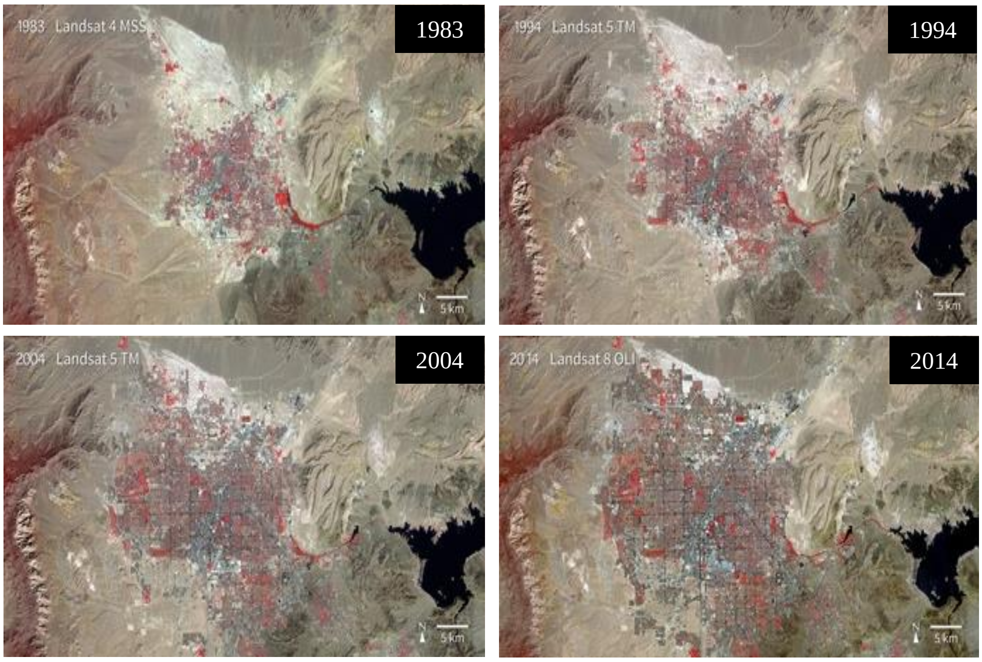


Figure 4.1 NASA Landsat data of Las Vegas city between 1983 and 2014, exemplifying the rapid sprawling land pattern of contemporary US cities (Source: https://svs.gsfc.nasa.gov/30215)

4.2.1 Sprawl and inner-city problems

Population decentralization does not fully capture the concept of suburbanization in the US context. Suburban sprawl is, indeed, recognized as a multidimensional geographical trend rather than merely a decline in average population density over time (Theobald 2005). The phenomenon of suburbanization with its often uncoordinated land-use patterns has had enormous environmental and socioeconomic impacts on US cities in many ways. Downs (1994) in his seminal book, *New Visions for Metropolitan America,* explained the substantial problems facing metropolitan America created by urban sprawl as follows:

> *"For half a century America has had one dominant vision of how its metropolitan areas ought to grow and develop. This vision encompasses personal and social goals- a home in the suburbs, a car, good schools, responsive local government- that most American cherish ... Yet this achievement has contributed to unexpected growth-related dilemmas*

that threaten the long-run viability of US society, something the US public and most leaders have yet to realize."

Environmentally, suburban growth has imposed great costs such as undeveloped-land loss, species endangerment, vehicle mileage, and home and industrial energy consumption (Kahn 2000). As development moved to open tracts of land in the suburbs, major land–use changes occurred across US cities. Sprawling land development has generated excessive consumption of land on the outskirts of US metropolitan areas (Freilich 1999). Large axes of undeveloped land have converted into human settlements including commercial and industrial uses, which have destroyed rural landscapes, agricultural communities and wildlife habitat at a considerable scale. The negative environmental consequences of sprawling development in the US are becoming increasingly obvious. Between 1982 and 2003, total prime farmland in the US dropped by 76 million acres in the lower 48 states, whereas the total developed land increased by 36 million acres (Wu 2008). The US Department of Agriculture Natural Resource Conservation Service estimates that over 18 million hectares of land were converted to urban uses in the United States during the 30 year period between 1982 and 2012 (NRCS 2015). In addition to increasing consumption of precious land resources, accelerated conversion of undeveloped rural-urban fringe land to low-density residential and commercial use has also posed a threat to air quality, as it causes longer and lengthier commutes. The US Census Bureau's report (USCB 2011a) shows that the average commute time for full-time workers in the US has increased from 21 minutes in 1980, to 25 minutes in 2009. The longer commute time coupled with heavy use of the automobile have significantly increased the level of air pollution in several major cities which has adversely influenced living and working conditions.

A further dimension of this structural change within US cities is rising poverty and crime rates in inner-city areas. Suburban growth and exclusionary zoning has often changed the identity of US metropolitan communities by creating ghettos in the central city. Based on the information collected by the US Census Bureau, poverty rates in central city areas are higher than in suburban locations, 19.1 per cent compared to 11.1 per cent in 2013 (DeNavas-Walt & Proctor 2014). Several studies demonstrate a strong empirical relationship between suburbanization and metropolitan crime in the US (Cullen & Levitt 1999; Jargowsky & Park 2008; Kneebone & Raphael 2011; Horatas-Rico 2015). Demographic movement of the middle and upper class families and outward flow of manufacturing and employment towards high-amenity suburban locations have left behind and isolated vacant lots and unemployed minority populations in urban core areas. According to Uniform Crime's report data for the 100 largest metropolitan areas in the United States (UCR 2008), the average of violent and property crime rates is estimated to be 3.3 per cent in principal cities and 1.8 per cent in suburban places in 2008. In other words, the number of criminal incidents in large city areas is nearly twice that in the suburbs.

The fastest-growing suburban sprawl has been also accompanied by a relative economic decline in inner-city areas, as a result of a declining economic base. In 1998, the average income of households in inner-city locations in Detroit metropolitan area was 47 per cent of that in the surrounding suburban neighbourhoods (Daskalakis et al. 2001). In addition, transformation of manufacturing industry into the fringe has produced a dramatic stagnation or decline in property values for many property owners in central cities. The more tax revenues and municipal services decanted to suburban area, the less attractive urban areas became to real estate developers, investors and individual homeowners (Calthorpe 1993). At present, a large percentage of manufacturing and industrial services is found in decentralized suburban locations in the United States and the central city is no longer the dominant economic and industrial centre that it once was. As development and the tax base moved away from the core urban environment, the less competitive markets were more likely to be urban than suburban. In other words, the distribution of industries and employment around the centre has created serious urban disinvestment and economic hardship, especially for declining industries that were in need of reinvestment. In 1960, 63 per cent of employment and services were centralized in city areas in the US (Glaeser & Kahn 2001). According to the US Census Bureau's report (Marlay & Gardner 2010), the low-density suburban locations in the US account for almost twice the share of employment as central business districts, following a trend that had been underway for years.

4.3 Brownfield in the US context

4.3.1 Rooted causes of brownfield emergence

The emergence of brownfields in the United States has often been conceptualized narrowly, in terms of dramatic decline in central city residential uses, manufacturing and businesses over years (Simons 1998). Following a widespread shift of existing households and production facilities toward the outer edges, the inner cities display an increasing number of factories, manufacturing centres and commercial properties that now stand vacant, idle and in some cases contaminated. This is a phenomenon that has been predominantly interpreted as the 'doughnut effect' or the effect of 'hollowing out' processes of the city centres that many US cities have been dealing with for several decades (Hollander et al. 2009; Wiechmann & Pallagst 2012). Analysis of the dominant paradigm of the exploding US metropolis and its uncontrolled outward land development reveals that the phenomenon of suburbanization has played a critical role in the creation of brownfield sites (Kibel 1998).

Underlying industrial suburbanization, there are major external economic forces at work. Inner-city industrial brownfields have emerged within many large cities as a result of mass relocation of manufacturing industries to suburban areas and overseas. This industrial restructuring process can be attributed to globalization and consequent industrial change in most developed economies in the 20th century (DiGaetano & Lawless 1999; Lawrence & Edwards 2013). During the post-1970 period, a large number of US cities witnessed their manufacturing sectors decline drastically (Bluestone & Harrison 1982). The city of Youngstown in Ohio, for example, experienced the closure of its steel mills in 1970s and accordingly dramatic loss of its residents, from 170,000 people in 1950 to 82,000 people in 2000 (Hollander et al. 2009). Following these closures, the United States Environmental Protection Agency (EPA) selected the city of Youngstown as a Brownfield Pilot Area, comprising 900 acres of brownfields (USEPA 1998).

The growth of competition from global emerging economies, e.g. Japan, China and ASEAN countries, and increased mechanisation resulting in less requirement for labour have driven a rapid process of restructuring in the United States. Industrial restructuring started from the mid-1970s and reached its heyday in the 1990s, particularly in the Northeast and Midwest regions. The share of manufacturing employment in the United Stated declined from a peak of 28 per cent in 1965 to only 16 per cent in 1994 (Rowthorn & Ramaswamy 1997). During the 6 year period from 1991 to 1997, the Baltimore region, for example, experienced an average manufacturing employment loss of 23 per cent in the central city (Howland 2004). As discussed in Chapter 2, the global restructuring trend further stimulated the flight of manufacturing activity/capacity away from industrialized cities, thus creating brownfields. Amongst all highly developed countries, the US is regarded as the first country in the post-World War II period that shifted to a service economy, with more than half of its aggregate employment and production in the service sector (Fuchs 1968). Such structural shift in demand away from manufacturing activity toward services has been increasing throughout the 21st century. According to the World Bank (2019), service industries contributed more than 77 per cent of GDP in the US in 2017.

Tertiarization of the economy has had important implications for the spatial structure of a large number of cities in the US, particularly those cities heavily dependent on a single industry, such as Detroit whose economy was dominated by automobile industry (Berry 1976; Bluestone & Harrison 1982; Breheny 1987; Champion 2001; De Sousa 2006). As a result of globalization and also labour-saving technological progress in manufacturing, many companies, enterprises and large factories have ceased to exist or gone into slow decline, leading to growing concentrations of 'urban vacant' lands or 'urban voids' in many major urban areas in the United States. Such decades-long industrial restructuring in response to the international competition and differential labour costs has proved instrumental in creating industrial brownfields within the fabric of US cities.

4.3.2 Definition and quantification of brownfield sites in the US

The term 'brownfield' was first used by the United States Environmental Protection Agency (USEPA or EPA), when it formally launched Brownfields Action Agenda in 1995 (Adams et al. 2010). This agency defined brownfields initially as *"abandoned, idled, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination"* (USEPA 1995). In 2001, the US Congress redefined brownfield by the enactment of Small Business Liability Relief and Brownfields Revitalization Act (BRERA). According to the BRERA, *"The term 'brownfield site' means real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant"* (US Congress 2001). The BRERA federal law was fundamentally developed in an attempt to promote regeneration of brownfields through providing further federal supports for the state brownfield programs (This will be discussed further in the following section). Although there have been various federal, state and local definitions of brownfield sites over the past several years in the United States, the EPA's old Glossary definition is still the most extensively used definition of brownfields (Yount 2003).

The EPA's broad and nationally agreed definition implies that all brownfields are labelled as contaminated lands or properties (Alker, et al. 2000). In fact, in US legal discourse, brownfields are essentially associated with the actual or potential presence of a harmful substance, pollutants or contaminants that often delay the process of site redevelopment. Furthermore, the use of the term 'under-used' implies that brownfields are not limited to closed industrial premises, abandoned commercial buildings or inactive warehouses, but partially-occupied sites can also be considered as brownfield (Alker, et al. 2000). Relying on the EPA's interpretation, there are four common characteristics attached to brownfields as follows:

1. Brownfields are mainly former industrial and commercial sites with existing infrastructure and buildings already in place. Examples are old factories, electrical power plants, warehouses, harbours, petroleum stations.
2. They are mostly derelict and abandoned but may also include under-used lands or properties situated in rapidly developing metropolitan areas.
3. These sites have real or perceived hazardous substances, pollutants or contaminants present that may lead to problems of blight and stigma. The polluting sources are often waste from manufacturing and commercial activities that contain variety of metals, toxic chemicals and building materials. The sources of contaminants and pollutants on brownfields can be both above-ground and underground, such as contaminated soil, surface water, and groundwater.
4. In order to minimize the risk to human health and ecological systems, certain assessment programs and remedial action are necessary to remove any contamination stigma and prepare the site for an appropriate future use.

It is difficult to accurately address the actual quantity of brownfields across the United States. The EPA estimates that there may be between 500,000 and one million brownfield sites in the US (Solomon 2003). The actual number of brownfield sites is likely to be many times greater, as the number estimated by the EPA only comprises sites for which an environmental site assessment has been conducted. There are a large number of brownfield sites that are not listed because they have lower contamination levels and remain to be assessed (Davis 2002).

Contamination varies significantly according to the nature and size of former operation. At present, the EPA has identified 1,250 sites that are in the National Priorities List (NPL). In fact, approximately only 0.1 per cent of nationwide brownfield sites in the US are the worst known contaminated sites that are high-priority for intervention.

Generally, brownfields can be found throughout the US, but are mostly located in large metropolitan areas with a long history of manufacturing activity (American Planning Association 2006). In other words, brownfield sites are often positioned where industry existed once, irrespective of population and size of the place. For instance, in 2000, San Diego, California, with a population of almost 1.2 million, reported only 7 brownfield sites, whilst the city of Atlanta, Georgia, with a population of 450,000, estimated over 600 sites (US Conference of Mayors 2000). An additional evidence for the disparity in reporting brownfields, concerning the size of the place, is the state of California. According to the Centre for Creative Land Recycling (CCLR 2016), in California- as the region containing the highest number of manufacturing industries, but representing only 5 per cent of the total land area in the United States-, the potential brownfield sites are estimated to be between 150,000 and 200,000. However, there are some other statistics demonstrating that this feature seems to be even much greater. Relying on the North US Industry Classification System, in 2002 there were nearly 400,000 reported industrial units in California having a high probability of environmental pollution and contamination (Brodsky 2007).

There may be several reports in regards to the quantity of brownfields for a single region that could vary significantly according to different estimation methods. It should be also noted, there is a lack of data on unlisted sites due to the unclear definition of brownfields in many cities (Simons 1998). According to the US Conference of Mayors (2000), *"several cities were unable to provide this data [in regards to the quantification of brownfields] or only included certain types of brownfields such as former industrial sites. Therefore, the numbers represent only a portion of the problem".* In fact, the complexity in statistical data and disparity in brownfields understanding across different states makes it difficult to identify the exact number of sites and, thus, accurately reflect the magnitude of brownfields problem, as one of the most pressing environmental and economic concerns in the United States.

4.3.3 Environmental degradation and policy response

The magnitude of the brownfield challenge in the US context must be first observed from the perspective of the US policy to protect the liveability of urban neighbourhoods and public health concerns. The environmental problems relating to brownfields were the major factors that motivated the federal and state governments to turn these long-neglected properties into healthy and productive urban areas (Greenberg et al. 1998; Heberle & Wernstedt 2006). Because of uncertainties associated with the liability framework and risk of profitable returns, most real estate developers, lending institutions, and investors initially had doubts about the feasibility of redevelopment, whereas from an environmental standpoint, the presence and critical condition of several site contamination cases across the US had caught the attention of the public and national environmental policymakers. In fact, considering US brownfield activity and legislative efforts, the vital task has been always to position environmental justice and contamination-related issues at the centre of the regeneration process.

Historically, the US government and developers became aware of the serious environmental problems of contaminated urban brownfields during the 1970s and 1980s, several decades before smart growth and new urbanism initiatives began to gain widespread recognition across the United States. As a result, many environmental policy initiatives were launched and undertaken by federal and state governments to encourage brownfield regeneration. In 1976, the United States Congress passed and enacted the Resource Conservation and Recovery Act (RCRA) as a principal federal law to address the problems of increasing volumes of solid and hazardous waste (Brandon 2013). Four years later, in 1980, the Congress passed the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), otherwise known as Superfund law, in an attempt to facilitate the clean-up and enforcement actions of sites that are perceived to be, or are in fact, contaminated with hazardous materials and pollutants. The principal target of CERCLA was, indeed, to determine responsible public and private agencies for regeneration of lands or properties having a high probability of environmental pollution and contamination, and then to require these agencies to pay the government for the environmental assessment and clean-up costs (Kibel 1998). Considering the limitation to address and recover natural resource damages and contaminated properties across the United States, CERCLA authorized the United States Environmental Protection Agency (EPA) to identify responsible parties and assure their cooperation in the clean-up program. Accordingly, the Superfund's National Priority List (NPL) was created by the EPA in order to respond to environmental emergencies with the purpose of prioritizing environmental remediation actions (Bearden 2012). NPL sites are contaminated sites with the most serious environmental problems in terms of releases of hazardous substances, pollutants, or contaminants.

The primary goal of the CERCLA or Superfund program was to provide required funding for removal and remedial actions on environmentally contaminated sites. The Love Canal disaster in upstate New York is known to be the first Superfund site on the NPL list. From 1942 to 1953, an electrochemical corporation dumped around 21,800 tons of toxic chemicals produced by nearby plants into Love Canal as a landfill (Nosenchuck 1985) (see Figure 4.2). In the late 1980s, the Love Canal experienced a record amount of rainfall, resulting in a widespread leaching of chemicals in the whole neighbourhood reported by the New York State Department of Environmental Conservation (NYSDEC). The EPA was given the responsibility to conduct site investigation and environmental assessment, and subsequently the Love Canal Area Revitalization Agency (LCARA) was established to remediate the site.

Figure 4.2 Hooker Electrochemical Plant Complex, from which the dumping of toxic chemicals in Love Canal originated
(Source: http://www.crixeo.com/love-canal/)

After the Love Canal regeneration experience, the EPA in addition to several state and federal stakeholders reworked the Superfund program on a larger scale to simplify and accelerate the development of contaminated sites in all 50 states and territories of the United States. In 2002, the US Congress issued the Small Business Liability Relief and Brownfields Revitalization Act, in response to CERCLA, which mainly focused on improvement of the economic regulations and legislation for regeneration of contaminated post-industrial sites, i.e. brownfields. This is explored later in Section 4.4 which deals with federal and state financial incentives and liability relief programs to turn distressed brownfields into productively used and tax-generating urban properties.

4.4 Legislative framework on brownfield regeneration

4.4.1 Federal brownfield initiatives

The United States federal legislative efforts and subsidies pertinent to brownfield policy have been manifold from the 1970s onwards. As previously discussed, during the 1970s and 1980s, the United States Congress passed and enacted the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or Superfund, as the earliest federal legislation and policies in order to help rectify the problems of hazardous-waste sites, including brownfields. The RCRA program is known as one the earliest pieces of legislation in the US that was initially designed to develop a coordinated national strategy for reinforcing the country's recycling infrastructure and increasing municipal and industrial solid waste control. The US Congress formulated RCRA as a proactive program in response to the growing threat of chemical compounds and hazardous by-products left from industrial activity and the problems they entailed throughout the nation (Espinosa 2000). One of the oldest and well-recognized examples in this regard is the Love Canal disaster of the 1970s which has been discussed in Section 4.3.2.

RCRA was, indeed, meant to identify areas of facilities and lands that are contaminated with hazardous substances and, accordingly, regulate how wastes can be managed. However, CERCLA seemed to be a broader and more straightforward piece of federal legislation compared to RCRA, as it compassed more areas of environmental pollution and contamination. In order to protect the health of members of the community as well as the environment, CERCLA authorized the EPA to, first, identify hazardous waste sites and, then, find potentially responsible parties to perform clean-up. However, each identified party must have complied with both EPA and state environmental requirements and principles. With the creation of the

CERCLA or Superfund program, a number of governments were also authorized to generate a tax on polluting industries, especially those that are perceived to be, or were in fact, dangerous concerning the release of pollutants, or contaminants, such as chemical and oil companies. During the 5 year period between 1980 and 1985, $1.6 billion was collected from these environmental taxes and accordingly, the collected federal monies went to a trust fund for the removal and remediation of contaminated and abandoned brownfields (USEPA 2016a). The trust fund was designed to be applied primarily when the responsible parties could not be found or they were incapable of paying for the removal and remediation of hazardous waste contamination. In such conditions, the EPA used Superfund's trust fund to pay for some or all of the entire of clean-up process (USEPA 1996). The selection of sites was in accordance with the NPL list. However, in many cases, the federal trust fund was not sufficient to cover the high cost of environmental remediation as well as the acquisition and assembly of land which created numerous stumbling blocks that discouraged the regeneration of brownfield sites (Dull & Wernstedt 2010). This resulted in many investors, developers and operators being driven away from brownfields as prospective lands for development.

The chronic shortage of federal funds for removal and remedial action compelled the federal government to amend CERCLA and establish new policies and procedures to handle this emerging challenge. As a result, the Superfund Amendments and Reauthorization Act (SARA) was passed in 1986. SARA, as a new broad-based taxation program, was essentially designed to make the clean-up process more economically feasible and subsequently motivate investor interest in brownfield recycling and reuse by providing more financial assistance. In fact, the US federal government reframed CERCLA and enacted SARA in order to moderate clean-up requirements and economic development of brownfields. Meanwhile, under SARA, the EPA was again authorized to conduct onsite investigation and assessment of the environmental compliance conditions of sites that might be put on the NPL. The core objective of the new Superfund legislation was to increase the amount of tax subsidies for environmental remediation activities. However, a few minor changes were also applied into the CERCLA's old regulations, e.g. the further provision of technical assistance from the federal government, increase the size of the trust fund and enhancement of state involvement in every phase of the Superfund program (USEPA 2016b).

Superfund laws and policies facilitated inner-city revival and countered suburban sprawl by attempting to minimize the financial burdens of brownfield clean-up and reuse for developers and investors. However, the major concern pertinent to US Superfund policies was the issue of the liability for pollution and environmental damages. In many instances, the federal RCRA, CERCLA and SARA legislation were unable to accurately address the actual generators of site contamination, in accordance with the Polluter-Pays Principle (PPP). Based upon the Superfund regulations, the new landowners, irrespective of whether they had a direct role in causing environmental damages, became firstly liable for remediation and restitution costs of contaminated site (McCarthy 2002). The extent and nature of contamination and pollution was often unknown for the purchasers at the time of site acquisition. Therefore the prospective landowners, developers and lenders were usually exposed to costs for contamination that they did not create. Even when purchasers were willing to risk liability, the lack of clear and concise clean-up standards and the approvals needed from multiple environmental agencies posed formidable obstacles to brownfield regeneration process (Whitney 2003). Meanwhile, as the parties responsible for removal and remedial actions had to comply with both EPA and state requirements, in many cases, the incompatibility between the EPA and State guidelines created further impediments to brownfield regeneration.

In 2001, The US Congress passed the Small Business Liability Relief and Brownfields Revitalization Act, commonly known as ‘the Brownfields Law’ or ‘the Act’, and enacted as public law in 2002 (Guariglia et al. 2002). The new model Act adopted a collaborative approach to reform Superfund’s liability scheme, and alleviate the environmental and economic concerns associated with paralysis in the brownfield regeneration process. The Act consists of two major titles (USEPA 2016c):

- Title I: Small Business Liability Protection Act,
- Title II: Brownfields Revitalization and Environmental Restoration Act.

In the first case, the aforementioned Act provided new exemptions from the prior Superfund liability in order to ensure the protection of innocent landowners. This legislative title was enacted to provide liability relief for new purchasers and landowners who did not cause or contribute to the release of contaminants or pollutants, even if they knew about the existence of contamination at the time of site acquisition. While, Title I of the Act essentially focuses on liability protections, Title II is to provide certain economic incentives for brownfields redevelopers coupled with creating additional environmental liability exemptions for them. Title II is composed of three major sections (USEPA 2016c):

- Section A: Brownfields Revitalization Funding
- Section B: Brownfields Liability Clarifications
- Section C: State Response Programs

Under Section A, the federal government increased its funding spent on brownfields assessment and remediation, from $98 million to over $200 million per year through 2006 (Collins 2003). This section also encourages the contribution of private parties and non-profit organizations in provisions of brownfields grants or loans, especially when the federal money might not be sufficient for site redevelopment. In Section B, the Act applied some changes to the pre-existing innocent landowner defence provided in Title I, focusing more on contiguous properties. Furthermore, through addressing Title II-Section C, the Act promotes regulations that reinforce state primacy in brownfield regeneration, by allocating federal monies to state brownfields programs. Based upon Title II-Section C, EPA is the dominant player to identify eligible sites and notify the respective state of any intended federal enforcement actions. In fact, although the EPA's Brownfields Program play a critical role in remediation and removal actions of contaminated properties, based on the new model Act the dominant authority and chief responsibility for addressing brownfields is now positioned at the state level (Wernstedt & Harsh 2006).

The new brownfield legislation model requires both old enforcement-based involvements- e.g. federal and state Superfund programs- and new non-enforcement-based involvements- e.g. State Voluntary Clean-up Programs (VCPs)-. However, the VCPs are today applied as the most extensive and widely accepted approach to brownfield regeneration across the United States. According to interviews of 51 state program authorities and results from a survey of remediation program participants in VCPs (Wernstedt et al. 2013), over 75 per cent of nationwide brownfields clean-up move through state voluntary clean-up programs.

4.4.2 State Voluntary Clean-up Programs (VCPs)

State programs presently receive the most attention in the US brownfield regeneration system. Since the mid-1990s, the majority of US states have begun introducing their own legislative programs, as they recognized that existing enforcement-based statutes could not provide adequate funding to ensure the clean-up of brownfields. As a result, many states initiated and developed voluntary clean-up legislation as supplementary programs to traditional enforcement-liability driven systems of the Superfund (Geltman 1996). Between 1994 and 1995, nine states- including California, Colorado, Connecticut, Nebraska, North Carolina, Ohio, Tennessee, Virginia and Wisconsin- passed legislation that expanded and improved these state's comprehensive approach to brownfield remediation, under the rubric of 'Voluntary Clean-up Programs (VCPs)' (OTA 1995). By 2000, more than 90 per cent of the states and by 2011, every state across the nation, had a voluntary clean-up program in place (Meyer 2000; USEPA 2011).

State-level voluntary legislation reflects a substantial paradigm change in the US brownfield regeneration system so that a majority share of nationwide site remediation is today conducted through voluntary programs (Geltman 1996). In fact, VCPs are regarded as the most prominent legislative efforts in ensuring protective and sustainable brownfield clean-ups. They basically represent cooperative activities between the state officials and EPA in the remediation of brownfields, protection of citizens from exposure to contaminants and promotion of economic development objectives. These state-level programs have been fundamentally developed in order to facilitate the enrolment of private sector agencies in brownfield redevelopment according to the states' guiding principles (Blackman et al. 2010). The VCPs attempt to encourage the participation of local economic development agencies in remediation of contaminated properties by offering relaxed clean-up standards, tax liability relief, low-interest loans and some technical assistance. In fact, the core objective of VCPs is to enable and leverage private investment and real estate markets in brownfields-related projects, while ensuring compliance with environmental regulations enforced by EPA, state governments or their designated agencies.

4.4.2.1 Different types of VCPs

State voluntary and brownfield clean-up programs, their contributions, provisions and requirements vary considerably from state to state (Eisen 1996; Meyer 2000; Guignet & Alberini 2010). This widespread variation in VCPs is justified on the following grounds:

1) *Dispersed funding sources and state monetary incentives, e.g. tax credits and low-interest loans*

There is a wide range of funding sources available to the state voluntary programs, as indicated in Table 4.1. The majority of state brownfield programs are supplied and directed by a combination of federal grants and the state general or clean-up funds. In some states, such as Georgia, Vermont, and Utah, the entire funding for the programs comes from federal brownfield grants. In these states, site clean-up is solely funded by federal grants from the EPA's Brownfields Program and no state-based monetary grants or loans are offered to eligible entities. On the other hand, the State of Florida is regarded as the only state in the US where its brownfield regeneration system is entirely supported by the State General Fund. Florida State's General Fund is provided, on a competitive basis, to assist with brownfields assessment and clean-up projects, and also spur communities and non-profit organizations to create new job opportunities.

Furthermore, as can be seen from Table 4.1, brownfield response programs vary significantly from state to state in terms of offering tax credits, low-cost loans and technical assistance grants. As an example, the State of Florida provides an investment tax credit of up to 50 per cent to entities that perform a state-approved clean-up on a qualified brownfield site, whereas tax credits on voluntary clean-up activity in the State of Massachusetts are limited to a maximum 25 per cent (USEPA 2014; USEEA 2016b). State sales tax credit on building materials, real property tax credits, abandoned building tax deduction, land value tax abatement and historic preservation tax credits are some other types of economic incentives offered by different states to advance brownfields activities. However, there are a great number of states, such as Illinois, California and Minnesota, that have not yet provided any type of tax incentives that can be leveraged for brownfields remediation and reuse. As indicated in Table 4.2, only 55 per cent of state voluntary response programs have already developed tax abatement policy and programs in their brownfield regulatory functions.

Table 4.1 An overview of some state's brownfield response programs

State	Funding Sources	Financial Incentives and Tools	Detail
Massachusetts	- Federal grants - State general fund	- Brownfields Tax Credit Program - Municipal Tax Abatement Program - Brownfields Tax Deduction Program - Economic Development Incentive Program (EDIP) - State Historic Tax Credit, etc.	- Interest-free fund up to $100,000 - Loans up to $500,000 - 25% tax credit for clean-ups - 10% abandoned building tax deduction etc.
Ohio	- Federal grants - Program fees	- Ohio Brownfield Fund - Ohio EPA Brownfield Inventory - Ohio EPA Technical Assistance for the Voluntary Action Program - EPA Tax Abatement, etc.	- Loans up to $500,000 for environmental assessment - Loans up to $5,000,000 for clean-up actions - 10% tax abatement etc.
Colorado	- VCP fees (80%) - Federal grants (20%)	- The Colorado Brownfields Revolving Loan fund - State Income Tax Credit for Environmental Remediation of Contaminated Land, etc.	- Up to $250,000 clean-up grants - 30-40% tax credit for clean-ups etc.
Maryland	- Federal grants (80%) - State general fund (10%) - State clean-up fund (10%)	- Brownfields Revitalization Incentive Program (BRIP)	- Site assessment and remediation assistance by covering up to 70% of the cost. - Real property tax credits of 50-70%
Michigan	- Environmental state funds - Bond funds - Federal grants	- Brownfield Redevelopment Authority (BRA) - Tax Increment Financing (TIF) - The Michigan Department of Environmental Quality (MDEQ)	- Annual limits up to $1 million grant and $1 million loan
Georgia	- Federal grants (100%)	- Federal Brownfield Tax Incentives - EPA Assessment, Revolving Loan and Clean-up (ARC) grants	- No monetary grants or loans are offered - Environmental liability and property tax relieves are provided
Washington	- Federal grants - State grants	- Brownfields Property Tax Abatement Program - Environmental Remediation Tax Exemption - Federal Brownfields Tax Incentive, etc.	- $10,000- $425,000 clean-up loans (loans exceeding this amount must be approved by the EPA) - Inventory grant funds of up to $400,000
Florida	- State General Fund (100%)	- Florida State tax credits - Florida State brownfields loan and guarantee programs - Job Bonus Refund	- 50% tax credit for clean-ups - Up to $2,500 for each new job creation etc.

Note: data and information have been primarily adapted from (USEPA 2014)
Other sources: (ODSA 2016; MDEQ 2016; Washington State Department of Ecology 2016; MDBED 2010; EEA 2016a)

Table 4.2 State's brownfield regeneration support tools and products
(Source: Author's elaboration on data and information adapted from (USEPA 2014))

State Provisions	**Technical or Grantee Assistance**	**Liability Relief Provisions**	**Environmental Insurance**	**Tax Incentives**	**MOA with EPA**
Ratio	35/56: **62.5%**	52/56: **92.86%**	4/56: **7.14%**	31/56: **55.38%**	24/56: **42.86%**
States and Territories	Massachusetts, Maryland, Illinois, Michigan, Ohio, Texas, Colorado, California, etc.	*States not offering LRF:* Nebraska, Guam, Northern Mariana Islands, Virgin Islands.	*States offering EI:* Wisconsin, Massachusetts, Vermont, Idaho.	Georgia, Ohio, Washington, Florida, Virginia, Michigan, etc.	California, Washington, Michigan, Maryland, Ohio, etc.

2) *Different types of non-monetary supports including environmental insurance, technical assistance and liability relief provisions;*

One of the significant tools employed to support brownfield redevelopment is Environmental Insurance (EI) that is subsidized and implemented in accordance with state statutes and administrative work plans. The EI coverage is essentially created to minimize uncertainties associated with brownfields sites by providing landowners, borrowers and public sector actors with protection against the likelihood that actual removal and remedial expenditures exceed initial estimates. For example, the Massachusetts Brownfields Redevelopment Access to Capital (BRAC) state program provides a subsidy of up to 50 per cent of the EI premium cost to brownfield redevelopers (EEAb 2016). However, the majority of states across the United States still do not apply or actively pursue the application of environmental insurance in the brownfield regeneration process. As demonstrated in Table 4.2, at the moment only four states- including Wisconsin, Massachusetts, Vermont and Idaho- offer state-subsidized environmental insurance to brownfield developers.

Despite the fact that there are a limited number of environmental insurance products available for brownfield clean-up and redevelopment, the states are active in providing exemptions from liability for environmental contamination. As shown in Table 4.2, over 92 per cent of VCPs provide liability protection tools for environmental clean-up of brownfield properties. Such tools have been developed in various state environmental statutes to facilitate the differentiation of new site contamination from pre-existing contamination. However, different states may offer different liability exemptions by their voluntary clean-up programs. Some of these programs attempt to protect innocent landowners, some limit liability of prospective purchasers and developers, some provide liability waivers for third parties (like lenders), and finally some state programs may protect trustees from clean-up liability expenditures (Geltman 1996). In general, the central mechanism of each state's liability protection regulation is to offer developers a means for faster-tracked clean-ups and, thus, reduction in stigma of contaminated sites.

3) *Varying degrees of state oversight in environmental assessment and site remediation procedures;*

In the majority of programs- such as Minnesota, Washington, New Jersey and Illinois- the principal oversight for clean-up process is retained at the state level (Eisen 1996). In such states, brownfield audits and clean-up activities are predominantly handled under the direct control of state governments or their designated agencies. These activities often include the development of clean-up standards, site assessment, remediation report preparation, technical assistance guidance, work plan progress, and finally project approval and the issuance of a certification of completion. However, in some states- such as Massachusetts, North Carolina and Ohio-state programs reflect a trend toward remarkably limited involvement in protective clean-ups of brownfield properties. In these states, a state-certified environmental agency or, in the most permissive level, a volunteer party is given the primary responsibility to perform site investigation, assessment and clean-up activities. In a number of state voluntary clean-up programs, the volunteer developer undertakes individual clean-ups at its own risk until the stage of the final remedial action report submission to the state (Eisen 1996). However, in such cases, the independent parties must still satisfy the state environmental requirements and clean-up standards during the remediation process.

In order to strengthen the amount of state oversight in brownfield clean-up activities, several state environmental programs (state EPA) have signed a Memorandum of Agreement (MOA) with EPA regional authorities (Regions). The primary objective of MOA is to promote EPA and state coordination on brownfields issues and also confine oversight of a brownfields site to one individual or entity (USEPA 2016d). Meanwhile, in some states- e.g. New Jersey- the extent and type of state involvement in removal and remedial process can be specified subject of the negotiation between the state committee and the waste facility developer upon signing the MOA (Eisen 1996). However, it must be noted that, presently, only 43 per cent of the entire state voluntary clean-up programs across the US have entered into the MOA (Table 4.2).

4.4.2.2 Principal characteristics of VCPs

Although VCPs, as the most widespread state voluntary brownfield response program, vary broadly in their structure and jurisdictions involved, there are certain characteristics shared by the majority of programs (Eisen 1996; Anderson 1996; McMorrow 2003; Reisch & Bearden 2003; Winson-Geideman et al. 2004; Page & Berger 2006; Wernstedt et al. 2013):

- The primary driver to adopt a VCP stems from the difficulties that numerous states initially experienced with performing clean-ups under the federal legislation or standards. The amount of awarded federal grant funds for remediation, redevelopment and reuse of brownfields appeared to be inadequate in most states before initiating their own state-level programs. VCP in the states of Minnesota, Wisconsin and Illinois are amongst the earliest and well-known examples in this regard.
- State brownfields and voluntary response programs commonly operate as none-enforcement-based programs. It means that the potential developers, property owners, and others affected by contaminated sites choose to enter into the VCPs voluntarily.
- The primary objective of each program is to strengthen the linkage between landowners and state environmental/economic agencies that, subsequently, minimizes the role of enforcement-driven federal programs in cleaning up and reusing brownfields.
- All programs are fundamentally designed to spur remediation of contaminated sites and reduce the stigma created at sites by offering economic- e.g. grants, loans and tax credits- and/or non-economic development incentives- e.g. environmental insurance (in a very few states) and technical assistance- .
- The key component of each VCP is to provide innocent developers and non-responsible parties with environmental liability assurance.
- Each VCP requires developers to meet the streamlined and site-specific clean-up standards defined by the relevant state laws and, in the most lenient level, federal Superfund Act.
- For the most part, VCPs have not sufficiently addressed the strong role of local community intervention in clean-up and reuse of brownfields. Only a limited number states- such as Wisconsin and Ohio- have encouraged the involvement of local authorities, communities and entities in brownfield-related projects.
- Voluntary clean-up regulatory framework has been developed to deal with the removal and remedial of environmental pollution or contaminants from brownfield properties, irrespective of whether they are reused in future.

4.5 Contaminated vs. non-contaminated land

It seems that none of the US brownfield policies and environmental regulatory baselines, including state VCPs and EPA legislation, have addressed brownfield problems in the large-scale land-use planning context. The EPA Brownfields Program directs the redevelopment and reuse of deteriorating urban brownfields, and state VCPs are primarily designed to focus on the clean-up of contaminated sites. Furthermore, the US land recycling and reuse system is solely limited to isolated contaminated lands, being less attentive to non-contaminated sites. In other words, the US policy response is much more focused on environmentally contaminated sites than clean ones. These non-contaminated sites or greyfields include abandoned housing and vacant commercial properties that have not been affected by the existence of any contaminative substances, but mildly or severely damaged by former usage.

Today, the pattern of urban land abandonment and vacancy is thoroughly dynamic across the US cities (Nassauer & Raskin 2014). A study undertaken by Newman et al. (2016) shows that an average of 16.7 per cent of the total land of US metropolitan areas is today considered vacant, indicating that urban land abandonment and vacancy is on the increase with an average area change of 5.6 per cent from 2000 to 2010. However, the definition of vacant land used in this study is very general, ranging from previously developed areas, e.g. brownfields, to unused agricultural lands and undisturbed open spaces. Also, urban areas expand over time. The percentage of land increase may simply represent the urban land increase. Therefore, it is difficult to accurately differentiate contaminated sites from uncontaminated ones, relying upon this estimate. It seems reasonable to assume that vacant industrial lands and structures are reflective of contaminated sites and abandoned housing units represent the uncontaminated sites. Using this assumption, the significant decline in population and households in several US cities can well illustrate the serious condition of uncontaminated land abandonment across the nation. According to a study (Dewar & Thomas, 2012), between 1950 and 2008, 21 of the 200 largest cities in the United States lost more than a quarter of their urban residents.

It should be noted that the role of the US brownfield legislative system in the ongoing problem of non-contaminated PDL or greyfield is undeniable, as it mainly focuses on remediation, redevelopment and reuse of environmentally degraded urban areas. The new brownfields federal and state programs with their large clean-up subsidies have made it far easier and more profitable for developers to build on previously contaminated sites instead of non-contaminated ones (Berger 2007). The vast majority of federal and state monetary and non-monetary incentive programs are established to solely serve the known contaminated sites for their environmental assessment and clean-up measures. Therefore, in most instances, greyfields lose the competition to brownfields in receiving federal and state financial incentives. As a result, the redevelopment of properties with real or perceived contamination issues will be given priority by potential investors and developers, as greater returns on investment are expected. Meanwhile, the clean-up cost has become significantly less over the past decades, as the use of innovative technologies and remediation technical knowledge has substantially advanced. As a result, non-contaminated and vacant patches of the cities that are, in many instances, located in highly desirable urban areas, remain unattractive to developers.

4.5.1 Urban land vacancy of Detroit; *from 'Motor City' to 'Ghost City'*

As discussed earlier, industrial restructuring (as a result of globalization and international competition) accompanied by suburbanization (out-of-centre movement of population and employment) have served as the main drivers of urban land abandonment and vacancy across the US cities. The historical development pattern of the Detroit metropolitan area, as the largest city of Michigan, is a good example of this phenomenon. Detroit is known as the biggest loser of population and employment amongst the 50 largest cities across the United States (Levy 2015). The city experienced a significant population decline between 2000 and 2010, losing almost a quarter of its urban residents from 951,270 to 713,777, its lowest since 1910 (USCB 2011b). By the mid-twentieth century, Detroit was known as one of the strongest industrial cities in the world, owing to its abundant automobile manufacturing companies, such as Packard, Hudson and, more broadly, the 'Big Three' (Ford, Chrysler and General Motors). But with the rise of strong international economic competition, the city of Detroit began to lose a substantial portion of its manufacturing jobs (Sugrue 1996; Bluestone 2013). Since the late 1990s, this hollowing-out process of industries has been further intensified in Detroit as the US economy responded to globalizing forces, most notably the North American Free Trade Agreement (NAFTA) and the Global Financial Crisis (GFC).

The prevailing conditions of depopulation and inner-city disinvestment had significant impacts on the physical structure of the city of Detroit. Several small auto-related industries with considerable employment capacity migrated to the surrounding suburbs in search of low-wage labour and open land for new manufacturing plants which fuelled the expansion of peripheral suburban communities (Sugrue 1996). As the auto industries collapsed in Detroit, a large number of industries and settlements spread out to suburban vacant lots and accordingly inner-city areas witnessed a substantial physical change. Meanwhile, the construction of the freeway system, which started in the 1950's, was the key factor in accelerating Detroit's expansive suburban growth (McDonald 2014). During the 6-year period between 1950 and 1956 alone, 124 manufacturing firms moved to suburban locations (Galster 2012). Within the following decades, this suburban sprawl development was fed by many other forces, such as deteriorating inner-city services while maintaining and improving the suburban infrastructure, social segregation and racial tension between black and white families, low mortgage rates in suburban areas and more broadly improvements in transport technology, e.g. private cars and new highways, that facilitated urban-to-suburban movement in considerable measure (Sugrue 1996; Galster 2012; Bluestone 2013; Levy 2015).

The city of Detroit has now transformed its image from a vibrant 'Motor City' into a daunting 'Ghost City'. Following the departure of big manufacturing industries, particularly automobile industries, the city faced an unprecedented physical deterioration, characterized by the growing number of high-vacancy neighbourhoods with fully or partly demolished buildings. Due to large amounts of vacant urban lots and dilapidated building blocks, Detroit, today, conveys an impression of *"the City of Holes"* (Bekkering & Liu 2015) (Figure 4.3). Based on the Detroit Strategic Framework Plan (Detroit Future City 2012), over 25 per cent of all Detroit properties are today considered abandoned or vacant, including nearly 100,000 vacant sites and structures that occupy almost 14 per cent of the total land area of the city, a geographic area larger than the entire city's parklands and amenity open spaces combined. However, some other estimates put this figure even higher. For example, according to the recent Financial and Operating Plan announced by the City of Detroit (2013), *"the City includes at least 60,000 parcels of vacant land (constituting approximately 15 per cent of all parcels in the City) and approximately 78,000 vacant structures, of which 38,000 are estimated to be in potentially dangerous condition".* Another estimate, (Nassauer & Raskin 2014), suggests that about 25 per cent of all residential structures, alone, in Detroit are considered vacant or abandoned, nearly 80,000 vacant houses.

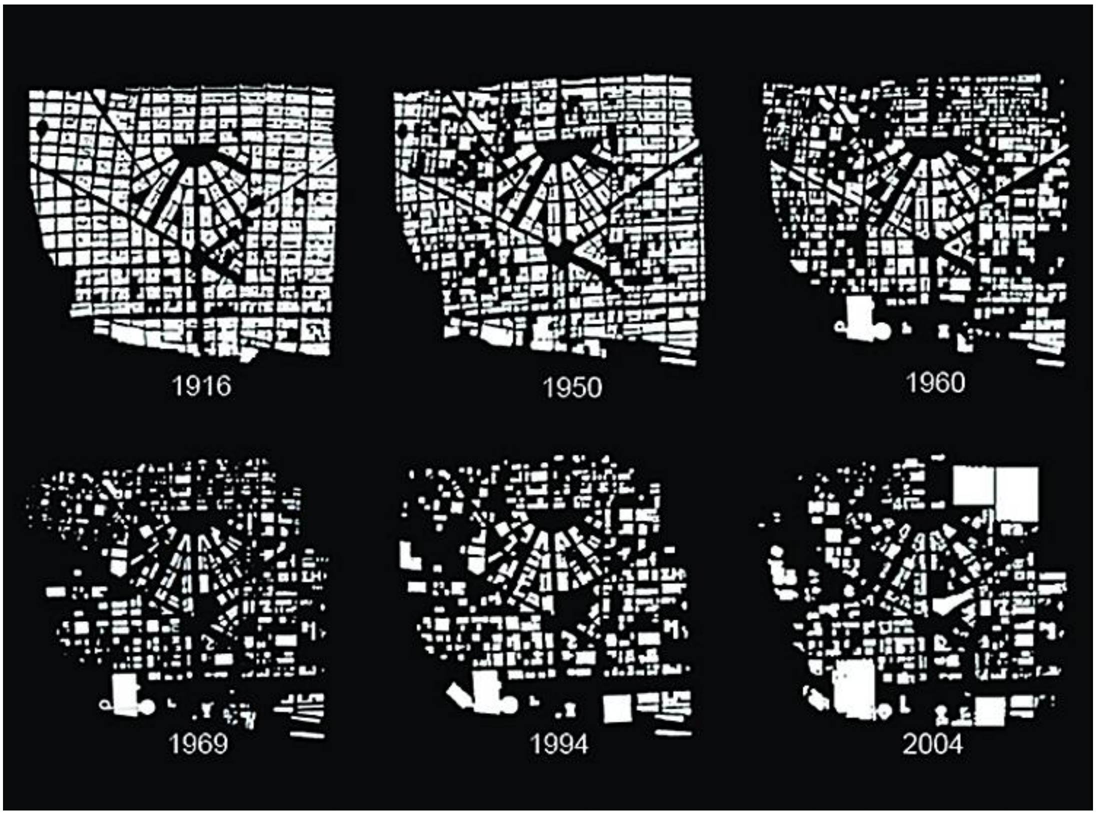


Figure 4.3 Ground drawings of downtown Detroit Between 1916 and 2004, presenting a clean-cut image of the Hole City.
(Source: Bekkering & Liu 2015)

4.5.2 Detroit brownfield initiative; did it work out?

As can be seen in Table 4.2, Michigan is amongst the states that have offered the greatest numbers of regeneration support tools in its brownfield initiatives, including a variety of tax incentives, liability relief provisions and site remediation technical assistance. Another significant component of the Michigan brownfield initiative is associated with the provision of a Brownfield Redevelopment Authority (BRA) for each municipal institutional structure, including the ‘city or village council, township board or county commission’ (MEDC 2016), to develop and implement brownfield projects. The primary goal of the BRA is to leverage the decision-making and investment authority of local governments in the multiple phases of brownfield redevelopment projects. At the moment, apart from the State of Michigan, only 14 other states and territories in the United States have a BRA in place (USEPA 2014). In these states, although the federal and state governments, under the EPA's Brownfields Program and State Voluntary Response Programs, provide such general assistance as environmental assessment and investment incentives, some important aspects of redevelopment activities are undertaken by local community-based organizations, such as local redevelopers, realtors, and bankers.

The City of Detroit Brownfield Redevelopment Authority (DBRA) is considered to be one of the oldest and best known local brownfield initiatives in the United States. DBRA was established, in accordance with the Michigan Brownfield Redevelopment Financing Act 381 of 1996, for the pursuit of combatting urban vacancy and optimization of brownfields within the municipal limits of Detroit (DEGC 2016). In order to address the pressing and pervasive problem of abandoned, but non-contaminated, land or properties, DBRA amended the legal definition of brownfields from merely contaminated sites to ones that are 'contaminated', 'blighted', or 'functionally obsolete' (Jones & Welsh 2012). Meanwhile, unlike the nationwide perception of brownfield that is confined strictly to abandoned or underused commercial and industrial properties, DBRA also classifies distressed residential properties under its brownfield plan. DBRA's broader designation of brownfields allows environmental funding mechanisms to be channelled for the redevelopment of uncontaminated properties, e.g. vacant housing stock (Lang 2001). The reason for this is that the number of abandoned and unused residential structures containing no contamination issues is largely increasing throughout the Detroit metro region. These properties are often unable to earn adequate incentives for redevelopment and, thus in most cases, remain untouched.

Despite the strong funding support from upper levels of government through the EPA's Brownfields Program and VCPs, Detroit's local government is still unable to fully rectify the problem of uncontaminated land and residential structures that are functionally obsolete. According to Detroit Economic Growth Corporation's record (DEGC 2016), only 33 complete land redevelopment projects, thus far, have been eligible to benefit from DBRA and TIF incentives, including for both environmental and non-environmental incentives. The reason for this is that contaminated sites often get preference over uncontaminated vacant sites in the race for financial subsidy. In fact, with a broad range of clean-up tax incentives and other funding platforms as well as dispersed liability relief programs offered by the federal and state governments, developers still track down known contaminated properties as an attractive alternative to non-contaminated infill sites.

4.6 Conclusion

The brownfield problem is extensive in the United States, induced by a combination of two marked trends, including industrial restructuring (largely as a result of globalization and differential labour costs), and industrial suburbanization (i.e. disproportionate flow of manufacturing activities away from central cities to suburban locations). The dimension of brownfield regeneration in US policy is predominately linked with environmental justice and contamination issues. In other words, the US brownfield activity and legislative efforts tend to focus on environmental and public safety drivers of brownfield regeneration. Needless to say, the economic potential of brownfields has always been an overriding selection criterion for subsequent development of these distressed, but mostly desirably positioned, urban sites (Lee & Mohai 2012).

In order to address growing concerns over environmental and economic issues, US federal and state governments have actively adopted collaborative approaches to area-wide brownfield remediation and redevelopment. The EPA's Brownfields Program and, more importantly, state voluntary clean-up programs have provided widespread environmental liability exemptions for non-responsible purchasers and developers as well as a great range of economic incentives, such as low-interest loans, land value tax abatement and clean-up tax credits. These environmental and economic incentives have increasingly facilitated and leveraged the contribution of private developers, business communities, and non-profit organizations and entities in regeneration of brownfields.

It is salutary to note that it has taken several decades of continually evolving policy to reach where the US is today. However, partly as a result of the way the system is framed, brownfield-related policy in the US is not capturing the sites that are non-contaminated. In fact, US brownfield policy may be successful in terms of the limited aims it pursues, but it has a knock-on effect on other areas. At present, the US brownfield legislative framework is systematically biased towards environmentally contaminated sites. It means that the remediation of hazardous waste sites and polluting industrial facilities has been placed at the centre of the US brownfield regeneration regime. In fact, as many scholars (Anderson 1996; Meyer 2000; Hula 2001; Fitzgerald & Leigh 2002; Jones & Welsh 2012; Lee & Mohai 2012) assert, brownfield regeneration in the U.S context has primarily coped with properties or lands containing hazardous substance, pollutant, or contaminant. This can be justified on the grounds of the narrow understanding of brownfields coupled with a broad range of funding resources offered for such sites under the current system. Detroit's experience provides convincing evidence for this complex and multi-faceted issue.

As observed in this chapter, the challenge of brownfield regeneration in the United States is predominantly managed by upper levels of governance, including the federal and, particularly, state governments. The US experience demonstrates that the federal and state governments provide the overarching policy framework and funding mechanisms for site clean-up. However, the real action occurs at the local level. The vast majority of brownfield problems in the United States are triggered locally. According to a report (Dull & Wernstedt 2010), between 2003 and 2007, nearly 53 per cent of applications to EPA's Brownfields Program were made by municipal governments, against only 14 per cent from the States and Counties. The same report demonstrates that approximately 69 per cent of these applications over the period were unsuccessful in winning EPA Brownfields Program pilot awards. As a result, many local brownfield projects remained undeveloped due to insufficient financial supports from the upper-level governments.

CHAPTER 05

Brownfield Regeneration in Europe

5.1 Introduction

Over the last two decades or so, governments at both the EU and national levels have been actively working on effective management of land resources, through reuse of underutilized lands and brownfields. A decades-long global trend of industrial restructuring driven by international competition and differential labour costs, accompanied by suburbanization and decentralization of urban areas have had significant influence over the structure of cities and brownfield location across Europe. Although it is difficult to generalize the pattern of urban decline and growth in Europe, Western Europe can be distinguished from former communist Eastern Europe. Western Europe experienced problems of economic and urban decline during the 1970-80s, but is now witnessing a re-urbanization trend. However, in Eastern Europe, this phenomenon happened later as a result of the fall of the Berlin Wall in 1989 and the re-urbanization trend has been less pervasive. This chapter seeks to investigate these processes, outline the extent of brownfield problems and unfold the European regulatory drivers for tackling those problems.

This chapter aims to shed light on different aspects of brownfield generation at a city level and regeneration policy from the European perspective and highlight the key issues in this regard. To achieve this, it is structured in three sections. The first section elaborates on demographic changes across European cities and briefly outlines the nature and scale of urban shrinkage posed by urban-industrial changes across Europe. Section 5.3 discusses the root causes of brownfield generation in European cities, followed by the legal definitions of brownfield across different regimes. This section also reviews the quantification of brownfield sites and existing status of contaminated and non-contaminated lands in Europe. The final section of this chapter is dedicated to the legislative framework on brownfield activities, investigating EU-wide tools and policies to encourage brownfield recycling and reuse.

5.2 Urban growth and decline in Europe

The concept of "urban decline" or "shrinking cities" has been used in a large body of academic literature. However, there is no consensus on the most suitable approach to define and study this phenomenon (Rudolph et al. 2016). In much of this literature (Rieniets 2005; Oswalt & Rieniets 2007; Banzhaf et al. 2007), the phenomenon of urban decline refers to a significant and sustained population loss over a significant period, particularly in a densely populated urban area. In other words, in such research studies, demographic decline is used as the main indicator of inner-city decline and shrinkage. For instance, according to (Oswalt & Rieniets 2007), *"The term 'shrinking city' first and foremost describes a symptom: population loss. A wide variety of processes and causes can be hidden behind this symptom"*. Rieniets (2005) views declining cities as, *"cities that have temporarily or permanently lost a significant number of their inhabitants"*.

It is difficult to capture a clear picture of the spatial organisation of urban Europe in respect of demographic growth and decline. The reason is that the cities have not been following a homogenous trend owing to the great structural and political diversity in Europe's spatial economy (Bosker & Marlet 2006). Hence, given disparate trajectories of urban development, in terms of population concentration or dispersion, the concept of urban decline in Europe cannot be generalized. There are a great number of cities in Europe (mostly in highly urbanized regions), where the population of inner-urban areas is declining, whilst the overall population of their metropolitan regions is growing quite persistently because of increasing growth of communities on the outer edge of the cities. But conversely, in a few European cities, urban and suburban areas, and in some cases exurban areas, are all losing a significant number of their inhabitants (e.g. in many former GDR and CEE cities).

Furthermore, urban growth and decline in Europe is a complex phenomenon associated with changing administrative boundaries and urban-suburban connectivity. The relationship between core area and its peripheral rings has taken different forms over time in most European cities. In other words, we cannot observe a common and steady interaction between core and rings, in terms of the population distribution pattern. In general, as suggested by several studies (e.g. Champion 2001; Kasanko et al. 2006; Couch et al. 2008; Bhatta 2010; Oueslati et al. 2015; Cox 2015), inner-urban areas tend to lose population to outer-ring suburbs and commuting hinterlands in several European cities since the 1970s. This has led to the appearance of fastest-growing suburban (and exurban) neighbourhoods around the declining inner-urban areas within certain administrative and functional boundaries of metropolitan regions. In most developed European nations, the metropolitan areas with an increasing level of overall population demonstrate a broad trend comprising declining central cores and growing outer rings. Figure 5.1 illustrates how dominant suburban and exurban population increase has been over the last 4 decades in Europe (Cox 2015). This is indicative of a fact that European households tend to live more at a distance from the central city, particularly along the transport corridors and commuting zones where they can gain easier access to central locations and facilities. However, there are notable examples such as Manchester and Paris, where the functional metropolitan regions (including the core, suburbs and exurbs) possess five times as much population as the core, as determined by administrative boundaries (EC 2016).

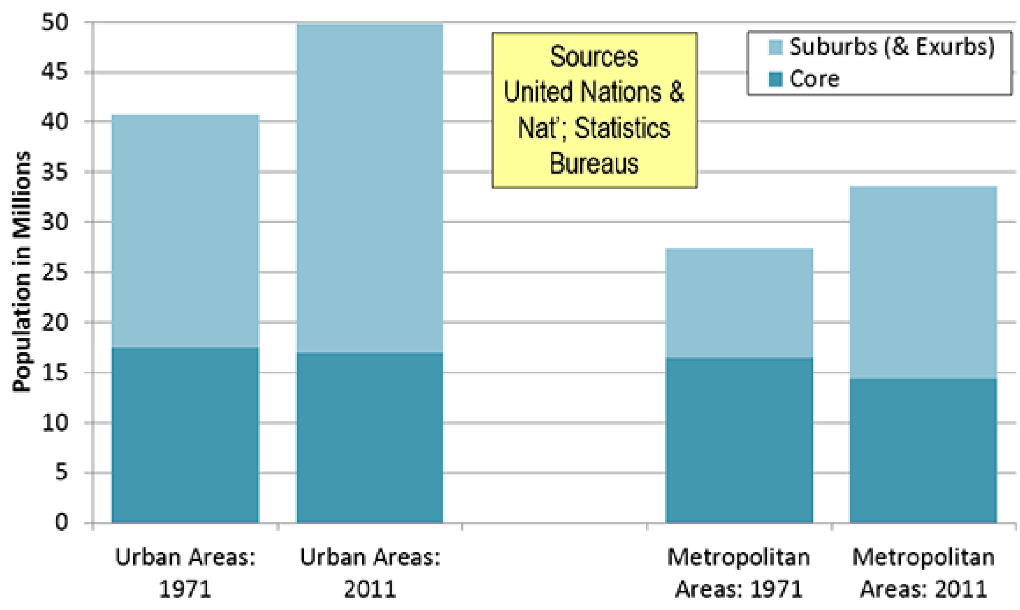


Figure 5.1 Dispersion of urban population in Europe between 1971 and 2011.
(Source: Cox 2015)

It is essential to note that the overall level of population growth is persistent and still high in Europe, as a whole. Relying on the latest available data from the Eurostat Statistics Database (EC 2016), the population of the EU-28 increased from 406.7 million in 1960 to 510.1 million in 2016, a population growth of over 25 per cent. This considerable population growth has been mainly influenced by increasing net migration, particularly in large and highly-urbanized areas in Western Europe. The most notable examples for European population concentration and growth can be found in the "Blue Banana" or "Central European Urban Region", in which more than 40 per cent of the EU population (1996) lives (Meijer 1993; Hospers 2002; Legtchenko et al. 2010). This area essentially includes metropolitan regions that are strategically located at the economic heart of Europe (e.g. London, Amsterdam, Brussels, Frankfurt and Milan).

Despite the fact that the overall population in Europe is increasing, inner-urban decline is considered as a widespread phenomenon across European cities. To acknowledge this phenomenon, it is useful to refer to the Joint EEA-FOEN report on urban sprawl in Europe (EEA 2016). As indicated in this report, the level of suburban sprawl increased across Europe between 2006 and 2009. It means that almost all European cities are either losing their overall population (e.g. in many former GDR and CEE cities) or the cores are extending to the outer-ring suburbs (e.g. in Western Europe). According to a comparative study on 24 urban areas in Europe (Cox 2015), during the 40-year period between 1971 and 2011, the overall population of cities increased by 9.1 million, with the combination of a 9.7 million increase in the suburbs and a 600,000 decline in the cores. This study shows that during this period, in Madrid, for example, the suburban population increased by 450 per cent, with only 5 percent growth in the core, while in Zurich, the suburbs grew by 186 percent with the core decline of 12 percent. Given disparate trajectories of demographic change in Europe, there can be two general scenarios imagined with regards to the European model of declining regions:

(1) Functional urban regions that are declining in overall population, presenting high levels of population loss in core regions. This has been witnessed, particularly, in many cities in the former GDR and CEE countries. Official data shows that, between 1996 and 2001, 125 out of 220 large and medium-sized cities (almost 57 per cent of urban regions in the European Union) have lost population (EU 2007). According to another comparative study (Turok & Mykhnenko 2007), approximately 40 per cent of 310 cities in 36 European countries (with 200,000 inhabitants or more) witnessed a population loss from 1960 through to 2005. The same study indicates that over 53 per cent of selected cities were declining in their overall population during the 5-year period of 2000-05, whereas this figure was less than 22 per cent in the period from 1965 to 1970. Given these statistical data and official reports, it is safe to affirm that there still exist a number of metropolitan areas in Europe that are experiencing demographic decline.

(2) Functional urban regions where overall population growth is persistent, but which exhibit an increasing out-flow of population from the core to peripheral rings (particularly in Western Europe and the Blue Banana region). Structurally speaking, these European cities are often

densely built-up in core regions but present a high level of sprawl with population distributed in corridors and rings radiating from urban centres. This sprawling pattern of development is most pronounced along transport corridors and coastlines (EEA 2016). In these European cities, urban decline is not the legacy of population loss, but it is more about the land taken by urban expansion and distribution of population beyond administrative boundaries. In other words, within these metropolitan regions, population loss is not occurring, but rather what really exists is an uneven distribution of population and high land uptake per inhabitant or job in wide rings around the cores. This has contributed to fragmentation of the metropolitan landscape and physical decline in diffused town centres. A great example in this regard is London, one the largest cities in the Blue Banana region. London is heavily built-up in the city centre, while highly sprawled in its town peripheries and suburbs.

There is no doubt that population change is a critical factor in recognizing the extent of urban decline or growth in certain regions, but not the only factor. A substantial number of studies suggest that the phenomenon of urban decline must be analysed using multidimensional indicators of decline in fiscal, social, political and demographic bases (Oswalt 2006; Pallagst 2008; Schilling & Logan 2008; Martinez-Fernandez et al. 2012; Pallagst et al. 2013; Haase et al. 2014; Bartholomae et al. 2016). According to these studies, the urban decline process is not solely triggered by a sustained decline in population size, but various other interrelated factors, such as economic downturn, industrial regression and high rates of unemployment, are integral to decline at different spatial levels. Such a perspective seems to provide a more precise metaphor for declining cities as it encompasses all levels of vacant and abandoned structures besides housing vacancy, including deteriorating industrial buildings and commercial properties. Given this comprehensive conceptualisation, an analysis of statistical data regarding recent industrial and economic transitions in Europe could reflect the magnitude of the problem of declining cities in Europe. The high level of population loss and the severe economic downturn with the resulting unemployment and outmigration, provide a persuasive evidence for the argument that there are many central cities in Europe where decline is common.

The pattern and contributing factors of urban decline vary and interact differently in different European countries. In many parts of Europe, declining cities exist as a result of industrial restructuring during the 1970-90s with a high level of transformations in economy and labour markets, particularly in old-established cities with heavy and auxiliary industries, such as Manchester and Liverpool in the UK, and the Ruhr district and Saarland in West Germany

(Hollander et al. 2009; Haase et al. 2016). Urban decline in such regions is predominantly characterized by the abandonment of industrial production premises and vacancy in heavy manufacturing factory sites. In post-socialist regions (e.g. Bulgaria, Romania, Hungary, Slovakia, and East Germany), the rapid decrease in fertility rates, depopulation and labour-related outmigration particularly since the political turnaround in the late 1980s are considered as the most notable contributing factors in urban decline. Indeed, what is observed as a declining city in such European regions is predominantly associated with the high level of housing vacancy and abandonment due to the rapid population and economic decline, particularly during the 1990s and 2000s. Over the 10-year period after the fall of the Berlin Wall, the city of Leipzig, as one of the major East German cities, lost about 100,000 of its inhabitants (Herfert & Röhl 2001) and over 90,000 of its jobs (Bontje 2004).

As previously discussed in Chapter 2, since the mid-1980s, there have been signs of a counter trend of repopulation of inner-city locations, particularly in Western Europe. As Haase et al. (2010) suggest, *"European inner-city areas are increasingly regaining their residential attractiveness after years of decline"*. This is an urban development stage that is commonly referred to as "re-urbanization" or "resurgence" of European inner cities (Champion 2001; Brühl et al. 2005; Bromley et al. 2005; Buck et al. 2005; Cheshire 2006; Buzar et al. 2007; Haase et al. 2010). Re-urbanization in Europe, as elsewhere across developed economies, is mainly driven by the agglomeration of service-based industries in the 21st century that favour inner-city regeneration. Re-urbanization has today become a crucial part of urban development strategy to reverse the decline and enhance the viability of central cities. Such back-to-the-city movement of population has stimulated a market for physical regeneration of abandoned or aging structures in many European cities. This market shift has been both supported and driven by government policy supporting land recycling, reuse of old buildings, and the rejuvenation of derelict areas and infrastructure such as canals and railway lines. The London Docklands and the Ruhr coalfield regeneration are two well-known examples of this phenomenon on a very large scale.

5.3 Brownfield in the European context

5.3.1 Rooted causes of brownfield emergence

A typical problem associated with the phenomenon of urban decline is the emergence of derelict or underutilized urban lands, defined as Previously Developed Land (PDL) in this research, as discussed in Chapter 1. In general, five distinct categories of PDL can be found in Europe, including:

- Former industrial areas
- Former housing sites
- Former mining areas
- Former military areas
- Waste and landfill sites

Apart from the waste and landfill sites whose emergence is not directly related to a specific structural development process, each category of PDL mentioned above has emerged as a legacy of marked global trends. Housing abandonment, for example, emerged predominantly as a legacy of a strong process of urban decentralization and suburban development that has dominated urban Europe since the 1960-70s. Industrial brownfields, i.e. industrial and former mining areas, are also the products of the urban decentralization process overlapped by strong waves of industrial restructuring and the shift towards a service-based economy. Furthermore, former military sites are another type of brownfield that has appeared as a result of the continuous process of demilitarization, defence cuts and changes in military technology over the last half-century.

- ***Former industrial areas***

As argued in a large body of literature (e.g. Cooke & Imrie 1989; Bennett et al. 1990; Gwilliam 1997; De Sousa 2008; Adams et al. 2010; Josef et al. 2014), the processes of industrial restructuring and population decentralization are believed to be the prominent driving forces behind the emergence of industrial brownfields across Europe. Each of these two marked trends and global processes has contributed to persistently changing the industrial landscape of Europe, particularly in established urban centres of heavy and auxiliary industries, e.g. steel and textile industries.

Driven by a series of internal (national) and external (international) factors, the strong wave of industrial restructuring in 1970-80s had significant influence over the structural pattern of cities, particularly in Western Europe (Saeger 1997; Rowthorn & Ramaswamy 1997). Camagni (1991) made a taxonomy of the industrial restructuring in Europe based on four principal causes that might lead to it, including (1) abrupt exchange rate movements and trade changes in non-manufacturing sectors, (2) irreversible international market crisis in 1970s and branch plant crisis in 1980s, (3) regional firm crisis in facing foreign competition, and (4) environmental and physical maturity of many highly urbanized and old-established industrial areas (Figure 5.2). The process of structural changes in industrial activity has spread continuously, but unevenly, across the Europe since the mid-1970s and gathered pace in 2000s, particularly, in response to Global Financial Crisis (GFC) of 2007-2009.

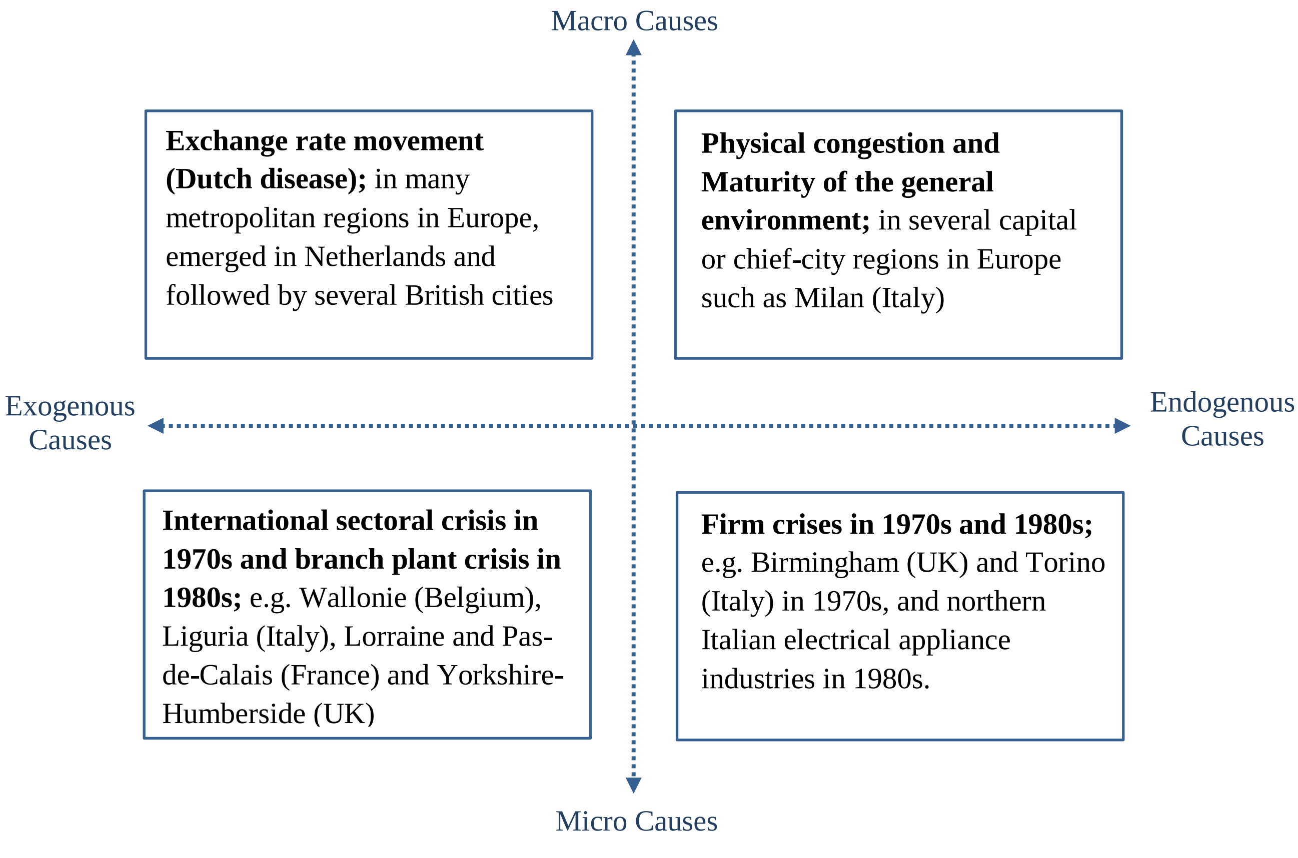


Figure 5.2 Taxonomy of industrial restructuring causes across the Europe during the 1970s and 1980s
Source: Author's elaboration on a figure from (Camagni 1991)

The global trend of industrial restructuring, has been important in spatial redistribution of industrialized cities across Western Europe. Affected by economic downturns, bankruptcy and mass-layoffs, a large number of production sites and business centres ceased to exist or went into terminal decline, leaving behind extensive areas of industrial brownfields within the fabric of cities. From the mid-1970s onwards, several traditional industrial regions in Western Europe, most notably in the UK, Germany, France and Belgium, have been hit by such industrial displacement. Abundant evidence for this phenomenon can be found, for example, in North West England, Yorkshire and the Humber and the West Midlands (in the UK), the Ruhr area and Saarland (in Germany), Nord-Pas de Calais, Lorraine and Rhône-Alpes regions (in France) and Flemish region (in Belgium) (see Figure 5.3).

Figure 5.3 A large-scale industrial brownfield site in Nord-Pas de Calais region, France. *(Source:* https://www.hauts-de-france.developpement-durable.gouv.fr/*)*

Industrial restructuring depicted a similar image for East European nations, such as Romania, Czech Republic, East Germany, Hungary and Poland, while taking place at different time periods and different scale. These countries were hit by industrial distress almost two decades after Western and Northern Europe's experience, in the late 1980s and early 1990s. The sudden fall of the Berlin wall in 1989 and subsequent collapse of the planned centralized economy was the key driving force in industrial manufacturing shrinkage across Central and Eastern European (CEE). This rapid political shift imposed drastic and abrupt changes in the economic structure of the former GDR and CEE countries, triggering steep decline in their manufacturing capacity and activity. In East Germany, during the first four year period after the fall of the Berlin wall, 45 per cent of all workplaces were shut down and thousands of jobs disappeared (Pinquart & Silbereisen, 2004). The notable examples in this regard are the cities of Halle an der Saale, renowned as a centre of the GDR's chemicals industry, and Leipzig that was once known for its strong manufacturing industry, trade and commerce base. Since the fall of the Berlin wall, Leipzig lost nearly 90 per cent of its manufacturing jobs (City of Leipzig 2019). The actual loss of manufacturing production and jobs has been accompanied by tertiarization and growth of service sector in the post-1990s period. For instance, between 1991 and 2019, employment in services increased by 17 per cent in Romania and 20 per cent in Poland (World Bank 2019b). As part of this structural change, many manufacturing industries disappeared or were split up and taken over partly by smaller domestic firms and international enterprises across several cities in Central and Eastern Europe, e.g. Brno and Ostrava (in Czech Republic), Braşov (in Romania), Budapest (in Hungary) and Warsaw (in Poland). This issue has been instrumental in creating inner-city industrial brownfields in such cities.

- ***Former housing sites***

Industrial restructuring accompanied by suburbanisation has resulted in the abandonment of housing in inner-urban areas in many countries across Europe, e.g. the UK, Germany and Italy. With the growth of peripheral rings with dominated service activities, the population has grown beyond the urban peripheries, leaving behind many abandoned housing sites in central cities. Such sites reached the end of their physical and functional life because they have been unused or ineffectively-used for a long time. In the UK, for example, Liverpool experienced significant urban shrinkage and decay of affected residential neighbourhoods due to the collapse of manufacturing and port industry, population loss and decline in public-sector housing construction during the 1970s and 1980s (Couch & Cocks 2013; Haase et al. 2016). In the Eastern Europe and East Germany, housing abandonment in inner-city locations was predominantly driven by the political changes of the late 1980s and early 1990s. According to one estimate, (Rink et al., 2012), approximately 20 per cent of the entire East German housing stock was vacant at the turn of the millennium. Moreover, beneath this general trend, low and falling demand for inner-city housing has led to surplus housing stock, with little hope of it returning to the market (Keenan et al. 1999; Gibb et al. 1999; Mumford & Lupton 1999). This was witnessed in a number of countries in Western Europe, such as the UK and Denmark in the late 1990s.

- ***Former mining sites***

Apart from the redundancy of industrial sites, the strong trends of industrial restructuring in 1970-90s followed by the global economic recession of 2007-2009, left a legacy of a number of mining sites within and surrounding cities (Neil et al. 1992; Laurence 2009). From this perspective, cessation of mining activity has been predominantly influenced by the rapid transition process from primary production industries into service-based industries. Many mining areas in Europe were forced to shut down as their operations were no longer economically profitable because of international competition. A notable example for this is the regional crisis provoked by closure of a large number of British coal mines in the wake of increasing foreign competition, especially cheap coal imported from Russia, the US, Colombia, and Australia. Nevertheless, it is important to note that economic competition has not been the only trigger for the closure of mining sites in Europe. Generally, there is a wide range of reasons for mining closure, such as geological or geotechnical reasons, equipment or mechanical failure, government policy and regulatory pressure (Laurence 2006). From a broader perspective, mining closure can be also viewed as a natural and unavoidable process, given the short and temporary operating life of a mine. In other words, as the mineral resource becomes exhausted after years of extraction, a mine is forced into closure. However, in many cases, mines shut down before the exhaustion or depletion of reserves due to their prime real estate appeal for new developers (Sánchez et al. 2014).

Another important issue that has received a great deal of attention in Europe is the environmental quality of mining regions (Dudka & Adriano 1997; Ghose 2001; Brown et al. 2003; Craik 2013). Many closed and operating mines have been recognized to pose significant risks to the environment or public health due to the existence of pollutants or contaminative substances (e.g. toxic mine spoils and acid mine drainage). This has resulted in major concerns from environmental and community groups all across Europe. However, many national and regional cooperation projects have been set up with the aim of reducing environment risks by stopping mining operations. This has been a common scenario for many European countries with a long-run history of mining activity, such as the UK, Germany, France and Poland.

- ***Former military sites***

Despite the fact that the majority of European brownfield sites appeared as a result of the underlying processes of industrial restructuring and urban decentralization, another type of brownfield in Europe has emerged as a legacy of a marked trend; namely 'demilitarization'. This widespread phenomenon is essentially characterized by the significant political and social transformations and changes in security/defence policies in many European nations over the past century or so, particularly during the post WWII and post-cold war periods. With the termination of active use of land by military forces and partial or complete loss of the military function from cities, large tracts of land, buildings and installations have become redundant and unused. Generally, these post-military sites consist of infrastructure (e.g. tunnels, bunker and military railways), administration buildings and open lands (e.g. training areas, shooting ranges and airfields) which are mostly located in remote areas. As widely argued in the literature, (e.g. Grimski & Ferber 2001; Bagaeen 2006; Hercik et al 2014; Osman et al 2015), many military brownfield sites across Europe are subject to concerns regarding the environmental damage and hazardous contaminants on site due to their former uses. Meanwhile, several former military compounds include a landmark or buildings with significant historical values and cultural breadth (Bagaeen & Clark 2016; Nenička 2016).

Redundant military brownfields are widespread across Europe. This redundancy process has accelerated during the last two decades (Bagaeen 2016). Several countries are affected by military sites closure, given the great number of foreign troops stationed in Europe during the WWII and Cold War. In Western and Northern Europe, many countries, such as the UK, France and West Germany, were hit hard by the departure of armed forces after WWII. A widely-known example of these military brownfields is RAF Greenham Common, a former US Army Air Force site in Berkshire (in the UK). Similarly, the structure of many cities in Central and Eastern Europe has been affected by the underlying trend of demilitarization following the fall of the iron curtain. The withdrawal of the Soviet army presence and abrupt transformation of political system in such regions, at the turn of the 1980s and 1990s, contributed to the emergence of huge tracts of military brownfields (Hercik et al 2011; Kadar 2014; Nenička 2016). There exists ample evidence for former Soviet military brownfields in CEE countries, most notably in Székesfehérvár and Szolnok (in Hungary), Wünsdorf-Waldstadt Soviet Headquarters (in the former GDR), Ezere, Aizpute and Gudenieki airfields (in Latvia) and Boží Dar and Czech Silesia (in the old Czechoslovakia) (see Figure 5.4).

Figure 5.4 An abandoned and evacuated military brownfield site in Boží Dar, former Czechoslovakia (*Source:* http://www.dailymail.co.uk/).

5.3.2 Terminologies for brownfield in Europe

5.3.2.1 The origin of the term

Brownfield is a term often associated with areas formerly in industrial use. However, in many European countries such as the UK, the term brownfield has not emerged only from former industrial activities. For example, Syms (1994) defines brownfield in the UK as *"any areas of land which have previously been the subject of man-made or non-agricultural use of any type. This would include industrial uses such as chemical works, heavy engineering, ship building and textile processing, together with unit housing clearance sites and docklands, both inland and coastal, as well as mineral extraction and those used for landfill purposes"*. Gwilliam (1997), the former Director of the Civic Trust England, considers brownfield sites to be, *"buildings and land either now vacant or that could become vacant or suitable for development, during a relevant [development] plan period"*. Or as Alker et al. (2000) quoted from an English retail and land investment manager, brownfield is as any type of land *"that has a previous use on it and is being put back for reuse (recycled land)"*.

Historically speaking, the origin and usage of the term brownfield in Europe can be traced to the British concept of "derelict land", as Britain was the first nation to industrialize and witness undesirable effects from industrialization. For the same reason, restoration of derelict and degraded lands has been a consistent element in the long-run history of British regional policy. Around the mid-twentieth century, Beaver (1946), in his pioneer survey for the Ministry of Town & Country Planning in the United Kingdom, first defined derelict land officially as, *"land which has been so damaged by extractive or other industrial processes or by any form of urban development that in default of special attention it is unlikely to be effectively used again within reasonable time and may well be a public nuisance in the meanwhile"*. After Beaver's seminal work, the phenomenon of derelict land reclamation received official recognition. Almost two decades later, in 1964, the government developed an amended version for Beaver's definition for the nation-wide Derelict Land Surveys. Hence, under the Local Government Act (Explanatory Memorandum 1966), the British government reinterpreted derelict land, as "*land so damaged by industrial or other development that it is incapable of beneficial use without treatment",* where treatment was regarded as different types of intervention; including demolition, clearing of fixed structures, foundations and levelling, or soil remediation. Following this official definition, various attempts have been made by a number of scholars and geographers to provide a better understanding of the term and, thus, recognize the magnitude of problems associated with widespread dereliction across the UK (e.g. Oxenham 1966; Bush 1969; Goh & Morgan 1973; Wallwork 1974; Gibson & Collins 1977; Bradshaw & Chadwick 1980). Despite all these attempts, the definition produced for derelict land in 1966 is still the one being used administratively by the UK government.

In 1998, a new project, the National Land-Use Database (NLUD), was commenced by Department of the Environment, Transport and the Regions (DETR) in response to the policy need for information on previously developed land and buildings that may be, or may become, available for redevelopment (Harrison 1999). The NLUD is considered as the oldest and most dependable data source that presents a record of all brownfield sites in England. The statistical data is gathered from individual local authorities. Meanwhile, the NLUD has been the first nation-wide policy initiative in Europe that officially defined the term brownfield for administrative purposes.

The NLUD was developed to shift the emphasis from derelict land to previously-developed land (PDL). The concept of PDL was introduced by the UK government in order to address two major problems associated with the definition of derelict land. Firstly, the category of derelict land only applies to the disused or abandoned land, whereas much land that is adversely affected by industrial or other development may still be in active use (Bradshaw & Chadwick 1980). In other words, the conception of derelict land does not form a perfect match with the notion of under-utilized buildings and structures. Secondly, this definition comprises land that is unlikely to be redeveloped and reused, specifically mineral workings and other sites in rural regions (almost half of the derelict land in the 1993 English survey was in rural areas) (EUGRIS 2017). Therefore, in order to allow greater planning flexibility and accessibility, it seemed logical for the UK government to define a new term suitable for lands, whether vacant or still in use, with known potential for redevelopment and reuse, particularly those with potential for new housing.

In order to facilitate the identification of previously-developed lands across the UK that may be available for redevelopment, the NLUD presented the first classification of brownfield, known as PDL, in Europe in 1998 which was updated in 2001 with minor changes. Generally, the NLUD considers brownfield sites and buildings under five marked categories as: (NLUD 2012)

- previously-developed land that is vacant (land that has been cleared)
- previously-developed buildings that are vacant
- previously-developed land and buildings that are derelict
- previously-developed land or buildings that are now in use and allocated in local plan or with planning permission for any use
- previously-developed land or buildings that are now in use with known redevelopment potential but no planning allocations or permissions

In 2012, The National Planning Policy Framework (NPPF) was published by DETR in England, as a key part of the government’s planning and policy reforms. The central objective of NPPF was to provide planning policy and practice guidelines for local governments, decision makers and communities in England. Furthermore, this national framework provided a comprehensive glossary of technical terms in urban policy and practice in order to facilitate the government’s planning and structural system. According to NPPF (2017), PDL is described as *“land which is or was occupied by a permanent structure, including the curtilage of the developed land (although it should not be assumed that the whole of the curtilage should be* *developed) and any associated fixed surface infrastructure".* Based upon NPPF's classification, PDL excludes:

- *land that is or has been occupied by agricultural or forestry buildings;*
- *land that has been developed for minerals extraction or waste disposal by landfill purposes where provision for restoration has been made through development control procedures;*
- *land in built-up areas such as private residential gardens, parks, recreation grounds and allotments; and*
- *land that was previously-developed, but where the remains of the permanent structure have blended into the landscape in the process of time (NPPF 2017).*

5.3.2.2 Existing definitions in Europe

After the British experience, the awareness of brownfield issues and of the possibility of redevelopment has grown in many other European countries, in particular those countries affected by degraded and derelict industrial areas, most notably Germany and France. In Germany, the Federal Environmental Agency (2005) defined brownfield lands as *"[previously developed lands] that are to be redeveloped for ecological reasons, urban development or social reasons but whose redevelopment potentials are hampered by [severe] conditions...Such hindrance could be for example a suspected contamination because of previous commercial, industrial or military use."*. Similarly, in France, brownfield is characterized as *"space previously developed that are temporarily or definitively abandoned following the cessation of activity; and, that need to be reclaimed for a future use. They can be partially occupied, derelict, or contaminated" (CLARINET 2002).*

Apart from a few cases, no common and legally accepted definition of brownfield exists in most of the EU states. However, there have been a number of network-based research studies on brownfields conducted by the European Commission or its designated stakeholders. The most notable examples of these European information networks are CLARINET (Contaminated Land Rehabilitation Network for Environmental Technologies), NICOLE (Network for Industrially Contaminated Land in Europe), RESCUE (Regeneration of European Sites in Cities and Urban Environments), ANCORE (Academic Network on Contaminated Land Research in Europe) and CABERNET (Concerted Action on

Brownfields and Economic Regeneration Network). These networks have been increasingly proactive in developing general understanding of brownfield sites across Europe and accordingly setting up thematic strategies for their development.

Table 5.1 Brownfield definitions in European countries based on the responses of members of the CLARINET and CABERNET networks

Category of Brownfield Definition	Country
Previously-developed land, neither necessarily derelict nor contaminated	Germany, UK (England and Wales), France, Latvia, Belgium – Wallonia
Derelict or unused land, not necessarily contaminated	France, Czech Republic, Ireland, Slovenia, UK (Scotland), Latvia
Contaminated land, either potential or confirmed	Denmark, Bulgaria, Italy, Spain, Romania and Poland
No official or commonly recognized definition	Austria, Sweden, Finland and Netherlands
No information	Greece, Hungary, Portugal and Slovakia

Source: Author's elaboration on the information gathered from (Oliver et al. 2005; CABERNET 2006; NICOLE 2011)

The first European approach to identify and characterize the term brownfield was made by the CLARINET Woking Group in 2002, (CLARINET 2002). Its definition was revised in the CABERNET network's report in 2006, (CABERNET 2006). This glossary definition was given based on the collection of responses from member states of the CLARINET and CABERNET networks, in an attempt to address the full context of environmental, economic and land use issues and emphasize the need for intervention (see Table 5.1). However, it must be noted that there seems to be a lack of available data and information for a large portion of Europe including both member nations, e.g. Greece, Hungary and Slovakia, and non-member nations, e.g. Croatia and Norway. Nonetheless, CABERNET's definition is considered as the most extensively used and widely accepted definition of brownfields throughout the EU and the accession states (Nathanail 2011; Doerle 2012). According to CABERNET (2006), building on CLARINET WG (2002), brownfields are generally considered as sites that:

- *have been affected by the former uses of the site and surrounding land,*
- *are derelict or underused,*
- *may have real or perceived contamination problems,*
- *are mainly in developed urban areas, and*
- *require intervention to bring them back to beneficial use.*

5.3.3 *Quantification of brownfield sites in Europe*

It is difficult to quantify the scale of the brownfield problem in Europe, as the term brownfield has been used in different contexts and meanings in different countries (Grimski & Ferber 2001; Oliver et al. 2005). As shown in Table 5.1, in some countries, e.g. Denmark, Italy and Spain, brownfields are identified as contaminated land, whereas in many other countries, e.g. the UK, Germany, France, Belgium and Czech Republic, brownfields are recognized as previously-developed land and buildings that might be derelict, vacant or contaminated. Meanwhile, some European countries, e.g. Austria, Sweden and Netherlands, have not characterized brownfields in the same way, and in some countries, e.g. Greece, Hungary and Portugal, there is yet no information available. Therefore, this complexity of brownfields definition coupled with the lack of national datasets in most countries has posed some difficulties in identifying comparative data on the scale of brownfield sites across Europe.

Regardless of whether brownfield is defined as contaminated or not in different countries, there are some other factors that make the estimation of brownfields difficult. This difficulty is associated with brownfield quantification crops up when sites are affected by contamination. There are three main reasons to be addressed in this regard as follows:

1. *Inaccurate data and information on the history of the site usage*; in many regions, there is no official recognition of contamination given the absence of a planning application.
2. *Government's unwillingness to publicly reveal their records on the actual number of contaminated lands*, particularly those sites with former or ongoing sensitive usages such as contaminated, but productive, factories and private military firms.
3. *Land owners and property professionals' unwillingness to register their contaminated lands*. In many countries, such as the UK, once a parcel of land was registered as a contaminated land, it could never be removed from the list, even after the site was thoroughly decontaminated and cleaned up (Kellett 1999). The 'contamination label' is a critical issue which is regarded by many as leading to depression of public and market demand for the registered contaminated sites and accordingly a fall in land value.

Despite the paucity of available data, there have been several research surveys to inform EU-wide policy and assist in identifying and comparing issues associated with brownfield development in Europe. The CABERNET network, the European Commission (EC) working group and European Environment Agency (EEA) are the most notable agencies that have conducted and published invaluable surveys in this regard. In 2006, CABERNET published a comprehensive report, 'Sustainable Brownfield Regeneration', based on the responses of its 22 member countries. This report has presented useful information on the number of brownfield sites in different European countries (see Table 5.2). Although the reported numbers and sizes of the sites in CABERNET's survey are subject to wide variations in results, this survey has been still the most detailed and widely-used data on brownfield quantification in Europe, to date. Furthermore, in the same year, a European Commission working group (EC 2006a) made an estimate of the number of potentially contaminated sites (sites after preliminary survey) and the contaminated sites (sites where implementation of remediation activities is needed) for European countries (see Table 5.3). This survey has been updated by a recently published report of the European Environment Agency (EEA 2014). According to EEA findings, in 2011, there were as many as 2.5 million potentially contaminated sites across Europe, of which over 342,000 sites were expected to require remediation (see Figure 5.5).

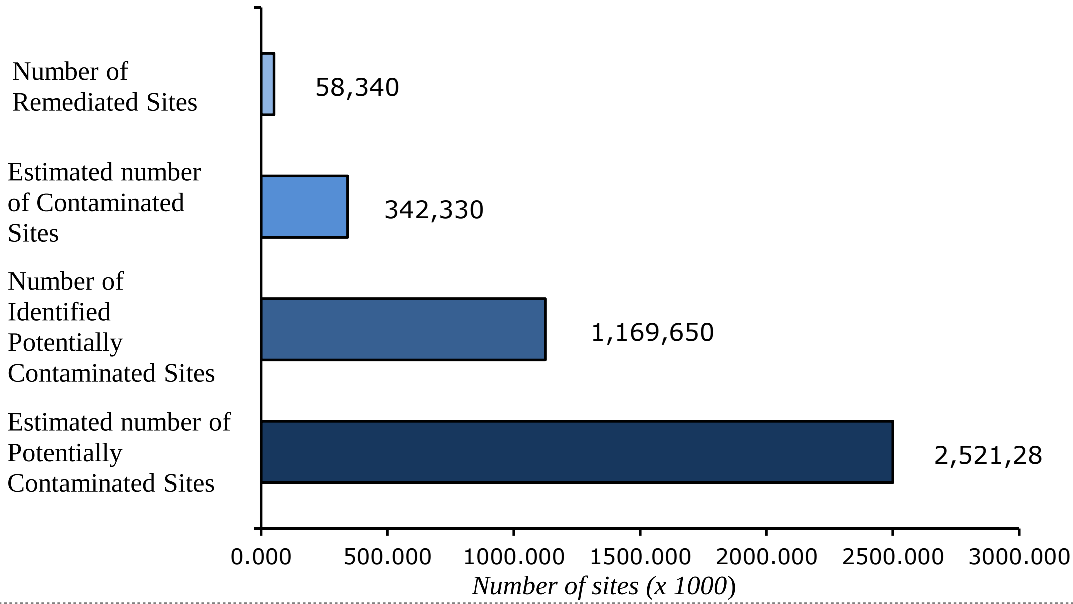


Figure 5.5 Overview of the quantification of (potentially) contaminated sites in Europe (EEA-39 countries) *Source: Author's elaboration on data and information collected from EEA (2014)*

Table 5.2 Information on the number of brownfield sites in Europe

Country	Estimated total area of brownfield land, *in ha*	Suspected / potential number of brownfield sites	*Data source*
Austria	- No data - 8,000-13,000[1]	- 2,500 - 3,000-6,000[1] (85% of which present no or little contamination)	*Umweltbundesamt Wien (2000 and 2004)*
Belgium	- 9,000 (Wallonia) - 5,500 (Flanders)	- 5,528 (Wallonia) - 53,000 (Flanders, estimate)	*European Environment Agency (EEA) (1999); GEHAT, Université Bruxelles (2000)*
Czech Republic	30,000	10,000	*Czech Brownfield Regeneration Strategy, Progress Report (2004) - Czechinvest*
Denmark	No data	30,000	*Danish Environmental Protection Agency (2000)*
Finland	No data	20,000	*EEA (1999); Finnish Environment Institute (2001)*
France	20,000[1]	- 222,000[2]	*EEA (1999) ; Ministere de l'Environnement (200)*
Germany	128,000	362,000	*Umweltbundesamt Berlin (2000)*
Ireland	No data	1,900-2,300 (contaminated sites)	*Environmental Protection Agency (2000)*
Italy	- No national data - 1260 (Milan Province)	9,000	*EEA (1999); Agenzia Nazionale per la Proteziojne dell'Ambiente (ANPA) (2001)*
Latvia	- No national data - 1900 (Riga only)	- No national data - 142 (Riga only)	*Riga City Council (2004)*
Netherlands	9,000 – 11,000	110,000 – 120,000 (estimate)	*EEA (1999); Environmental Ministry (2000)*
Poland	800,000	3230	*Ministry of Environment (2002)*
Portugal	No data	2,000 (estimate)	*Lab. Nac. De Engenhaira Cicil (1998)*
Romania	900,000	No data	*Romanian Ministry of Waters and Environment (MAAP) (2000)*
Spain	- No national data - Basque Country: 7930 potentially contaminated land, 482 industrial ruins	- 4,900 (potentially contaminated sites) - Basque Country: 9,328 potentially contaminated sites, 459 industrial ruins	*Ministerio de Medio Ambiente (2001)*
Sweden	> 5000 (estimate)	40,000	*Unofficial estimate (C.Egelstig, JMAB, 2004)*
Scotland	10,847	4,222	*Scottish Executive (Scottish Vacant and Derelict Land Survey 2003, published 2004)*
Bulgaria, Greece, Hungary, Slovakia, Wales Northern Ireland	No data	No data	

Source: Author's elaboration on data collected by the CLARINET and CABERNET networks (Oliver et al 2005; CABERNET 2006) with some updated data collected from EEA (2007)[1] and NICOLE (2011)[2]

Table 5.3 Information on the number of (potentially) contaminated sites in Europe (EU-25)				
Country	Potentially contaminated sites (Number of sites after preliminary survey)		Contaminated sites (Number of sites where implementation of remediation activities is needed)	
	Identified by a preliminary survey	Estimated total number	Identified	Estimated total number
Austria	2,000	30,000	No data	2,500
Belgium (Flanders)	No data	70,000- 80,000	No data	11,000
Czech Republic	No data	49,785	No data	500
Denmark	5,810	30,000	No data	No data
Finland	18,000	20,000	No data	6,500
France	160,751	900,000	3,745	No data
Germany	271,267	No data	12,843	No data
Hungary	15,044	30,000	No data	3,000
Ireland	No data	2,300	No data	200
Italy	14,017	100,000	2,944	No data
Latvia	255	No data	No data	No data
Lithuania	5,319	15,000	73	No data
Malta	No data	300	1	No data
Slovenia	No data	2,692	No data	No data
Spain	15,228	26,440	No data	No data
Sweden	41,000	53,000 – 60,000	No data	11,500
the Netherlands	600,000	600,000	No data	60,000
Cyprus, Estonia, Greece, Poland, Portugal, Slovakia, Belgium (Wallonia & Brussels)	No data	No data	No data	No data

Source: Author's elaboration on data by (EC 2006a), originally collected from the following sources;
- Dutch inventory 2004 "Landsdekkend beeld", May 2004 and "Jaarverslag bodemsanering over 2002" RIVM for the Dutch ministry of environment (min. VROM)
- Progress in the management of contaminated sites, EEA 2002 and Progress in the management of contaminated sites released by EEA in 2005 with data from 2003
- Data unofficially provided by delegates form Member States in the Common Forum to the DG Environment (June and July 2005)
- "ontwerp milieubeleidsplan" 2003-2007 Flemish ministry

5.4 Legal framework for brownfields at the EU level

There has been a wide range of general policies tackling interrelated environmental problems at the EU level. In respect of brownfield redevelopment, soil contamination is receiving a good deal of attention. Despite the fact that the European Commission has been proactive in promulgation and formulation of integrated soil-related policy (Thornton et al. 2007), soil is still not subject to a coherent set of regulations across all EU Member States (EC 2017a). According to the official European Union dataset -EUROPA- (EC 2017a), at present, only a small number of countries in Europe (such as Netherlands, France, Germany and the UK) have legislation specific to protection, management, and sustainable use of soil. However, over the past decade, land contamination and soil-related issues have become the focus of attention in the existing legislative framework for brownfield clean-up and redevelopment at the EU and national level (Nathanail et al. 2007; Vanheusden 2009; Rizzo et al. 2015; Bardos et al. 2016). This is because concerns over soil contamination and its potential risks to human health, the environment and economic development have been growing steadily in Europe in the last few years.

Generally speaking, the EU legal system takes account of two strategic actions in relation to land contamination problem:

1. *Forward Strategies:* that are essentially associated with the prevention of future problems and protection of soil against pollution.
2. *Backward Strategies*: which are drawn up in dealing with the problems of already contaminated land. These strategies and legal framework are often mapped out with the purpose of providing indispensable tools and incentives for remediation and development of contaminated lands. The EU backward strategies are important in development of environmental liability and risk transfer for the management of both historically and newly contaminated sites. Such liability protection policies have been framed within the EU legal system in line with the Polluter-Pays Principle (PPP) in order to transfer the immediate and actual remediation costs to the original polluter (NICOLE 2011).

In response to growing concerns over soil protection and remediation issues, the European Commission published a Communication 'Towards a Thematic Strategy for Soil Protection' in 2002. This was the first occasion on which the EU Commission had publically addressed the soil contamination problem at the EU level (EC 2017a). The next, and as suggested by many (Thornton et al. 2007; Vanheusden 2007), the most important, step towards the development of a soil-related policy in the European Union was taken in 2006, when the European Commission proposed and published the 'Thematic Strategy on Soil Protection'. This was a strategic measure in delivering one of the environmental objectives formulated in the Sixth Environment Action Programme (6th EAP), adopted by the Council and Parliament for the period 2002-2012 (EC 2006b). The overall aim of European thematic strategy on soil protection was to address the problems caused by environmental damage and analyse the impacts of various soil policies. Meanwhile, by proposing the Thematic Strategy in 2002, the European Commission emphasised an absolute necessity of establishing a legal framework for an environmental liability regime to be applied across Europe. Accordingly, in 2004, the Commission created an EU-wide liability framework for the remediation of contaminated sites, namely the Environmental Liability Directive (ELD) or EU Directive 2004/35/EC (this is further discussed in section 5.4.1).

In general, the thematic strategy of 2006 was built around four key pillars, as follows:

- *Framework legislation with protection and sustainable use of soil as its principal aim;*
- *Integration of soil protection in the formulation and implementation of national and Community policies;*
- *Closing the current recognized knowledge gap in certain areas of soil protection through research supported by Community and national research programs;*
- *Increasing public awareness of the need to protect soil* (EC 2006b).

After proposing the EU Soil Directive in 2006, several Member states– including Germany, France, Netherlands, Austria and United Kingdom- that had their own soil management legislation in place, did not accept the content of the Directive. These countries took the position that the proposed EU Directive would interfere with their existing legislation and that the cost of justification and implementation of Directive would be prohibitive for them. Six years later, the European Commission presented a compromise proposal in order to meet these States' concerns. In 2012, following the EU commitment to implementation of the four pillars of the Strategy- including the legislation, integration, research and awareness raising- the Commission published a policy report, namely *'The Implementation of the Soil Thematic Strategy and Ongoing Activities'*. This report was essentially presented in order to ensure and reinforce the implementation of the Soil Thematic Strategy of 2006 in each individual Member State. However, in 2014, the European Parliament and the Council of the European Union took the decision to withdraw the Thematic Strategy of 2006 and formulated a new proposal for a Soil Framework Directive, namely Seventh Environment Action Programme (7th EAP). This proposal entered into force in the same year to guide environmental policy-making framework in Europe until 2020. According to EC (2017), 7th EPA provides "*that by 2020 land is managed sustainably in the Union, soil is adequately protected and the remediation of contaminated sites is well underway and commits the EU and its Member States to increasing efforts to reduce soil erosion and increase soil organic matter and to remediate contaminated sites"*. It also states that *"The Union and its Member States should also reflect as soon as possible on how soil quality issues could be addressed using a targeted and proportionate risk-based approach within a binding legal framework"* (EC 2017a).

5.4.1 EU initiatives for contaminated sites

As discussed above, there has been a wide range of environmental initiatives and policies for brownfields- as contaminated or potentially contaminated sites- developed by the European Commission. In general, the EU initiatives for brownfields comprise four focal areas, as follows:

1. *Providing legal liability for the economic operator who caused or contributed to the contamination*

Proposed in 2002 and entered into force 2004, the European Parliament and the Council of the European Union co-established a comprehensive liability framework for the prevention and restoration of environmental damage, namely the Environmental Liability Directive (ELD) or EU Directive 2004/35/EC (CEU & EP 2004). ELD was essentially designed based on the EU's Polluter-Pays Principle (Article 191(2) TFEU), by means of which the actual polluters are forced to bear the legal responsibility and potential expenditures for prevention and remediation measures. In other words, ELD offers a liability relief for the economic operator engaged in all professional activities (e.g. the landowner, purchaser or site developer) who did not cause or contribute to the release of contaminants or pollutants. Under this comprehensive liability scheme, all EU Member States were obliged to transpose the ELD in their national laws by 2007 (EC 2017b). However, the ELD has permitted the Member States to keep their own legislative systems if they meet the minimal requirements of the EU Directive (Justice and Environment 2015).

Environmental damage under the EU administrative liability regime is defined in three categories including; “damage to protected species and natural habitats”, “water damage” and “land damage” (CEU & EP 2004). Given the occupational activities listed by the EU government, the ELD provides two types of liability regimes, under which site operators are considered to be of actual or potential concern. The first type is called ‘Strict Liability’ that applies to operators or polluters who are engaged in, at least, one of the hazardous activities identified by the ELD’s occupational list. In this type of liability regime, the polluter has to carry out remediation and bear the costs when damage is caused by a hazardous activity, even if no fault or negligence lies with the polluter (EC 2017b). The second type of liability regime is called ‘Fault-based Liability’ that takes place when the operator’s activity does not fall within the ELD’s list. Under this regime, an operator will only be held liable when he has committed any fault or negligence that causes damage solely to protected species and habitats (EC 2017b). In fact, the Fault-based Liability Directive does not hold operators financially liable for water and land damage caused by non-listed occupational activities.

2. *Collection and management of data on the contaminated lands or potentially-polluting entities through the European network.*

In order for the management and control of land contamination issues, the European Commission (EC-DG Environment) and the European Environment Agency (EEA) established a thematic centre for soil-related data across Europe, namely the European Soil Data Centre (ESDAC). The ESDAC dataset provides a large body of data and information associated with soil properties at the European Union level. It also hosts several web-based services that offer access and update of the information to individuals and organizations (Panagos et al. 2012). According to the European Commission’s Joint Research Centre (JRC 2017), the ESDAC stores and manipulates four broad categories of data, as follows:

- *Category I;* general data stem from the European Soil Database (ESDB)

- *Category II;* data related to soil threats (erosion, soil organic carbon, landslides, compaction, salinization, soil biodiversity, contaminated sites, soil sealing, etc.)
- *Category III;* soil point data (LUCAS, SPADE, etc.)
- *Category IV;* data stem from projects.

As considered by the ESDAC datasets, the contaminated sites data at the European level is collected and managed in the second category of data (data related to soil threats). The contaminated sites data collection and management consists of three levels. At the first level, the data relating to polluting activities is collected from the national data inventories in each Member States and the EEA representative organizations. The management and control of land contamination data at the local level includes four steps itself including; "*site identification (or preliminary studies), preliminary investigations, main site investigations, and implementation of risk reduction measures"* (EEA 2014). At the second level, the comprehensive inventories will be analysed and assessed by the EEA and its partnership network, the European Environment Information and Observation Network (EIONET). And finally, this data and information will be transferred to the JRC European Soil Portal where ESDAC datasets become available. Some of these datasets hosted by the ESDAC can be freely downloaded by the public, whilst the major part of them can only be accessed after registration, through a fill-in form (JRC 2017).

In order to address the problem of contaminated sites in Europe and make the contamination-related data available to the public, the EEA in cooperation with its affiliated countries developed a series of indicator assessment reports, namely 'Progress in Management of Contaminated Sites (CSI 015)'. There have been already five comprehensive CSI 015 reports published by the EEA since its launch in 2001, the last one in 2014. These reports provide very detailed information about the management of contaminated land, such as the actual/potential quantity of contaminated sites, key sources of contamination, annual national expenditures on the management of contaminated sites, frequently applied remediation techniques and progress in the control of contamination (EEA 2014). Figure 5.6, as an example, shows one of the comprehensive indicator assessment data provided by the CSI 015 in its latest version in 2014.

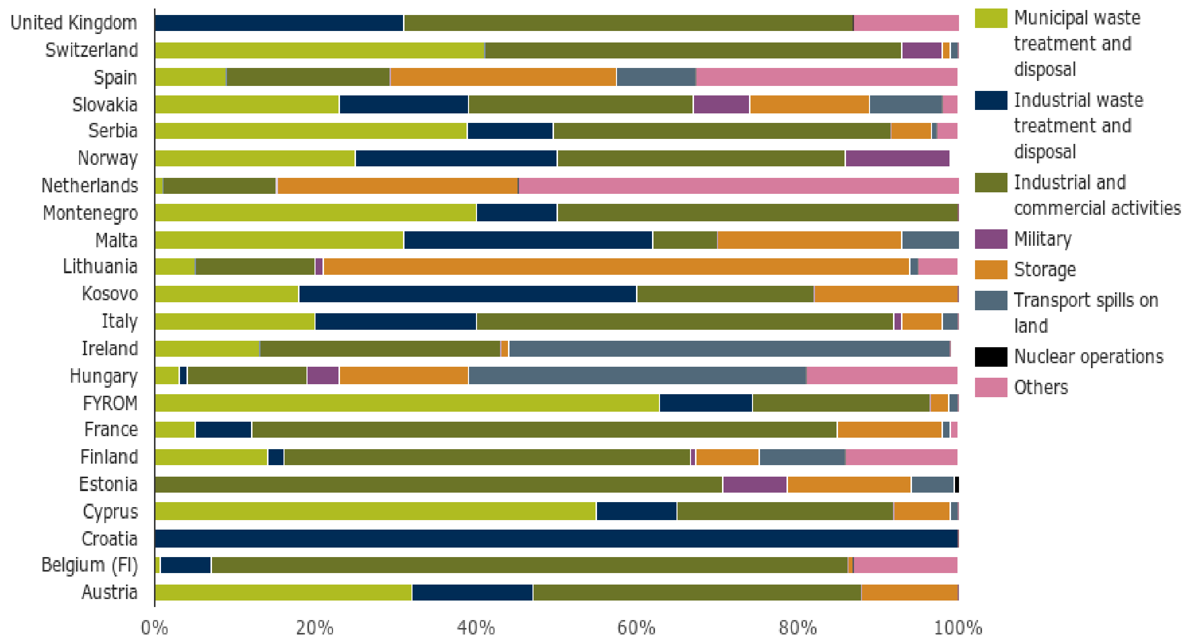


Figure 5.6 Detailed sources of activities causing soil contamination in Europe *(Source: EEA 2014)*

3. *Establishment of cooperative networks to ensure the remediation and redevelopment of contaminated sites*

One of the core activities of European policy on the remediation of contaminated sites is associated with the establishment of cooperative networks and information platforms. In doing so, the EU legislative system has identified several government and non-government working groups with the purpose of promoting the cooperation between relevant research centres, industries, service providers and site developers all over the Member States. Some notable examples of these EU-supported networks, common forums or information platforms regarding contaminated sites are listed as follows:

- The European Topic Centre on Urban, Land and Soil Ecosystems (ETC-ULS),
- The Joint Research Centre (JRC) - Land Management and Natural Hazards Unit,
- The Network for Industrially Contaminated Lands in Europe (NICOLE),
- The European Groundwater and Contaminated Land Remediation Information System (EUGRIS),
- The Concerted Action on Risk Assessment for Contaminated Sites (CARACAS),

- The European Coordination Action for Demonstration of Efficient Soil and Groundwater Remediation (EURODEMO), and
- Risk Abatement Centre for Contaminated Sites in Central and Eastern European Countries (RACE).

4. *Establishment of funding mechanisms to support the remediation costs;*

The required subsidies for the assessment and remediation of brownfields at the European Union level is supplied from the EU Structural Funds (through the ERDF and CF resources) which are comprehensively discussed in the following section.

5.4.2 EU funding support for brownfield development

In Europe, certain funding resources and operational programmes have been designed at the European Union level for redevelopment and reuse of brownfield properties. The EU financial incentives for brownfield regeneration are essentially provided through the 'European Structural and Investment Funds (ESIF)'. ESIF specific grant allocations are today considered as strong support for decontamination of brownfield areas in Europe (Thornton et al. 2007). The European structural and investment funds are originally supplied at the EU level and dispensed to the Member States. However, the organizations managed by national, regional and sub-regional authorities bear the main responsibility for distribution of the funds at different levels (Thornton et al. 2007).

The ESIF is generally meant to promote economic development across EU Member States through applying 11 investment priorities and supporting guidance recognized as thematic objectives. Within these thematic objectives formulated by the EU legislative framework, objective 6- i.e. 'environment protection and resource efficiency'- encourages recycling and reuse of brownfield sites. According to the European Commission Cohesion data (EC 2017a), the total budget of European structural and investment funds for the 2014-2020 funding period is over €454 billion (at the EU level), from which a small percentage is allocated to thematic objective 6, in which brownfield-related projects are involved.

European Structural and Investment Funds (ESIF) consist of five different EU and national co-financing resources that are managed by the EU Member States themselves, mainly through the national public and private funds. These structural funds include (EC 2017a):

- *European Regional Development Fund (ERDF);* 43.9 per cent of ESIF during the period 2014-20
- *European Agricultural Fund for Rural Development (EAFRD);* 23.7 per cent of ESIF
- *European Social Fund (ESF);* 19.1 per cent of ESIF
- *Cohesion Fund (CF);* 12 per cent of ESIF
- *European Maritime and Fisheries Fund (EMFF);* 1.3 per cent of ESIF

Amongst the mentioned-above Structural Funds, the European Regional Development Fund (ERDF) and Cohesion Fund (CF) are the relevant monetary incentives for brownfield redevelopment activities. Based on the existing EU legislative framework, the ERDF and CF co-financing supports may attain 85 per cent of the eligible expenditure for remediation and/or redevelopment of a brownfield project (ECA 2012). In the following, the ERDF and CF structural funding programs are explained briefly.

- ***European Regional Development Fund (ERDF)***

The European Regional Development Fund (ERDF) is one of the earliest and most coherent EU-wide strategies that has been designed by the European Commission to promote balanced economic development across European Member States. Created in 1975, the ERDF provides large-scale grants and loans for projects related to regeneration of urban areas, social spaces and housing infrastructure (EU 2010). The general prospective of this funding program is to establish and promote socio-economic cohesion amongst EU Member States. Today, ERDF provides the most significant funding support for brownfield land recycling and reuse projects at the EU level. The share of budget is determined depending on the region's development level in four categories including: (1) less developed regions, (2) transition regions, (3) special allocation for outermost and sparsely populated regions, and (4) more developed regions (European Parliament 2017). Based upon the existing EU budget and financial legislation, the less developed a Member State is, the higher is the ERDF funding allocation.

Furthermore, different interregional co-operation and operational programs have been initiated under ERDF direct funding support. The Brownfield European Regeneration Initiative (BERI), Promoting Sustainable Inner Urban Development (PROSIDE), Development of a Central European Conversion Network (CONVERNET), Technique of Urban Soil Evaluation in City Regions– Implementation in Planning Procedures (TUSEC-IP), Restructuring Cultural Landscapes (REKULA) and Revitalising Industrial Sites (REVIT) are notable examples of these programs which are all managed by INTERREG and URBACT EU-funded networks. The main emphasis of interregional brownfield programs has been placed on the transitional exchange of best practice and mutual learning on different aspects of brownfields development including soil contaminations, management models and public participation (Ferber 2010; EU 2010).

- ***Cohesion Fund (CF)***

The Cohesion Fund (CF) is another important financial tool that was launched in 1993 with the aim of consolidating the socio-economic and structural cohesion within the Member States of the EU. The CF has been essentially designed to provide financial assistance for environmentally-friendly projects related to infrastructure, energy or transport in the least-developed and prosperous Member States. According to the European Commission (EC 2017a), *"the Cohesion Fund is aimed at Member States whose Gross National Income (GNI) per inhabitant is less than 90 % of the EU average. It aims to reduce economic and social disparities and to promote sustainable development".* At present, the CF allocates an overall budget of €63 billion to 15 EU Member States including; Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia and Slovenia (European Parliament 2016).

Based on the EU- led approach, the decision to grant brownfield projects is made through the co-funding channel of ERDF and CF. The projects are first chosen by the national/regional authorities of the Member States and then sorted out according to 11 thematic objectives and investment priorities formulated by the European Commission. Two priority areas are environmental protection and resource efficiency, where redevelopment of brownfield sites is addressed. Activities that enable this may include: (1) "the remediation of unstable and contaminated land, (2) the redevelopment of sites, or (3) the full regeneration of contaminated brownfield sites combining both remediation and redevelopment measures" (ECA 2012). The structure of EU-driven grants allocation to brownfield redevelopment projects is depicted in Figure 5.7.

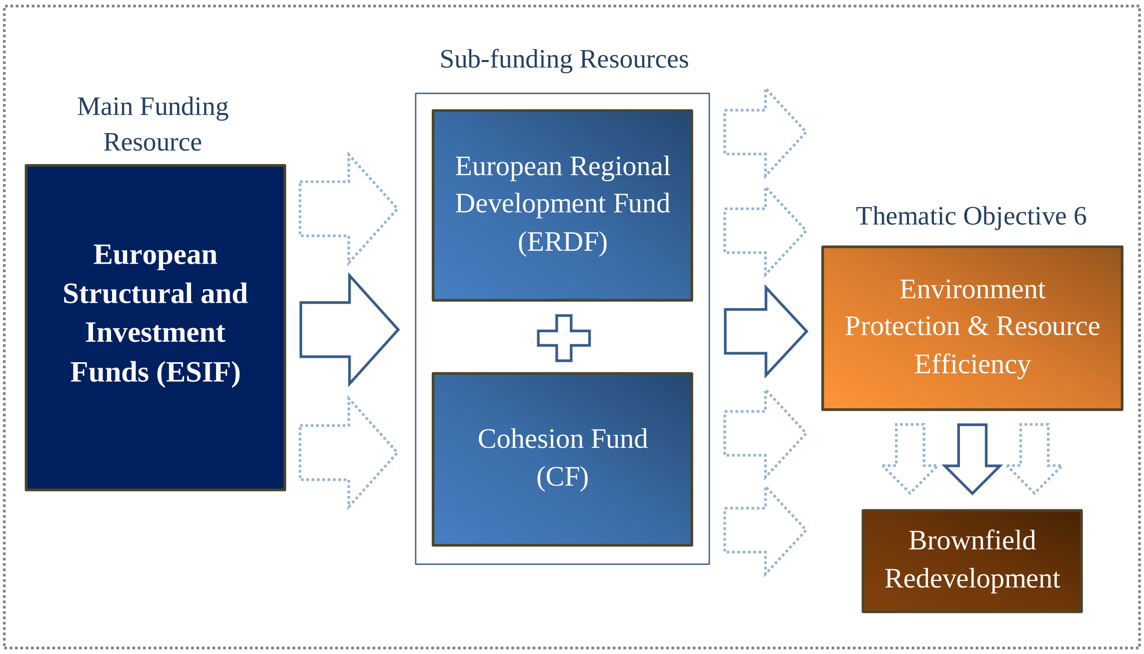


Figure 5.7 The structure of EU Structural Funds allocation to projects related to brownfield sites (*Source: author*)

It is important to note that not all EU Member States receive financial assistance from the same resource for their selected brownfield projects (EC 2017a). In most developed countries- e.g. the UK, Germany, France, Italy, Netherlands, Belgium and Spain- the budget for brownfield redevelopment at the EU level is solely supplied from the ERDF funding resource. However, in the less prosperous regions - e.g. Czech Republic, Romania, and Portugal- brownfield projects are co-funded by the ERDF and the CF. In such countries, CF acts the most important funding resource, whereas in a few cases, e.g. Estonia, the whole money comes from the CF funding tool. Meanwhile, in Scandinavia and Luxembourg, there is presently no EU structural fund available to support actions to recycle land. Table 5.4 summarizes the distribution of EU Structural Funds for brownfield redevelopment projects across the member states.

Table 5.4 Distribution of EU structural funds for brownfield activities				
Funding Tool	**ERDF**	**ERDF & CF**	**CF**	**No Fund**
EU Member States	UK, Germany, France, Italy, Netherlands, Belgium, Spain, Ireland,	Czech Republic, Romania, Portugal, Croatia, Malta, Bulgaria, Poland Hungary, Greece, Slovakia, Slovenia, Lithuania, Cyprus	Estonia	Sweden, Denmark, Luxembourg, Finland,

Source: Author's elaboration on information from the European Commission Cohesion data (EC 2017a)

The distribution arrangement of EU Structural Funds between the Member States for their brownfield activities is made by two European Commission directorates-general including;

1. *DG Regional and Urban Policy;* that deals mainly with the distribution of Structural Funds in the area of regional policy, under which the redevelopment of industrial and military brownfields is co-financed (ECA 2012),

2. *DG Environment;* that is responsible for proposing and implementing EU policies on the environment-related projects (EC 2017a). Therefore, it mainly deals with establishing a framework for the protection of contaminated sites and allocation of Structural Funds to such sites which is implemented in close cooperation with DG Regional and Urban Policy.

As previously mentioned, at present, there is no exact share of budget predetermined within the EU structural funds to be allocated for the redevelopment of brownfield sites. In 2012, the European Court of Auditors (ECA), ECA published a special report in which it identified the total sums of money spent on brownfield projects across the EU Member States during the 2000–06 and 2007–13 programming periods. According to this report (ECA 2012), during the period 2000–06, the total funding of €2.3 billion and during the period 2007–13, the total funding of €3.4 billion was allocated for the regeneration of industrial and military brownfields.

This report also provided a detailed overview of funding distribution between the EU Member States, as depicted in Table 5.5.

Table 5.5 EU Structural Fund allocation for industrial and military brownfield regeneration *(Source: ECA 2012)*

2000–06 Structural Measures regeneration of industrial and military sites				2007–13 Structural Measures regeneration of industrial and military sites			
Member State	Rank	Amount allocated (euro)	%	Member State	Rank	Amount allocated (euro)	%
Germany	1	645 490 864	28,7	Hungary	1	475 191 832	14,0
United Kingdom	2	574 288 905	25,5	Czech Republic	2	372 290 509	11,0
France	3	195 305 373	8,7	Germany	3	335 518 228	9,9
Netherlands	4	160 821 924	7,2	Romania	4	316 430 710	9,3
Portugal	5	156 012 908	6,9	Italy	5	298 355 961	8,8
Italy	6	143 383 095	6,4	Poland	6	278 413 953	8,2
Belgium	7	65 421 025	2,9	Portugal	7	191 960 262	5,7
Greece	8	55 655 389	2,5	United Kingdom	8	178 957 047	5,3
Spain	9	54 873 962	2,4	Spain	9	177 403 701	5,2
Czech Republic	10	46 073 161	2,0	Estonia	10	138 045 325	4,1
Poland	11	43 940 360	2,0	Slovenia	11	130 400 000	3,8
Hungary	12	28 773 946	1,3	Bulgaria	12	108 322 014	3,2
Finland	13	18 104 950	0,8	France	13	90 193 437	2,7
EU interregional	14	17 035 874	0,8	Belgium	14	62 048 204	1,8
EU cross-border	15	13 996 478	0,6	Latvia	15	49 000 000	1,4
Latvia	16	11 414 454	0,5	Malta	16	48 280 000	1,4
Luxembourg	17	10 019 687	0,4	EU cross-border	17	47 801 926	1,4
Slovenia	18	2 924 609	0,1	Netherlands	18	28 799 000	0,8
Malta	19	2 539 367	0,1	Greece	19	26 295 000	0,8
Estonia	20	1 712 389	0,1	Cyprus	20	16 150 000	0,5
Austria	21	674 726	0,0	Lithuania	21	14 501 892	0,4
				Luxembourg	22	3 786 550	0,1
				Finland	23	2 071 886	0,1
TOTAL EU		2 248 463 446	100,0	TOTAL EU		3 390 217 437	100,0

Table 5.5 shows how former communist European States have come to take the larger share of Structural Funding for their brownfield activities in the last few years. Part of the issue here stems from the fact that there has been a great number of under-utilized and/or contaminated

lands and properties in Eastern part of Europe which have been untouched for many years. It also recognises fact that, in the last few years, the EU has come to understand the significance of brownfield recycling and reuse in such regions. As the ECA's report suggests, the EU structural funds for brownfield activities have been predominantly channelled into the Eastern countries over the last decade or so. For example, the share of budget for Hungary has increased from 2 percent to 14 percent between the 2000-06 and 2007-13 programming periods. This figure has been recorded to increase by 9 percent for Czech Republic, by over 6 percent for Poland and by 4 percent for Estonia during the same period. Conversely, it is important to recognize that most of States in Western Europe have reduced their share. As shown in Table 5.5, the shares of budget for the industrial and military brownfields regeneration have declined by over 14 per cent for Germany and the UK, and by almost 6 percent for France and Netherlands. However, in a few Western countries, e.g. Italy and Spain, we can still observe a slight increase in their EU Structural Funding share.

5.5 Conclusion

Urban decentralization in Europe was apparent from around 1960 followed by significant structural changes in manufacturing industries almost a decade later. These processes have left large tracts of industrial sites within the fabric of European cities. Many local enterprises and large-scale manufacturing industries closed down or went into terminal decline, losing substantial amounts of production and industrial job capacity during this period. Besides such post-industrial areas, cities in Europe have experienced an increasing volume of underutilized land, abandoned or aging housing, mining and military sites owing to a series of structural and geopolitical factors. The widespread phenomenon of inner-urban decline and associated socio-economic, spatial and environmental problems have ensured increasing prominence for brownfield regeneration within the European context over the last few decades.

Brownfields have been understood differently across Europe. The diversity of brownfield definition in Europe can be justified on the grounds of diverse policy, market and legislative drivers in different countries. In several countries, e.g. the UK, Germany, and France, the physical deterioration or dereliction of land is considered when arriving at a legal definition of brownfield. In such countries, the concept of brownfield has not been integrated as an environmental problem, but as a broader urban-structural problem. On the other hand, many

European countries, e.g. Denmark, Italy, Spain, and Poland, have recognized brownfields as potentially or actually contaminated lands, and in several countries, e.g. the Netherlands, Sweden and Austria, brownfields are still undefined. Under comprehensive information networks, most notably CLARINET and CABERNET, the European Commission has come to address the existing definitional and conceptual complexity associated with brownfields and developed a robust definition to be applied across the member states. However, the EU-wide definition of brownfield has not been still integrated within the national policy and legislative systems in many countries.

The policy response to brownfield-related issues in many European countries is encapsulated in regional planning strategy concerned with sustainable urban regeneration. The regeneration/land recycling agenda in Europe acts as strong and decisive motivation for policy development. However, given the growing concerns over environmental and public health issues in recent years, soil contamination has become of paramount importance to brownfield policy and practice across Europe. Over the last two decades or so, the European government has taken a pragmatic approach to contaminated sites. The EU statutory initiatives for such sites address four main areas, including a comprehensive data management system (i.e. ESDAC), cooperative networks and information platforms (e.g. CABERNET, NICOLE), environmental liability transfer mechanisms (ELD), and structural funding resources (i.e. ERDF and CF). These initiatives are widespread across Europe. However, in some aspects particularly regarding environmental liability schemes, the EU-wide environmental directives do not comply with the national and regional soil management legislation in some member states, e.g. the UK, Germany, and the Netherlands, that have had their own liability system in place for a long time. Meanwhile, despite the increasing share of funding resources in the last few years, there is no exact share of budget predetermined within the EU structural funds for contaminated sites. In other words, neither the ERDF nor the CF is meant to exclusively address brownfield decontamination and/or redevelopment.

CHAPTER 06

Brownfield Regeneration in Japan; the Case of Musashi Kosugi Area

6.1 Introduction

With the advent of ‘the Japanese Economic Miracle’ and significant growth of industries after the end of the WWII, Japanese cities experienced an absolute decentralization of population away from central urban areas towards suburbs and provincial small towns. Following the expansion of railway networks during Japan’s post-war period, many new industrial plants and infrastructure were developed along the railway lines. However, since the early 1990s, Japan’s economy has gone into serious structural recession, resulting in the unprecedented withdrawal of heavy manufacturing industries from the old industrial-based cities. This has left behind a legacy of several underutilized and vacant industrial sites, known as brownfields, in many big Japanese cities. Needless to say these brownfields are often subject to soil and groundwater contamination issues due to the high concentration of polluting industrial activity.

Musashi Kosugi Area in Kawasaki city is an example that well reflects the Japanese process of brownfield emergence, driven by rapid urbanization during the post-war period and intensive industrial relocation after 1990s. Over the last 20 years or so, this area has undergone substantial physical changes, following a series of legislative measures set up by the Japanese governments. Under a revitalization plan developed by the local government of Kawasaki in 1993, a large number of brownfields and underutilized sites have been redeveloped in this area. This chapter seeks to explore different aspects of the Musashi Kosugi Redevelopment project to examine critical issues regarding the emergence, and regeneration policy and practice of brownfield sites in Japan.

The chapter contains three main sections. The first two sections are dedicated to a detailed discussion on the redevelopment planning of Musashi Kosugi area. Section 6.2 outlines the historical background and geographical overview of the site. Section 6.3 is focused on the key issues regarding the redevelopment plan, highlighting its triggers, challenges and effects. Having analysed different aspects of the case study, the final section of the chapter provides in-depth insights into the broader picture of brownfield in Japan. The central objective of this section is to address two critical questions; (1) how have brownfield sites occurred in Japan?, (2) what kinds of land-use and environmental policies have been framed to facilitate the regeneration of brownfields. To answer these questions, in the final section, the drivers of brownfield emergence, the definition and quantification of brownfield in Japan, as well as the brownfield-related policies and regulatory framework are argued.

6.2 Background of the former site of the Musashi Kosugi Area

6.2.1 General overview of the site

6.2.1.1 Geographical location and regional overview

Musashi-Kosugi is a town located in the central part of Kawasaki city, in Kanagawa prefecture (Figure 6.1). This area has a long history of industrial activity, so that it was formerly known as 'Industrial City Station', given the concentration of business sites of large enterprises. However, given the rapid growth of cities and relocation of factories in the 1990s, a large-scale and high-pace redevelopment has progressed throughout the town which has transformed the former industrial-based town into a vibrant and multi-functional urban area. The city of Kawasaki is located between the Tokyo Metropolitan Area and Yokohama City and is divided into seven wards and administrative centres including; Kawasaki, Asao, Miyamae, Nakahara, Saiwai, Takatsu, and Tama. Musashi Kosugi Area is located in the Nakahara Ward, the most populated ward in Kawasaki, with the population of 251,248 (Kawasaki City 2016a).

Figure 6.1 Musashi-Kosugi Redevelopment Area (foreground), located at the heart of Kawasaki city *(Source: Author's elaboration on a photo from Kawasaki City 2017b)*

The Musashi-Kosugi Area is considered as an important transport node point along the Tamagawa (Tama) River, as three national railway lines (JR Nambu Line, JR Shonan Shinjuku Line and JR Yokosuka Line) and two private railway lines (Tōkyū Tōyoko Line and Tōkyū Meguro Line) intersect (Figure 6.2). These multiple railway routes accompanied by Tsunashima Highway- that connects Shinagawa Ward in Tokyo to Kanagawa Ward in

Yokohama - have made the Musashi-Kosugi Area freely accessible to the downtown areas of Tokyo and Yokohama.

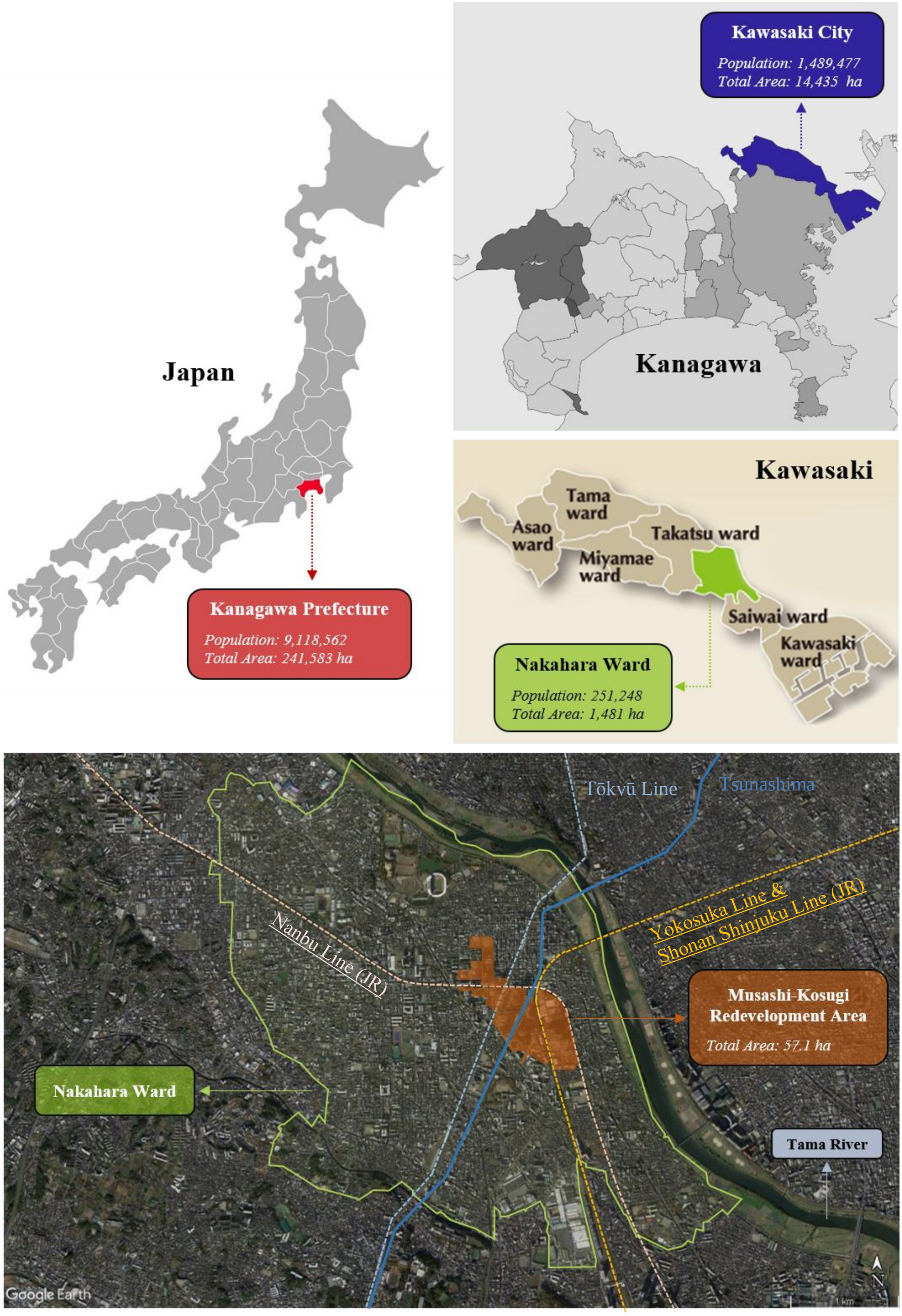


Figure 6.2 Regional overview of the Musashi-Kosugi Area *(Source: Author's elaboration on data collected form GSI 2015; Kawasaki City 2016a; Kanagawa Prefecture 2017)*

6.2.1.2 Background of Kawasaki and Musashi Kosugi

The city of Kawasaki is typical of Japanese cities that have rapidly progressed following the industrial growth during the post-war recovery and high-speed economic boom. However, it is important to recognize that Kawasaki began its urbanization years before the World War II, in 1920s, when several municipal towns and villages were merged and established the city of Kawasaki. Nakahara Ward was also formed in this period, in 1925, from the combination of two villages; Sumiyoshi village and Nakahara village (Kawasaki City 2016b). This development was supported by the improvement of national railway system in Japan, particularly along the industrial belt, connecting Keihin Industrial Region (including Tokyo, Kawasaki, and Yokohama) to the Hanshin Industrial Region (including Osaka and Kobe). The most notable example is the construction (in 1926) and opening (in 1927) of the Tokyo-Yokohama Electric Railway (presently known as Tōkyū Tōyoko Line) which connected major cities in Greater Tokyo Area including Tokyo Metropolis and its three neighbouring prefectures including Saitama, Kanagawa and Chiba. At the same time, in 1927, JR Nambu Line also started operating as an important railway route, connecting the western portion of Tokyo Metropolis (Tachikawa Station) to Kawasaki Station and passing through the Musashi-Kosugi Station (Kawasaki City 2016b).

From cargo to resident transportation, the transition of the area around the Musashi-Kosugi Station has been largely based on the transportation growth over past century or so. The supply of widespread transport infrastructure and significant extension of railway networks had led to a scattered zoning pattern of residential development in the vicinity of the station. Meanwhile, in pre-war years, several large-scale industries advanced into the region one after another. Among them, assembly industries, electric machinery, steel and chemical industries were highly specialized, such as NEC Tamagawa Plant (in 1936), Fuji Communication Equipment Manufacturer (in 1938), Manufacturer of Tokyo Radio Equipment, Ebara Corporation (in 1939), and Daido Steel (in 1941). The opening of Musashi-Kosugi Station (Tōkyū Tōyoko Line) in 1943 was connected to the strong industrial activity of the surrounding areas. In 1953, the station integrated with the *"Industrial City Station"* (opened in 1939) and formed the existing station (Kawasaki City 2015).

Despite the growing transition of rural land to residential and industrial land stimulated by transport development, the Musashi-Kosugi area still acted as a small suburban town before WWII and mainly consisted of agricultural lands. Before and within the war years, some portions of agricultural lands and several industrial sites (e.g. NEC Tamagawa plant) were taken over or controlled by military industries, training and related facilities.

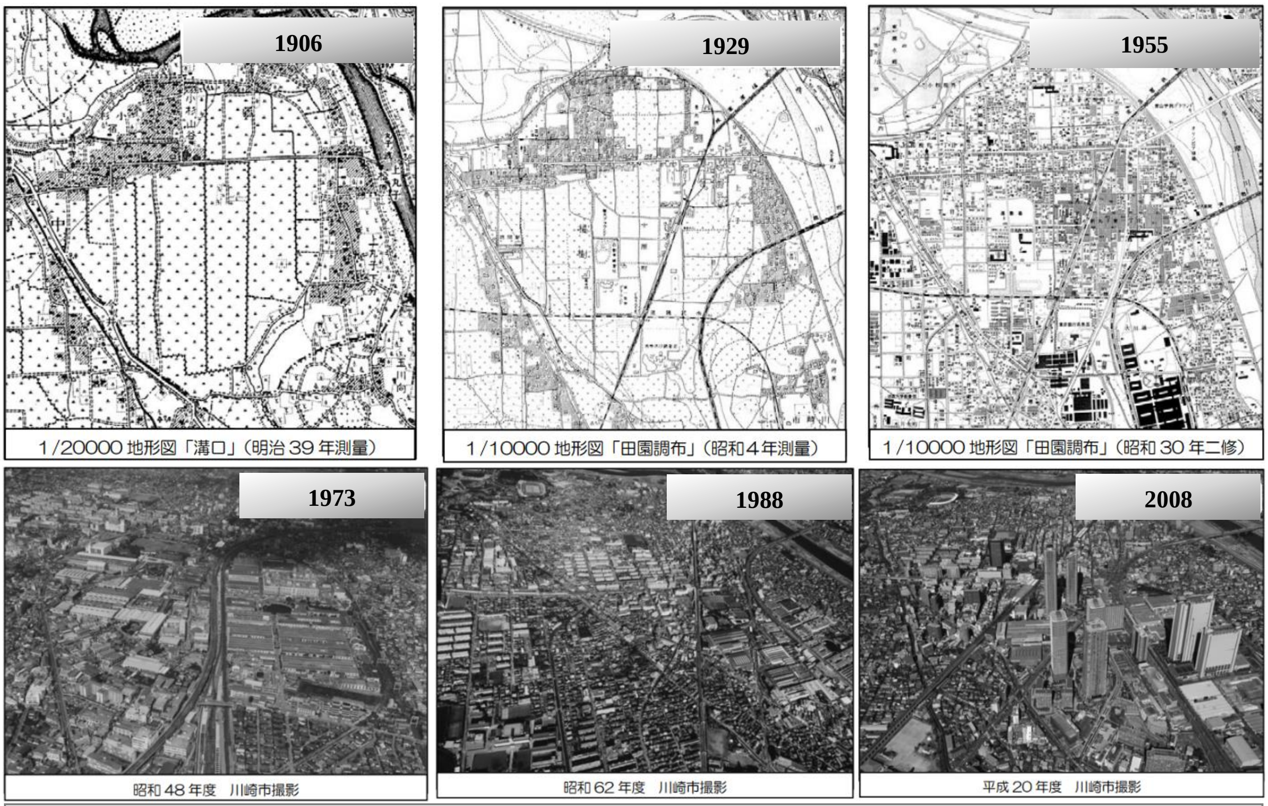


Figure 6.3 Transition of the Musashi-Kosugi Area from 1906 to 2008
(Source: Kawasaki City 2015)

Based on a report by Kawasaki City (2015), much of the land development around the Musashi-Kosugi Station occurred after the war, particularly during the Japanese Economic Miracle period, from 1950 through the early 1970s (see Figure 6.3). Japanese Economic Miracle is regarded as an important restructuring period when a great number of heavy manufacturing industries and enterprises shifted into the Kawasaki region, leading to rapid growth of private investment and development. During the 1960s and 1970s, Kawasaki was known as a major powerhouse driving Japan’s high-speed economic growth (World Bank 2011). Its bay area progressed as the heart of the Keihin industrial region and developed to become one of the largest and most important industrial centres in Japan (Kanada et al. 2013). Accompanied and driven by the industrial concentration, the city experienced a high level of population inflow and, accordingly, an accelerated progress of residential land development. Over the 20 years period of 1955-75, the population of Kawasaki had significantly grown from 445,520 to 1,014,951, an absolute increase of over 56 per cent (Kawasaki City 2016a). Since 1975, the population change of Kawasaki has remained relatively stable. For example, from 1975 to 1995, the overall population of the city increased by almost 15 per cent, and this figure is reported to be 19 per cent during 1995-2015 (Kawasaki City 2016a).

Given the economic recession, bankruptcy coupled with physical constrains on the supply of land for further development, manufacturing factories and their related facilities were successively relocated from Kawasaki in 1990s, thereby leaving behind a vast tract of idle and underutilized land around the Musashi-Kosugi Station. In 1993, following an effective revitalization policy of unused areas promoted by the Ministry of Land, Infrastructure and Transport (MLIT), Kawasaki City formulated a comprehensive development plan for the area around Kosugi station, aiming at the creation of a compact, vibrant and multi-functional urban region. This issue will be discussed further in the following sections.

6.2.1.3 Former land uses of Musashi-Kosugi Area

From the beginning of development around 1920s until the formulation of redevelopment plan in 1990s, the land use function of the area around Musashi-Kosugi Station had been changing. Although the arrival and departure of big manufacturing industries have been almost simultaneous with the establishment and redevelopment of the Musashi-Kosugi area, there have been several small-scale town factories, enterprises, corporate houses and public facilities which arrived in and disappeared from the area over time. However, as illustrated in Figure 6.4, before the implementation of redevelopment plan, the Musashi-Kosugi area had the following land uses:

- *Industrial areas*; which includes three large-scale manufacturing industries; NEC Tamagawa Plant (for IT production and services), Tokyo Kikai Seisakusho (TKS) Plant (for production of printing machine and related peripheral equipment) and Fujisash Plant (for aluminium production, sliding doors and curtain walls).
- *Commercial and business areas*; including small and medium-sized enterprises (e.g. NEC business office and Musashi Kosugi Tower).
- *Public facilities;* such as Nippon Medical University, schools, public health centre and fire station.
- *Residential areas;* including the low-rise apartments for workers of the JXTG Nippon Oil & Energy Corporation located in the western side of the Musashi Kosugi Tower.

- *Park and green space;* in areas between the Musashi Kosugi Station and TKS Plant.
- *Vacant land;* particularly in southern parts of the station and Fujisash Plant.

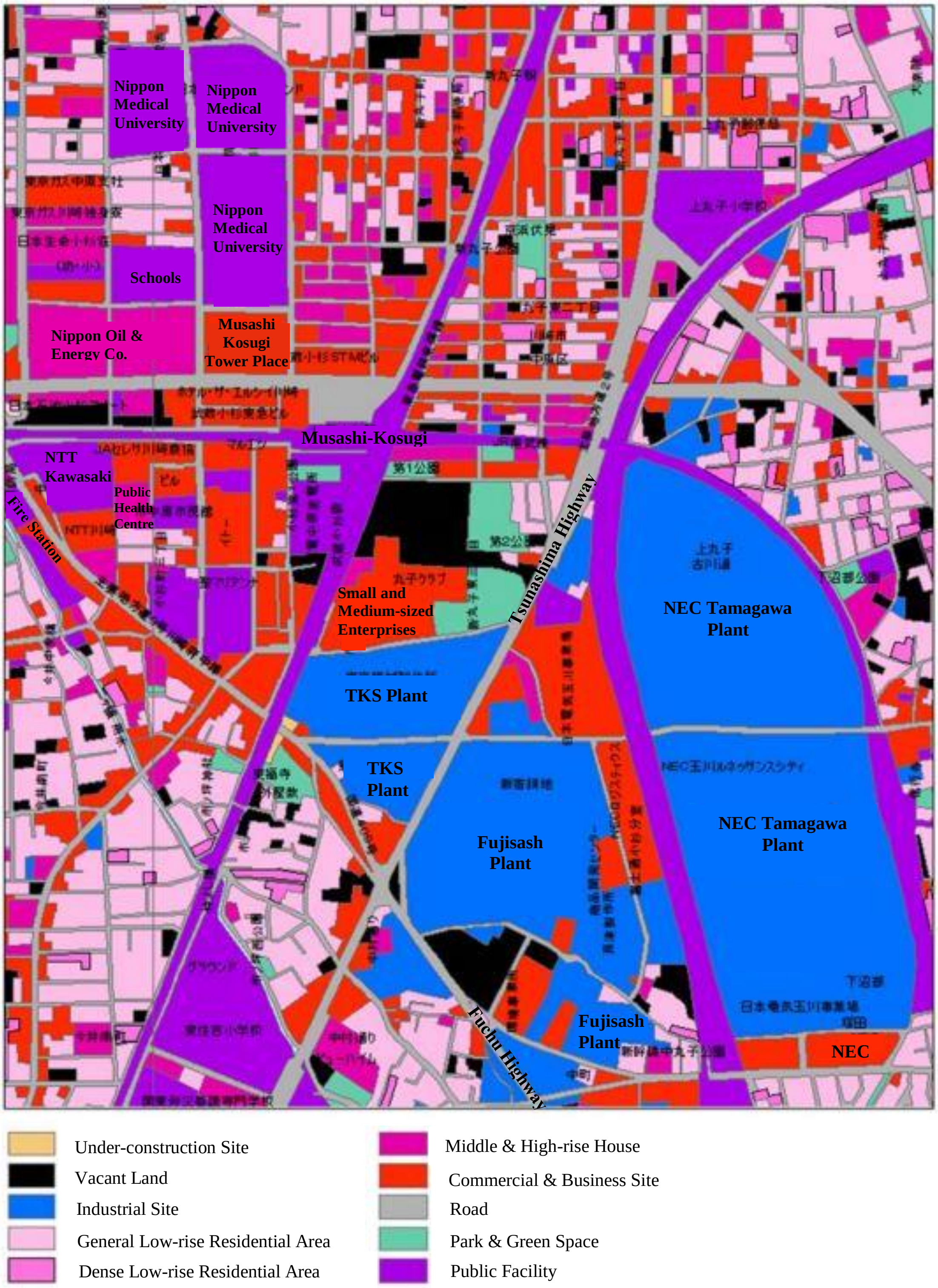


Figure 6.4 The land use around Musashi-Kosugi Station (as of 1998)
(Source: Iwami 2013, translated by author)

6.3 Redevelopment of Musashi Kosugi Area

6.3.1 Possible stimuli to the site redevelopment

The closure of manufacturing industries (NEC, TKS and Fujisash) in Musashi-Kosugi area and redevelopment of the entire district have been strongly stimulated by two marked trends, including; (1) the transport-oriented growth of the city which started in 1920s, and accelerated since 1950s, and (2) strong economic recessions and the resultant relocation of industries from the central city since the 1990s. The former has been discussed formerly (in the section 6.2.1.2) and the key issues associated with the latter are highlighted in the following sub-section:

6.3.1.1 Industrial restructuring and hollowing-out of industry

Following the rapid industrial-led economic growth and urbanization after the WWII, Kanagawa prefecture, and particularly Kawasaki, developed as a collective region of key manufacturing industries in Japan. However, since the 1990s, Japanese economy has experienced two strong economic shocks, including 'the bubble burst of 1990s' and 'GFC of 2008-2009'. Each of these two economic downturns has had profound consequences in industrial relocation and overall manufacturing activities in big Japanese cities (which will be discussed further in section 6.4.1.3). The Kanagawa prefecture, as a highly industrial-based region, is typical of regions in Japan which witnessed this hollowing-out process of industry. A great number of manufacturing industries (e.g. steel, electric machinery, and petrochemical industries) has moved out from the region since the burst of Japanese bubble economy. For example, from 1987 to 1993, Kanagawa prefecture lost 138 establishments and 16010 jobs in the electric machinery and appliance manufacturing industry in Yokohama, Kawasaki and Yokosuka (Guelle 2001). After 1993, also, the strong hollowing-out wave of manufacturing industries has accelerated. The data driven from the Census of Manufactures (Kougyo Toukei Hyo) shows that, between 1993 and 2001, Kanagawa prefecture along with Tokyo, Aichi, Hyogo, and Saitama recorded the highest level of decline in manufacturing employment in Japan (World Bank 2011).

The case of Musashi-Kosugi area provides classic examples for different models of industrial relocation in Japan driven by the bubble burst of 1990s. NEC Tamagawa plant is a typical case representing large-scale manufacturing factories in Japan that reduced their national capacities and transferred the main production bases to overseas location (particularly to China and

ASEAN countries) in facing foreign competition and global capital markets. However, NEC Tamagwa Plant has retained some of its manufacturing activity in the Musahsi Kosugi area. The closure of Fujisash plant represents several medium-size industries in Japan that have gone into terminal decline and, therefore, reduced or ceased their operations. Fujisash reduced their production capacity in early 1990s and, eventually in 2007, sold the land in Musashi-Kosugi area to a construction company (Haseko Co.) for 12.2 billion yen (equivalent to over 100 million USD) which was an investment for Fujisash Company (Iwami 2013). Furthermore, Tokyo Kikai Seisakusho (TKS) plant is an example of Japanese small-scale firms and factories which retained their core production capacity, but relocated to non-urban areas in the same or the nearby prefectures (Chiba prefecture in the case of TKS). This type of industrial relocation took place mostly due to the increasing advantage of production in non-urban areas, given the great economic profitability achieved from selling invaluable urban land. Meanwhile, shifting to inexpensive suburban areas with more land available for development facilitated further expansion of their production and operation. As an instance, during the relocation of the electric manufacturing industries in Kawasaki and other industrialized and urbanised regions in Kanagawa prefecture between 1987 and 1993, the western inland area of Kanagawa (Nishi-Kanagawa) simultaneously recorded a significant level of industrial growth, gaining 308 companies and 18,225 jobs (Guelle 2001; Horaguchi 2004).

6.3.2 Redevelopment stages

As previously mentioned, in 1993, the local government of Kawasaki city formulated a comprehensive master plan for a large-scale revitalization of underutilized and vacant areas around Musashi Kosugi station. The master plan was developed in accordance with the City Planning Act, a fundamental planning law introduced by MLIT in 1968, aiming at the prevention of uncontrolled land-use growth and promotion of inner-city redevelopment. Following this national Act, the improvement and reutilization of areas around the Musashi Kosugi Station was strongly promoted by the Kawasaki government. As outlined in the Kawasaki City’s planning statement (Kawasaki City 2017a), the central objective of the Musashi Kosugi redevelopment project was to expand the regional diversity; to promote the accumulation of various urban functions, public facilities and infrastructure; and to create a compact town that can live by walking.

Following the central objective of the redevelopment plan and in order to strengthen the economic viability of the district, the local government of Kawasaki has actively encouraged the participation of private business operators, especially in development of residential, commercial and business areas. As a result, several external private entities and real estate companies (such as ORIX Real Estate and Nomura Real Estate) became involved in investment in different phases of redevelopment project (Kawasaki City 2017a). This was also accompanied by the investment from some corporations and land-owners (such as Haseko Co, and NEC Co.) whose land was retained and redeveloped using their own resources. However, in most cases, the land redevelopment occurred based on a shared-ownership and profit approach. By this means one or a group of real estate companies acquire the land by taking the responsibility of the entire redevelopment phases, but under an obligation to allocate a number of units to the previous land-owner, equal to the value of land (Participant 01-JP). This was a common scenario for the majority of residential development projects in Musashi Kosugi area.

Figure 6.5 Musashi-Kosugi Redevelopment Area
(Photos were taken by the author in June 2017)

The main emphasis of the redevelopment plan of Musashi-Kosugi area has been placed on the intensive construction of super high-rise buildings, accompanied by the provision of new public plazas, open spaces and parks and also the improvement of roads and transport infrastructure (Figure 6.5). According to the plan, 16 high-rise residential, commercial and office buildings with over 100m height planned to be constructed in the district, 13 of which have been already completed (Kawasaki City 2017a). From 2006 to 2018, nearly 25,000 residential units have been (and planned to be) constructed (Iwami 2013). Furthermore, many green urban spaces have been provided on the previously developed areas and vacant lands, including the Nippon Medical School Park, southern parts of the station and the green spaces around the NEC and Fujisash redevelopment zones. As part of the plan, Tsunashima and Fuchu Highways, as key roads connecting different areas of the district, have been significantly restored and widened. Furthermore, the withdrawal and readjustment of a large area of previously-developed land around these two highways (particularly of the former site of TKS Plant, Fujisash Plant and NEC business sites) facilitated the development of many pedestrian zones and public plazas in the district. This has increased the walkability of the neighbourhood substantially, leading to the creation of ample sidewalks and footpaths integrated in green spaces all around the Musashi Kosugi Station (Figure 6.6). Many of these green and auto-free areas now act as gathering spaces for local communities or as disaster prevention zones (Kawasaki City 2017b).

Figure 6.6 A pedestrian area along the Tsunashima highway, developed on the former site of the TKS Plant *(Photo was taken by the author in June 2017)*

According to the redevelopment plan, the Musashi Kosugi Tower Place, as the first skyscraper and landmark of the district, was built in 1995 on the north side of the Musashi Kosugi Station

(JR Nambu Line, Yokosuka Line and Tokyu Toyoko Line). Since then, a large number of high-rise condominiums, business towers and commercial buildings have been constructed in the area, such as the residential-based tower of ‘Park City Musashi Kosugi Mid Sky’ completed in 2009 which rises 204m and contains 59 floors. Table 6.1 illustrates different stages of the redevelopment around the station since 1995, in chronological order.

Table 6.1 Redevelopment stages of Musashi Kosugi Area

Year	Completion and Opening Details	Main Usage
1995	Completion of Musashi Kosugi Tower Place	Commercial & Office
2000	Completion of NEC Tamagawa Renaissance City- South Tower	
2005	Completion of NEC Tamagawa Renaissance City- North Tower	
2006	Completion of R-Styles Musashi Kosugi Apartments	Residential
2007	Completion of Residence The Musashi Kosugi	
2008	Completion of Riet coat Musashi Kosugi, East Tower & West Tower	
	Completion of The Kosugi Tower	
	Completion of Park City Musashi Kosugi Station Forest Tower	
2009	Completion of Park City Musashi Kosugi Mid Sky Tower	
	Completion of Proud Musashi Kosugi Green Front	
	Completion of Royal Parks Musashi Kosugi	
2010	Completion of Nomura Real Estate Musashi Kosugi Building N & Building S	Commercial & Office
	Completion of NEC Tamagawa Solution Center	
2011	Completion of Brillia Musashi Kosugi	Residential
	Completion of Nice City Arena Musashi Kosugi, Airlie Court	
2013	Completion of Eclass Tower Musashi Kosugi	
	Completion of KDX Musashi Kosugi Building	Commercial & Office
	Completion of Park City Musashi Kosugi, The Grand Wing Tower	Residential
2014	Beginning of Tsunashima Highway widening project	-
	Opening of Grand Tree Musashi Kosugi	Commercial
	Completion of Park City Musashi Kosugi, The Grand Wing Tower	Residential
	Opening of LaLa Terrace Musashi Kosugi	Commercial
2015	Completion of Proud Tower Musashi Kosugi	Residential
2016	Completion of City Tower Musashi Kosugi	
2017	Completion of Park City Musashi Kosugi The Garden Towers East	Residential, Commercial, & Convention Hall
2018	Completion of Park City Musashi Kosugi The Garden Towers West (Planned)	
2019	Opening of Kawasaki Municipal Primary School (Planned)	School
2020	Completion of Kosugi Town 3 – Chome East District, First Type Urban Redevelopment Project (Planned / Building name undecided)	Residential & Office
2022	Completion of Mitsubishi Estate Residence Twin Towers (Planned)	Residential
2025	Completion of Nippon Medical School Musashi Kosugi Campus (Planned)	Educational, Hospital & Park

Sources: Author’s elaboration on data and information collected from the following sources:
- Iwami 2013,
- Kawasaki City 2017a,
- http://www.musashikosugilife.com.

6.3.3 Soil contamination issues

Since the formulation of the redevelopment master plan by the local government of Kawasaki in mid-1990s, in order to facilitate the new construction measures, a large number of buildings and structures left over from the former sites should have been removed. This includes many industrial facilities, residential structures, derelict commercial properties and low-quality infrastructure in the vicinity of the station which have not been well-developed or effectively-used. As illustrated in Figure 6.4, the majority of land, buildings and structures existed before the redevelopment belonged to the former industrial areas of the NEC, TKS, and Fujisash Plants. In total, 34.2 ha of the entire redevelopment area (57.1 ha) have been formerly utilized by industries, suggesting that almost 60 per cent of the land use around Musashi-Kosugi Station before redevelopment was industrial. Given the high concentration of manufacturing activities, all of three factory sites have left behind soil contamination issues after the closure or relocation (Participant 01-JP; Iwami 2013; TKS 2013; Kawasaki City 2017a). During the removal and construction phases, harmful substances and toxic materials were detected over the surface and in different layers of the soil (Participant 12-JP). In general, soil contamination incidents around the Musashi Kosugi Station have taken place in different construction phases and timeframes within the 20-year implementation period of the redevelopment plan, including:

- Constructions of the high-rise office building of NEC Tamagawa Renaissance City Towers (1997-2005) on the former site of the NEC factory (total land of 4 ha),
- Constructions of the high-rise residential and commercial buildings coupled with the development of park and green spaces in district 4 (2005-2011); on the former site of the Fujisash factory (total land of 9 ha),
- Widening of Tsunashima Highway (2009-2010); along the former site of the TKS factory (see Figure 6.7),
- Widening of Fuchu Highway (2011-2012); along the former site of the TKS and Fujisash factories (see Figure 6.7),
- Constructions of the high-rise residential building of City Tower Musashi Kosugi (2012-2016) and shopping complex of Grand Tree Musashi Kosugi (2012-2014); on the former site of the TKS factory (total land of 4.1 ha) (see Figure 6.7).

It is important to note that there is limited amount of data and information available regarding different aspects of soil contamination issues and clean-up measures adopted in Musashi-Kosugi redevelopment area. In general, development of contaminated land (or brownfield land) in Japan has become stigmatised, mostly as a result of ingrained cultural attitudes to environmental problems (Otsuka & Abe 2008; Dixon et al. 2010). Having considered the negative image and perceived risks of contamination in Japan, most land-owners and developers are unwilling to reveal the existence of soil contamination at the site (to the public, not to the government), even after the remediation and construction are completed. For the same reason, according to the existing legal system, i.e. Soil Contamination Countermeasures Act of 2002, local governments are obliged to remove previously-known contaminated lands from their records, when it is confirmed that the site is fully cleaned (Participant 04-JP). This situation has made it rather difficult to access the brownfield-related data and information in Japan.

Figure 6.7 Soil remediation measures during the widening projects of Tsunashima (picture no. 1, 2) and Fuchu highways (picture no. 3), as well as the construction projects on the former site of the TKS factory (picture no. 4)

(Sources: http://musashikosugi.blog.shinobi.jp & http://www.musashikosugilife.com)

In the case of Musashi-Kosugi area, there are also doubts about different issues associated with the soil contamination and remediation, such as the nature and level of pollution, the responsible parties for treatment and applied remediation techniques. Nevertheless, it is safe to affirm that:

- Considering the nature and intensity of industrial activity, all three land uses of former industries in Musashi Kosugi Area have high potential of soil contamination, based on an Australian assessment system (DSE 2005). Meanwhile, a Japanese identification of potentially contaminated land for different types of industries (Yasutaka et al. 2007) shows that all three post-industrial sites have the highest potential of soil contamination, with the potentially of 67 per cent (see Table 6.4 in section 6.4.3).

- The nature and level of soil pollution differ in three factory sites of NEC, TKS and Fujisash, given the variety of manufacturing activity. Due to the different nature, characteristic and distribution pattern of contaminants, different countermeasures techniques have been implemented in former industrial areas. In the case of TKS site, for example, the main pollutants were found to be 'tetrachloroethylene' and 'lead' left from the intensive chemical activity of printing machinery works (Participant 12-JP). These toxic heavy metals tend to become dispersed in the atmosphere through contaminated dust. Based on personal communications (Participant 01-JP; Participant 12-JP), perhaps, for the same reason, during the widening project of Tsunashima highway, the soil surface was covered by vinyl sheets in order to prevent scattering of hazardous substances in surrounding areas (see Figure 6.7).

- The entities and individuals responsible for remediation and redevelopment of the contaminated sites varied in Musashi-Kosugi area, having considered different institutional structures, size and financial situation of former industrial corporations as land-owners. In the case of NEC Tamagawa Renaissance City Towers, the land was retained and redeveloped by NEC as the principal business operator. They have conducted a voluntary soil and groundwater investigation and after the discovery of contamination, some designated building companies were given the responsibility to clean-up and develop the land. In the case of TKS, the land was sold to a real estate and construction company and, accordingly, the site investigation, remediation and construction measures have been entirely implemented by the new land-owner. However, in all cases, the former industrial companies, as the responsible polluters, have borne the remediation and liability costs. For example, According to the business report by TKS (2013), when closing the facilities of Tamagawa plant, this company allocated a considerable sum of money for the land remediation expenditures to be paid as part of land transfer process to the new-land owner.

- Regarding the policy issues, the situations have been relatively different for NEC, TKS and Fujisash. The soil remediation of former site of NEC plant took place in the late 1990s and by that time there was no legal and regulatory framework specified for soil contamination, at the national level. Until 2002, there had been no national law facilitating the remediation measures of contaminated land in Japan. However, given the long-run history of industrial activity of Kanagawa prefecture and Kawasaki city, the local government of Kawasaki came to establish their own environmental policies for soil contamination issues, years before the enactment of the national law in 2002. Therefore, the remediation phases, including the discovery of contaminants, risk assessment and clean-up measures, were conducted under the guidance and enforcement regulation of the local government. In the cases of TKS and Fujisash, however, the remediation of contaminated land should have mainly complied with the local ordinance reformatted based on the operational system from the Soil Contamination Countermeasures Act (SCCA) which was formulated in 2002 and put into force in 2003 (Participant 12-JP). Different aspects concerning the SCCA and its operational system are highlighted in section 6.4.1.

6.4 Insights into the broader picture of brownfield issues in Japan

Having analysed different aspects of redevelopment in Musashi-Kosugi area, it is useful to provide in-depth insights into the broader picture of brownfield regeneration activity in Japan. Hence, three critical issues are argued this section of the chapter, including; (1) the emergence of brownfield sites, (2) the concept and quantification of brownfield, and (3) legislative framework on contaminated sites in Japan.

6.4.1 Emergence of brownfield sites

Brownfield sites in Japan have, generally, emerged as the legacy of two marked trends after the end of World War II, including; the transport-led urbanization since 1960s and industrial restructuring since 1990s. This situation has been well-reflected in the case of Musashi-Kosugi Area. As a result of steady growth of urban areas, many residential and industrial developments took place within and around big Japanese cities. However, driven by the strong economic recession in early 1990s, a great number of manufacturing industries in Japan shut down or relocated, leaving behind a large tract of underutilized, and in many cases contaminated, land. The key issues associated with these two urban and industrial movements during the Japan's post-war period are discussed in the following sections.

6.4.1.1 Transport-oriented urban growth

Post-war Japan is essentially characterized by rapid population growth, economic recovery and a new cycle of restructuring in Japanese urban system (Douglass 1993). As the statistics show (Ajisaka 2010), the total population of Japan increased from less than 72 million at the end of WWII in 1945 to over 84 million in 1950, an approximate increase of 17 per cent in only 5 years. During this period, widespread urban and regional transformations arose all over Japan. The cities resumed growing in both population and size, mainly due to unbalanced labour demands and further development of railway networks that facilitated the immigration of people from rural area and provincial small towns into metropolitan regions (Okamoto 1997; Okata & Murayama 2011). By the end of 1950s, this geographic and demographic growth continued in both urban and suburban regions of major Japanese metropolitan cities, including Tokyo, Osaka and Nagoya (see Table 6.2). In fact, from the end of WWII to the early 1960s, within the growing metropolitan regions, the central cities grew more rapidly than their surrounding suburbs.

Table 6.2 Population change in central city and suburbs in major metropolitan areas of Japan, 1955-1990 (*Source: Okamoto 1997)*

Metropolitan Area	1955-60	1960-65	1965-70	1970-75	1975-80	1980-85	1985-90
Tokyo	19.2	20.3	15.9	12.8	6.4	5.6	4.9
Central City	19.2	7.0	-0.6	-2.2	-3.4	0.0	-2.3
Surrounding Area	19.2	35.2	30.5	22.9	11.6	8.2	8.0
Osaka	14.0	20.8	13.0	9.1	3.6	3.0	2.0
Central City	18.2	4.8	-5.6	-6.8	-4.7	-0.5	-0.5
Surrounding Area	12.3	27.7	19.6	13.5	5.6	3.8	2.5
Nagoya	10.9	12.9	11.1	9.7	5.4	4.0	3.6
Central City	19.5	14.0	5.2	2.1	0.4	1.4	1.8
Surrounding Area	7.3	12.4	13.9	12.9	7.3	4.9	4.2
Three Metropolitan Areas	16.0	19.2	14.2	11.1	5.4	4.6	3.8
Remaining Areas	-0.1	-1.7	0.3	4.1	4.0	2.6	0.8
Japan Total	4.7	5.2	5.5	7.0	4.6	3.4	2.1

Note: *As defined in Okamoto's study, "metropolitan area is the region within 50 kilometers (31mile) radius of each central city. The central city is, respectively, the Tokyo Ward area, Osaka City, and Nagoya City. Surrounding area (suburbs) is all but the central city in a metropolitan area".*

With the advent of 'Japanese Economic Miracle' and impressive growth of industries in the mid-twentieth century, urbanization in Japan became more pronounced and metropolitan suburbs grew more rapidly than inner-urban areas. During this period, the central government highly promoted the private investment in residential development and modernization of industrial plants and infrastructure. Owing to comprehensive national economic development plans- e.g. National Income Doubling Plan (NID), the Medium-term Economic Plan (ME), and the Economic and Social Development Plan (ESD)- construction of expressways, railways, ports, artificial harbors and public housing sprung up rapidly all over Japan (Pernice 2006; Yoshioka & Kawasaki 2016). The result was an absolute decentralization of population from central cities towards suburbs and provincial small towns with high public transit accessibility, particularly during the first half of 1960s. As shown in Table 6.2, since 1960s, suburbanization and uncontrolled growth of cities came to be predominant in Japan. The suburbs grew rapidly and dispersal of population, houses, jobs and industries out of those major central cities became significant (Yamada & Tokuoka 1991). In the case of Tokyo, for example, between 1960 and 1965, the population in central city increased by only 7 per cent, whilst the suburban population increased by 35 per cent. From the second half of the 1960s, the inner-city population in Tokyo started declining, whilst the suburbs kept growing in both size and population.

The remarkable suburbanization of Japanese cities during the first five years of 1960s continued growing, but less rapidly, in following decades. As shown in Table 6.2, by the end of 1980s, the suburban regions were still gaining population from central cities in major metropolitan areas of Japan. This large-scale expansion of urban areas beyond the central cities was accordingly supplemented by an incremental development of industries, infrastructure, retail, and housing in suburban neighbourhoods. Concurrent with the rapid urbanization trend was the growing economic activity in many suburban areas and small towns all over Japan leading to the appearance of *"self-dependent suburbs"*, particularly after 1970 (Okamato 1997). In the case of Tokyo, the most significant employment growth in suburbs from 1970 to 1990 was for clerical, technical and managerial jobs (Okamoto 1997). However, the number of people occupied in production and transport sectors in suburban regions was much higher than the number in central Tokyo in 1990.

Having reviewed major works of literature, (e.g. Harris 1982; Hebbert & Nakai 1988; Yamada & Tokuoka 1991; Douglass 1993; Hayashi et al. 1994; Kato 1996; Okamoto 1997; Osada 2003; Pernice 2006; Sorensen 2011), in general, there are 7 explanations for the fast-paced growth of suburbs in Japan during post-war period, as follows:

- *Steady population growth after the end of WWII;*

Population change is considered as one of the main indicators for suburban growth in Japan. The figures show that the total population of Japan had been constantly increasing from the end of World War II in 1945 to 2010. In the space of half-century after the WWII, the Japanese population increased considerably, from less than 72 million in 1945 to more than 125 million in 1995, an absolute increase of 74 per cent (Ajisaka 2010).

- *Accelerated development of expressways*

Following the comprehensive recovery programmes and in response to ascending traffic demand after WWII, the Japanese government accelerated the construction and improvement of suburban roads throughout the country. During the 20 years period of 1950s and early 1970s, five important national development programmes were enacted by the central government, including; the Act on Special Measures concerning Road Construction and Improvement (1952), the Act on Japan Highway Public Corporation (1956), the Act on the Metropolitan

Expressway Public Corporation (1959), the Act on the Hanshin Expressway Public Corporation (1962), ant the Act on the Honsyu-Shikoku Bridge Authority (1970) (MLIT 2015).

As a result of active government policies on road construction, 8 expressways had been developed by 1972 connecting major metropolitan cities and provincial small towns in Japan (MLIT 2015). The notable examples are the construction and development of Hanshin Expressway (1963), Meishin Expressway (1963), Chuou Expressway (1967) and Tomei Expressway (1968). The initial objective of rapidly expanding construction of national expressways during the 1960s was to connect two core industrial regions in Japan; the Keihin Industrial Region (consisting of Tokyo, Kawasaki, and Yokohama) to the Hanshin Industrial Region (consisting of Osaka and Kobe). However, since the early 1970s, expressway development has expanded significantly in Japan, not only within the core industrial regions, but also into the non-industrial regions, e.g. the Niigata and Hokkaido prefectures. This widespread expressway development during the post-war period was critical in promoting the urban-suburban connectivity of Japanese cities.

- *The growth of car industry and dramatic car ownership;*

With the advent of Japanese Economic Miracle, the automobile industry started growing dramatically. Large-scale car production and availability of affordable cars during this period contributed to an abrupt boom in Japanese car ownership in 1960s and 1970s. Between 1955 and 1973, passenger car ownership in Japan soared from approximately 150,000 to more than 14 million (Townsend 2013). The rapidly increasing car ownership can be regarded as a critical factor in substantial growth of commuting distances and, thus, low-density sprawl of Japanese cities. Originated from the high-speed growth period, private cars made huge gains in their share of movement until 1990 in Japan (Hart 2001).

- *Continued improvement of public transport networks;*

Development of public transport networks started from pre-war years, but gained faster pace after the WWII. From 1910s to 1950s, the backbone of transit system in major Japanese cities, such as Tokyo, were formed by trams (Hirooka 2000). However, by the end of 1960s, because of the increasing traffic congestion in inner-city areas, the majority of tram networks stopped operating in favour of buses and subways. The new epoch of transport network in Japan started with the advent of high-speed train in the 1950s (Amos et al. 2010). This had given a strong impetus to the further expansion of suburbs and small provincial towns in major metropolitan cities of Japan. In order to carry the growing number of commuters, more railway lines were built with a much higher frequency of service. The opening of Tokaido Shinkansen between Tokyo and Shin-Osaka in 1964 (which is presently known as the most travelled fast train route in the world) delivered a big improvement in travel network in Japan. The success of the Tokaido Shinkansen led to the introduction of the 'Nationwide Shinkansen Railway Development Act' in 1970 which further fuelled the steadily extension of high-speed transportation network and, thus, suburban development in Japan (Amos et al. 2010).

The development of high-speed train networks became most significant in the 1980s. Given the rapidly increasing investment of private companies in urban and suburban railway infrastructure, Shinkansen or bullet train grew faster. For example, Tōhoku Shinkansen (covering 492.9km, between Tokyo and Aomori) and Jōetsu Shinkansen (covering 269.5km, between Tokyo and Niigata) both opened in this period. Meanwhile, the adaptation of 'JNR Reconstruction Act' by the government in 1980 and privatization of Japan National Railway (JNR) in 1987 are considered as two critical events in further development of Japan's high-speed transport networks in the 1980s (Mizutani & Nakamura 1997).

- *Land price boom driven by nation-wide economic recessions;*

Substantial increase in land price is also an important factor that allowed continued suburban development of Japanese cities after the WWII. As argued in previous section, after the high-speed growth period, Japanese economy witnessed two marked structural recessions; (1) widespread oil crisis from 1973 to 1985, and (2) Bubble Economy from the mid-1980s through the early 1990s. In the late 1980s, particularly, the economic bubble boosted the demand for land, causing an across-the-board increase in the price of commercial and residential lands in Japan (Okamoto 1997). The rapidly increasing land prices created an incentive to speculate, so that it had become extremely difficult for home buyers to find reasonably-priced housing sites in central cities and neighbouring suburbs of major metropolitan areas in Japan, e.g. Tokyo and Osaka. Consequently, housing development was pushed further and further away from central cities, jumping over large tracts of still undeveloped land, e.g. remote farmlands, in Japan (Okamoto 1997; Sorensen 2011).

- *Weak development control system in 1970s;*

In an attempt to prevent rapidly increasing suburban sprawl, several development and planning laws were adopted by the Japanese government during the post-war era. The most notable examples are the 'Land Readjustment Act of 1954' and 'City Planning Act of 1968'. Although, these planning acts were essentially designed to squeeze the suburbanization of Japanese cities, because of weak development control system they somehow stimulated unplanned sprawl of built-up areas towards suburbs and undeveloped lands. As Sorensen (2011) explains:

> "*Loopholes in the development control system have allowed continued sprawl development. The most important loophole is the exemption of developments of 0.1 hectare or less from the need for development permission, which has encouraged the development of land in small bits. A significant majority of all developments since 1970, including a majority of all land developed, have been small enough that they did not require a development permit. A wide range of other loopholes exists, which have been created primarily to allow small land owners the chance to develop parcels of land with the minimum of restrictions… This regime has produced a suburban landscape with a fine-grain sprinkling of single family homes, small apartment blocks, small- and medium-sized businesses including small factories, shops, service establishments such as hairdressers, the ubiquitous convenience stores, and tiny restaurants*".

6.4.1.2 Re-urbanization trend in Japan

Since the mid-1990s, Japanese urbanization process has reflected an opposite direction to the extensive suburbanization and population deconcentration of former years. Population has become re-concentrated, as people shift back into the urban central areas from the suburbs (Sorensen 2011). This re-urbanization trend has been particularly significant in major metropolitan regions of Japan, such as Tokyo, Osaka and Nagoya. For example, in the case of Tokyo Region or Greater Tokyo Area (Tokyo Metropolis and its three neighbouring prefectures including Saitama, Kanagawa and Chiba), the population trend in entire region reversed from the stage of 'declining inner-city and suburban growth' in 1990-1995 to the stage of 'inner-city growth and declining suburbs' in 2000-2005. This rapidly increasing population concentration was most pronounced for the Tokyo central city or the bay area wards, e.g. Koto, Minato, and Chuo. In such areas, the population was decreasing by over 1 per cent between 1990 and 1995, whilst increasing by over 2 percent between 2000 and 2005 (MLIT 2006). This strong trend of population concentration in the Japanese urban central area has been maintained and even reinforced over the following years, not only in Tokyo central city, but also in many other cities in the Greater Tokyo Area (such as Kawasaki and Yokohama) and cities in other Japanese metropolitan regions (such as Osaka and Nagoya) (MLIT 2012). Some of the key drivers to re-urbanization trend in Japan are highlighted as follows:

- *Slowing down spatial development*

In terms of a regional structure, Japanese urbanization is very much transit-oriented characterized by fragmented metropolitan regions with relatively high urban population density (Okata & Murayama 2011; Sorensen 2011; World Bank 2015). The Greater Tokyo Area, for example, consists of 240 municipalities in 7 prefectures which are highly developed, urbanized and well-connected by advanced railway networks. According to the World Bank's report on East Asia's changing urban landscape (World Bank 2015), "*between 2000 and 2010, Japan had the second highest total amount of urban land in East Asia, but the lowest rate of spatial expansion*".

As argued previously, the inner-urban areas in Japan have been constantly gaining population from the suburbs since the mid-1990s which has led to the growth of densely inhabited core zones. There are several factors that have stimulated the suburban-to-urban population flow and, thus, spatial concentration of Japanese cities. One the key contributing factors is associated with the topographical characteristic of Japan's territory. Japanese urbanization is constrained by extremely high population density and limited availability of habitable land for development (Hart 2001). Much of Japan is covered by mountains, so that only 31 per cent of its territory (excluding forests and inland bodies of water) is habitable (BCJ 2016). Another important reason for the low level of spatial expansion in Japan is regarding the population decline of the past decade. Except during the war years, the overall population in Japan had been constantly increasing from the beginning of nineteenth century. After the end of WWII, Japanese population increased from almost 84 million in 1950 to over 123 million in 1990, and to a peak of about 128 million in 2004 (Ajisaka 2010). However, Japan has been dealing with steady population decline since 2010, mainly due to steep decline in the total fertility rate over the past four decades (Figure 6.8). Meanwhile, as estimated by the Ministry of Internal Affairs and Communications (MIC 2017), the Japanese population would continue to decline, even more rapidly, in following years. Therefore, it is expected that spatial development in Japan continues to slow down more dramatically, as fewer dwellings will be required, considering the declining number of households (Sorensen 2011).

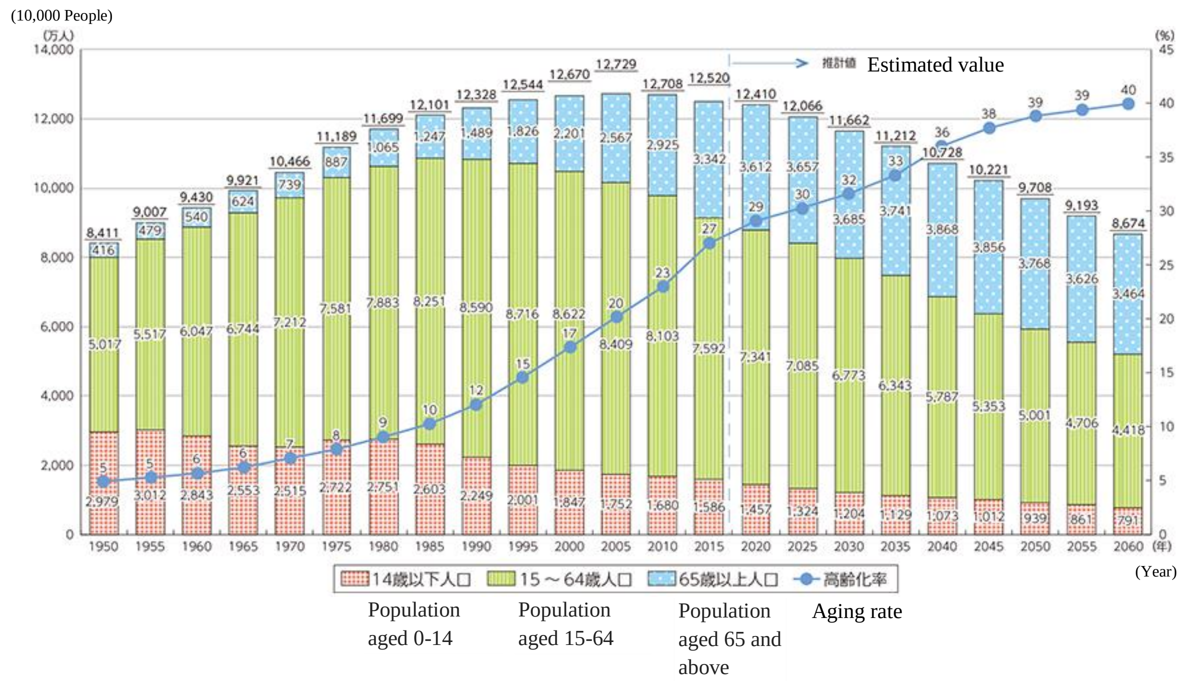


Figure 6.8 Population trends in Japan since 1950 (*Source: MIC 2017, translated by the author)*

- ➢ *Relative decrease in car ownership and commuting distances*

The statistics show that car ownership has decreased in Japan, after rising steadily during the high-speed growth period and even during the strong economic downturn of the 1990s. Car demand has shrivelled significantly in Japan, mainly due to heavy driving and maintenance costs (e.g. fuel taxes, car tax levies and inspection fees) combined with high tolls of highways and expressways. According to the latest data released by the Automobile Inspection & Registration Information Association (2016), the average number of cars (registered cars and mini vehicles) owned per household in Japan has been declining almost every year since 2006. An inevitable consequence of declining car dependency in Japan has been the declining commuting distances. The average distances travelled per car in Japan decreased from over 11,000 km in 1990 to less than 9,000 km in 2010 (The Economist 2012). In other words, in order to avoid vehicle-related costs, most Japanese people now choose to live in or around central cities, where they are provided with relatively cheaper and convenient public transport.

- *Increasing high-rise housing development and declining land value in central cities*

Until the 1990s, most Japanese cities remained rather low rise, despite high population and employment density (Sorensen et al. 2010). However, since the mid-1990s, the new regulatory frameworks for the intensification of inner-city construction activity have considerably changed the low-rise image of Japanese cities (Fujii et al. 2007). Over the last two decades or so, both central and local governments in Japan have been proactively attempting to encourage private investment in high-rise residential development in urban centres, following nation-wide programmes to promote land development profitability and urban intensification. This has been accompanied by the persistent fall in land value after the bursting of the bubble economy, so that the average urban land prices in the six major Japanese cities declined 15.5 per cent from the peak by 1992 (Goel & Gupta 2017). After the crash of the economic bubble in 1990, it has become increasingly viable to build and market housing developments in inner-city locations, particularly on abandoned industrial or railway sites (Lützeler 2008; Sorensen 2011). In the case of Tokyo, for example, most of these super-high-rise residential towers are built on former industrial sites in the Tokyo Bay wards (e.g. Koto, Minato, and Chuo), or on large lots in inland urban areas (Okata & Murayama 2011). Indeed, the rapidly increasing development of reasonably priced and conveniently located high-rise buildings is a crucial factor that has substantially stimulated the shift of people into central cities from the outer suburbs in Japan.

6.4.1.3 Industrial restructuring and nation-wide economic downturns

From the 1990s onwards, Japan has experienced two sharp downturns in its economic structure. The first, and the most important, economic downturn and financial crisis occurred in the early 1990s and lasted for almost a decade, so called *"The Lost Decade"* (失われた十年 Ushinawareta Jūnen). However, since the 1990s's crisis has had profound implications for the Japanese economy even in recent years, many (e.g. YoungGak et al. 2010; Hamaaki et al. 2012; Fukao 2012) would call the 20-year period of 1990-2010 as the *"Two Lost Decades"* (失われた二十年, Ushinawareta Nijūnen). The second crisis that has heavily hit the Japanese economic and industrial structure is the Global Financial Crisis (GFC) of 2007-2009. The profound consequences of each of these two economic downturns for industries and manufacturing activities in Japan are discussed briefly in the following sub-sections.

➢ *The Bubble Burst of 1990s*

From the mid-1980s through the early 1990s, Japan witnessed a significant economic movement, namely the *"Bubble Economy"* or the "*Asset Price Bubble"* (バブル景気 Baburu Keiki), which is characterized by inflated stock market and land prices, unbalanced money supply as well as strong appreciation of the yen (Smith 1998; Gordon 2003). During the bubble economy period, the overall economic rate and GNP increased considerably, thanks to expansive capital expenditure and real consumer spending. However, this economic growth did not last long. In late 1991 and early 1992, the Japanese economy went into serious structural crisis after the over-accumulation and, then, bursting of stock market and property price bubbles. The expansion of domestic demands, together with uncontrolled growth of government investments and increasing unemployment, moved Japan's manufacturing and consumer economy into a sharp recession. As shown in Figure 6.9, the potential employment, productivity and, accordingly, GDP growth rate in Japan have fallen sharply from the early 1990s onwards. According to the Annual Report on National Accounts (ESRI 2017) and Otsubo (2003), the average annual growth rate of per capita GDP is reported to be 1.5 per cent in the 1991-1995 period and 1 percent in the 1995-2000 period, whereas this figure was almost 5 per cent in the 1986-1990 period and over 11 per cent two decades earlier, in the 1966-1970 period.

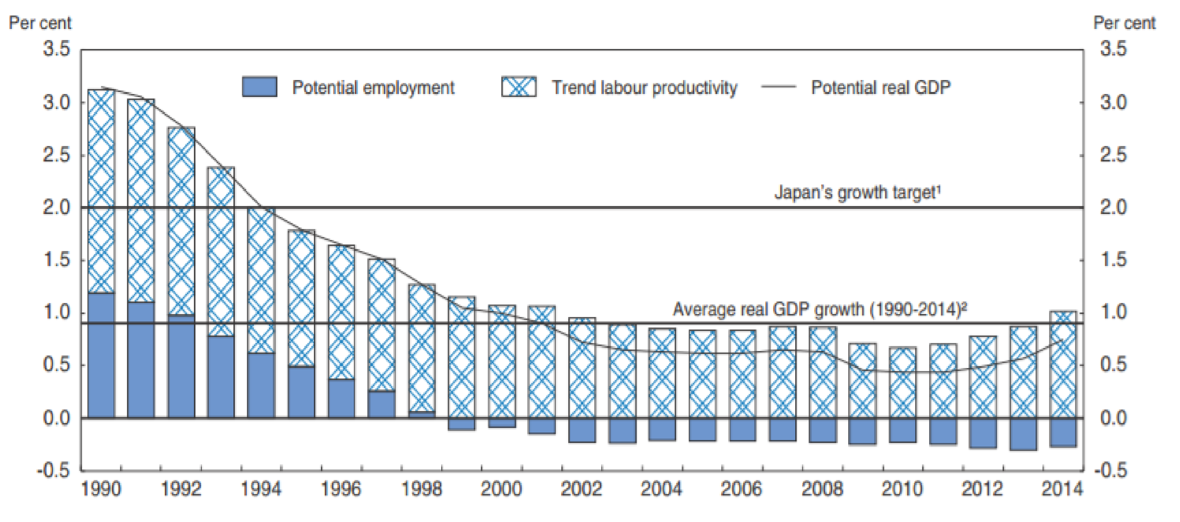


Figure 6.9 The potential employment, productivity and GDP growth rate in Japan since 1990 (*Source: OECD 2015)*

Enormously influencing the entire Japanese economy, the bubble burst of 1990s harmed the industries and manufacturing activities inside the country seriously. According to the Labor Force Survey (METI 2010), from 1994 to 2008, Japan lost over 42 million of its manufacturing jobs, nearly 30 per cent of the jobs in 1994. In the electric machinery and appliances manufacturing sector alone, more than 500,000 jobs were lost during a 10-year period of 1991-2001 (Horaguchi 2004). One side of this dramatic job loss is associated with the bankruptcy of several Japanese financial institutions and banks as result of bursting of stock market and asset price bubbles. This had devastating effects, particularly, on small and medium-sized manufacturing industries and enterprises in Japan, given their strong reliance on small business loans and credits. By 1995, the problem had run into a national crisis and a large number of Japanese regional companies and small businesses went into bankruptcies. The notable example is the bankruptcy of over 500 small businesses in Osaka that was mainly triggered by the Osaka Credit's demise in 1995 (Schaede 1996).

On the other hand, the economic crisis of the bubble years had fundamentally transformed the structure and economic performances of big Japanese manufacturers and enterprises. As shown on the Basic Survey of Overseas Business Activities, overseas production in Japan increased from almost 8 per in 1994 cent to 17 per cent in 2008 (METI 2010). This survey, together with the Labor Force Survey, indicate that several Japanese manufacturing industries were expanding the overall overseas operations and production (particularly in China and ASEAN countries), while contracting their local operations during the post-bubble period of the 1990s (Sumiya 2000; Gordon 2003). As a result, a great number of large-scale manufacturing firms and industries in Japan went into production decline in facing foreign competition and global capital markets after 1990s. The important and worth mentioning examples are Toshiba, Sony, Olympus, Honda and Kyocera companies, all of which relocated most of their operations and production bases to China in the late 1990s and early 2000s (Gordon 2003).

- *The GFC of 2008-2009*

Like most industrial and developed countries, the Japanese economy has been heavily hit by the Global Financial Crisis (GFC). In comparison with most other economies which came to witness the side-effects of GFC in early 2007, the Japanese economic downturn triggered by GFC started relatively late, in 2008 reaching its heyday in 2009. During the 2008-2009 period, Japan’s GDP and industrial production recorded negative growth that led to an unprecedented decline in domestic Japanese employment and economic activity. According to the Cabinet Office (2017), over only two years from 2007 to 2009, GDP growth rate in Japan decreased from +1.8 per cent to -5.4 per cent. Furthermore, industrial production index (on an annualized basis) decreased substantially from almost +6 per cent in February 2008 to over -37 percent in February 2009 (METI 2017). Resulted from remarkable contraction in the global trade market, Japan experienced an abrupt decline in a large share of its exports and imports. This was most significant in vehicle, electric machinery and appliances manufacturing sectors. For example, from October 2008 to January 2009, the level of Japanese exports to the United States and East Asia declined by over 40 percent (Ando & Kimura 2012). In terms of the import level, the situation was almost the same. Over the GFC period, the Japan's total imports shrank from over 7,000 billion yen to less than 4,000 billion yen, an absolute decline of 43 per cent (CEIC 2017). As a result of this widespread shrinkage in industrial capacity, several manufacturing factories in Japan went into seminal decline and, therefore, squeezed or ceased their operations. Most notably for the Japanese automobile industries, almost all big manufacturers, e.g. Toyota, Honda Motor, Suzuki and Mitsubishi Motors, recorded a significant drop in their employment and output volume during the 2008-2009 (Bai 2012).

6.4.2 Legal definition of brownfield in Japan

Over the past 2 decades or so, there have been a number of research surveys, (e.g. Miyagawa & Nakayama 2001; Miyagawa & Nakayama 2003; Murayama et al. 2006; Sato 2007; Yasutaka et al. 2007; Kurose & Han 2007; Otsuka & Abe 2008; Otsuka et al. 2010; Miyagawa et al. 2016) to inform Japanese policy and assist in identifying and comparing issues associated with brownfield development. This has been most pronounced in early 2000s, when brownfield was still undefined officially and the need for a comprehensive legislative approach towards brownfield issues became highly recognized by Japanese scholars. The important point to acknowledge is that all Japanese literature and governmental surveys had been employing a narrowly defined term for their research studies, placing special emphasis on environmental aspects of brownfield issues. Brownfields were commonly regarded as contaminated or potentially contaminated lands in Japanese literature, even before the official definition in 2007, being much influenced by the U.S. approach. For example, brownfield was defined as *"a contaminated land potentially to be developed"* by Murayama et al. (2006), as *"a site caused by the actual presence of a contaminant"* by Yasutaka et al. (2007), or as "*a land parcel which became to be used as significantly lower application than potential value of the original land or became abandoned due to presence of soil contamination or concerns over potential presence of contamination"* by Sato (2007).

In March 2007, the Ministry of Environment (MoE) released an interim report, namely *"the Current Status of the Brownfields Issue in Japan"*. The MoE's interim report was essentially based on a detailed inquiry survey, conducted in February 2007, amongst the member companies of Geo-Environmental Protection Center in Japan (including the investigation and research, construction consultant, and construction companies) (MoE 2007). The central objective of this report was to grasp the actual status of brownfields in Japan, estimating the scale of contaminated or potentially contaminated lands and examining the possible approaches to redevelopment. More importantly, for the first time, brownfield was defined for legislative purposes through this comprehensive examination and research survey. According to this report, MoE suggested an official and nation-wide definition for brownfield sites in Japan as: *"Lands which are unused or with extremely limited use compared to their intrinsic value because of existence or potential existence of soil contamination".*

MoE's definition is the most common used definition of brownfield in Japanese urban literature to date. Three important points can be driven from this definition. The first point is associated with the actual physical condition of the site. According to MoE's definition, brownfields are unused or with extremely limited use, emphasizing on 'vacancy or dereliction' of the land. The second point is connected with the environmental aspect of the site, as MoE identifies *"actual or potential presence of soil contamination"* as a critical feature for a land to be labelled brownfield. Finally, economic value of the site development is an important point that can be understood from MoE's definition. This mainly implies on the relationship between the clean-up cost of the contaminated soil and intrinsic value of the land, based on which the economic profitability of brownfield regeneration can be generally estimated (see Figure 6.10).

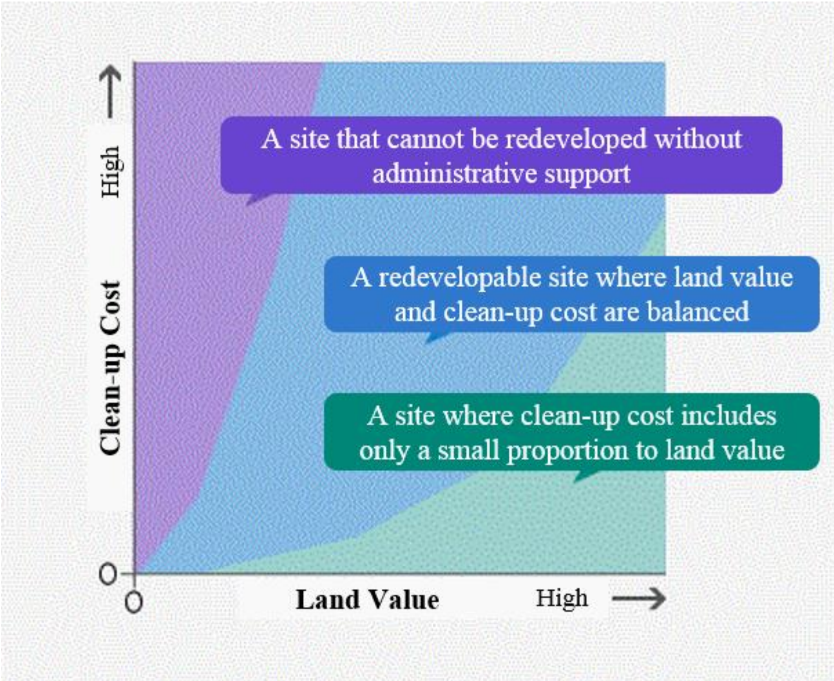


Figure 6.10 Classification of brownfield sites in Japan, based on the relationship between the clean-up cost and intrinsic land value. *(Source: KKC 2016, modified and translated by the author)*

6.4.3 Brownfield quantification in Japan

At present, it is difficult to estimate the actual quantification of brownfields in Japan. The only official estimation was made by the MoE in 2007 which is relatively outdated. Relying on the MoE's interim report, there is estimated to be 113,000 hectares of land assets with the value of ¥43 trillion and clean-up cost of ¥17 trillion in Japan (as of 2007) known to have soil contamination and, thus, having high potential for turning into brownfield. Additionally, in terms of ownership status, the MoE's report shows that 98,900ha of contaminated land in Japan are legal person-owned land (with the estimated value of ¥37 trillion) and 13,700ha are family unit-owned land (with the estimated value of ¥6.13 trillion). However, this report suggests that only 24 percent of land with soil contamination issue is expected to be "brownfields", defined as the sites where land-selling is difficult due to the high clean-up cost. This estimation implies on the fact that brownfield sites account for 2.2 per cent of total urban land area in Japan (as of 2007).

Based on a suggested concept framed by MoE, brownfield occurs when clean-up cost per land area exceeds 30 percent of land price in a site (MoE 2007). In some literature, such sites are also defined as *"Potential Brownfield Sites"* (Yasutaka et al. 2007) or *"Hardcore Sites"* (Dixon et al. 2010). Dixon et al. (2010), for example, consider four critical factors for a site to be called Hardcore Brownfield in Japan. They defined it as a site which is:

1. Small (perhaps less than 5ha), located in a relatively isolated or marginal location;
2. Difficult to redevelop due to ownership constraints and lack of infrastructure;
3. Contaminated;
4. Suffering from long-term dereliction and vacancy.

It is important to note that, by 2007, MoE identified only about 450 sites throughout Japan to be known as contaminated (Yasutaka et al. 2007). Unfortunately, MoE's survey data has not been updated yet.

Apart from MoE's official report, Yasutaka et al. (2007) made a significant contribution to the estimation of the quantity of contaminated or potentially contaminated brownfield sites in Japan. Employing a comprehensive conceptual model, they estimated the amount of contaminated land in an objective region and then all over Japan (Table 6.3). This estimation seems to be, still, the most complete and comprehensive one in terms of contaminated brownfields in Japan. Another remarkable contribution to brownfield quantification in Japan was made by Dixon et al. (2010). Using the British approach, they have put the figure of brownfield as Previously Developed Land (PDL) at 2,048,293 in number of sites and 195,213ha in size (as being 15.5 per cent of total urban land area in Japan). However, it is important to note that the classification of brownfield made by Dixon et al. (2010) is largely based on the physical condition of the site which is pretty much different from the classification made by the MoE and other works of literature emphasizing on the environmental and economic conditions of the site.

Having reviewed the existing literature and official reports, Table 6.3 summarizes the available figures on brownfield quantification and size in Japan, in different categories of land.

Table 6.3 Brownfield quantification and size in Japan in different categories of land *(Sources: Yasutaka et al. 2007; MoE 2007; Sato 2007; Dixon et al. 2010)*

Category of Site	**Definition**	**Number of Sites**	**Size** (ha)
Previously Developed Land (PDL)	Unused or less-used land in urban area, including vacant land and vacant building as well as parking lots and stock yards for construction material.	2,048,293	195,213
Brownfield as a Contaminated land			
Potential Contaminated Sites (PCS)	The sites which might be contaminated.	898,387	272,000
Contaminated Sites (CS)	The sites known to be contaminated.	331,612	113,000
Potential Brownfield Sites (PBS) or Hardcore Brownfield Sites	The sites where land-selling is difficult due to high clean-up cost (clean-up cost exceeds 30 percent of land price). These sites are contaminated and expected to turn into brownfield when they are closed down.	80,030	28,000
Brownfield Sites	The contaminated sites already turned into brownfields.	450	N/A

Furthermore, in Yasutaka et al. (2007)'s research, the number of PBS or Hardcore Brownfields was calculated by multiplying the number of CS (from MoE's data) by the probability of a contaminated site (CS) becoming a Brownfield site. This was done by using two important parameters, (1) the number of potential contaminated sites (PCS) in different types of industries in Japan, and (2) the probability that PCS has soil contamination in every type of industries. These two parameters are important in understanding the primary causes of brownfield issues in Japan (see Table 6.4).

Table 6.4 Number of PCSs and probability of having soil contamination per industries in Japan *(Source: Yasutaka et al. 2007)*		
Type of Industries of PCS	**Number of PCSs**	**Probability of having soil contamination**
Manufacturing I	445,627	11%
Manufacturing II	334,631	67%
Gas Stand	59,449	33%
Dry Cleaner	58,680	61%
Notes: Yasutaka et al. divided the manufacturing industries in Japan into two types, as follows: - Manufacturing I uses little or no chemical substances (e.g. food manufacturing) - Manufacturing II uses and/or used a lot of chemical substances (e.g. automotive manufacturing and petroleum refineries)		

6.4.1 Legislative framework on contaminated sites

As discussed earlier, in the 1990s and the beginning of the 21st century, the Japanese economy faced an extensive change in manufacturing activity, given the backdrop of growing international investment by multinational companies (Dixon et al. 2011). The relocation and closure of many heavy manufacturing plants in Japan during that period posed issues concerning the environmental condition of the sites (Mitsunari 2009). The growing concern over environmental problem of post-industrial sites, in particular soil contamination problem, together with the public health and safety issues compelled the Japanese policymakers to take legislative actions in this regard. As a result, in order to investigate soil contamination and reduce the threats to public health, in 2002, the Japan's legislature, the National Diet, introduced and passed a uniform environmental law, namely *"Soil Contamination Countermeasures Act (SCCA)"* which was put into force in 2003. This legal Act has been amended once in 2009.

The Soil Contamination Countermeasures Act has designed an operational system that determines how the investigation, removal and remedial actions should be implemented for each single site (see Figure 6.11). The first step under the SCCA system is the investigation and site assessment process that is often done by the designated investigation institutes. This assessment process allows to identify whether or not there is real or suspected contamination caused by the former operation at the site. In order to facilitate this process, the SCCA has prepared a list of 25 contaminants and corresponding limits for each (Otsuka et al. 2010). Having completed the investigation and site assessment process, if such land is found to exceed the limits for any of these contaminants, the site is then listed contaminated and is registered in the prefectural and city governments' records (Mitsunari 2009). The final step is then the removal and remedial action that is implemented by the original polluter. The polluter could be the landowner, manager, occupant or anyone who caused or contributed to the release of contaminants or pollutants. The original polluter is identified by the prefectural governor and should bear the remediation costs. In case that the polluter cannot be identified or is not present, the land-owner is responsible for the execution of contamination remediation. In such cases, the land-owner can potentially apply for the designated fund for the remedial action. Finally, once the land is fully remediated, the designation will be cancelled and the site will be removed from the governments' records.

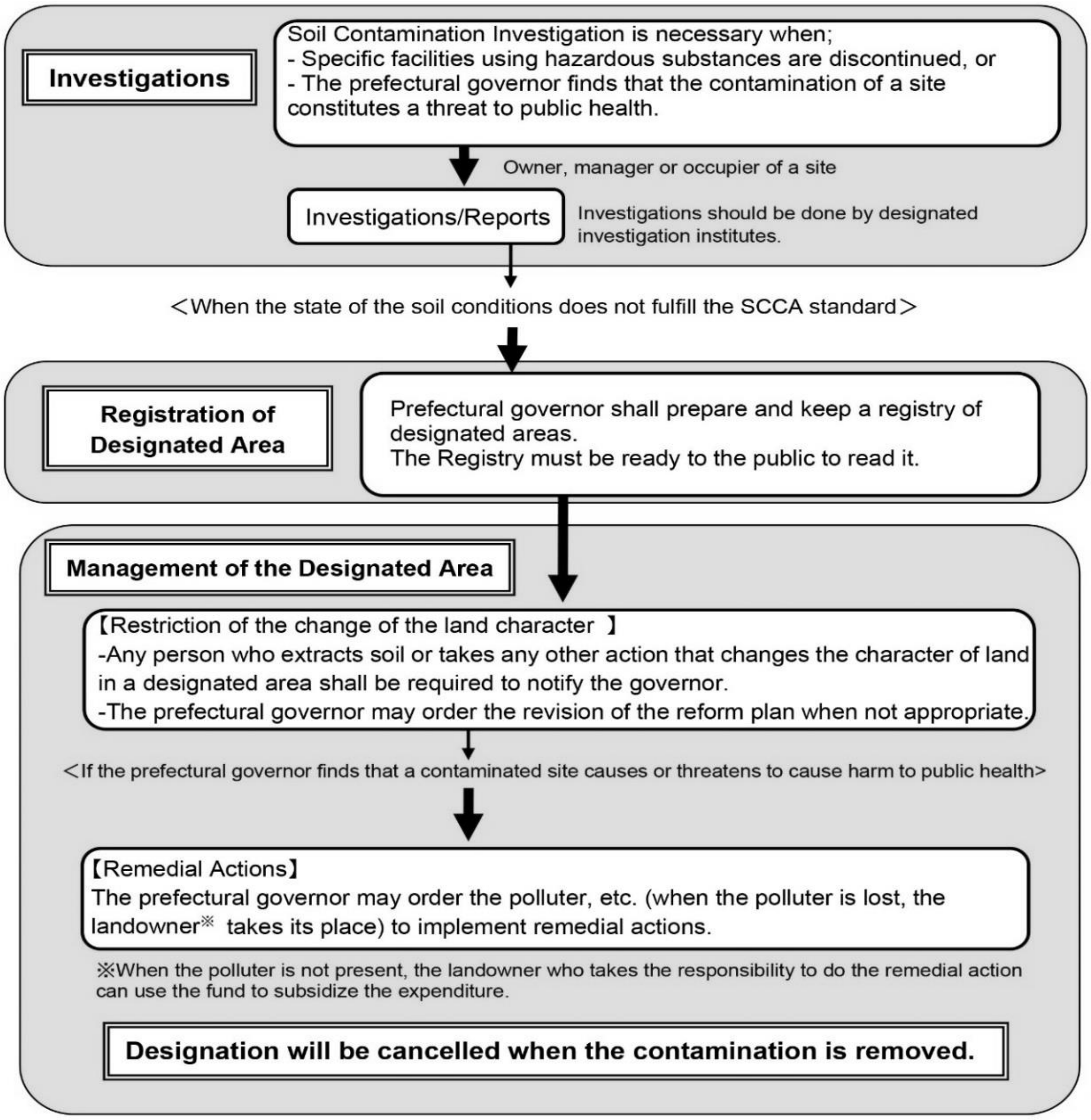


Figure 6.11 Overview of the remediation system under the Soil Contamination Countermeasures Act *(Source: MoE 2006)*

Having followed the operational framework of the remediation system, SCCA also introduced a financial support scheme in order to treat certain environmental remediation expenditures (see Figure 6.12). This scheme has been specifically designed to support those landowners who do not have enough financial resources for removal and remedial measures (Kasai et al. 2011). Based on the scheme, if the landowner or polluter can prove for his/her inability to bear the remediation expenditures, then he/she will be responsible for only one-quarter of the total cost and the rest of the money will be provided by the prefectural government. Within this procedure and legal system, the prefectural government can also take subsidies form the Supporting Corporation designated by the Ministry of Environment (MoE). Meanwhile, the Designated Support Corporation itself is often supported financially by both governmental and none-governmental sectors. As stated in the Article 47 (Chapter VI, Soil Contamination Countermeasures Act No. 53 of May 29, 2002), "*the Government may subsidize the funds to be appropriated for the Fund to the Designated Support Corporation within the scope of the budget*".

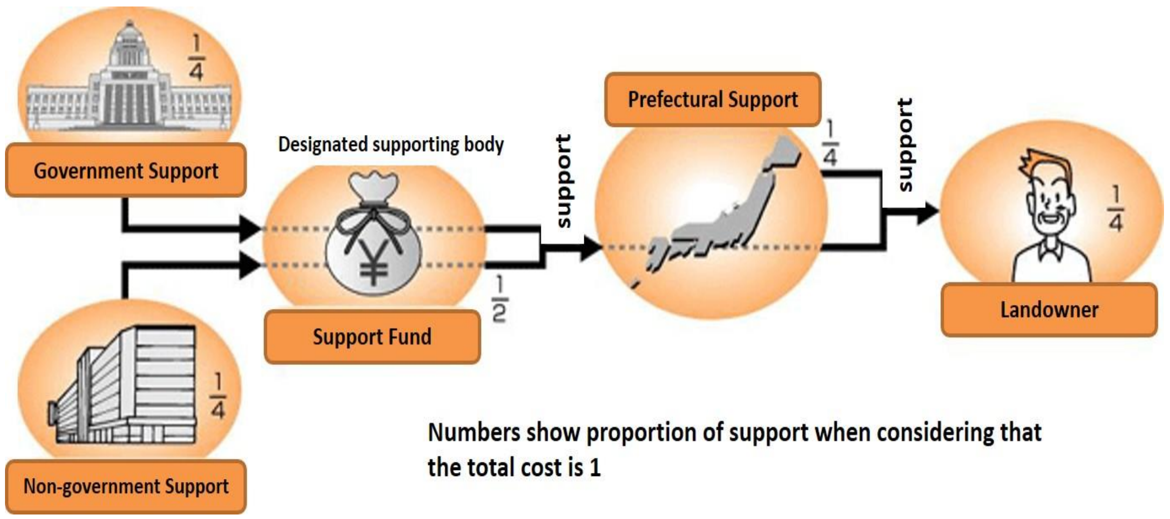


Figure 6.12 Financial support scheme under the Soil Contamination Countermeasures Act *(Source: Kasai et al. 2011)*

6.5 Conclusion

Studying the connections between urban-industrial change and brownfield emergence is of great importance for this chapter. In the Japanese context, two periods after the end of WWII play the critical role in this regard; including the steady development of urban area since 1990s as well as two strong industrial-led economic recessions from the early 1990s onwards. The area around the Musashi-Kosugi station well-represent the substantial impact of these two marked trends upon the occurrence of underutilized and contaminated land in Japan. Furthermore, as argued by a large body of literature, since the mid-1990s, the new stage of re-urbanization being followed by the anti-sprawl planning policies have greatly stimulated the inner-city redevelopment and construction activity, particularly in old industrial-based cities, such as Tokyo and Osaka. In the case of Musashi-Kosugi redevelopment project, thanks to the close relationship between public (e.g. local government) and private sectors (e.g. private land-owners, developers and real estate companies), a variety of new infrastructure, services and facilities has been provided on the post-industrial areas of Kawasaki. Indeed, this project can be regarded as a great brownfield regeneration example improving environmental conditions, reinforcing physical structure, maintaining economic viability and strengthening social interactions among residents. However, given the lack of data availability, there is a great deal of uncertainty about the effectiveness of environmental remediation and different soil-related issues, e.g. the degree and nature of contamination, the actual condition of soil as well as the remediation methods.

Having analysed various redevelopment aspects of the case study, this chapter attempted to present a comprehensive overview of brownfield-related issues in Japan. In doing so, the emergence, contextual definition, quantification and relevant policies in tackling brownfield issues have been highlighted. Having reviewed the existing literature and according to several personal interviews and site visits, the key success and failure factors in brownfield regeneration policy and practice in Japan are outlined as follows:

- As presented by the case of Musashi Kosugi, Japan has greatly taken advantage of two economic recessions after the 1990s as great opportunities for regeneration of post-industrial urban areas (Participant 03-JP; Participant 04-JP; Participant 06-JP).
- Institutional barriers between environmental and non-environmental policies have caused serious conflicts in managing brownfield activities in Japan (Participant 03-JP).

Despite the long-run history of land-use planning in Japan, the environmental countermeasures policy for land contamination (SCCA) is relatively a new agenda in Japanese legislative system. In practice, these general land-use and environmental planning policies are not well-coordinated in brownfield remediation and redevelopment practice.

- Under SCCA, the local governments are given the major responsibility and legislative power for brownfield land management, especially for large-scale development projects, such as Musashi Kosugi project. The local regulations are often administrated and implemented by municipal statutory authorities (Participant 06-JP; Participant 08-JP). These local regulations are not to deregulate the SCCA but to help create more opportunities and to facilitate the site investigation and remediation measures (Murayama et al. 2006).
- Within the environmental act of SCCA, there is a lack of comprehensive funding mechanism that encourages land clean-up process (Participant 04-JP). SCCA has designed a very general financial support scheme for those landowners who do not have enough financial resources for removal and remedial measures. However, this system seems to be ineffective, as most of contaminated lands presently or formerly belong to industries owned by large-scale manufacturing companies who are not eligible to apply for fund. In the case of Musashi Kosugi, for example, none of the land-owners or developers of former contaminated sites were able to benefit from such funding support.
- As a final mark and as believed by many (Otsuka & Abe 2008; Dixon et al. 2010; Participant 03-JP), Japanese people seem to be highly sensitive to any public health threat caused by human-made disasters, whereas they are more resistant to natural disaster, e.g. earthquakes. Hence, land contamination has become a stigma in Japan, due to its negative cultural and social aspects. Therefore, in many cases, the polluters are unwilling to disclose appropriate site information. This has greatly influenced the Japanese institutional framework tackling soil contamination. Under SCCA, once the land is found to be fully remediated, the site must be removed from the governments' records. Considering the negative image and perceived risks of contamination in Japan, it has become rather difficult to access information regarding the previously-known contaminated land in Japan, as the government does not keep an accurate record of it.

CHAPTER 07

Brownfield Regeneration in China;

the Case of Former Liaocheng Chemical Plant

7.1 Introduction

Rapid growth of urbanization coupled with significant transition of economic structure have left behind a large number of underutilized industrial sites in several Chinese cities and peripheral regions. As a result of long-term and extensive industrial activity, these sites are often found to contain hazardous materials in the soil and groundwater which pose a serious threat to human health and ecological system. This chapter takes account of one of these contaminated sites in China that has been intensively used by industrial activity for several decades. Liaocheng Chemical Plant, located in a small town in the East of China, is an example that could well reflect the Chinese government's attempts to shut down old and polluting industries and reuse the land after certain environmental treatments. Having analysed different aspect of clean-up and development of the former site of the Liaocheng Chemical Plant, the chapter seeks to address a key question as how the Chinese policy and regulatory framework for the prevention and treatment of land contamination has operated in a practical case.

This chapter is composed of four sections. After the introductory section, Section 7.2 sets the stage by discussing the background of the former site of the Liaocheng Chemical Plant. The purpose of this section is to provide a general overview of the site, in terms of its geographical location, former use and environmental condition. Section 7.3 elaborates on different aspects of the site redevelopment. It first discusses the existing government directives and action plans associated with the relocation of polluting industries and remediation of contaminated soil. It then explains how the clean-up process has been implemented at the site, and also how the land is going be used for development in the future. Finally, Section 7.4 offers a brief insight into the broader picture of brownfield issues in China, highlighting the overall state of urban-industrial structure and examining the relationship between Chinese policy and practice.

7.2 Background of the former site of the Liaocheng Chemical Plant

7.2.1 General overview of the site

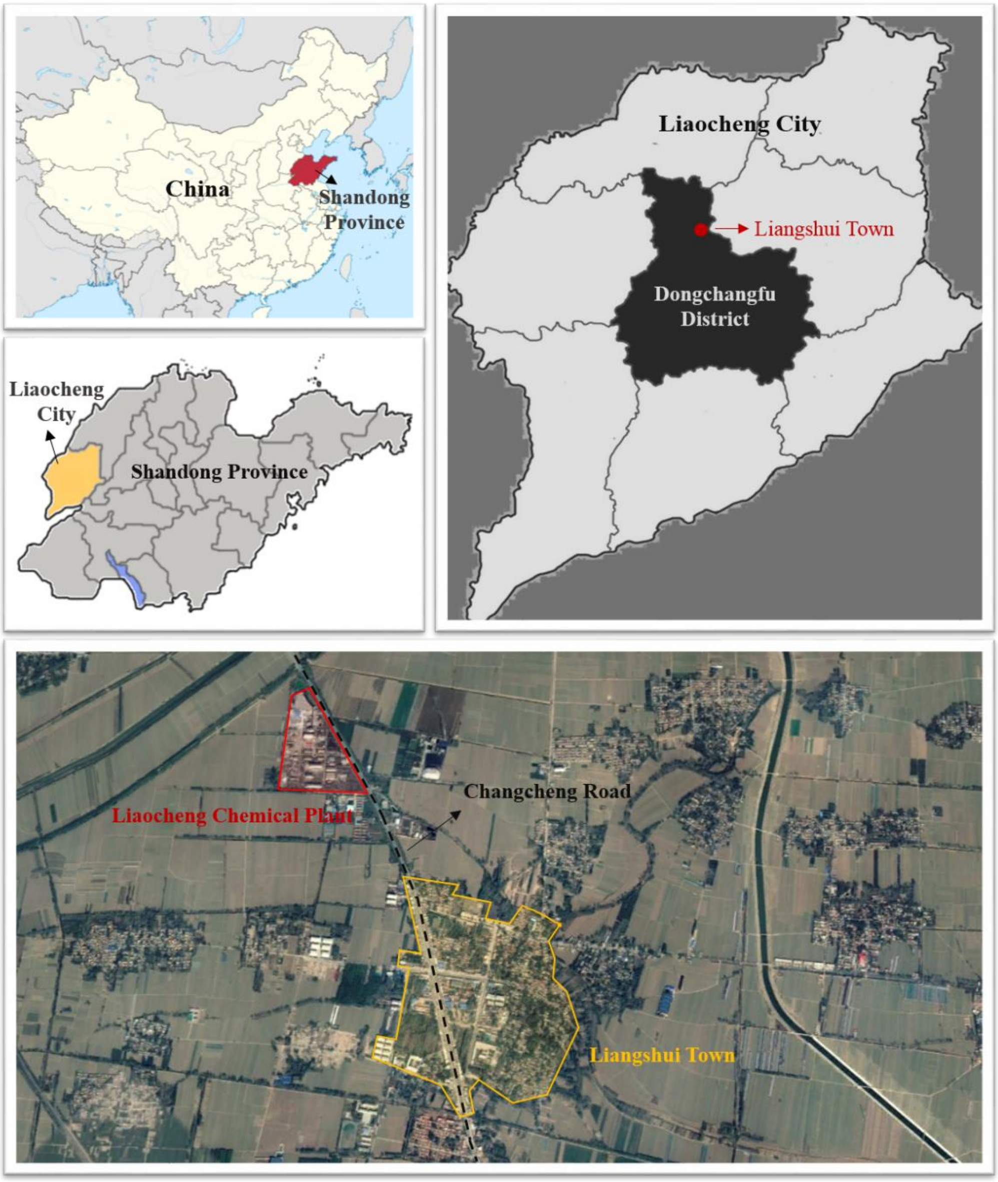
7.2.1.1 Geographical location and regional overview

Liaocheng Chemical Plant, covering a total area of around 15 ha, is located 1 km northwest of a suburban town, called Liangshui. The plant and the town are connected by Changsheng Road (Figure 7.1). Liangshui has a total population of 67,000 people and a total area of 142 km^2, comprising 108 small villages (Dongchangfu Government 2017). Liangshui is an agricultural town and its economy is predominantly based on agricultural production. However, there are a number of industries and factory sites led by private and national enterprises that are scattered around the town, such as Chang Yun Edible Fungus Company, Jinhong Food Company, and Tai Lin Chemical Co. Ltd. The most notable and the largest enterprise of the town was Liaocheng Chemical plant which ceased its operation in 2013. The growing industrial activities and, particularly, the rapid development of private enterprises have been influential in keeping the economic engine of the town and surrounding cities running.

Figure 7.1 Changsheng Road (see Figure 7.2) that connects Liangshui Town to the Liaocheng Chemical Plant
(Photo was taken by the author in July, 2017)

Liangshui is located in the northwest of 'Liaocheng City' in Shandong province in China. As of the end of 2016, the total area and total population of Liaocheng city were recorded to be 8,715 km^2 and around 6 million inhabitants (Liaocheng City Government 2017). Liaocheng is administratively divided into eight counties, including one district (Dongchangfu), one county-level city (Linqin), and six county-level districts (Yanggu, Dong'e, Chiping, Gaotang, Guan and Shen) (Liaocheng City Government 2017). Liaocheng Chemical Plant is located in Dongchangfu district, which covers a total area of 829 km^2 and includes a total population of 899,000 people (Dongchangfu Government 2017). Figure 7.2 shows the geographical location and regional overview of the plant in the county, city, state and country level.

Figure 7.2 Regional overview of the Liaocheng Chemical Plant
(Source: author)



7.2.1.2 Production overview and former use

The original enterprise of ‘Liaocheng Chemical Plant’ was established in 1975. The plant was originally located in another area and relocated to Liangshui in 1997. One year later, in 1998, the Liaocheng Chemical Plant started its production in the new location. The plant recorded over 500 employees, and was formerly used for the production of chemical raw materials, such as sulfuric acid, zinc ingots, zinc sand, phosphoric acid and phosphate fertilizer. The main production of the factory was, however, sulfuric acid, with a production capacity of 30,000 Tons per Annum (T/A) (EPPI 2017). For this reason, this factory has been commonly referred to as ‘Liaocheng Sulfuric Acid Plant’. In 2003, the plant was expanded and the production output increased substantially, reaching the production capacity of 60,000 T/A of sulfuric acid and 30,000 T/A of zinc ingots (EPPI 2017). Following the expansion of production volume, the plant was renamed as ‘Xin Chemical Plant’. In 2013, the plant ceased its overall production due to the market inefficiency and economic difficulty of the factory. Since then the site has been left unused (Figure 7.3).

Figure 7.3 Existing condition and dereliction of the former Liaocheng Chemical Plant *(Source: EPPI 2017 (pictures no. 1 & 2, as of May 2017) & author (pictures no. 3 & 4, as of July 2017).*

7.2.2 Soil contamination issue

After the closure of the Liaocheng Chemical Plant in 2013 and following an intensive monitoring of the land, the soil and groundwater at the site were found to be highly contaminated (See Figure 7.4). As a result of long-term and extensive chemical activity of former plant from the production to the final disposal stage, the soil and groundwater became widely polluted by hazardous materials and toxic heavy metals, such as zinc, arsenic, lead, cadmium and copper (Participant 03-CN). According to the detailed environmental analysis conducted by the Environmental Protection and Planning Institute (EPPI 2017), the soil and groundwater contamination problems at the former site of the Liaocheng Chemical Plant were mainly caused by four principal factors, including:

1) The long-term production of raw materials and product stacking,
2) The process of transportation of materials,
3) Ineffective disposal of hazardous materials and toxic heavy metals (given the long-term production history of the site, a great amount of industrial waste scattered and buried on and under the soil)
4) The lack of environmental protection facilities and technologies which could prevent or control the spread of contaminates.

Figure 7.4 Soil contamination of the former Liaocheng Chemical Plant
(Source: EPPI 2017 (pictures no. 1, as of May 2017) & author (pictures no. 2, as of July 2017).

Having analysed the main sources of pollution at Liaocheng chemical plant, EPPI's survey (2017) identifies four key factors in the spread of contaminants over the soil surfaces and groundwater system across the site, including:

1) Horizontal migration of contaminants at the surface of the soil (through runoff, sedimentation, stacking and dust diffusion) which resulted in absorption of pollutants into wider soil surfaces in the migration path.
2) Vertical or downward migration of contaminants (mainly through the rainfall) which resulted in pollution of groundwater and lower strata of the soil.
3) Horizontal or vertical migration of contaminates as the groundwater flowed through the lower surfaces of the soil.
4) Atmospheric diffusion of pollutants caused by flue gas and wind which spread out the contaminants over a large surface area of the site.

7.3 Redevelopment of the Site

7.3.1 Possible stimuli to the site redevelopment

It is important for this research to discover the possible causes and reasons of redevelopment of Liaocheng Chemical Plant's former area. Based on information gathered from the field-survey and personal interviews in China (Participant 01-CN; Participant 02-CN; Participant 03-CN; Participant 06-CN), two main factors have predominantly stimulated the redevelopment of Liaocheng site, including the government's attempt to control industrial pollution as well as the steady growth of Liangshui city. These two stimuli are briefly discussed in the following sub-sections.

7.3.1.1 Government's attempts to control industrial pollution

The first stimulus to the closure and redevelopment of the former Liaocheng Chemical Plant is associated with environmental issues and severe pollution of the site. Since the late 1980s, the national government has made several attempts to prevent and control the environmental pollution sources caused by urban industries all over China. In 1989, the government formulated the first environmental act as 'Environmental Protection Law of the People's Republic of China'. This was a general law aiming at improvement of the living environment, protection of public health, and promotion of sustainable economic and social development. Following the act of 1989, there have been several relevant national laws, directives and legal notices addressed by the government to control the environmental pollution problems caused by various industrial activities. The notable examples of these national environmental laws and notice are as follows:

- *"Opinions on Strengthening Soil Pollution Prevention and Control";* introduced in 2008 to establish a fundamental management system framework for soil pollution prevention and control at the national level.
- *"The Protection of Industrial Enterprises to Redevelop the Use of Environmental Safety Notice";* as a general law promulgated in 2012. This Act provided nine guiding principles on the protection and remediation of the soil and groundwater contamination caused by heavily polluting enterprises that have been already shut down due to bankruptcy or relocation,
- *"Soil Pollution Prevention and Control Action Plan" (Commonly known as Soil 10);* that was introduced in 2016 to provide some guidelines and basic support for the promotion of soil and groundwater pollution prevention in such industrial sites where the nature of the original land-use has changed.

Apart from above-mentioned environmental action plans and legal notices, the Chinese government has addressed a number of directives that strongly encourage the closure, relocation and environmental treatment of old and polluting industries. In 2004, an important directive was issued by the Ministry of Environmental Protection, namely *"Notice on the Work of Preventing and Treating Environmental Pollution in the Process of Enterprise Relocation"*. This was a very general directive by the government to limit and control the environmental incidents caused by soil pollution of already relocated or relocating industrial sites, at three levels of site investigation, clean-up implementation and waste disposal (MEP 2017a). In 2014, the Ministry of Environmental Protection issued another national directive on relocation of polluting industries and soil contamination issues, namely *"Notice on Strengthening Pollution Prevention and Control of Industrial Enterprises in Restraining, Relocating, Redevelopment and Utilization of Site".* The central objective of this legal directive was to enforce relocating or closed industrial enterprises to promptly announce the quality of soil and groundwater of the site prior to and within the closure process. Meanwhile, according to this directive, local environmental protection departments at all levels should urge the relocation of polluting industrial enterprises, following the process of public pollution prevention (MEP 2017b).

7.3.1.2 *Steady growth of urban area*

One main issue that has significantly stimulated the redevelopment of the former Liaocheng factory site is connected to the steady growth of urban landscape and disproportional expansion of urbanized land. As cities grow, large-scale factories (such as Liaocheng Chemical plant) that were once located within the non-urbanized or less-urbanized areas can become part of already urbanized or potentially-urbanized areas, causing them to cease operation. Their sites provide land for redevelopment. This has been a common scenario for many Chinese cities since the economic reforms started in the late 1970s and early 1980s. As indicated by the Chinese government's official report, the number of cities and towns increased from 2911 in 1981 to 17632 in 1995 -an absolute increase of over 500 per cent- (Zhang 2000). This was most significant for small towns around the cities, such as Liangshui. The number of towns in China was recorded to be 16992 in 1995, 6.34 times of that in 1981 (Zhang 2000). After the mid-1990s, disproportional expansion of urban land in China continued to become an obvious urbanization trend (Lin 2014). As statistics suggest, the total area of urbanized land in China increased from 3.4 × 104 km^2 in 1990 to 6.0 × 104 km^2 in 2010, an increase of over 75 per cent (see Figure 7.5) (Kuang et al. 2016). In the coastal zone (where Liaocheng City is located), this figure has been the greatest, from 1.7 × 104 km^2 in 1990 to 3.2 × 104 km^2 in 2010, a substantial increase of over 88 per cent.

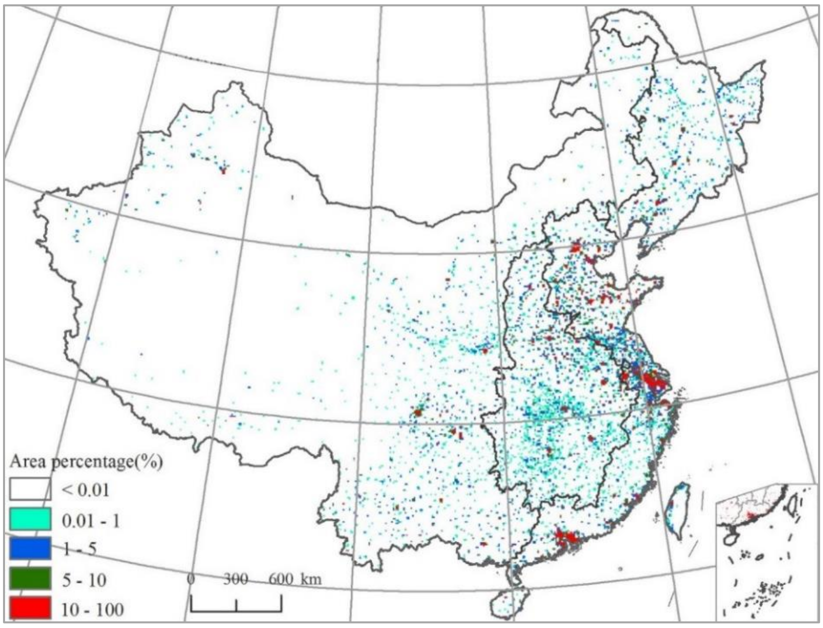


Figure 7.5 Urban land expansion in China from 1990 to 2010 *(Source: Kuang et al. 2016).*

It is important to recognize the key role of the local government in substantial expansion of urban land in China. In the case of Liaocheng city, the municipal government has been actively taking actions to promote the development of the city area over the past two decades or so. In 2001, after the approval of the Shandong Provincial government, the Liaocheng City Planning Bureau presented a comprehensive development vision, so called ‘Liaocheng City Master Plan (2001-2020)’. The central objective of this master plan was to determine new layouts for land-use planning and development of Liaocheng City, within three layers of core area, Dongchangfu district and Liaocheng city (LCPB 2014). Meanwhile, having defined various development zonings and new urban areas, the municipal government designed relevant laws and regulations to support the implementation and management of the master plan.

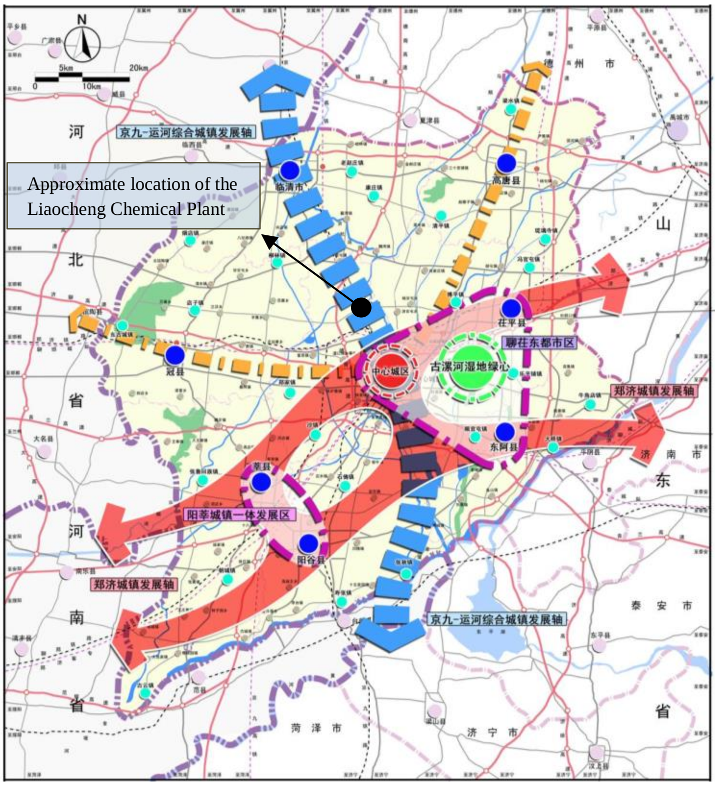


Figure 7.6 Liaocheng City Master Plan (2013-2030); draft zoning
(Source: LCPB 2014)

In October 2014, the master plan was revised and reformatted as ‘Liaocheng City Master Plan (2013-2030)’ (see Figure 7.6). According to the master plan, by 2030, the urbanization level of Liaocheng city will reach 68 per cent, with anticipated urban population of 4.68 million people (of which 1.8 million people in the central city) (LCPB 2014). More importantly, as proposed by the master plan, in order to ensure the healthy, orderly and harmonious development of economy and society in Liaocheng City, it was found to be necessary to define new layouts for spatial organization of major industries within the designated zonings (Participant 01-CN). For this reason, having addressed critical land-use planning and development issues, the Liaocheng City government's master plan has provided a strong stimulus to the closure and redevelopment of former 'Liaocheng Chemical Plant'.

7.3.2 Different phases of redevelopment process

The redevelopment of former plant area took place in three phases, as follows:

7.3.2.1 Demolition and removal of former building structures

After the closure of the factory site, several buildings (e.g. offices and warehouses) and industrial facilities (e.g. production units, storage tanks and maintenance equipment) were left unused and abandoned. The left-over structures and facilities needed to be removed from the site to prepare the land for further redevelopment phases. There is no official data indicating the exact date when the demolition and removal process started. However, the satellite maps show that parts of the site construction facilities (particularly those located in the north-western side) were removed in 2015, two years after the closure of the factory in 2013 (Figure 7.7). Furthermore, having visited the site personally in 2017, it was observed that the demolition and removal process of former industrial facilities is still underway (Figure 7.8).

Figure 7.7 Satellite Maps from Liaocheng Chemical Plant before (in 2012) and after the Closure (in 2015) *(Source: Google Earth)*

Figure 7.8 Demolition and removal work at the site, as of July 2017
(Source: author)

7.3.2.2 Remediation of contaminated soil and groundwater

The remediation of contaminated soil and groundwater at the former Liaocheng factory site has been conducted by an environmental institute, designated by the Liaocheng local government. The remediation practice was done based on certain technical standards and guidelines identified by the national government and the Ministry of Environment; such as Groundwater Quality Standard (1993), Soil Environmental Quality Standard (1995), Geotechnical Test Method Standard (1999), Guidelines for Site Assessment (2009), Site Soil Environmental Risk Assessment Screening (2011), Technical Guidelines for Site Environmental Survey (2014) and Technical Guidelines for Risk Assessment of Contaminated Sites (2014). Having followed national soil pollution standards and technical guidelines, the remediation and clean-up work has been done in three levels as follows:

- *Site investigation and sampling measures*

The first task was to conduct an investigation to first ensure that the land is contaminated and, if so, then identify the nature and basic characteristic of contaminants on site. This was done through comprehensive soil and groundwater sampling measures which included 9 groundwater sampling points and 112 soil sampling points (See Figure 7.9) (EPPI 2017). The sampling points were chosen based on the principle of representation, so that each sample represented different characteristics of contaminants found at different parts of the site (EPPI 2017). Meanwhile, in order to understand the extent and spatial distribution of the contaminated areas, some samples were taken from farmland located to the northwest of the factory site.

Figure 7.9 Sample collection from the soil (picture no. 1) and groundwater (picture no. 2) *(Source: EPPI 2017)*

- *Laboratorial analysis and risk assessment*

After an intensive process of soil and groundwater sampling, the samples were transferred to an off-site laboratory for further analysis. Based on the results of several tests and analyses, the type and geographical boundaries of pollutants were identified. The test results showed that almost all soil and groundwater pollutants were caused by heavy metal production (including zinc, arsenic, lead, cadmium and copper) from manufacturing units located in the southern and south-western parts of the site (EPPI 2017). After having verified the nature and distribution pattern of the pollutants, a quantitative risk assessment method (following a model designed by US RBCA; Risk-Based Corrective Action) was applied in order to identify the level of contaminants. This was done to ensure whether the level of contamination for each pollutant exceeded standards established by the national technical guidelines. According to the analytical assessment report (EEPI 2017), the level of zinc, cadmium, lead, arsenic and copper at the factory site was found to be respectively 20 times, 321 times, 133 times, 467 times and 13 times higher than the standard level.

- *Remediation measures*

Remediation measures have not yet been implemented at the contaminated site of the former Liaocheng Chemical Plant. However, having completed the site investigation, contamination verification and risk assessment phases, the Environmental Protection and Planning Institute's report (EPPI 2017) has come up with general recommendations for treatment of contaminated soil and groundwater. After having carefully analysed different parameters (such as geological and hydrogeological conditions of the site and surrounding environment, characteristics and degree of pollutants as well as the cost and timing issues), four technical solutions have been proposed, as follows (EPPI 2017):

- Stabilization of soil to prevent further migration of contaminants, by adding cement, lime, asphalt and other adhesives or stabilizers.
- Application of 'High Temperature Sintering Technology', mainly, to reduce the arsenic leaching levels. Based on this technology, a high temperature remediation process (with the optimum temperature of 1200°C) is used to destroy the hazardous organics and substances in the contaminated soil.
- Application of 'Phytoremediation Technology' that refers to the use of metal-tolerant plants for the removal and remediation of soil contaminated by metal-based pollutants at the site.
- Application of 'Ex-situ Soil Washing Technology'; which is a water-based technology for remediation of contaminated soil. In this type of treatment, the contaminated soil is first excavated and divided into different particle levels, and then soil particles are washed with water or a chemical agent dissolved in water to remove the contaminants.

7.3.2.3 Construction of new buildings and infrastructures

The final redevelopment phase of the former Liaocheng Chemical Plant area is the construction of new building structures and facilities which is expected to start in the late 2017. According to Liaocheng city's new land-use planning program, after appropriate remediation measures, the former factory site is going to be redeveloped and reused as a detention centre and office buildings. It is necessary to note that there is limited information or public report regarding the future land-use planning or relevant development issues, due to the sensitivity of the area. The draft development plan (see Figure 7.10) released by the Environmental Protection and

Planning Institute's working report (EPPI 2017) indicates that the future land-use of the former Liachong Chemical Plant area includes:

1. Detention centre and prisons
2. Office buildings and reception areas
3. Education-based area for the officers
4. Watchtowers
5. Utilities, facilities and services *(including public toilets, car parks, logistic centre, electric power rooms and sewage treatment buildings)*

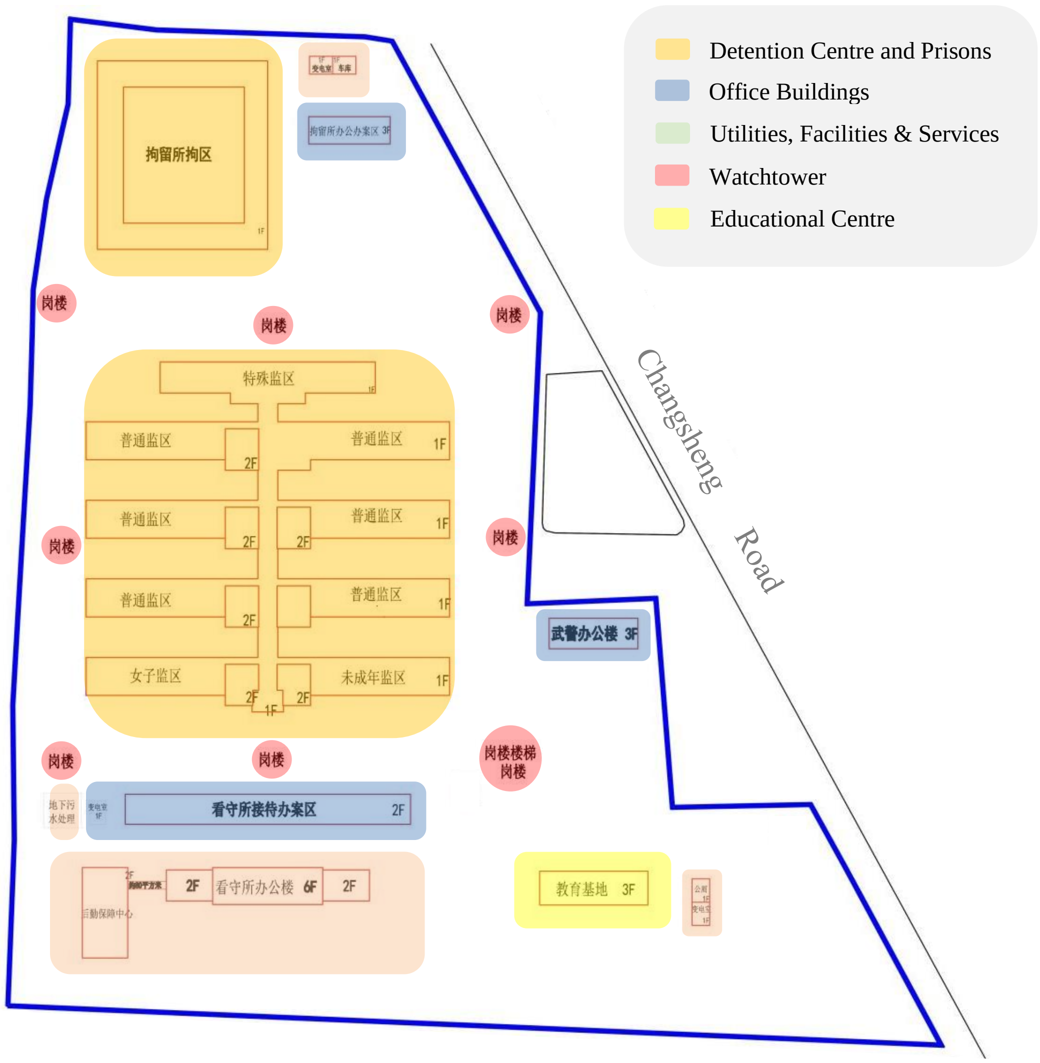


Figure 7.10 Future development plan of the former Liaocheng Chemical Plant
(Source: Author's elaboration on EPPI 2017)

7.4 Insights into the broader picture of brownfield issues in China

Having discussed various remediation and redevelopment aspects of Liaocheng factory area, it seems to be essential to draw a broader picture of brownfield regeneration activity in China. In doing so, two important issues are exposed to discussion in this section including: (1) the emergence of brownfields in China, and (2) legislative framework on contaminated sites.

7.4.1 Emergence of brownfields

The contaminated site of the former Liaocheng factory is a good example that illustrates the formation mechanism of brownfield sites in Chinese cities. As discussed in section 6.3.2.1, the steady growth of cities has given a great stimulus to the closure of industries, creation of brownfields, and accordingly regeneration of left-over contaminated sites in China. In other words, substantial expansion of urban areas can be viewed as the principal contributing factor to the brownfield emergence in China, being accompanied and fuelled by regional relocation of industrial activity within the country. In general, as a city grows in an uncontrolled fashion, given the pressure of rapid urbanization, inner-city sites with the history of manufacturing activity are left unused and abandoned. This has been a common scenario in terms of the formation of urban brownfields in China.

7.4.1.1 Urban growth

As argued by a large body of literature (e.g. Zhou & Ma 2000; Zhang 2000; Lin & Ho 2003; Lin & Ho 2005; Lin 2007; Liu et al. 2014), disproportional urban land growth occurred as a dominant trend across China from early 1980s to early 1990s, particularly in large coastal cities where the pace of economic growth was blistering. As suggested by national statistics, during the 10 year period between 1985 and 1995, the urbanized area in China increased by 486 per cent (Zhang 2000). Many (e.g. Montinola et al. 1995; Zhang 2000; Zhao et al. 1998; Liu et al. 2014) have attributed this continuous process of urban growth to the increasing construction of new development zones away from the crowded and fully developed central cities.

It is important to recognize that the strong trend of urban land growth in 1980s has continued in following years, however at slower pace, so that rural agricultural land is still being converted to urban land and suburban housing in many Chinese cities. As argued by Lin & Ho

(2005), despite the fact that the pace of farmland loss has considerably slowed down since the early 1990s, *"no downward trend has been found in the conversion of farmland into industrial and urban developments"*. Based on an investigation conducted by (Lin 2007), from 1984 to 1996, the urban built-up area of 284 identical Chinese cities had increased by 62 per cent, from 8713 to 14 135 square kilometres. Furthermore, the new research findings affirm that the urban areas have been growing persistently. According to Kuang et al. (2016), the total urban built-up area in China increased by over 3 per cent during the period of 1995-2000, 22 per cent during the period of 2000-2005 and 15 per cent during the period of 2005-2010.

Generally, much of the existing research on land management and urban planning (e.g. Zhang 2000; Wu 2001; Zhou & Ma 2000; Wei 2001; Ho & Lin 2003; Zhu 2012; Ye & Wu 2014; Fang & Pal 2016) have attributed China's urban growth to the post-Mao economic growth, marketization of urban land and institutional/political forces. The Chinese model of urban development is strongly connected with the economic restructuring, and government jurisdictions over land reform and land-use change. Since the introduction of Chinese economic reform in the late 1970s and unprecedented economic growth of the country, the economic value of land has been entirely recognized by government officials in China (Zhang 2000). Meanwhile, rapid economic growth has led to significant physical changes, mostly reflected in provision and improvement of infrastructure, amenities and housings, especially on the eastern coast region (Zhu 2012). The reform and opening-up of the late 1970s brought about major changes in land-use system in China as well, so that the land regulation power becomes decentralized from the upper-level governments (central and provincial governments) to the local level (municipal government). As a result, localities and enterprises have been awarded greater power in land-use regulation and financial decisions which had previously been under the control of the upper-level governments before the reform (Zhang 2000).

Since the beginning of economic reform and with the implementation of a market economy, a number of land-related reforms have been adopted by the Chinese government which substantially increased the municipal power and pressure in marketization of land (Participant 06-CN). This has been considerably influential in acceleration of urban expansion in China. In 1988, the State Council passed the 'Regulation of Urban Land Use Rights', as an amended clause to the Constitution of 1982 (stating that "no organizations or individuals may appropriate, buy, sell, or lease land, or unlawfully transfer it in any way") (Liu et al. 2014). However the amendment of 1988 redefined the land property rights by legalizing the separation of land ownership (by the state) from land-use rights (Lin 2010). It allowed the conveyance and transfer of the land-use rights from the local municipal governments to private developers by stipulating that “the right to use land may be assigned in accordance with the provisions of the law” (Lin 2009). This policy reform defined new revenue distribution regulation between the governments of all levels. Under the policy of separation of use rights from ownership, land has become the main source of financial profit for multiple interest groups in China, i.e. the government, real estate companies, and individual villagers (Zhang 2000). Therefore, local governments are willing to generate more revenue to pursue economic growth; developers and real estate companies are interested in making more profit through land holding and development projects particularly in less regulated rural land; and villagers are attracted to obtain higher compensation for their land in comparison to their low farming income (Fang & Pal 2016). Despite these reciprocal interests in land conversion and development, the new regulation system for tax revenue regulations has placed an enormous pressure on the local government to bear the land-related costs. Ye & Wu (2014) outlined this situation perfectly;

> *“The central government controls over 51% of the national fiscal revenues while covering less than 20% of the expenditures. In other words, local governments have to be responsible for over 80% of the fiscal expenditures with less than 50% of the revenue, despite some intergovernmental transfers from the central government. The gap has continued to widen in recent years. Therefore, in order to keep up with the budget shortfalls, local governments in China have to look for additional revenue sources that are not controlled by the central government”.*

As a result, the municipal governments have to sell or lease more land in order to compensate for the gap between their fiscal expenditures and limited revenues on land transfer fees. In other words, decentralization of land regulation power after the reforms of the past three decades provided strong incentives for local governments to stimulate land and infrastructure development through attracting foreign and domestic investment (Wu 2001). Under these legislative reforms and in response to market forces, local municipalities are willing to use their planning instruments for growth promotion and release more land for development to unshackle constraints from the central government (Wu 2015). This has resulted in irrational urban sprawl and substantial loss of agricultural land to non-agricultural land-use in several Chinese cities. As Zhang (2000) argues:

> *"Clearly, under the pressure of the central/superior government's fund cutting and increasing land demand, the main driving force of urban sprawl in China is local government's willingness to lease more land in responding to market forces after the reform. Decentralization of land regulation power gives local governments a tool to realize their objective. High land prices stimulate local government's willingness to "sell" more land. The combination of the marketplace and government's willingness results in the loss of cultivated land and causes urban sprawl".*

It is essential to note that the dramatic drop of cultivated land in China began only a few years after the economic reform and opening-up of the late 1970s was introduced. During the 2 year period of 1984–1986, China reportedly witnessed a net loss of 2.1 million hectares of cultivated land, primarily to urban and rural development as well as agricultural restructuring (Lin & Ho 2003). From 1986 to 2003, over 2.9 million hectares of cultivated land in China was removed as a result of a variety of construction activities (Chen 2007). The massive decline of land resource base in China has resulted in a 'wake-up call' about national as well as global food security and production (Heilig 1994; Brown 1995; Seto et al. 2000), raising major concerns over the capability of Chinese to feed themselves (Lin & Ho 2003; Lin 2007).

In addition to the shrinkage of total cultivated land and soil resources due to the accelerated urbanization, an issue of serious concern in China is related to the quality of agricultural soil and groundwater. Owing to the urbanization-related land-use changes and explosive economic growth, China is facing great challenges in terms of the protection of soil quality and agricultural production from polluting industrial activities (Chen 2007). A large area of agricultural land in rural and suburban regions has now become affected by waste disposal and contamination problems of adjacent industries. Based on an estimate by the Chinese Academy of Sciences (CAS), almost one-sixth of the total agricultural land in China is believed to be contaminated by heavy metals, causing an annual grain yield loss of 10 million tons (Chen 2007).

7.4.1.2 *Regional restructuring*

Another important contributing factor to the brownfield issue in China is associated with the industrial relocation process. Unlike most developed countries, industrial restructuring in China only exists at the regional level. The statistics do not imply on the existence of national restructuring in China (Liu et al. 2014). According to the National Bureau of Statistics of China (2017), between 2000 and 2014, urban manufacturing employment increased by over 61 per cent, from 32.4 million to 52.4 million jobs. Conversely, regional relocation of manufacturing activity has occurred in many big and, particularly, old industrial-base cities in China such as Shanghai, Beijing and Tianjin (Wang et al. 2012). In Beijing, for example, between 2000 and 2005, a total number of 144 old manufacturing plants were relocated from the central city to suburbs (Li 2011). A more detailed research survey (Boyang et al. 2014) shows that in 1985, almost 21 per cent of the manufacturing enterprises in Beijing were located in the centre of the city, 60 per cent in suburbs and 19 per cent in rural areas; whereas in 2004, these three figures were recorded to be 7 per cent, 41 per cent, and 52 per cent respectively (Table 7.1).

Table 7.1 Spatial distribution of manufacturing plants in Beijing (1985–2004)
(Source: Boyang et al. 2014)

Area	Percentage of Plants %	
	1985	2004
Central Urban	20.96	6.55
Suburban	60.18	41.43
Rural Fringe	18.86	52.02

Similar to the process of urban land expansion, the relocation of industrial enterprises from central urban to suburban and rural areas has been predominantly influenced by the acceleration of the China's economic and urban land reforms. As the reforms progressed and cities grew in a rapid pace, the concentration of old manufacturing sites in urban cores has been recognized piecemeal as a serious economic and environmental problem (Xie et al. 2014). Therefore, many industries located in central cities, especially in traditional industrial-base cities such as Beijing and Shanghai, closed down due to either bankruptcy or market force for land relocation.

Under the economic consideration, high land prices resulting from urban growth act as a strong stimulus to the relocation of industrial land, particularly from the coastal cities to inland cities

(Chang et al. 2013). This has been mainly driven by growing foreign direct investment in coastal land development promoted by local governments and their designated enterprises. On the other hand, many traditional manufacturing industries located in inner cities have been dealing with serious environmental degradation and pollution issues. In this regard, several directives have been addressed by the Chinese government encouraging the closure, relocation and environmental treatment of old and polluting industries in urban areas (see section 6.3.1.1). It is significant to recognize that, under both economic and environmental considerations, local governments in China have been more responsive to the challenge of industrial relocation. Although the central government has made continuous legislative efforts in this regard, not much progress has been yet achieved in the issue of urban land (Li 2011).

7.4.2 Legislative framework on contaminated sites

Brownfield is a new agenda into both urban land-use and environmental legal systems in China. At the moment, the Chinese legislative model for brownfield remediation and redevelopment is still in its infancy (Xie & Li 2010). This seems to be more complex when we come across the fact that there is, at the moment, no legal and nation-wide definition of what constitutes brownfields in China (Xie et al. 2014). However, over the past decade or so, there has been a large body of literature (Fangfang 2007; Cao & Guan 2007; Xie & Li 2010; Li 2011; Cheng et al. 2011; Wang 2013; Liu et al. 2014; Xie et al. 2014) formulating a basic definition of brownfields and arguing different aspects of land remediation activities across the country. Given the lack of awareness of brownfields, these works of literature have taken critical approaches to provide a general overview of the existing situation of contaminated land redevelopment in China. Indeed, the existing literature has placed a great emphasis on the vital necessity of effective and efficient management of land contamination at all level of Chinese governments.

One of the most comprehensive surveys on the Chinese legal and regulatory framework on soil pollution prevention and control has been conducted by the World Bank in 2010. According to this survey (Xie & Li 2010), the national/provincial brownfield legislative system in China lacks an operational management approach that could comprehensively address issues regarding remediation and redevelopment of contaminated lands. As the survey report concludes (Xie & Li 2010):

> *"Currently [as of 2010], brownfield management in China is guided by an ad-hoc set of documents, rules and guidance issued by the government over the past several years, issued by MEP (formerly SEPA), in 2004 and 2008 respectively….These relevant legal provisions, however, are not systematic or consistent, and none of them are focused on land contamination. They also are too general, and lack operational details and accountability deterrence provisions. Control and prevention requirements, and measures pertaining specifically to land pollution, are largely missing. It is therefore necessary to develop a specific law for prevention and control of land contamination."*

However, in 2014, in response to the growing concerns over the lack of a brownfield-related management system at the national level, the Ministry of Land and Resources (MLR) in conjunction with the Ministry of Environmental Protection (MEP) released a nation-wide bulletin survey of soil pollution. This has been the first, and so far the latest, national soil pollution report in China. According to this joint survey, the overall state of the soil condition and remediation action in China is not optimistic. The report shows that over 16 per cent of total land in China is believed to be slightly or severely contaminated (MLR & MEP 2014). Although the joint survey report of 2014 is presently the most recognized report available to the general public, it does not accurately describe the actual situation of brownfields in China. First, there are doubts as to how effectively the survey has been carried out, because the sample points were evenly distributed across the entire land of China and, thus, a large number of contaminated lands might have been missed in this survey (Participant 05-CN). Secondly, many questions have been raised about the accuracy of analytical method and tools being used by the survey (Participant 05-CN). Hence, the total area of contaminated land in China is expected to be several times higher than the estimate from the national survey of 2014.

The joint survey report of 2014 also provided guidelines for local governments to take a series of measures for the prevention, control and treatment of soil pollution, following five central objectives, including (MLR & MEP 2014):

1. Preparation of soil pollution prevention and control action plan
2. Speeding up the legislative process of soil environmental protection
3. Carrying out detailed investigation of soil pollution situation
4. Implementation of soil remediation works
5. Strengthening the soil environmental regulation.

Following the national bulletin survey and in response to major concerns raised by two ministries, the MEP introduced a national action plan as 'Soil Pollution Prevention and Control Action Plan', commonly known as 'Soil 10' (see section 6.3.1.1). This action plan is the first, and the latest, national legislation passed regarding brownfields in China. However, in reality, Soil 10 seems to be still a very general and immature action plan, being less specific into different environmental and economic aspects of regeneration process, including both monetary issues (e.g. liability regulation and public funding), and non-monetary issues (e.g. site identification, investigation and technical assistance). Some of the major challenges and problems which have not been explicitly and comprehensively addressed by the Chinese legal and regulatory framework are discussed in the following sub-sections.

7.4.2.1 Identification and characteristics of the sites

One of the major challenges the policy system is confronted with is the lack of unified and universally applicable methods for identification of contaminated, suspected contaminated or non-contaminated lands across China (Xie et al. 2014). At present, there are no quantitative standards or statistical database that could help quantify, characterize and classify brownfields by providing helpful information, such as the location and size of the site, value of the land, nature of former use, period of idleness, type of contamination as well as the level of associated risk or hazardous rank. At the moment, apart from the national joint bulletin survey (MLR & MEP 2014) that offers a very general overview of contamination at the national level, there is no systematic approach envisaged within the Chinese regulatory framework that supports identification of contaminated lands. This has led to a situation where the nature of several contaminated sites is still unknown and, therefore, the redevelopment of such sites may take place with no or ineffective environmental treatment. Moreover, for those sites that are known to be contaminated, the processes of site investigation, assessment and remediation often take a long time due to the uncertainty about the type and degree of pollution. This situation has become widespread throughout China. The remediation project of the former site of the Liaocheng Chemical Plant is a notable example in this regard.

7.4.2.2 *Environmental liability issues*

Environmental and legal liabilities associated with land contamination and remediation have been always inevitable concerns for both landowners and developers. In respect of liability issues, China's regulatory system is presently in its infancy. At present, there is no legislative framework at the national level in China that draws up clear and concise guidelines for identification of liability, stakeholder responsibilities and associated penalties (Fangfang 2007; Xie & Li 2010). The legislation that exists at the national level regarding liability issues is pretty much fragmented into a series of laws or regulations, such as Environmental Protection Law, Land Management Law, Solid Waste Pollution Prevention Law, Law of Water and Soil Conservation, and the Urban Real Estate Development and Management Regulations (Xie & Li 2010). These laws or regulation are not specifically focused on liability for contaminated land management.

In the case of Liaocheng Chemical Plant site redevelopment project, for example, the remediation expenditures were borne by the new land-owner (the Liaocheng Public Security Bureau), while the polluter was the former industry. It might be that the Liaocheng Public Security Bureau paid for the remediation expenditures as part of land transfer process (given the high level of barriers to data accessibility, this cannot be certainly affirmed). There have been several brownfield remediation cases in China, in which the liability costs were deducted from the land transfer expenditures, so that the developer or new land-owner (not the past polluter) bears the whole or a large amount of clean-up costs. In such cases, *"when retroactive liabilities are unable to be imposed to the responsible parties (e.g. former enterprises that are bankrupted, closed, or restructured), the government typically intervene in these matters to negotiate with potential developers to recover the remediation costs from land transfers"* (Wang 2013). Redevelopment project of the Hongshi Paint Plant site in Beijing is one of these cases (Xie & Li 2010).

Despite the existing loopholes related to soil pollution liability within the national law, there are a small number of local governments in China that had already addressed liability concerns before the national government came up with Soil 10. In many states in China, the municipal government takes the overall control of environmental liability issues of contaminated sites. The most notable example in this regard is the Chongqing Municipal government. In 2007, Chongqing Municipality issued 'Chongqing Environmental Protection Regulations (CEPR)' which stipulated that soil remediation measures must be implemented by polluting industries before they may relocate or transfer the land (Chongqing EFB 2017). This municipal-level regulation addressed the liability of contaminated land based on three key principles, including; the ‘Polluter Pays Principle’, the ‘Investor Benefits Principle’, and the ‘Land Owner Takes Responsibility Principle’ (Xie & Li 2010). However, despite considerable efforts made by the Chongqing government to resolve liability concerns, there seems to be still an ambiguity in CEPR which needs to be clarified. As Wang (2013) explains, according to his personal interviews with the Chongqing EFB:

> *“…Contaminated sites that proposed to be redeveloped are required to be cleaned up to “pristine conditions” at a cost paid by responsible polluters. However, in actual cases, governmental agencies are reluctant to impose liability on responsible parties for contamination, except when the contamination at a site imposes a severe risk to human health or to the environment. They typically allow responsible parties to clean up sites voluntarily without strict risk assessment, supervision and post-evaluation, especially for those state-owned industrial enterprises that are occupying the land.”*

7.4.2.3 Funding sources

At the national level of Chinese government, there is to date no direct funding or financing mechanisms (e.g. tax credits, low-interest loans and grants) tackling brownfield remediation and redevelopment issues. The only national-led funding sources which indirectly support the clean-up of selected types of contaminated sites in China are associated with the development of innovative treatment technologies and equipment for environmental risk assessment and remediation. However, only a small number of these technologies have proved to be practical and economical (Xie & Li 2010). However, despite the lack of funding designation at the national level, there have been a small number of state and local governments in China offering subsidised funds for contaminated site remediation (Wang 2013). This has been substantially progressing over the past years in several provincial and municipal governments across China. For example, in 2007, the Chongqing Municipal government spent 200 million RMB on 15 contaminated sites, while by 2009 the figures had risen to 800 million RMB spent on 45 sites (Xie & Li 2010).

7.4.2.4 Technical issues

Since the mid-1990s, the Chinese national government has been proactive in providing several technical guidelines and standards for the prevention, control and remediation of land contamination. These national standards have provided significant technical assistance for many environmental remediation engineering and practices associated with brownfield sites. However, it seems that these standards are very fragmented and need to be reframed within the newly developed regulatory system for soil pollution prevention and control in China (Participant 05-CN). Therefore, in many cases, the already established guidelines are not taken into account by the environmental agencies and institutes. Xie & Li's (2010) well explain this situation:

> *"Despite some local practices and provisional standards and guidelines issued at the national level, government agencies and research institutes have been using or referring to different methods and standards of contaminated soil risk assessment used in other countries; the result has been inconsistent and incomparable assessment results and conclusions".*

Meanwhile, in terms of the remediation technologies, China has still a long way to go to improve the soil and groundwater contamination. As explained by Xie & Li's survey report (2010):

> *"The most commonly used remediation practice [in China] is excavation followed by ex-situ treatment, such as depositing contaminated soil in an off-site landfill, and or neutralizing with kiln treatment. In-situ remediation technologies are still in the early stage of research and piloting".*

The case of the former site of Liaocheng Chemical Plant could be considered as one of the uncommon examples in China adopting an innovative approach to soil pollution control and clean-up. In this project, detailed assessment and remediation techniques have been developed in accordance with several national standards and technical guidelines, such as the 'Groundwater Quality Standard', 'Site Soil Environmental Risk Assessment Screening' and 'Technical Guidelines for Risk Assessment of Contaminated Sites'. After a comprehensive process of soil and groundwater analysis, both soil and groundwater system of the Liaocheng Chemical Plant were found to be highly contaminated. In the final proposal made by the EPPI (2017), the report came up with some technical solutions for soil contamination control and treatment. Some of proposed remediation techniques are innovative and deemed as emerging technologies in the marketplace of soil clean-up, such as the ‘High Temperature Sintering Technology’ and ‘Phytoremediation Technology’ (USEPA 2017). However, it must be noted that despite the high degree of groundwater pollution found at the former site of Liaocheng Chemical Plant, no technical solution has been yet offered for the control and clean-up of contaminated groundwater system (Participant 03-CN).

7.5 Conclusion

Similar to many developed and developing nations, brownfield land in China can be viewed as a legacy of two marked and inter-related trends; urban expansion and regional relocation of industries. These trends are still underway in many Chinese cities. Many cities are rapidly growing and several post-industrial (and often contaminated) sites have now become available for redevelopment owing to the closure and relocation of industries. This is the scenario of how the former site of the Liaocheng Chemical Plant has emerged as a brownfield site. Similar to the case of Liaocheng, there are several formerly lands in many traditional industrial-base cities, e.g. Beijing and Shanghai, that have received legal and technical recognition for land decontamination. Despite individual attempts made by the lower-tiers of local government, real estate developers, investors or individual land-owners, there is still no widespread recognition for a strategic and effective approach to encourage the regeneration of contaminated sites in China. This has led to many failed remediation practices over the past few years posing a serious threat to human health and environment in China, particularly in densely populated areas. The most notable example is the soil contamination incident of the Changzhou Foreign Languages School in Jiangsu Province in 2015 (Liu et al. 2017). The School’s new site was contaminated by chemical factories spread it further afield. The contaminated land was not treated prior to reuse and, as a result, many students became sick due to the existence of toxic chemicals in the soil and groundwater system (Participant 04-CN).

Land contamination and remediation in China seems to be a common concern for both land-use planning and environmental protection systems. Over the past few years, positive signs of moving forward in respect of land contamination issues appeared in Chinese legal and regulatory system. Nevertheless, it seems that there is still a lack of consensus on how to tackle various issues associated with remediation and redevelopment of contaminated lands, such as the identification of sites, legal liability, technical issues and financing mechanisms. Despite the national government's attempt to encourage the regeneration of contaminated land, there are still several elements of ambiguity and inadequacy in the national act, i.e. Soil 10. It is important to note that, in comparison with the upper-level of governments, the local and provincial governments have a closer and more effective control of remediation practices in China. However, several key issues, such as funding allocations and provision of technical standards and guidelines, are still sorted out at the national level. This disconnection between multiple levels of government has presented significant challenges to brownfield remediation and reuse practices. The response to these challenges must be viewed at every level of government, and requires the national government sets appropriate brownfield-related legislative targets, and accordingly creates a detailed operational framework. Given the rapid pace of development and growth in China, it is imperative that the Chinese government accelerates the design and implementation processes to achieve these legislative targets.

CHAPTER 08

Discussion I;

Comparative Analysis of International Case Studies

8.1 Introduction

Having discussed and analysed various aspects of brownfield development in the US (Chapter 4), Europe (Chapter 5), Japan (Chapter 6) and China (Chapter 7), Chapter 8 of the thesis assesses the findings from each country, adopting a comparative approach. This chapter is organised into four sections. The first section elaborates on the existing conceptualisations associated with brownfield, highlighting the key defining characteristics in different countries. Section 8.3 explains the existing contributing factors to the emergence of brownfield sites worldwide. As discussed in Chapter 3 (Figure 3.2), this chapter contributes to the research by developing the idea of EPI into an analytical tool, namely EPIB. In the light of the outcome of case study analysis, Section 8.4 elaborates on the development of the EPIB tool to understand and explain brownfield regeneration pathways and processes across various world regions and political regimes. The final section of this chapter summarizes the important findings from this study on the 'widespread and diverse perception of brownfield sites', along with their 'generation process' and 'regeneration policy response'.

8.2 An integrated definition of brownfield

Having reviewed the usage of the term 'brownfield' and related terminologies in the United States, Europe, Japan and China, it can be clearly observed that there is a great deal of variation in legal interpretation of brownfield sites. Despite the lack of a universally agreed term for brownfield, there are three defining characteristics of brownfields sites, including:

- *Characteristic I- Environmental degradation*; which mainly relates to real or suspected existence of hazardous materials in the soil and/or groundwater system. The environmental damage to brownfields is often caused by a hazardous activity of previous manufacturing industries, as well as commercial or military use which considerably restricts or hampers the redevelopment of sites. In many countries- such as US, Japan, Denmark, Italy, Spain, Romania and Poland- soil and groundwater contamination is regarded as the distinguishing characteristic of brownfield sites. In these countries, environmental contamination has been placed as the main issue concerning brownfield and the legislative process subject to it. In other words, in these countries, brownfield has a clear and straightforward interpretation; as a contaminated land that may require environmental treatment before reuse.

- *Characteristic II- Physical deterioration*; as brownfields have been often unused or ineffectively-used for a period of time, the physical and site condition factors are of great importance for legal characterisation of brownfields. For example, brownfield is defined as *"vacant or derelict land"* in Scotland, as *"degraded/abandoned building or land usually inside urban areas"* in Slovenia and as *"derelict land"* in Ireland (CABERNET 2006). In such countries, a site should not be necessarily affected by contamination in order to be called brownfield. Therefore, another defining characteristic of brownfield is associated with the physical deterioration which includes abandonment, dereliction, vacancy or ineffective utilization of sites.

- *Characteristic III- Economic instability;* is another important factor in characterising brownfield. In this respect, brownfield land is viewed as an asset that is economically unstable and requires intervention to be brought back to realize its value. In spite of the fact that economic issues would appear to dominate much of the brownfield-related discussion (Alker et al. 2000), there are only a few countries that have specifically taken account of economic potential and viability of brownfield sites within their legal definition. The notable examples, in this regard, are Japan and Belgium–Wallonia.

Belgium–Wallonia defined brownfields as *"sites previously dedicated to economic activities, and where the current situation is contrary to 'efficient land use'"* (CABERNET 2006). Japanese Ministry of Environment (MoE 2007) characterized brownfields as *"lands which are unused or with extremely limited use compared to their intrinsic value because of existence or potential existence of soil contamination"*.

Having considered the above-mentioned attributes, there are critical issues pertinent to brownfield terminology that are highlighted as follows:

- Some countries have come across a composition of various attributes to brownfield sites, when arriving at a definition. For example, Belgium–Flanders has attributed both physical abandonment and environmental contamination to brownfields, in their legal definition. Meanwhile, in the Japanese legal definition, brownfields are physically unused or ineffectively-used, have real or perceived environmental contamination and are economically distressed.
- In many countries- such as China, Austria, Sweden, Finland and Netherlands- there is still no legally recognized definition of brownfield. However, despite the absence of the term 'brownfield' in official urban land-use or environmental vocabularies, in such countries brownfields are publicly known as contaminated sites, following the original definition introduced by USEPA. In China, for example, the major works of academic literature tackle brownfields under the consideration of environmental contamination issues, i.e. soil and groundwater pollution.
- In several European countries- such as the UK (England and Wales), France and Germany- the policy-based definition of brownfield is broader than merely contaminated land, being more concerned with the previous use of the site. In order to benefit from greater planning flexibility, these countries have attempted to eliminate the necessity of soil pollution issues for their legal consideration of brownfield. In England and Wales, the term brownfield has evolved in meaning as 'previously developed land (opposite of greenfield)', in Germany as 'an inner-city building and area not under use' and in France as 'space previously developed that is temporarily or definitively abandoned and can be partially occupied, derelict or contaminated' (CABERNET 2006). According to these wider terminologies, brownfields *"can include land within urban areas, such as, controversially, large domestic gardens and school playing fields, that are neither derelict nor contaminated"* (NICOLE 2011).

- At the EU-wide scale, the European Union and Commission have found a necessity to avoid the diversity in usage of the term brownfield. The intention was to resolve immense development complexity among different stakeholders involved across Europe. Hence, through two comprehensive reports, including the CLARINET and CABERNET, it was attempted to provide a robust definition for brownfield sites, mostly targeting effective interventions for beneficial use of a site, irrespective of its physical and environmental condition. However, it is important to note that the EU-wide definition of brownfield has been, thus far, applied only in a few number of European countries, including Austria, Czech Republic and Latvia (NICOLE 2011).
- It is important to acknowledge the fact that there is a clear definitional complexity in regards to brownfields in many countries. This complexity has arisen not only when arriving at understanding of these urban areas but also for policy purposes. In the US, a new term, namely 'greyfield', has begun to be applied for 'vacant land and abandoned structures', mainly referring to outdated retail and commercial sites (Adams et al. 2010). However, the legislative system and supportive redevelopment tools in US are heavily biased in favour of brownfields, or contaminated lands, being less attentive to greyfields.

8.3 Key contributing factors to the emergence of brownfield sites worldwide

Brownfield emergence in different countries is commonly explained by two critical drivers, namely industrial restructuring and urban growth. Meanwhile, we can observe military brownfield sites having appeared mostly in Europe as a result of demilitarization and strong withdrawal of military structures over past years. These three marked trends are highlighted briefly in this section.

8.3.1 Structural changes in manufacturing industries

As observed in most international cases, structural adjustment away from manufacturing industry is regarded as an important driver of closure, relocation and mass-layoffs of many factories and production sites across the developed world. Industrial restructuring is commonly characterized by rapid decline in manufacturing shares both in terms of output and in terms of employment, being followed by tertiarization as a transition process from a production-based economy into a service-based one. In general, both general and local economic forces have played critical roles in the withdrawal and cessation of production sites and business centres, particularly in inner-urban regions. Driven by restructuring and steady migration of manufacturing activity/capacity out of inner cities, industrial brownfields have emerged over the past 40 years or so. This has been a common scenario for three international cases studied in this research, including the US, Europe and Japan. Nevertheless, it is apparent that, similar to the urban growth process, these countries have witnessed industrial restructuring in different patterns of development and timeframes. In the Chinese context, however, there has been no significant restructuring trend observed at the national scale. Brownfields in China have mainly emerged as a result of industrial relocation process triggered by the steady growth of cities and pollution-related concerns. Table 8.1 summarizes the notable events of industrial restructuring and their key characteristics in different contexts. Furthermore, this table shows the critical periods when industrial shifts did occur, and accordingly, when brownfields began to appear.

Table 8.1 An overview of industrial restructuring in four international cases
(Source: the author)

<table>
<tr><th>Countries</th><th>Critical Periods</th><th>Details</th></tr>
<tr><td>The United States</td><td rowspan="2">▪ 1970s-1990s
▪ GFC of 2007-2009</td><td rowspan="2">- There was a decline in industrial employment and production, followed by a high level of tertiarization.
- In US and Western Europe, industrial restructuring began to occur mostly from mid-1970s and reached its heyday in the 1990s, whereas in post-socialist Central and Eastern Europe the late 1980s and early 1990s are the critical occurrence breakpoints.</td></tr>
<tr><td>Europe</td></tr>
<tr><td>Japan</td><td>▪ Early 1990s
▪ GFC of 2007-2009</td><td>- Japanese model of industrial restructuring originated from the Bubble Burst of 1990s which is characterized by expansion of domestic demands, uncontrolled growth of government investments and steep fall in manufacturing employment and production.
- The Bubble Burst had devastating effects, especially, on the electric machinery and appliance manufacturing industries, whilst the GFC has hit the Japanese automobile industries, in particular.</td></tr>
<tr><td>China</td><td>▪ Early 2000s</td><td>- There is no national restructuring, as China has become home to many manufacturing industries relocated from US, Europe and Japan.
- Regional restructuring has occurred in the 21st century, characterized by manufacturing decentralization in big and industrial-based cities.
- The government's anti-pollution policies are significant drivers of industrial closure and relocation in China.</td></tr>
</table>

8.3.2 Urban growth

One of the key drivers to brownfield emergence in different countries is the steady growth of urban areas. Given the rapid expansion of cities and out-flow of population from central areas, many industries and factory sites that were once located in remote suburbs have become part of urbanized or potentially-urbanized areas, forcing them to shut down and leave the city. The experience of the East Midlands in England during the 1960s-70s, for example, confirms this point (Fothergill & Gudgin 2018). Driven by the widespread shift of households and production facilities to suburban rings and, thus, further extension of city boundaries, the central cities often contain to several housing areas, manufacturing industries and commercial properties that now stand underutilized or abandoned.

It is important to recognize the significant role of transport advances in stimulation of suburban development processes in different countries. In Japan, for example, urban growth is essentially transport-oriented, characterized by development and improvement of the railway network and expressway, particularly during the past 50 years. In the European context, most notably in Western Europe, suburban railways and trams followed by busses facilitated the expansion of urban population, settlements and industries to suburban peripheries. In US, however, steady process of suburbanization has been heavily reliant upon the increasing number of car users and commuting distances.

Broadly speaking, urban decentralization and growth occur in response to a range of cultural, economic, geographical and political circumstances. For example, geographically, the available space was much larger for the US and Chinese cities to sprawl compared to European and Japanese cities. In terms of cultural aspects, suburban sprawl in US has been characterized as an individual preference (Johnston 1982; Young 1995). Moreover, the structural pattern of urban growth is found to be profoundly different in each country because of different policies and political events. For example, in Eastern Europe and post-socialist countries, the fall of the Berlin wall and collapse of state communism is viewed as strong political force driving urban growth and relocation of industries. Similarly, the political reforms and marketization of economy in the post-Mao period in China have played significant roles in the steady expansion of Chinese cities over the past three decades. Table 8.2 provides an overview of urban growth process in US, Europe, Japan and China, highlighting the critical periods, breakpoints and spatial characteristics.

Table 8.1 An overview of urban growth trend in four international cases *(Source: the author)*			
Countries	**Period**	**Turning-point**	**Details**
The United States	▪ During 1950-70s	Transportation advances, new communication technologies and modernization of industries	- Doughnut effect; hollowing out of housing and industries from inner-urban areas - Strong decentralization of activities as a natural product of an inherent trait or cultural preference - Growth of new suburbs, driven by increasing number of private cars.
Western & Northern Europe	▪ Relative trend until 1950s with an extreme stream in 1960-80s		- Expansion of urban population and industries to suburban peripheries. - Shift from stable metropolitan to free-standing non-metropolitan regions.
Central & Eastern Europe	▪ Since early 1990s	The fall of the Berlin wall and collapse of state communism	- Out-flow of people, industries and employment in substantial numbers to the suburban and non-metropolitan areas. - Emerged as a free-market mechanism and chaotic privatization of space.
Japan	▪ During 1950-90s	Post-war economic recovery and industrial progress	- Significant growth of urban area both in population and size - Development and improvement of railway network and expressways - Land price boom and weak development control and planning system
China	▪ Most notably since the mid-1990s	The political reforms and marketization of economy	- Rapid pace of urbanization triggered by post-Mao economic growth, marketization of urban land and institutional/political forces - Critical role of local governments in urban expansion process

8.3.3 Demilitarization

In addition to industrial restructuring and urban growth as two dominant trends triggering the creation of brownfields, another type of brownfield sites has emerged as a legacy of another trend; namely 'demilitarization'. This trend has been most pronounced in many European countries, such as UK, Germany and France, and particularly across the post-communist countries since the turn of the 1980s and 1990s. Driven by rapid transformation of political boundaries in Europe, a vast tract of land, buildings and structures with former military uses became redundant and unused. The strong withdrawal of post-military areas has ensured increasing prominence for military brownfield issues, particularly in the European context.

8.4 Legal response to brownfield challenges

Having taken all of these definitional and causal issues into account, it is necessary to observe how different regimes have dealt with the challenges to brownfield sites. The brownfield-related challenges for governments are widespread, ranging from socio-economic and spatial challenges to environmental challenges. Having analysed different international cases, it is safe to affirm that the extent of environmental and public health challenges to brownfield development seems to be highly pronounced. This is predominantly justified on the grounds of pressing and pervasive concerns over environmental pollution and natural hazards that have increasingly focused policy-makers' attention over the past few decades. In response to these environmental concerns and averting public health risks, several countries have taken pragmatic approaches to the regeneration of brownfield sites. However, in this respect, there seems to be a strong disconnection and inconsistency amongst environmental and non-environmental policy sectors- in particular land-use policies- in most countries. The fragmentation of policy decisions made by these separate sectors often poses enormous obstacles to brownfield remediation and redevelopment, resulting in numerous failed practices.

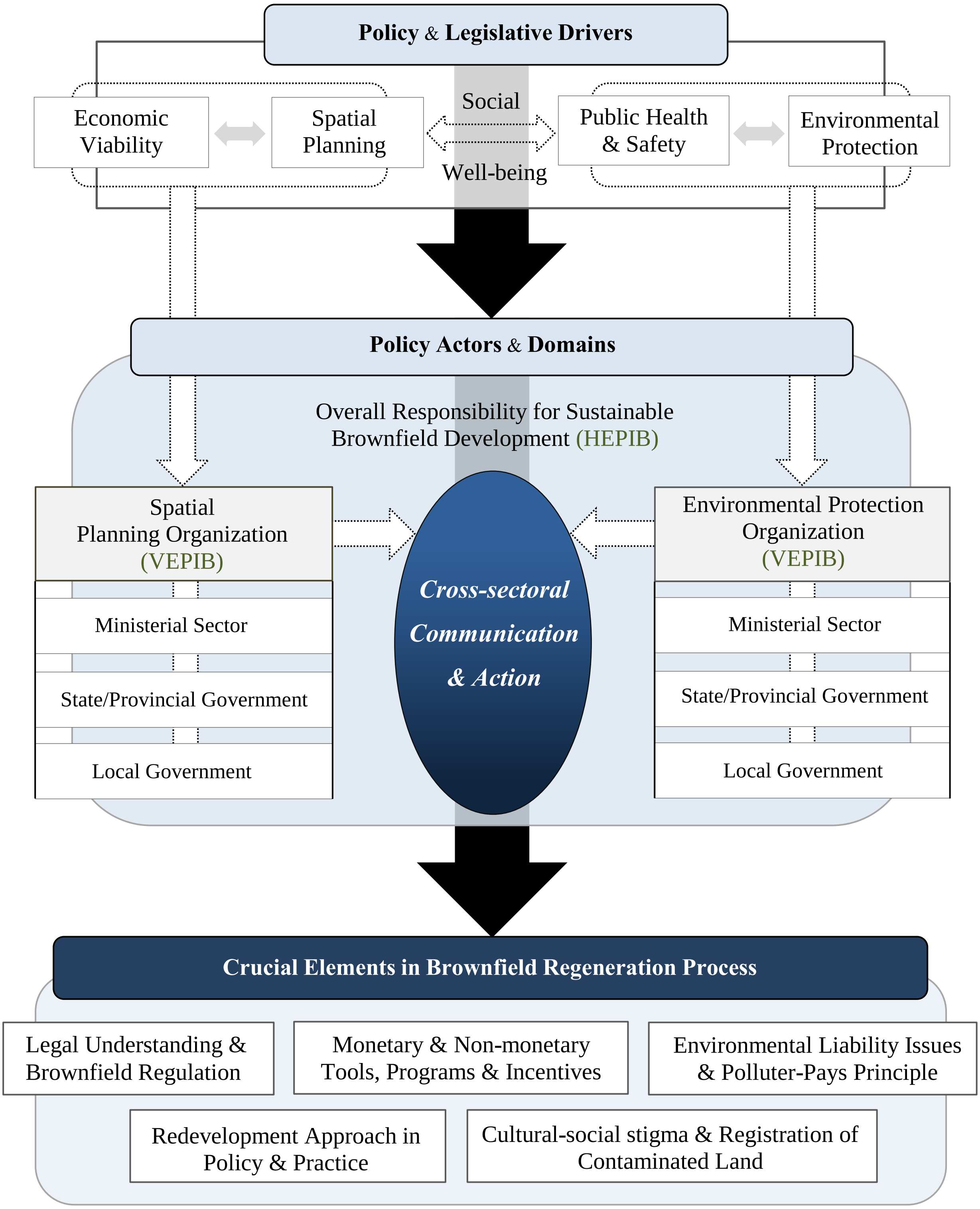
During the past decades, an immediate necessity has arisen for regeneration of contaminated sites across most developed countries owing to the marked decline in manufacturing activities and, thus, steady closure of polluting industries. The economic potential of these underutilised areas accompanied by environmental, spatial and social considerations demand for more rigorous approach across the brownfield policy development and implementation process. In China, for instance, the government's statistical data (MLR 2015) shows that over 100,000 factories have shut down since 2001, resulting in the emergence of over 2 million hectares of abandoned and high-risk contaminated sites that have been left untreated in major cities of China. Relying upon the same statistic, the size of such sites in China would increase 33–47 thousand hectares annually, following the continuous process of manufacturing relocation. In Japan, also, more than 1 million sites with a real or perceived problem of contamination were estimated to exist, covering a total area of over 400,000 hectares (Yasutaka et al. 2007). It is essential to note that this figure was recorded in 2007 and, thus, is likely to have increased given the persistent cessation of manufacturing activities across Japanese cities.

8.4.1 Development of 'EPI for Brownfields' (EPIB)

Chapter 3 introduced Environmental Policy Integration (EPI) as a framework originally developed by the European Union to raise environmental awareness and promote coherence across the policy development and implementation process. This framework aims at finding a collaborative and intra-governmental approach across various actors and policy sectors. Having highlighting EPI's principles and mechanism in Chapter 3, the research recognises a need for coordination of environmental and land-use planning policies to achieve sustainable urban development. Spatial-environmental integration policy has been increasingly practiced in several European countries, especially in the Netherlands where several supporting environmental programs have been developed for urban planning and policy development.

This study builds on the underlying principles of EPI and suggests an analytical tool for understanding brownfield regeneration pathways and processes, namely the Environmental Policy Integration for Brownfields (EPIB). The EPIB tool aims to explain the brownfield phenomenon from both policy and practice perspectives, and can be applied in different political or regional contexts. This thesis establishes a framework for the application of the EPIB tool (see Figure 8.1). EPIB is composed of three successive dimensions including; (1) legislative drivers, (2) governance, and (3) crucial elements in the development process. In each dimension presented within the tool, the experience of the four international case studies are discussed and analysed.

Figure 8.1 Brownfield regeneration explored through EPIB
(Source: the author)



8.4.2 Policy and legislative drivers to brownfield regeneration

Using the findings from the case studies discussed in Chapters 4-7 above, the EPIB tool suggests that brownfield regeneration is essentially driven by four main factors, namely economic viability, spatial planning, environmental stewardship and public health. Amongst these driving factors, there is a strong inter-relationship between ‘environmental protection and public safety’ drivers, and ‘economic growth and spatial planning’ drivers (Figure 8.1). Needless to say, the governments’ emphasis on spatial-economic development or their attempt to promote public health by enacting strict environmental regulations eventually contributes to the well-being of the surrounding community. Hence, it is impossible to argue that brownfield development at the policy level is influenced by any single driving factor in each regime. Drivers to brownfield policy are often recognized as an integration of some of the inter-related factors discussed above and depicted in Figure 8.1, taking account of social well-being as the ultimate objective.

The policy and legislative drivers to brownfield regeneration differ significantly across different regimes. In the US and Japan, for example, environmental concerns and public health issues are considered as the most powerful driving factors in the formulation of brownfield regeneration policy. For such countries, soil contamination has been the key trigger and accordingly environmental protection organizations are regarded as the key actors. It is important to take note of the fact that the environmental policy driver is often accompanied by strong economic motives in different regimes in respect of the clean-up and redevelopment of contaminated sites. For example, in the US, the emphasis of brownfield policy and activity has been largely placed on the provision of environmental liability programs, remediation tools and various economic incentives for stakeholders interested in redeveloping contaminated sites. In Japan, however, the economic perspective of development has been greatly overshadowed by the environmental and social problems created by the abandoned and high-risk brownfields. Perhaps for this reason, unlike in the US case, the Japanese government has not yet established a strong mechanism to enable and leverage private investment and real estate markets in brownfield projects. On the positive side, the social perspective of brownfield development plays a critical role in legislative decisions and actions in Japan which can be justified on the grounds of the strong stigma and negative image attached to environmental contamination in Japanese society.

From the European perspective, brownfield regeneration is justified on the wider ground of spatial priority given the sheer necessity for physical consolidation and demographic concentration of cities. The EU has recognized brownfield recycling and reuse as a planning solution adopted within the agenda of sustainable urban regeneration, rather than simply as environmental protection. In such contexts, the urban regeneration and land recycling agenda provides strong motivation for the development of brownfield policy. In the case of China, however, the value of land and economic drivers for urban development seems to be the main reasons that have encouraged the government to take a pragmatic approach to brownfield regeneration.

8.4.2.1 Organizational relationship at different levels of governance

A successful brownfield redevelopment process requires active and effective collaboration at all levels of governance, including the national (central or federal), state and local levels. Indeed, government's collaborative arrangement and engagement in brownfield projects are of great importance. Given the essence of brownfields, two policy sectors at the highest-level of governance (i.e. environmental protection and spatial planning ministries or departments) play a crucial role in multiple phases of brownfield redevelopment projects (as depicted in Figure 8.1). Building on the EPI's framework (see Figure 3.3. in Chapter 3), the idea of EPIB must be developed and put into action simultaneously along two dimensions of brownfield policy actors and domains, namely, Horizontal Environmental Policy Integration for Brownfields (HEPIB) and Vertical Environmental Policy Integration for Brownfields (VEPIB). The former is meant to underline the overall responsibility for sustainable development and environmental consideration- which is often done by national cabinet-, whilst the latter is to map and specify major environmental challenges across various ministerial sectors and their composite departments.

To achieve long-term brownfield planning goals (underlined by HEPIB), spatial and environmental sectors are required to develop a coherent structure based on shared and mutual authority, however with differentiated sectoral responsibilities. Relying upon the EPIB tool, this cross-sectoral communication is justified on the grounds of VEPIB as to how environmental issues and challenges pertinent to contaminated sites can be delivered within and across urban development legislation. In Japan, for instance, institutional barriers and differing directions within environmental planning visions (outlined by Ministry of

Environment) and land-use planning visions (outlined by Ministry of Land, Infrastructure, Transport and Tourism) have led to serious inconsistencies between brownfield-related policies in Japan, ending in failure in several redevelopment practices. The most famous example is the relocation project of Tsukiji Fish Market in Tokyo. In 2008, soil and groundwater under the proposed new site for the market were found to be highly contaminated. The relocation scheme has been delayed for over a decade, mainly due to the lack of communicative approach adopted by high-ranking officials during the decision-making process for construction and decontamination work of the site.

Furthermore, successful brownfield activities demand a collaborative management approach between the upper-level and lower-level of governments. Generally, the national government is responsible for providing holistic regeneration mechanisms and resources, based on which the state and local government jurisdictions can pursue a robust plan for brownfield activities. In fact, local decision-making must take place within a broad vision developed by the national policy framework. Needless to say, this situation differs between regimes. In Japan, China and many European countries, e.g. UK and Germany, the management authority and control of brownfield regeneration is given to the local and municipal governments. In China, for example, the local municipalities and their designated departments have the main authority and accountability in land-use planning and environmental regulation of brownfields, with limited connectivity to the central government. In the Chinese context, local government often deals with key issues associated with brownfield development, such as the environmental planning and practice guidelines for assessment and remediation of contaminated land. Conversely, the US government has taken a conventional top-down approach to tackling brownfield issues. By this means, the policy and funding challenge of brownfield regeneration in the US normally involves the federal and state governments, whilst local government deals with on the ground regeneration.

8.4.2.2 Crucial elements in the brownfield regeneration process

This research identifies a series of key elements that must be taken into account in the regeneration process of brownfield sites. As part of the overarching framework represented by the EPIB tool, it is necessary to analyse these elements at the level of both policy and practice. Hence, this section provides a comparative analysis of the existing legal and regulatory framework for brownfields in four international cases considered in the research. The key brownfield-related issues in planning policy and practice in US, Europe, Japan and China are briefly examined, and then the key success and failure factors in each case are summarized (see Table 8.3).

- ***Legal understanding and brownfield regulation***

It is important to recognize that brownfield legal definition and regulation are strongly correlated, and tend to be explained by the respective drivers of brownfield regeneration policies in different regimes. In other words, there is an ingrained linkage between the concept of brownfield and the legal response to it. This can be well understood by looking at how brownfields have been defined and tackled in each case study regime. In the US, for example, we can observe clarity of definition. Environmental concerns and health risks are regarded as the main redevelopment triggers, and accordingly the United States Environmental Protection Agency (US EPA) has been placed in charge of developing remediation programs. The narrowness of definition and redevelopment application of brownfield in US, however, has posed a policy problem for non-contaminated sites. Given the one-sided supporting legal system in favour of contaminated sites (under the narrow definition of brownfield), the private sector is relatively unwilling to engage in redevelopment of underutilized- but non-contaminated- land in US due to insufficient financial incentives for such sites. Although the US brownfield policy has been relatively successful in dealing with contaminated sites, it has had a knock-on effect on redevelopment of non-contaminated sites. The case of Detroit is particularly interesting because it shows how the policy-making practices have failed to fully address and rectify the pressing and pervasive problem of non-contaminated properties in the US.

In the UK, given the significance of land-use planning issues, brownfields -including both contaminated and non-contaminated lands- are managed by the Ministry of Housing, Communities and Local Government. This ministry was formed in 2006 replacing the Department of the Environment, Transport and the Regions (DETR), under the power of which both environmental and land-use issues pertinent to brownfields used to be addressed. Hence, brownfields have been tackled within a broader planning system in the UK, in comparison with environmentally-driven brownfield regulation in most countries, such as the US and Japan.

➢ ***Monetary and non-monetary tools, programs, and incentives***

Brownfield regeneration is largely reliant upon the real estate market and private investment. Therefore, to assist and promote the regeneration of brownfield sites, it is important to strengthen the linkage between the public and private sectors. Indeed, it is essential to ensure and facilitate the contribution of private landowners, developers, business communities, and non-profit organizations and entities in brownfield redevelopment projects. This will be more significant when the site is contaminated, given the potential environmental, physical, and socio-economic complexities. In general, brownfield-related incentive programs can be offered by governments in two different forms of support including: (1) monetary supports (e.g. tax credits, loans and technical assistance grants), and (2) non-monetary supports (e.g. environmental insurance, technical guidelines and liability relief provisions).

The US legislative system has been highly proactive in providing redevelopment tools for brownfield remediation and redevelopment. Over the past two decades or so, a great range of financial incentives and environmental liability exemptions have been provided under the comprehensive federal and state programs. Most of these supportive tools and fiscal incentives are usually granted through the State Voluntary Clean-up Programs (VCPs) as the most systematic approach to brownfields within the existing legal and regulatory framework in US.

In Europe, there has been a great effort to reduce barriers to private redevelopment of contaminated or potentially-contaminated land, more specifically for industrial and military brownfields sites. Some of the notable EU initiatives and policies in this respect are the establishment of a comprehensive data management system (ESDAC) and cooperative networks for contaminated lands (e.g. CABERNET, NICOLE), providing legal liability mechanism (ELD) and allocating a wide range of structural funding resources (ERDF and CF). Unlike the US and EU cases, land contamination is regarded as a new agenda in the Japanese and Chinese legal systems. Therefore, brownfield regulations in these two countries are still in their infancy. In Japan, despite the designation of grant exemptions within the legislative framework on contaminated sites (SCCA), there is no comprehensive funding mechanism stimulating land remediation and reuse. Similarly, the Chinese government provides no direct funds for regeneration of contaminated sites. However, in both the Japanese and Chinese cases, several technical guidelines and environmental standards have been developed by the government to assist land-owners and developers in remedial and removal measures.

➢ *Environmental liability issues and Polluter-Pays Principle*

Environmental and legal liabilities associated with land contamination and remediation have always been important concerns for brownfield land owners, developers and authorities. The liability issues induce risks for developers. The risks of profitable returns often cast serious doubts on the feasibility of redevelopment. As presented by EPIB, successful regeneration of brownfields demands serious consideration and application of the Polluter-Pays Principles (PPP) across various phases of the policy–making and implementation. The environmental liability and PPP have been thoroughly addressed within the US and EU legal and regulatory system since the 1970s. In the context of US, many federal legislative programs, e.g. RCRA, CERCLA, SARA and, particularly, Small Business Liability Relief and Brownfields Revitalization Act, together with the state-driven VCPs have been developed to provide liability protection for new land owners, purchasers and developers. In Europe, the Environmental Liability Directive (ELD) is the liability program offering widespread exemption tools for remediation of brownfield sites. However, since the enactment of ELD in 2006, the European Commission has been dealing with difficulties matching the local soil management legislation in several member states, e.g. UK, Germany, France and Netherlands, that have had their own liability system in place for a long time.

In Japan and China, the liability situation is relatively complicated. In these countries, the application of the PPP has become relatively difficult to achieve due to two main reasons. The first reason is associated with the existing legal and regulatory system at the national level of governance. In both countries, environmental liability is mainly handled by the local authorities, by prefectural governments in Japan and a small number of municipalities in China. In Japan, the national regulatory framework under SCCA does address the liability issue, however vaguely, whereas the Chinese soil remediation system (soil 10) provides no concise guidelines for identification of liability and associated penalties (Xie & Li 2010). The second reason is pertinent to the rapid pace of development and land-use change in such countries, most notably in the Japanese context. Given the compressed time-scale between active use and redevelopment of land, in several cases, it is not possible for local authorities to trace the original polluter and, as a result, innocent land-owners or developers are compelled to bear the entire remediation costs.

- ***Redevelopment approach in policy and practice***

The redevelopment approach to contaminated sites may vary from place to place, and accordingly the policy emphasis in each regime may be placed on different drivers. However, in general, two approaches are often adopted in brownfield redevelopment practices. The first redevelopment approach is the 'total clean-up approach', based on which the site is fully decontaminated, regardless of the type of end use (Kellett 1999). This is a widely-recognized approach, having been tried in many countries, such as US, Japan, China and several European countries. In such countries, the policy emphasis is placed on the reason why the land became contaminated, pursuing the primary objective to alleviate or eliminate the environmental and public health risks associated with brownfields. Following this environmentally-driven approach, most remediation projects in Japan and China are implemented using expensive and traditional 'dig and dump' method.

The second approach is commonly known as the 'risk-based' or 'suitable for use' approach, in which the main emphasis is placed on identifying and minimizing unacceptable risks on the basis of proposed end use (Burden 2009). This approach seems to have mostly evolved with justification for economic feasibility of redevelopment. Under the Seventh Environment Action Programme (7th EAP), the European Commission has called on the member states to address soil contamination issues developing targeted risk-based approach within their legal system until 2020.

- ***Cultural-social stigma and registration of contaminated land***

Another important issue that strongly correlates brownfield planning policy and practice is associated with public attitudes to contaminated land. Environmental contamination in most cultural and social contexts is viewed as a stigma (Eisen 2015). The stigma risk of contaminated sites often poses formidable obstacles to outlining a broad picture of the extent of land contamination in many countries. Some of these obstacles include;

- Difficulty in communication risk management to public, particularly amongst developers and new land purchasers,
- Land-owners' reluctance to register their contaminated lands
- Governments' reluctance to publicly reveal their records that results in inaccurate data and information on the history of contaminated land in many regimes,

- Depressed demands for brownfields from developers and real estate markets.

Bearing in mind the economic issues and lack of infrastructure investment, the cultural complexity of brownfields has presented a considerable challenge for different countries in terms of finding more effective methods in their planning system. In Japan, particularly, the stigma associated with brownfield is extremely noticeable, given ingrained public attitudes towards environmental problems (Otsuka & Abe 2008; Dixon et al. 2010). Under strong pressure from land-owners, the Japanese government has been forced to remove contamination records when a site is fully decontaminated, causing enormous difficulties in public accessibility of data and information on previously-contaminated sites. This can be mainly justified on cost grounds and economic value of land. In many European countries, governments have been dealing with the same problem. For example, in the late 1990s, the UK government abandoned the national registration of contaminated land for the same reason. However, the public registration has been resumed in England and Wales since mid-2000s, through establishing a comprehensive dataset for contaminated land register.

Amongst various international cases examined in this research, the US government has taken a relatively effective approach to eliminate the stigma and negative image of brownfields. Over the past two decades or so, the clear and straightforward environmentally-driven system for brownfields has significantly raised the public awareness of land contamination issues in the US. In addition, widespread fiscal incentives and implementation programs offered by the federal and state governments have maintained or even significantly increased the market demands for brownfield sites. Because of the supportive planning policy for contaminated land, brownfield sites have become valuable assets in the US and, thus, potential developers and investors tend to be attracted to them. Meanwhile, under the legal and regulatory system in US, brownfield land-owners are less concerned about the 'contamination label' and public registration of their land or properties. This can be justified on the grounds of the transparency of US system in disclosure of information as well as the resource provision and financial support to ensure the economic viability of land development.

8.5 Conclusion

This chapter has underlined the key issues regarding brownfield development in policy and practice based on a comparative analysis of four international case studies (i.e. US, Europe, Japan and China) considered by this study. In order to do so, the chapter attempted first to highlight the different concepts and terminologies of brownfield across different countries. Having reviewed the legal usage of the term brownfield, this study identifies three defining characteristics of brownfield sites, including; (1) environmental degradation, (2) physical deterioration, and (3) economic instability. Following the argument over brownfield definition and critical issues pertinent to it, the root causes of brownfield emergence were analysed and compared in different contexts. In this respect, as thoroughly discussed in the previous chapters, urbanization and industrial transformation are regarded as two marked trends and global processes that have played a leading role in the emergence of brownfield sites in almost every country. These two critical drivers are accompanied by another trend- namely demilitarization- that has largely triggered the creation of military brownfields, most notably in Europe. Having argued the definitional and causal issues, the chapter examined how different regimes have responded to the challenges associated with brownfield sites.

As previously discussed in Chapter 3, this study introduces EPIB as an analytical tool for understanding brownfield-related policy and practice across different nations and political regimes. Building on the EPI's framework, EPIB is proposed as an analytical and process-oriented approach to incorporate environmental concerns and goals in multiple phases of brownfield policy-making and practice. In order to achieve better practical outcomes, EPIB suggests that it is essential to build up cross-sectoral coordination and collaboration across various levels of governance, policy actors and stakeholders. This demands a balance between often contradictory environmental and non-environmental objectives and interests in brownfield redevelopment activities, both at one governmental level (HEPIB) and across disparate governmental levels and jurisdictions (VEPIB). To assist in establishing a comprehensive and flexible framework for brownfield regeneration process, this chapter identified a series of variables which drive the ultimate objectives throughout the process. Having analysed and compared each element within the experience of four international case studies, Tables 8.3 summarizes the critical factors in brownfield policies and practices through the analytical lens of EPIB.

Table 8.3 Critical success and failure factors in different brownfield policies and practices *(Source: the author)*

Countries	Success factors	Failure factors
The United States	- Clarity of legal definition and strong legislative actions - Widespread fiscal incentives and marketization of contaminated sites - Extensive non-monetary supporting programs, including technical assistance, liability relief and environmental insurance - Strong collaboration between national and state governments in brownfield management	- Narrowness of definition - Unattractiveness of non-contaminated land due to biased legal system in favour of contaminated sites - The limited role of local government
Europe	- Consideration of brownfields under broader land-use policy agenda, most notably in UK and Germany - Redevelopment tools and EU-wide funding supports - Extensive research-based and collaborative networks, setting up thematic strategies for brownfield regeneration - Risk-based and cost-effective remediation solutions	- Diversity of definition amongst member states - Institutional barriers and strong inconsistency between EU-driven and state-driven legal policies. - The lack of specific and unanimous EU-wide planning policy for non-contaminated sites
Japan	- Several technical guidelines and clean-up standards developed by the national and local governments - Significant engagement of local authorities in decision-making process of environmental measures - Land assembly and increasing value of brownfields, driven by long-running land readjustment methods and programs	- Narrowness of definition - Serious stigma associated with environmental contamination - Disconnection between land-use and environmental policies on brownfields - The lack of information on contaminated sites due to ineffective data management and land registration system - Traditional and costly remediation methods; 'dig and dump' - Superficial regulatory framework in terms of environmental liability issues
China	- Several technical guidelines and clean-up standards developed by the national government	- The lack of definition - The lack of unified applicable methods for identification and quantification of brownfield - Immaturity of national law for land contamination and brownfield regeneration - The lack of cooperative management system at national and state levels - Traditional and costly remediation methods; 'dig and dump' - Fragmentation of technical guidelines and clean-up standards within the national law - Limited understanding of liability issues and PPP principles, given the lack of legal and regulatory vision

PART III

CHAPTER 09

Brownfield Emergence in Iranian Cities

9.1 Introduction

As discussed in Chapter 1 and Chapter 3, one of the key objectives of this study is to enrich the subject area of brownfield emergence and governance in the broader international context. In order to set the current state of brownfield knowledge, Part II of this study, i.e. Chapters 4-8, looked at how the phenomenon of brownfield is understood and dealt with in policy terms across four nations and political regimes, namely the US, EU, Japan and China. Building on this narrative, Part III, i.e. Chapters 9-12, now attempts to address the central objective of the study as 'the development of an understanding of brownfields in Iran'. The final part of the thesis takes learnings from around the world which are intended to inform the analysis of the Iranian situation set out below.

This chapter shows how brownfields have emerged within the fabric of Iranian cities. To achieve this goal, the chapter is structured in five main sections. The first section, i.e. Section 9.2, attempts to build up a general picture of Iran. It briefly outlines the fundamental issues associated with the geographical situation, population, economic structure and administrative division of the country. Reviewing existing literature and official reports, Section 9.3 explores the process of urbanization in Iran, highlighting the prominent drivers and characteristics of rapid growth of urban areas from the early 20th century onwards. In Section 9.4, the chapter addresses issues pertinent to the structural transition of manufacturing industries in Iran. Having presented a broad overview on development processes of cities and industries, the next section underlines how these two processes have contributed to the occurrence and growth of brownfields as underutilized lands in different cities. It also presents some other types of brownfield sites, e.g. former military sites, prisons and local service areas, whose emergence are not directly related to the structural transformation of Iranian industries. The final section of this chapter explains the national policy initiatives for structural reorganization of distressed industrial and military areas in inner cities in Iran. The argument in the final two sections of this chapter, i.e. Sections 9.5 and 9.6, is essentially based upon personal interviews and site visits conducted in several large, medium-sized and small Iranian cities, e.g. Tehran, Shiraz, Sari, and Qaemshahr.

9.2 Profile of Iran

Iran, in southwest Asia (commonly known as the Middle East), is located between the Caspian Sea in the north, and Persian Gulf in the south, covering an area of 1.65 million square kilometres (SCI 1991). Iran shares its northern borders with Armenia, Azerbaijan, and Turkmenistan, its western borders with Turkey and Iraq, and its eastern borders with Afghanistan and Pakistan (Figure 9.1). Geographically speaking, Iran encompasses a variety of soils, topography and climate conditions. The wettest (960mm average annual rainfall in Gilan Province) and driest (82.8mm average precipitation per year in Yazd Province) areas are in the northern and central regions respectively (IMO 2014). Despite the wide spread of fertile land in the northern and western regions, only 20 per cent of Iran is potentially able to be cultivated and more than half of the country consists of arid desert and highland (Ferdowsian 2002). Meanwhile, almost the entire western region and a large part of northern Iran are covered by a complex of mountain chains. This climatic and topographic variation is the dominant factor, not only in spatial patterns of development and population distribution, but also in cultural diversity throughout Iran (Kamiar 1988; Ferdowsian 2002).

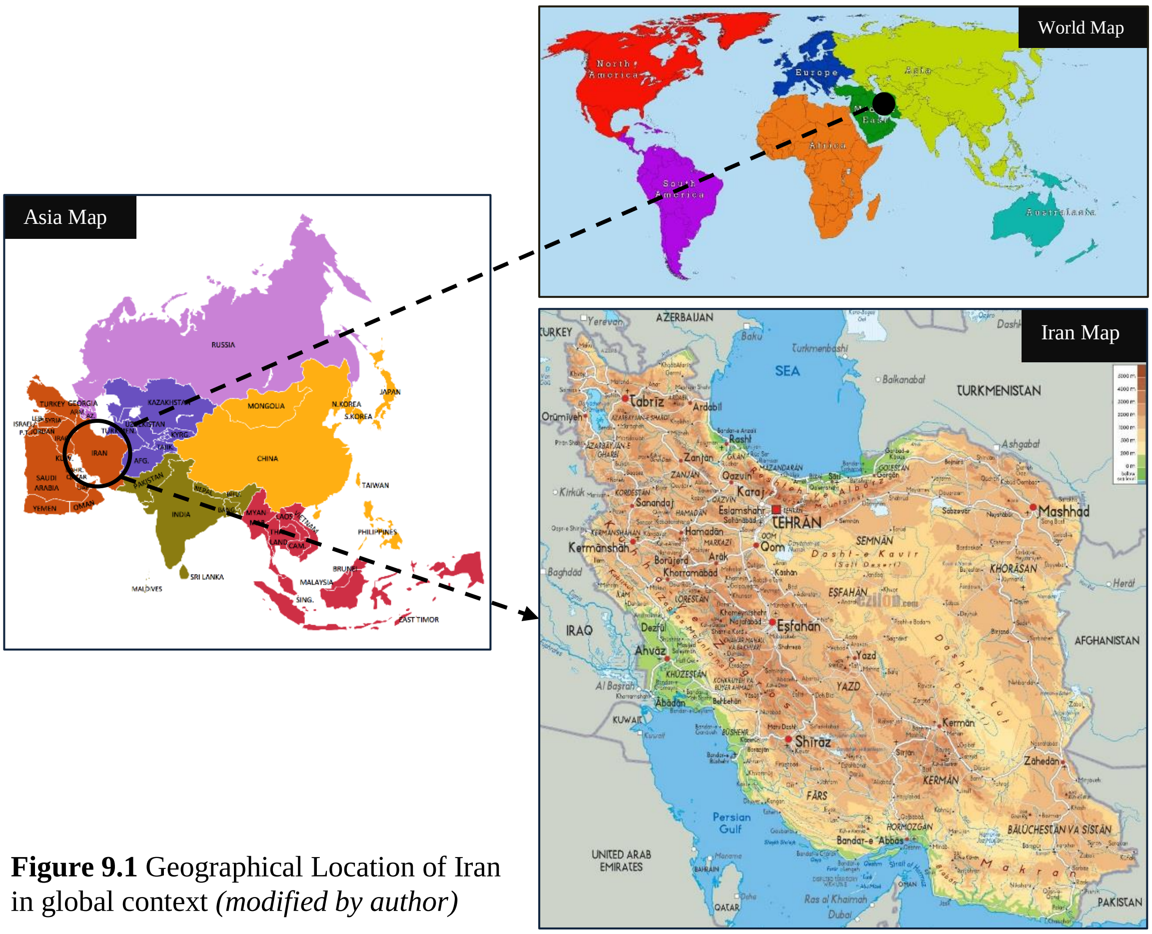


Figure 9.1 Geographical Location of Iran in global context *(modified by author)*

Table 9.1 Shares of main economic sectors in Iran's GDP growth *(Source: CBIRI 2017)*				
Sector	**Service**	**Industry and Mining**	**Oil**	**Agriculture**
Share	57.1 %	22.7 %	12.3 %	10 %

Iran's economy clearly relies on its natural resources, including oil and gas production. However, the service sector presently contributes to the most significant share of economic base and GDP growth in Iran (see Table 9.1). At the moment, Iran has an estimated population of 80 million people which ranks 10th in Asia and 18th in the world. As of 2017, the country's overall literacy rate is reported to be almost 88 per cent and the employment rate is over 80 per cent (SCI 2018). Administratively, Iran is divided into 30 provinces which are further divided into 429 counties, 1057 districts, 1245 cities, and 2589 rural districts (SCI 2016) (see Figure 9.2). Located at the foot of the Alborz Mountains, Tehran is the capital and biggest city of Iran, playing the central role in economic and cultural bases of the entire country. Tehran along with Shiraz, Isfahan, Tabriz and Mashhad are regarded as the most important metropolitan cities in Iran.

Figure 9.2 Administrative division of Iran
(Source: https://www.mapsofworld.com/)

9.3 Urbanization in Iran

9.3.1 Pre-revolutionary period

During the pre-revolutionary period, there were key political moments during which the Iranian urban system underwent significant structural and socio-economic transformations. The first transformation took place during the ruling period of the 'Qajar Dynasty' (1794-1925), when Iran experienced strong economic instability influenced by foreign powers, notably the British Empire and Tsarist Russia. Given the disability of the Qajar's central government, the economy of the country was put in the hands of Europeans, leading to the decline in the authority of the government (Ferdowsian 2002). Because of the long-lasting disconnection between the Qajar central government and Anglo-Soviet governments, Iran went into deepened economic crisis which reduced the country to a buffer state (Mclean 1979). Despite the stagnation of the urban development process driven by political and economic instability (Madanipour 1998), Iran's urbanization during the late Qajar years took initial steps towards a shift from traditional Islamic cities- characterized by a central Bazaar and Great Mosque surrounded by rural settlements- to modernized cities.

After WW I and the end of the Anglo-Soviet occupation period, the 'Pahalavi Dynasty' (1925-1979) came to power. With the rise to the power of Reza Shah, as the first ruler of the Pahlavi Dynasty, several modernisation projects and national development plans were developed laying an emphasis on capitalization, administrative centralization and economic development of the country (Madanipour 2006). Reza Shah nationalized foreign trade and made the USA and Germany the major partners (Knapp 1977). This exerted profound impacts on socio-economic and spatial structure of Iranian cities, in particular Tehran, as the capital city functioning as the core extracting surpluses from the peripheries (Farzaneh 2011). During the Reza Shah's ruling period, assorted urban development and planning laws were enacted to change the functional structure of cities. Development plans were mainly concentrated on physical transformation and restructuring of towns and cities, e.g. development of communication networks, modernization of military bases, road-widening projects and improvement of public buildings. The trans-Iranian Railway, as the first railway construction project in Iran, was developed in this period, during 1927-38.

Given the rapid modernization and centralization of economic activity during the Pahlavi period, Tehran became an open city absorbing population, jobs and services from other cities and rural areas, which established the basis for rapid expansion of the city. This process of urbanization was remarkable during the late 1930s and early 1940s. During less than a decade between 1932 and 1941, Tehran's population increased from 310,000 inhabitants to 700,000, i.e. by over 125 per cent (Madanipour 2006). It is important to note that given the occupation of Iran by the Allied forces in WW II and abdication of Reza Shah in favour of his son, the country encountered drastic economic decline. However, the demand of the Allies for urban facilities, expansion of professions and continued growth of the army and bureaucracy stimulated the urbanization in Iranian cities (Madanipour 1998). This was accompanied by rapid boom in residential construction and speculative land and property development, particularly during 1945-49 (Bharier 1971). As stated by Toshtzar (1985):

> *"Rapid urbanization in Iran since the early 1940s has resulted in a polarized and uneven settlement pattern, with a concentration of population and economic activities in Tehran and a few large urban areas and a relative decline and depopulation in most other urban areas."*

The uneven spatial development pattern of 1940s continued in the following years, accelerating in the 1950s-70s. The industrial and political changes occurred during this period played crucial roles in urbanization and stimulation of rural-urban migration in pre-revolutionary Iran. Starting from the late of 1950s and early 1960s and accelerated during the 1970s, Iran experienced rapid industrialization and labour-intensive industrial growth, dependent on financial support from advanced capitalist countries and growing revenues from oil sales (Toshtzar 1985). The dramatic rise in oil revenues and investment in infrastructural and industrial development contributed to immigration of population to Tehran and a few large cities (Graham 1979). The subsequent migratory process in this period was accompanied by population growth, mainly due to high fertility rates. Given the lack of a national-oriented development program and also the monopoly of foreign trade granted to the capital, the majority of production facilities, revenues and services were concentrated in Tehran. This issue had resulted in rapid population growth in Tehran, with simultaneous depopulation in most small and medium-sized cities and rural areas. During the 20 year period between 1956 and 1976, the total population of Tehran substantially increased from 1.5 million to 4.5 million, i.e. by 200 per cent (TURPC 1994). Indeed, the centralization of economic activities coupled with the remarkable inflow of population caused the city to expand into the surrounding land in all directions, creating an uneven development pattern of suburban villages and satellite towns, particularly in 1970s (Madanipour 1998) (Figure 9.3).

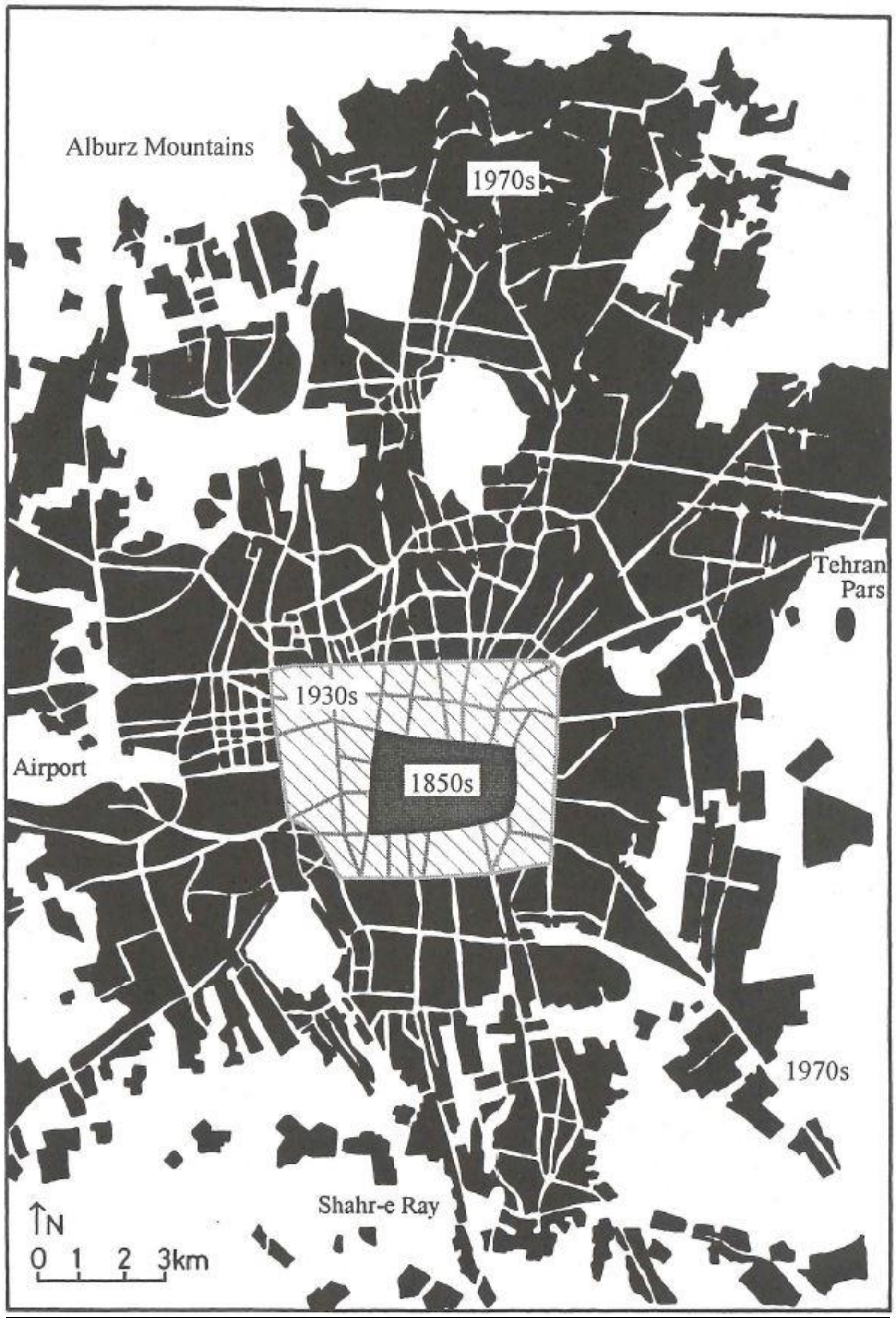


Figure 9.3 Expansion of Tehran in pre-revolutionary era
(Source: Madanipour 1998)

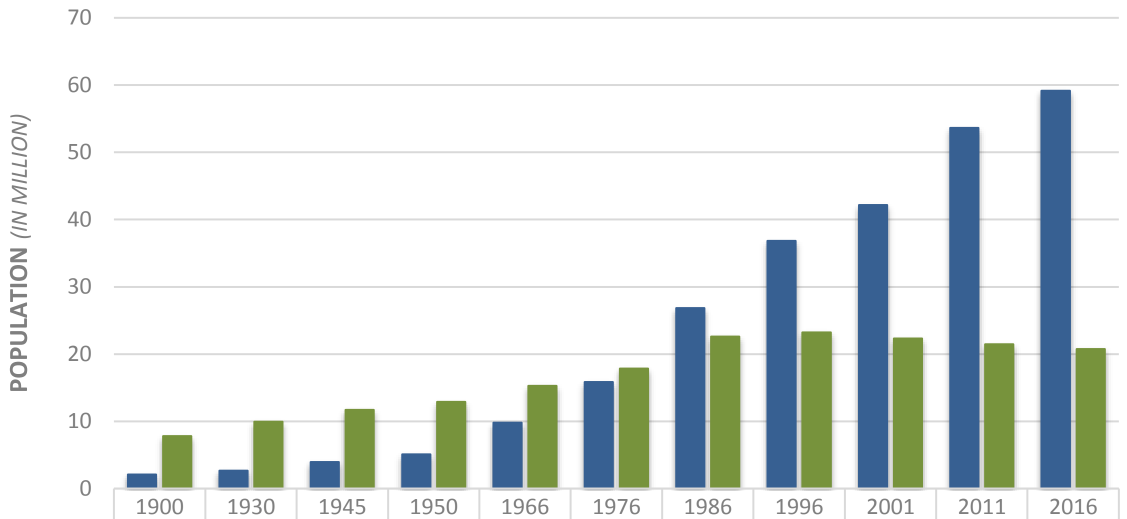
It is important to recognize the critical role of government land-use programs in the rural-urban migratory process and, thus, the physical expansion of large Iranian cities before the

Islamic Revolution. The most important program, in this regards, was the "Land Reform Act of the 1960s" which strongly stimulated the transition of capital from the agriculture sector to other sectors in the country. Although the initial intention of the reform was to facilitate structural transformation, the implementation of the program did not enhance any structural adjustment (Majd 1987; Ardeshiri 1996). On the other hand, under this reform, the acquisition process of agricultural land in Iran greatly changed, mostly in favour of old feudal magnates. By this means, the traditional system of agriculture, characterized by direct peasant-landlord relations, was replaced by capitalist agriculture, characterized by state-private land ownership and tremendous hangovers of feudal relations (Mohtadi 1990). In essence, land reform provided strong impetus to those peasants who had received insufficient or no land to migrate to large urban areas (Madanipour 2006). The release of surplus labour from rural areas brought by land reform, when combined with urban-urban migration from the small and medium-sized cities, led to the rapid expansion of Tehran and some other major cities in pre-revolutionary period (Toshtzar 1985).

9.3.1.1 Urban-rural population figures in pre-revolutionary Iran

At the start of twentieth century, the process and nature of urbanization in Iran was essentially characterized by the concentration of population in rural areas. Of the 9.86 million total population of the country in 1900, 7.79 million, i.e. 79 per cent of total population, were residing in rural areas (see Figure 9.4). The concentration of rural population continued in following decades. As shown by figures, there were no major rural-urban migrations in Iran until the mid-1930s and the growth of large cities was mainly driven by natural increase in their population (Toshtzar 1985). However, driven by political changes and the introduction of new economic development programs, we can observe a gradual trend of population shift from rural to urban areas from the early 1940s. The average annual growth rate of the urban population in Iran increased from 1.38 per cent during 1926-1934 to 2.37 per cent during 1934-1941, whereas the rural population declined from 1.36 per cent to 1.08 per cent over the same period (Toshtzar 1985). As discussed earlier, following the government's industrialization policies and land reform programs, the rural-urban migratory wave accelerated significantly in 1960s and 1970s. Official statistics indicate that (see Figure 9.4), the country's total population living in cities increased exceptionally from 5.11 million in

1950 to 15.85 million in 1976 (two years before the Islamic Revolution), which represents 19 per cent increase in total share of urban population over this period.



	1900	1930	1945	1950	1966	1976	1986	1996	2001	2011	2016
Urban	2.07	2.64	3.96	5.11	9.79	15.85	26.84	36.82	42.17	53.65	59.15
Rural	7.79	9.95	11.7	12.91	15.29	17.85	22.6	23.24	22.33	21.45	20.73

Figure 9.4 Urban and rural population in Iran from 1900 to 2016
(Source: Author's construct on data gathered from Bharier 1968; Bharier 1972; Toshtzar 1985; SCI 2011; SCI 2016)

9.3.2 Post-revolutionary period

In 1979, the Pahlavi Dynasty collapsed as a result of the Islamic Revolution. The revolution of 1979 has strongly transformed the political and socio-economic structure in Iran over the past 4 decades or so. Under this political transition, the Islamic regime came to power, placing emphasis on traditionalism, local bourgeoisie, nationalism and independence. With the advent of the revolution, a new form of economic development was introduced in order to reduce the foreign influence and oil-based global market forces. The new economic system was based on the development of local industries, decentralization of the administrative system and promotion of agricultural bases (Ferdowsian 2002). However, despite the initial intentions of the revolution to push ahead economic reforms thorough reducing the dependence on oil, after almost 4 decades oil still remains the principal source of revenue in Iran. In the aftermath of the Islamic revolution, in 1980, a long war with Iraq was imposed on Iran which lasted for 8 years. The war halted the process of economic development in Iran, leading to widespread physical destruction as well as decline in infrastructural investment and development.

The new regime initially intended to encourage the agricultural economy and prevent further urbanization of the country. With this intention, several organizations (e.g. Jahad-e-sazendegi) were developed by the government to control the rapid and disorderly growth of population in big cities, being much focused on development of rural areas and remote towns. However, the figures indicate that the urbanization process in Iran progressed even further after the revolution. Due to a series of economic difficulties and executive obstacles faced by the government, e.g. the deterioration of infrastructure, lack of industrial investment, high inflation and budget deficit, the private sector grew considerably in post-revolutionary Iran (Madanipour 1998). As a result, a large number of housing construction projects were developed through private investments, particularly at the periphery of large Iranian cities, e.g. Tehran, Mashhad, Isfahan, Tabriz and Shiraz, and their jurisdictional areas. This private-sector driven development was essentially promoted by the government's land-use policies. The most notable policy, in this regard, is the Urban Land Law (ULL) or the Act of 1987 that was put into practice during 1980s in an attempt to encourage urban land development, especially for housing projects.

ULL and such policies led to a sudden boom in the housing market and, thus, the high rate of population growth in most big cities in Iran. During just five years from 1987 to 1992, the amount of land taken for housing development in Iran increased by a factor of three (Ardeshiri 1996). As a result, large urban areas continued to grow more rapidly after the revolution, gaining population from rural areas. As shown in Figure 9.4, during a 40 year period between 1976 and 2016, the proportion of population living in urban areas in Iran increased remarkably from almost 16 million to 60 million, i.e. by over 275 per cent. During the same period, the share of urban population increased by 37 per cent. Based on the 2016 population census, almost 74 per cent of total population in Iran now reside in urban areas.

Another important urban trend that started before the revolution, but considerably accelerated in post-revolution years, is associated with the formation of new suburbs and small towns around large cities. Before the revolution the free-standing towns were built away from cities mainly based on political and military objectives, whilst since 1979 the main emphasis has been placed on the control of population density in large metropolitan areas (Ziari 2006). Therefore, promoted by government housing policies, e.g. Mehr Housing Project, a large amount of affordable housing has been provided in new towns and small cities to absorb the surplus population of large cities and overcome the urban housing problem, particularly for vulnerable and low-income families. According to the Statistical Center of Iran (SCI 2016), the number of cities and towns in Iran is recorded to be 1245 in 2016, against 617 cities in 1996 and 373 cities in 1976. Some of the most notable suburban towns that have been built after the revolution are Parand, Hashtgerd and Pardis on the periphery of Tehran, Baharestan and Fooladshahr on the periphery of Isfahan, and Sadra on the periphery of Shiraz (see Figure 9.5).

Figure 9.5 Rapid expansion of suburban towns in Iran; Pardis in Tehran Province (top) and Sadra in Fars Province (bottom)

(Sources: MRUD 2015; MRUD 2017)

Given varied employment opportunities, industrial establishments and infrastructural development provided by the government and also driven by the inflation of housing prices in large cities, a large amount of population has been attracted to suburban areas and small towns from the mid-1990s onwards (Ziari & Gharakhlou 2009). This has resulted in an unbalanced and scattered distribution pattern of population on the periphery of large cities. For example, in 1956 over 43.5 per cent of the total population in Iran were concentrated in five metropolitan areas, including Tehran, Mashhad, Isfahan, Tabriz and Shiraz, whereas in 1996 these cities contributed to 33 per cent of the total population of the country (Ziari 2006). Despite the fact that most of these new suburban towns were successful in offering sufficient affordable housing, they have been dealing with a series of functional problems, such as inferior housing quality, social conflicts, the lack of proper location and limited accessibility to public services (Jamali & Dadashzadeh 2016).

9.3.2.1 Urban growth pattern of post-revolutionary Iran

In general, the growth pattern of Iranian cities has taken place in three tiers of development in the post-revolutionary period, i.e. from the late 1970s onwards. Over the first decades after the revolution, Tehran was the primary city attracting population from other areas. After the revolution and war, a period of reconstruction started in the late 1980s and lasted for most of the 1990s which represents a number of efforts at urban planning and development in Tehran (Madanipour 2006). Most notably, comprehensive development plans were formulated as key municipal policy documents to control population growth and concentration through setting limits within a strict administrative boundary. However, these strategic plans have had little success mainly due to the lack of implementation tools and limited financial resources for local government (Madanipour 2011). The continued growth of population and housing coupled with the development of inner-urban infrastructure have contributed to higher densities and overcrowding in Tehran and outside its administrative boundaries. In other words, the city is witnessing urban sprawl, but at high density. The city of Tehran has grown outwards developing several satellite towns on its periphery, e.g. Pardis New Town, with high concentration of high-rise residential buildings (see Figure 9.5).

High-density growth of population in Tehran continued in following years, but extended to other four major cities, including Isfahan, Shiraz, Mashhad and Tabriz, as the second tier of growth. Due to a high fertility rate, rural-urban migration and continued concentration of economic activity, these large metropolitan cities have witnessed rapid growth in both population and size. Between 1975 and 2006, the population and total land areas in Isfahan increased by 142 and 145 per cent, respectively (Soffianian et al. 2010). Similarly, in Shiraz, from 1976 to 2005, the population increased by 188 per cent and the built-up area expanded by 181 per cent (Sarvestani et al. 2011). However, the process of physical expansion in these five major metropolitan cities has become relatively stabilized or continued at a slower pace (see Figure 9.6). For example, during 2001-2006, the built-up area of Isfahan expanded by 174 per cent, whereas this figure has reduced significantly, reaching 15 per cent during 2006-2011 (Ghadami & Yousefiyan 2015).

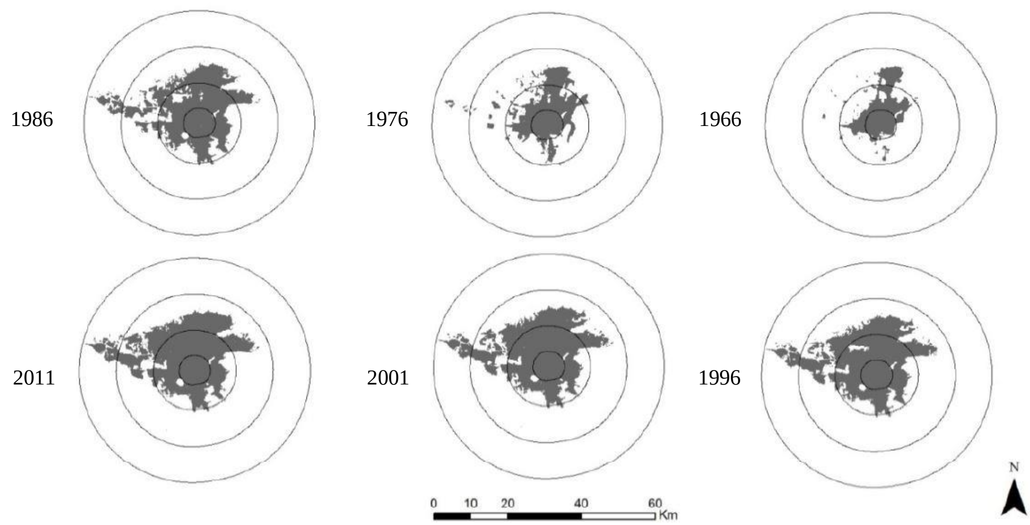


Figure 9.6 Urban growth in Tehran, 1966-2011
(Source: Seifolddini & Mansourian 2014)

Given the high population density in key cities and associated environmental problems, the small and medium-sized cities in Iran have started to grow dramatically, both in population and built-up area. This is the third tier of growth in Iranian urban system after the revolution that has mainly occurred from the early 2000s onwards. For example, in Yazd, the capital of Yazd Province, built-up areas climbed from 7465 ha in 2000 to 13802 ha in 2009, i.e. by almost 85 per cent (Shahraki et al. 2011). Such medium-sized cities in Iran, have grown beyond administrative boundaries with agglomeration of housing development, services and infrastructure in inner-urban areas (Figure 9.7).

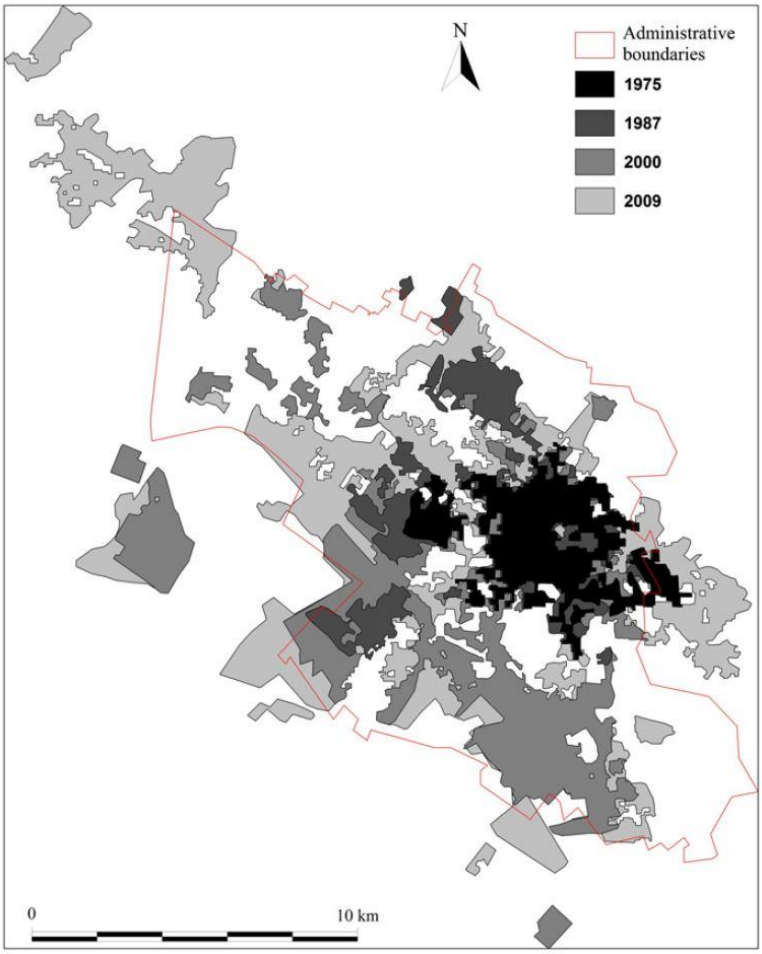


Figure 9.7 Urban growth in Yazd, 1975-2009
(Source: Shahraki et al. 2011)

In general, there are two key issues that characterize the nature of spatial development in different Iranian cities. The first issue is associated with the topographic characteristics of cities in Iran. In fact, the urban growth pattern of Iranian cities has been highly influenced by the geographical diversity of the country. This can be argued in terms of form and structure of urban land development. In desert cities, such as Yazd, both agricultural and urban expansion have been strongly reliant upon the development of water supplies because of the very arid climate (Shahraki et al. 2011), whilst in coastal cities along the Caspian Sea, e.g. Sari and Rasht, availability of water has not been the critical issue (see Figure 9.8). Meanwhile, the nature of topography is viewed as an important contributing factor in the growth pattern of Iranian cities (Habibi 1996). In cities, e.g. Tehran and Shiraz, the natural landscape is a limiting factor in physical expansion, while in cities, e.g. Yazd and Isfahan, it acts as a stimulating factor. For example, from northern and eastern sides, Tehran is surrounded by rugged landscape and mountainous terrain posing a physical obstacle to the growth of built-up areas. Conversely, the nature of such cities as Yazd and Isfahan is characterized by the flat terrain and desert landscape, allowing them for boundless expansion.

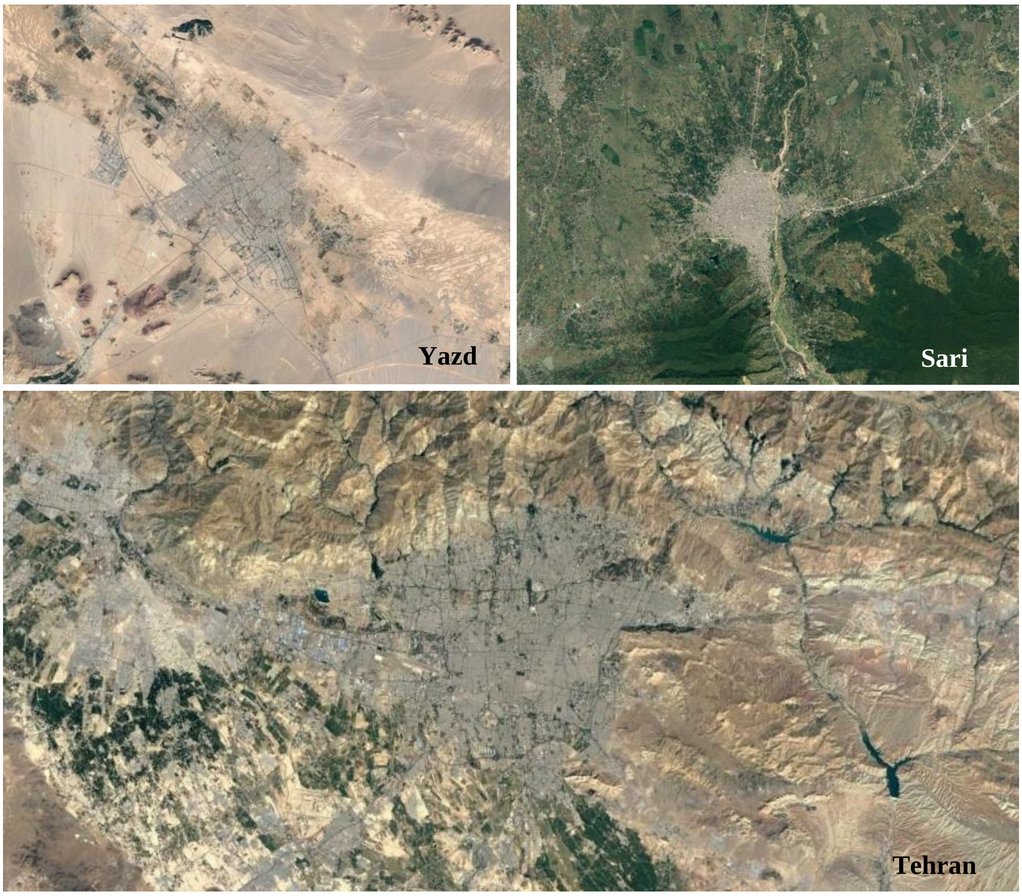


Figure 9.8 Topographic diversity of Iranian cities
(Source: Google Earth)

The second key issue is pertinent to the role of transportation development in urban growth process. In Iran, there is an apparent absence of a coherent solution to the problems of public transport (Farzaneh 2011). Unlike most developed countries, it seems that the rapid and uneven expansion of urban area in Iran has not been much influenced by the growth of public transport, e.g. buses and trains. Since the late 1990s, 5 major Iranian cities, including Tehran (in 1999), Mashhad (in 2011), Shiraz (in 2014), Tabriz (in 2015) and Isfahan (in 2015), began developing rapid subway systems. However, the figures show that urban growth in these cities emerged years before the development of their suburban subway networks. In fact, the growth rate of built-up areas was steeper during 1970s-80s, compared to the years of 1990s-2000s when the rapid transit system was introduced in Iran. For example, between 2000 and 2014, urban built-up land grew by less than 6 per cent in Tehran, whereas this figure is recorded to be almost 15 per cent during 1973-1985 (Kaviani et al. 2017).

Despite the limited role of public transport in the urban growth process, the increasing number of car users has contributed greatly to the physical development of cities in Iran, particularly in densely populated and traffic congested cities such as Tehran (Figure 9.9). Most notably since the late 1990s, Iranian transport and urban growth system has been heavily auto-oriented. Driven by rapid development of the automotive industry, the number of private cars in the entire country increased substantially from 2.5 million in 1999 to 6.1 million in 2006, by almost 2.5 times (Poorjafari & Yue 2012). This trend has contributed to the increasing volume of personal daily trips generated throughout the metropolitan areas, leading to further expansion of urban boundaries in Iran (Soltani & Ivaki 2011).

Figure 9.9 Traffic congestion in Tehran
(Source: MRUD 2017)

9.4 Structural transformation of manufacturing industries in Iran

As discussed in the previous section, the initial steps towards industrialization in Iran were taken during the first Pahlavi period (1921-1941). Beginning in the late 1920s, manufacturing industries began to grow gradually, but steadily, in Iran. Following major institutional changes and several modernisation programs, the government started making direct investments in manufacturing industries and development of various production lines. Between 1932 and 1941, the budgetary allocations to the industrial sector in Iran increased by over 60 times which made the industry the second largest recipient of government investment (Toshtzar 1985; Hakimian 2012). Driven by government promotion programs during the late years in the first Pahlavi period (from mid-1930s to early 1940s), several manufacturing plants were established in major Iranian cities, particularly in Tehran. This led to a marked increase in manufacturing production and employment, most significantly over a 4 year period between 1934 and 1938. During this short period, 53 large manufacturing plants were established in Iran employing over 27,000 workers (Bharier 1971). This was unprecedented in that period, considering the fact that only 20 large factories were established during 1926-1933 creating less than 7,000 industrial jobs (Bharier 1971). Further small and medium-sized manufacturers, in total 265 manufacturing plants were established during 1930-1940 employing over 47,000 workers, within which more than 62 per cent of employment and 27 per cent of plants belonged to textile industries (Hakimian 2012). These figures exclude the government cement factories.

After the end of WW II and political transition of the Pahlavi Dynasty, the economic structure in Iran began changing significantly. The political change within the Dynasty was followed by the nationalization of oil and its associated economic collapse ended with a coup in 1953 that created much larger shares of oil exports for Iran (Esfahani & Pesaran 2009). Due to the growing oil revenues as well as financial aid and technical support received from foreign countries during the period under Mohammad Reza Shah (the second ruler of the Pahlavi Dynasty), the country experienced a rapid industrial expansion on a large scale. Unlike the early stages of industrial development in the first Pahlavi period which was predominantly dependent on local investments, the new government encouraged investment from foreign manufacturing enterprises and companies. In 1955, the government introduced a new legal Act, *"Law for the Attraction and Protection of Foreign Investment"*. This law provided a strong stimulus to the inflow of foreign capital into the Iranian economy for industrial investment (Toshtzar 1985; Karshenas & Hakimian 2012).

During the 1960s and 1970s, the process of industrialization and growth of the manufacturing sector accelerated remarkably in Iran. During the period 1966-1976, almost 2000 manufacturing firms were established in the country (Ardeshiri 1996). From 1963 to 1976, the level of non-oil GDP per capita grew at unprecedented rates that averaged 8.6 per cent annual growth (Esfahani & Pesaran 2009) (see Figure 9.10). The process of industrial growth during this period was mostly dominated by the light consumer goods industries, e.g. food, textiles and clothing, which accounted for over 75 per cent of total production in the mid-1960s (Karshenas & Hakimian 2012). However, we can observe a gradual decline in the manufacturing output of light industries with simultaneous growth in heavy manufacturing sectors in Iran since the mid-1960s. For example, textiles and clothing industries contributed to almost 33 per cent of total share of manufacturing output in 1964 which decreased to less than 21 per cent in 1976, whereas the share of metal and steel manufacturing output increased from 5 per cent to 19 per cent over the same period (Karshenas 1990).

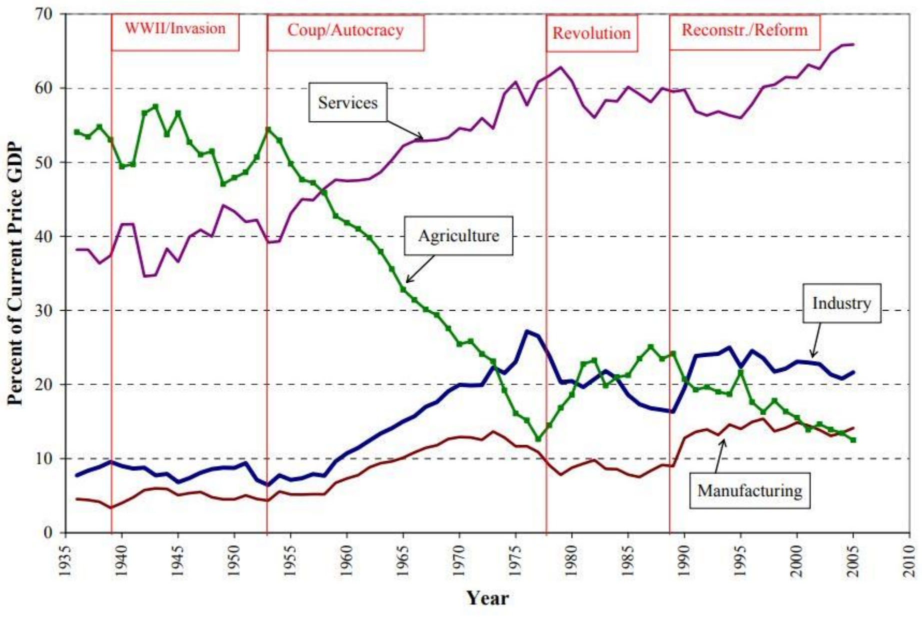


Figure 9.10 Structural change in different economic sectors (non-oil value added production); 1935-2009 *(Source: Esfahani & Pesaran 2009)*

Following the Islamic revolution of 1979 and the outbreak of a highly destructive war with Iraq, Iran's economy witnessed a major setback. The initial action taken by the government of the Islamic Republic was to take control of major industries through appointing state managers for many private enterprises. This was done under a national law, *The Law for Protection and*

Development of Iranian Industries, enacted in 1979. Under this law, three groups of industrial firms came under the direct control of the government including; (1) heavy and strategic industries, e.g. steel, automobile and aerospace manufacturing industries, (2) industries belonging to those linked to the Pahlavi regime, and (3) bankrupt and debtor industrial firms (Rahnema 1995). Following the nationalization of major industrial firms, private investors became reluctant to invest in the manufacturing sector due to insecurity resulting from political conflicts as well as the much higher profitability of commercial and real-estate activities (Rahnema 1995).

Furthermore, right after the revolution, the US government imposed strong economic sanctions against Iran. The sanctions had devastating effects on Iran's economy, causing a serious shortage of imported materials and an abrupt departure of foreign investors, particularly in heavy manufacturing industries. The US embargo together with a series of inter-related factors, e.g. declining oil revenues, exodus of many skilled professionals and adoption of adverse economic policies, manufacturing industries went into drastic decline in terms of both production and employment in post-revolutionary Iran (Pesaran 2000; Esfahani & Pesaran 2008). The average annual rate of growth of manufacturing output declined from 12 per cent during the period 1965-77 to just over 1.9 per cent during the period 1977-93 (Hakimian & Karshenas 2000). Similarly, the annual growth of manufacturing employment fell from 8.9 per cent to 2.8 per cent over the same period (Hakimian & Karshenas 2000).

After the end of the eight-year war with Iraq, however, Iran's economic structure showed signs of revival and reform. As can be seen in Figure 9.9, after the cease-fire with Iraq in 1988, manufacturing industries in Iran began to recover gradually. The process of post-war reconstruction was strong, particularly during the first four years. This period is mainly characterized by increasing oil revenue, infrastructure development, gradual liberalization of foreign trade, adoption of privatization policy and growth of private investment (Amirahmadi 1990; Amuzegar 1992; Hakimian & Karshenas 2000). The robust economic growth in the post-war recovery period facilitated a rapid increase in establishment of manufacturing industries in Iran, most notably between 1989 and 1992. For example, during this 3 year period, the share of manufacturing value added in GDP increased at an unprecedented rate, by over 5 per cent (World Bank 2018c). However, this recovery period was short-lived due to several reasons, such as falling oil revenues, a sharp rise in inflation, adverse government policies in multinational market controls, accumulation of foreign debts and particularly intensification of economic sanctions (Esfahani & Pesaran 2008). Based on statistics compiled by the World Bank (2018a), GDP growth rate in Iran was recorded to be 13.6 per cent per annum in 1990 which decreased to 1.35 per cent in 1997 and -7.4 per cent in 2012. However, following the lifting of major economic sanctions on Iran in 2015, the GDP growth rate soared from -1.3 per cent in 2015 to 13.4 per cent in 2016 (World Bank 2018a).

Observing the structure of Iran's economy over the past two decades, it can be seen that manufacturing industry has been following two marked trends. The first trend is associated with a considerable drop in manufacturing activity, against the rise of services and the informal sectors. In general, services have been acting as the driving engine of Iran's economy in post-revolutionary period. The share of services value added in GDP increased by 4 per cent between 2001 and 2016 (World Bank 2018b). In contrast to services, the share of the manufacturing sector declined by over 5 per cent during the same period (World Bank 2018c). Mainly because of economic crises, a large number of manufacturing factories have closed or substantially squeezed their production bases in different Iranian cities. The notable examples are Arj (electric machinery and home appliances), Zagros Khodro (automobile manufacturing), Polyacryl Esfahan (polyester and textiles manufacturing), Foolad-e Sahand (steel manufacturing), Pars-e Ghoo (vegetable oil manufacturing), and the Varamin Sugar Refinery Factory which have all gone bankrupt and, thus, ceased their operations over the past 5 years. This steep decline in manufacturing activity had forced a large proportion of the labour force in Iran into the service sector. From 2003 to 2017, the share of service sector in total employment of the country grew by nearly 8 per cent (World Bank 2018d).

The second trend is pertinent to the internal restructuring within the manufacturing sector in Iran which is characterized by the steady decline of light industries, e.g. textiles and food, in favour of heavy industries, e.g. steel, machinery and chemical industries. This structural transition from light to heavy manufacturing has started almost a decade before the Islamic revolution in Iran, but gathered much faster pace in post-revolutionary period, particularly over the past two decades or so. According to a study (Yousefi et al. 2013), the share of light industries value added in manufacturing sector declined by over 16 per cent between 1995 and 2009 (see Table 9.2). The largest drop belongs to the textiles and clothing industries. Another study (Zonooz 2013) shows that the share of textiles industries in overall manufacturing activity declined by nearly 17 per cent from 1990 to 2008, whilst the share of heavy manufacturing such as chemicals and machinery industries increased by 10 per cent and 5 per cent respectively during the same period. These figures imply that manufacturing activity in Iran has become relatively concentrated on heavy industries, which can be justified on the ground of high production demands, inexpensive oil and gas resources as well as restrictions on the import or procurement imposed by economic sanctions.

Table 9.2 Composition of heavy and light industries in manufacturing activity in Iran; 1995-2009 *(Source: Yousefi et al. 2013; translated and elaborated by author)*

	1995		2000		2005		2009	
	VA (%)*	*Employment (%)*	*VA* (%)*	*Employment (%)*	*VA* (%)*	*Employment (%)*	*VA* (%)*	*Employment (%)*
Light Industries**	32.1	43.78	20.78	40.03	18.24	35.32	15.69	32.13
Heavy Industries***	67.9	56.22	79.12	59.97	81.76	64.68	84.31	67.87

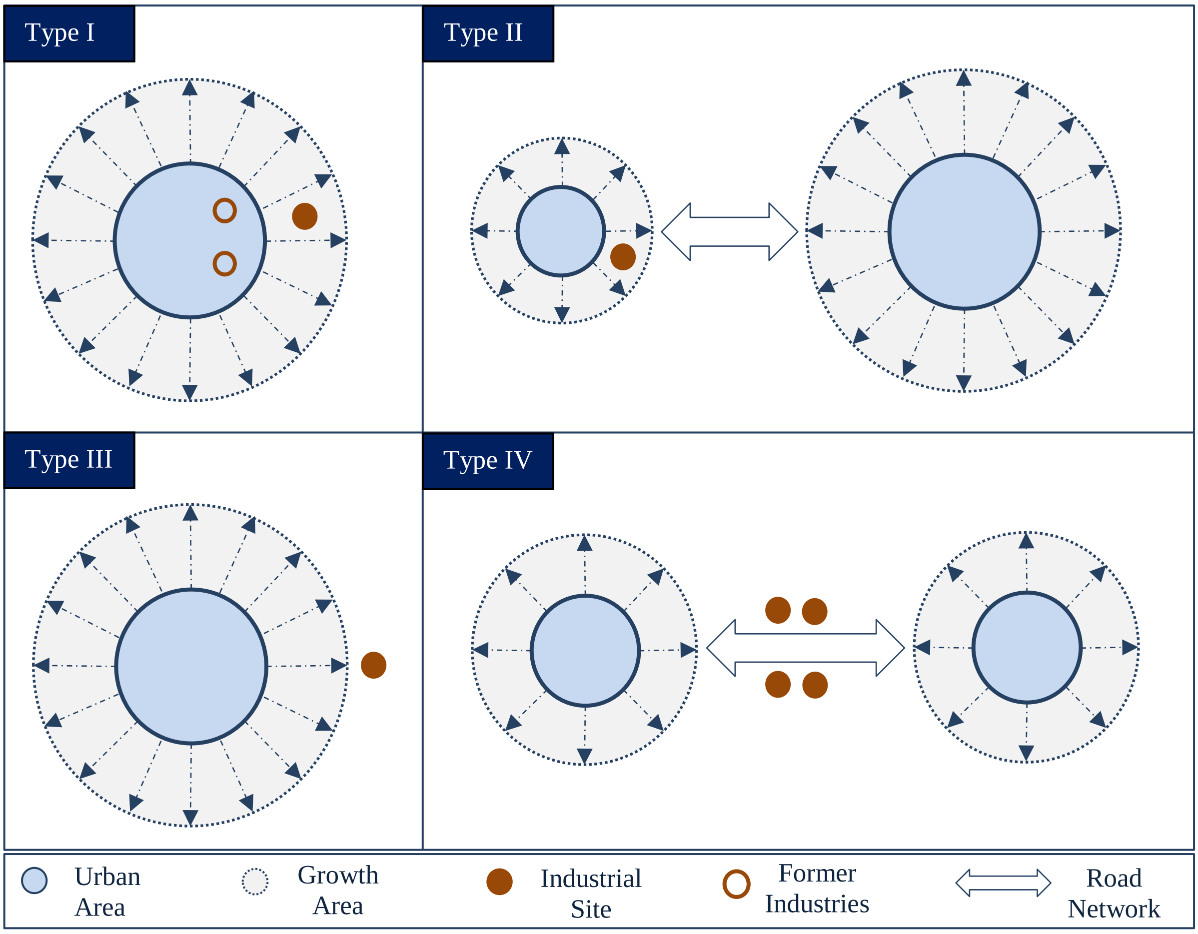
Notes:
**= Value Added*
*** Including food and beverages, tobacco, textiles and clothing, publishing, leather, wood, rubber and plastics, furniture and recycling industries.*
**** Including paper production, petroleum production, chemical, iron and steel, office machinery, electric machinery and appliances, medical equipment and transport industries.*

9.4.1 Spatial distribution of industries in Iranian cities

Generally speaking, the spatial organization of manufacturing plants in Iranian cities can be categorized in four major types:

- ***Type I;*** comprises the former industries located in core urban areas (see Figure 9.11). Most of these types of manufacturing plants belong to light industries established in Pahlavi period. Given the rapid growth of cities coupled with the shrinkage of light industries over the past decades, a large number of old factories shut down or relocated to other areas. Some of these manufacturing sites have been already redeveloped and many of them are still unused. The notable examples are Shiraz Textiles Manufacturing (in Shiraz) that was established in 1920s, Nassaji Mazandaran Textiles Manufacturing (in Qaemshahr) established in 1930s and Narges Vegetable Oil Manufacturing (in Shiraz) established in 1950s.

Figure 9.11 Typology of former and present industrial location in Iranian cities
(Source: the author)



➢ ***Type II;*** that were initially located away from major large cities, such as Tehran, Shiraz and Isfahan (see Figure 9.11). The growth and regional development of such industries has been followed by the rapid urbanization process in Iran. These types of industrial sites were mainly developed in non-urbanized areas, but given the rapid growth of urban areas they have become now part of urbanized regions. These newly-developed regions range from large cities, e.g. Karaj at the peripheries of Tehran, to small or free-standing towns, e.g. Fooladshahr and Baharestan at the peripheries of Isfahan. The majority of such manufacturing plants have been established after the Islamic revolution in Iran. Some of the notable examples of this type of manufacturing industries are Simindasht Industrial Centre in Karaj, Steel Manufacturing Centre in Fooladshahr and several lumber industries in Baharestan.

- ***Type III;*** includes newly-established industries located in the vicinity of large cities (see Figure 9.11). These types of industrial sites have been mostly developed around a large metropolitan city, with no or limited connectivity to other cities. Shiraz Industrial Park, established in the early 2000s, is a good example representing this model of industrial organization in Iranian cities. This large-scale industrial park, with an approximate area of 1,400 ha, is regarded as the biggest and most important manufacturing centre in Shiraz, encompassing a wide range of heavy and light industries, e.g. steel, chemical, food processing and integrated electric industries.

- ***Type IV;*** represents those manufacturing industries that have been strategically developed along road networks connecting two cities (see Figure 9.11). These industries were mostly established by private sectors after the Islamic revolution. They are either located between two large cities, e.g. Shams-Abad Industrial Park along Tehran-Qom Road (see Figure 9.12), or between one big and one small cities, e.g. Parand Industrial Park along Tehran-Robat Karim Road, or between two small or medium-sized cities, e.g. Tabarestan Steel Foundry along Qaemshahr-Sari Road (see Figure 9.13).

Figure 9.12 Shams-Abad Industrial Park established in 1990s along the Tehran-Qom Road at the southern periphery of Tehran
(Source: Author's elaboration on photo from http://shatanews.ir)

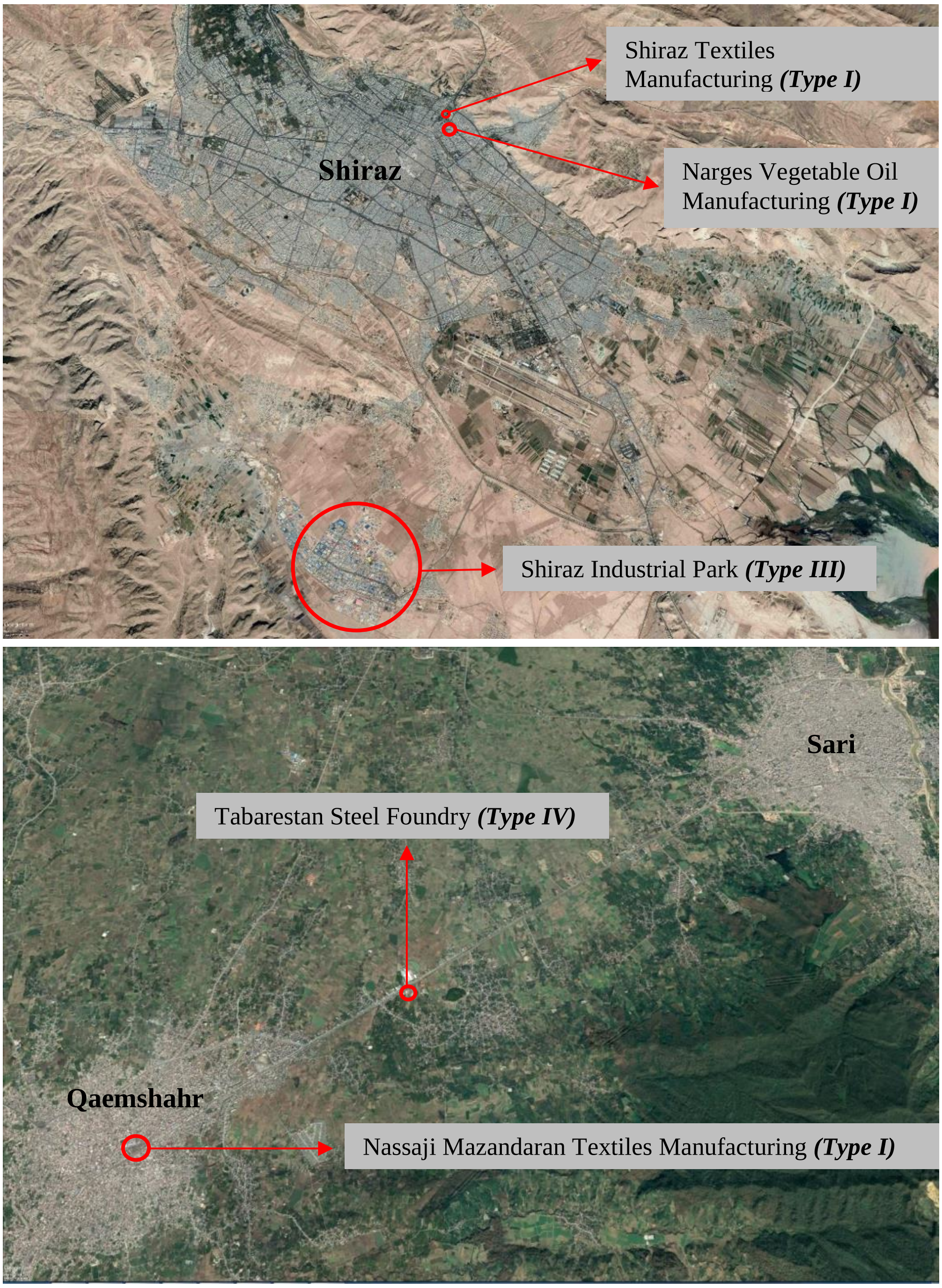


Figure 9.13 Location of industries in and around Shiraz and Qaemshahr
(Source: Author's elaboration on maps from Google Earth)

9.5 Brownfield emergence in the context of Iran

There is, to date, no recognition of the term brownfield in Iran (this will be discussed further in the final chapter). However, following the analysis of international cases in previous chapters, two distinguished categories of brownfield sites, including the industrial and institutional sites, are discussed in this section.

9.5.1 Former industrial sites

Following the restructuring of manufacturing industries in Iran particularly after the revolution, a large number of factories have ceased operation and, thus, become left over within the Iranian urban fabric. The majority of these industries belong to the light manufacturing sector, such as textiles and food processing industries, established in pre-revolutionary Iran. As discussed previously, decline in light industries in both production and employment started before the Islamic revolution in Iran and accelerated in the post-revolutionary period. This has been much pronounced over the past two decades or so, when the country witnessed serious economic crisis following the intensification of sanctions. Apart from economic factors and bankruptcy as the main triggers of closure, several factories had to shut down given the political transition and resultant ownership conflicts after the revolution. A good example in this regard is Shiraz Textiles Factory which closed after the revolution due to the regime change.

In terms of typology of the industries discussed earlier (see Figure 9.11), the majority of industrial brownfields in Iran belong to the first type, where the former industries were either relocated or left over due to the expansion of cities and industrial decline. A large number of these former industrial brownfield sites have experienced years of abandonment and physical degradation in Iranian cities (Figure 9.14). Given the age of industries, many of these factories, such as Nassaji Mazandaran Textiles Manufacturing in Qaemshahr, have industrial heritage value.

Figure 9.14 Long-term abandonment of Nassaji Textile Manufacturing in Qaemshahr, Mazandaran *(Photo taken by the author in May, 2018).*

In addition to large-scale industrial brownfields, some local manufacturing and small service industries, such as welding services, foundries, as well as vehicle repair and services are emerging in the Iranian urban fabric. These sites tend to be located in both central urban and peripheral areas given the steady growth of cities. Apart from some physical and structural deficiencies, these urban sites often exhibit soil and groundwater contamination problems caused by waste oil and hazardous materials leaking.

Furthermore, some small manufacturing areas have historic value. The most notable examples of such sites are traditional but obsolete brick factories that are found abundantly in inner-urban areas of several cities in Iran, such as Tehran, Shiraz, Qom and Neka. These sites have become redundant and abandoned due to various reasons, such as steady growth of cities, technological changes and the serious environmental pollution they cause. Traditional furnaces in Iran used mazut as a source of heating. Mazut is a low-quality and heavy residual fuel which is highly contaminative, causing a serious threat to the living environment, particularly soil and underground water (Beškoski et al. 2011). As mazut is an oil-based fuel, it is likely that the groundwater system at and around brick factories is affected by the movement of this contaminative oil. Meanwhile, the smoke and toxic gases resulting from burning mazut create air pollution and associated public health issues, as most of these brick factories are now located in residential neighbourhoods. Apart from contamination problems, the soil that exist at and around brick factories often suffers degradation due to the excessive and deep exploitation of clay. In most cases, large collapsed holes with fragile soil around the furnaces and brick chimneys can be observed. This has caused some difficulties in terms of redevelopment of old brick factory sites, given high demolition costs (Participant 02-IR). Hence, in most of the old urban fabric of Iranian cities, such as Tehran and Shiraz, these urban sites have been left untouched (Figure 9.15). Following the long-term abandonment of factories, many areas at and around the furnaces in Iran exhibit social issues, insecurity and crime. This is very noticeable in the peripheral district 19 of Tehran whose initial formation was predominantly dependent upon the activity of these furnaces (Figure 9.15). At the moment over 35 per cent of the entire district is comprised of abandoned brick factories, with an approximate area of 140 ha (Baharloo 2009).

Figure 9.15 Redundant brick furnaces in Iranian cities; Tehran district 19 (pictures no. 1 & 2) and Shiraz (picture no. 3) *(Photos were taken by the author in May and June, 2018).*

9.5.2 *Institutional sites*

Considering the revolution-related conflicts, the eight-year war with Iraq and geopolitical condition of the country, Iran has been actively engaged in military activities throughout the past half-century or so. Many large-scale military-based areas were built outside the cities, several of which can be traced back to the pre-revolution period. However, with the substantial expansion of the cities, these sites have been gradually integrated into the urban fabric. It is estimated that 5 per cent of the 600km^2 area of Tehran is owned by a variety of military centres and barracks (Bahrami 2015). Following the national policy to transfer military areas outside the cities, many of these military areas have been closed and left abandoned, for example Jey Garrison in Tehran. Some have been partly redeveloped, for example, Ghale Morghi military site in Tehran a 300 ha site part of which has been redeveloped as an urban park. A few sites have been fully redeveloped, for example the former garrison site in Sari which has turned into a public park. In addition to military areas, there are a number of prison sites located in urban areas that are intended to be closed, e.g. Central Prison in Mashhad, or have been already closed and left obsolete for several years, e.g. Sari Prison (Figure 9.16).

Figure 9.16 Former prison site in Sari, Mazandaran, abandoned for several years
(Photo was taken by the author in May, 2018).

Apart from economic factors and high land value due to the central location of these sites, social issues and residents' wellbeing are considered as important factors stimulating the government to transfer and reuse such areas. It is important to note that both military-based and prison areas in Iran are owned by powerful organizations at the national level of government that are institutionally disconnected with urban-related legislative and executive bodies (Participant 01-IR; Participant 02-IR; Participant 03-IR). Even though this institutional miscommunication and inconsistency may pose considerable development challenges, prison and military-based areas in Iran often benefit from public ownership, which can often facilitate the land transfer process of such areas in contrast to privately-owned industrial and service sites. In the case of Sari Prison, however, the land was initially purchased by the local municipality form the Organization of Prisons and National Security Activities and finally sold to the private sector (Participant 26-IR). Although the former structures of this prison have been removed, due to financial reasons the private land-owner is still unable to develop the land which has resulted in long-term abandonment of this site in the middle of city of Sari (see Figure 9.16).

9.6 Policies addressing distressed urban areas

Over the past decade, the Iranian government has adopted two national policies to promote the structural and spatial reorganization of distressed urban areas, namely "*Regulation on Organizing Distressed Industries and Business Centres*" as well as *"The Law of the Sale and Transfer of Barracks and Other Places of Armed Forces outside the Urban Areas".*

The first policy is associated with restructuring distressed industrial and service areas introduced by the Ministry of Interior in 2017 under a national regulation and action plan, namely "*Regulation on Organizing Distressed Industries and Business Centres*". According to this regulation, a group of industries were listed to be inefficient due to high pollution, physical deterioration or insecure conditions (Participant 11-IR). These industries should be ceased and transferred out of the city or into industrial towns and authorized trade centres. Under this regulation, the local municipalities have been given total responsibility to determine measures for removal and relocation of such areas. In Shiraz, for example, the municipality classifies the industries and occupations according to their types and the level of pollution and disturbance they may cause. By this means, industries are divided into three following categories (Participant 10-IR; Participant 11-IR):

1. *Green Industries*; as high-tech industries that adopt advanced and non-polluting technologies. The environmental pollution caused by these industries per unit of production is minimal.
2. *Yellow Industries*; include a group of industries that might cause pollution. The removal or stay of these industries is conditional upon some environmental and technical monitoring. The notable examples of this type are car services, foundries and welding services which are mainly located in urban and sub-urban areas.
3. *Red Industries*; known as dangerous industries that must be urgently relocated to industrial towns away from cities, given the high volume of environmental pollution they cause. Narges Vegetable Oil Manufacturing Factory, Dena Tire and Rubber Manufacturing Factory, and Fars Cement Factory are some of the large-scale factories that are all listed as red industries in Shiraz.

It is essential to acknowledge the fact that, in almost all cases, the municipality in Shiraz has been practically unable to shut down red industries mainly due to ownership complexity coupled with the lack of financial resources for removal and relocation. In the most optimistic case, these industries simply receive a warning notice from the municipality (Participant 10-IR). In Tehran, however, the local municipality which is more powerful economically and institutionally than many others, has already relocated a few distressed industrial and service areas from the city. Tehran is divided into 22 administrative districts. The closure of entire foundries in districts 15, 16 and 20 and their relocation to surrounding industrial towns, the closure of stone cutting factories in district 16, as well as the closure and relocation of brick furnaces in districts 18 and 19 are some of the significant measures taken by the Tehran municipality (Tehran Municipality 2018).

In addition to the industrial and service urban centres, the Iranian government has provided legislative support for restructuring military sites, particularly those located long-term in inner-urban areas. In 2009, the Iranian Parliament enacted a national legislation, namely *"The Law of the Sale and Transfer of Barracks and Other Places of Armed Forces outside the Urban Areas"*. This law was introduced in 8 articles, according to which relevant organizations, especially local municipalities, were authorised to purchase military sites and transfer them outside of city boundaries under a specified framework. Since the promulgation of this law, a few barracks have been relocated and redeveloped after the closure. In most cases, local municipalities either purchase the entire land and redevelop the site with their own capital or, more likely, intervene in the project by cooperative land-sharing development (Participant 05-IR). The second approach is often favoured, given the budgetary limitations most municipalities in Iran are facing (Participant 02-IR). Therefore, in most cases, the municipalities cooperate with military organizations as the land-owners and allocate part of the garrison sites to the provision of public facilities, services and open space areas. This has been a common scenario for several redevelopment projects of former military-based sites in Iranian cities, such as the transformation of the former military site of Ghale Morghi Airport to urban parkland in Tehran, and the development of Velayat Park on the former garrison site in Sari (Figure 9.17).

Figure 9.17 Redevelopment of a public park on the former garrison site in Sari; before (pictures no. 1) and after the redevelopment (picture no. 2 & 3)
(Source for photo no.1: http://www.pasokhnews.com)
(Photos no. 2 & 3 taken by the author in May, 2018)

9.7 Conclusion

This chapter first attempted to investigate the spatial transformation pattern of Iranian cities. It is crucial for this study to examine how Iranian cities have been changing in size, form and population. It is observed that the Iranian model of spatial development has been strongly influenced by geopolitical factors. The Islamic Revolution of 1979 is, particularly, deemed a critical turning-point that has transformed the face of the country in many aspects. Before the revolution, following the government land-use policies and economic development programs, large Iranian cities witnessed physical expansion triggered by the growing rural-urban migration. The growth of cities in population and size before the revolution was most pronounced in Tehran, as the core city attracting surplus population, jobs and services from other areas. During the post-revolutionary period, the urbanization process gathered much faster pace in three tiers of development chronologically, including (1) the continued growth of Tehran as the main city, (2) extension of growth to four other major cities, i.e. Isfahan, Shiraz, Mashhad and Tabriz, and (3) the growth of small and medium-sized cities since the early 2000s mainly due to the environmental problems faced by bigger cities.

Moreover, the chapter reviewed the structural transformation of manufacturing industries in Iran from the late 1920s onwards. Similar to the urban change process, geopolitical factors play critical roles here. WWII invasion, the Revolution of 1979, the eight-year war with Iraq (1980-88), and strong economic sanctions are regarded as the main political events influencing the industrial activities of the country. It is safe to affirm that Iran's manufacturing industry has been following two marked trends during the past two decades, including (1) significant decline in manufacturing activities against the growth of services, and (2) steady shrinkage of light industries in favour of heavy industries started before the revolution, but accelerated in post-revolutionary years. A large number of light manufacturing industries, most notably textiles and food processing industries, have closed, mostly due to the economic crisis, and to a lesser extent because of the revolution-driven political transition and associated ownership conflicts.

This chapter explored the urban and industrial transformation processes in Iran in order to examine the emergence pattern of industrial brownfield sites within and at the margin of cities. The majority of these former industries belong to light manufacturing sector established in pre-revolutionary Iran. Given the steady expansion of cities and decline of light manufacturing industries over the past decades, many factories closed or relocated to other areas. A large number of these former factory sites have been left abandoned and redundant for many years.

In addition to industrial brownfields, the chapter has identified another category of brownfields as institutional sites, including the former military sites and prisons, which are found abundantly within Iranian cities. The chapter concluded with a brief discussion about the Iranian government's policies to address distressed urban areas. As discussed in section 9.6, over the past decade, the government has adopted two national regulations to transfer distressed industrial and military sites away from inner-city areas. The promulgation of these laws and actions plans has contributed to the closure or relocation of many factories, and military sites, thus, creating further urban brownfields in Iran. It is, however, important to recognize that such national legislation largely focuses on land ownership and transfer issues, being less attentive to the redevelopment following closure or relocation. The land redevelopment procedure is predominately handled by local municipalities within the Iranian urban management system. This will be discussed further in the following two chapters.

CHAPTER 10

Urban Management & Regeneration Policies in Iran

10.1 Introduction

This chapter aims to outline urban management and regeneration policies in Iran. The chapter has two main objectives; (1) how the urban planning and development system operates in Iran, and (2) how regeneration policies are developed and implemented within the system. In order to achieve these objectives, the chapter is structured in four sections. The first section, i.e. Section 10.2, presents the structure of urban management and development system, highlighting the responsible authorities, their institutional relationships as well as the executive procedure of urban development plans. Sections 10.3 reviews the Iranian urban regeneration policies with the purpose of exploring legal basis for intervention in deteriorated and underutilised areas. Section 10.4 outlines the legal and executive bodies responsible for regeneration measures under the existing system. The final section of the chapter demonstrates the targeted areas for regeneration within the legal and regulatory framework in Iran, adopting a chronological approach to change over the past two decades or so.

10.2 Urban planning and management in Iran

Cities in Iran are essentially administrated relying upon a series of development plans which are prepared and enforced by various stakeholders and legal organizations. In general, there are three levels of development plans in different scales within the framework of planning and management system in Iran, including the national, national-local and local levels (Javadi 2017). Table 10.1 outlines the urban-related planning and development plans in Iran, their main objectives as well as the responsible organizations. The national development plans are mainly intended to outline a long-term and broad vision for the country as a whole, whilst the national-local plans aim to maintain a liaison between national and local plans, concentrating on territorial management, geographical attributes and new town development. At present, the most critical and decisive urban development plans in Iran, e.g. comprehensive development plans, detailed plans and regeneration plans, fall into the local level and accordingly the Ministry of Roads and Urban Development (MRUD) and local municipalities act as the principal legal bodies in formulation and implementation of such plans. In the following section, these two organizations are briefly introduced and their main roles in management of cities in Iran are highlighted.

10.2.1 Ministry of Roads and Urban Development (MRUD)

MRUD is the most direct legislative body in land-use planning and management issues in Iran with two principal responsibilities, including; (1) policy making, master planning and providing detailed development plans, guidelines and regulations, (2) supervision at the implementation of urban development plans (Participant 03-IR). It maps out national strategies and provides legal supports for urban planning and development. This ministry was formed by merging the 'Ministry of Housing and Urban Development' and the 'Ministry of Roads and Transportation' in 2011. At present, the majority of urban planning or related development plans in Iran are prepared and/or ratified by MRUD. In spite of the fact that the local municipalities has the major operational responsibility, the ministry is authorized to directly intervene in implementation of some development plans, such as Regional Physical Plans and District Plans (Javadi 2017). Meanwhile, operational responsibility is sometimes given to affiliated organizations, such as NTDC (New Towns Development Company) and UDRC (Urban Development and Rehabilitation Organization), that operate under the direct control and supervision of MRUD.

Within the instructional framework of MRUD, Supreme Council of Urban Planning and Architecture of Iran (SCUPA) acts as the most powerful legislative body. This council was founded before the revolution, in 1966. In 1973, the "Act on Establishment of the Supreme Council of Architecture and Urban Development" was promulgated which is still in place with partial amendments. The central objective of this Act was to enable local authorities to control dispersed establishments outside their city's boundaries and divert them into new town projects (Ardeshiri 1996). In order to do so, SCUPA was given the responsibility to provide comprehensive development plans and set up standards for their implementation for medium-sized and large cities (of population more than 25000 people) and certain regulations and development guidelines for smaller cities. At present, SCUPA consists of 16 members from various government ministries, such as the Ministry of Agriculture, Ministry of Defence and Armed Forces Logistics, Ministry of Energy, Department of Environment, and Ministry of Industry, Mine and Trade (MRUD 2018b). According to MRUD (2018c), the key responsibilities of SCUPA include:

- Reviewing the proposed general urban planning and development strategies to be submitted to the cabinet;
- Remarking upon the urban planning proposals and regulations concerning the Comprehensive Development Plans (CDPs) that includes zoning and land use techniques, identification of commercial and residential areas, office buildings, public services and infrastructures, green spaces and other urban public facilities;
- Inspecting, examining and approving CDPs, Detailed Plans (DPs) and their amendments;
- Approving the urban development criteria, regulations and guidelines

The key responsibility of SCUPA is to formulate and review the Comprehensive Development Plans (CDPs) *(Tarhhaye-Jamee-e-Shahri)* as the most important planning agenda in the Iranian urban system (see Figure 10.1). It is essential to acknowledge that CDPs are strategic and structural plans which only propose long-term development prospects in terms of spatial and physical organization of cities (Participant 07-IR). In order to facilitate the sound implementation of broad principles established by CDPs, the master plans are supplemented by another plan, namely Detailed Plans (DPs) *(Tarh-e-Tafsili)*. These plans provide detailed regulations and criteria, such as for land use zoning, population density, physical conditions of streets, transportation network, and building construction as well as the special characteristics regarding the property ownership. DPs also set out priorities for renovation and revitalization of certain urban areas (Javadi 2017). At present, the majority of Iranian cities have a CDP and a relevant DP. For those cities without CDPs, the central government provides short-term planning solutions under the City Guidance Plans which are prepared and ratified by the Ministry of Interior (MoI) and implemented by the governorates (see Table 10.1).

Figure 10.1 Compressive Development Plan (CDP) of Tehran, prepared in 2007
(Source: Tehran Municipality 2018)

Table 10.1 Urban planning and development plans in Iran, responsible organizations and details
Source: Author's elaboration on (Javadi 2017; MRUD 2018a)

Plans	Preparation	Ratification	Implementation	Key Objectives
National Level				
National Development Plans	Central Government	Parliament	National Organizations	- Broad economic, social and cultural development plans for the entire country, established every 5 years
Territorial Comprehensive Plans	MPO[1] & MRUD	MRUD	Governorates	- Long term vision for distribution of population, infrastructure and industries
National-local Level				
Regional Physical Plans	MRUD	MRUD	MRUD	- Geographic and information references for national regions
National Document for Development of Provinces	MPO	MPO	Governorates	- Defining areas of population, resources, infrastructures and socio-economic and cultural activities
District Plan	MRUD	MRUD	MRUD	- Liaison between National and Regional Plans and lower level plans
Urban Complexes Plan	MRUD	MRUD	Municipalities & MRUD	- Management of the large metropolises and their surrounding cities
New Towns Plan	MRUD (NTDC[2])	MRUD	MRUD (NTDC)	- Development plans for new towns around the large cities and metropolises
Residential Township Plan	MRUD	MRUD	MRUD (NTDC)	- Development plans for residential towns as new population centres
Special Plan	National Organizations	National Organizations	Local Organizations	- Territorial management by addressing urgent trans-regional problems
Local Level				
Comprehensive Development Plans (CDPs)	MRUD	MRUD	Municipalities & MRUD	- General spatial and physical organization of cities along with pertinent rules and regulations
Detailed Plans (DPs)	Municipalities	MRUD	Municipalities	- Supplementary plans for CDPs providing more development details at an executive scale
City Guidance Plans	Ministry of Interior	Ministry of Interior	Governorates	- Providing solutions for acute problems of those cities without CDPs and DPs
Regeneration Plans	MRUD (UDRO[3])	MRUD	MRUD (UDRO)	- Equivalent to DPs, but for spatial-physical and functional aspects of deteriorated and distressed urban areas
Land Preparation Plans	MRUD	MRUD	Municipalities	- Land preparation and management regulating (e.g. land readjustment and levelling, asphalt roads, electricity networks, garbage disposal system, and sewerage system)
Urban Design	Municipalities, MRUD & ICHTO[4]	Municipalities, MRUD & ICHTO	Municipalities, MRUD & ICHTO	- Providing architectural and design guidelines, especially for urban areas with historical and cultural value

Notes:
1. MPO (Management and Planning Organization). In 2016, this organization was divided into the Plan and Budget Organization (PBO) and the Administrative and Recruitment Organization (ARO).
2. NTDC (New Towns Development Company) which operates under MRUD
3. UDRO (Urban Development and Revitalization Organization) which operates under MRUD
4. ICHTO (Iran Cultural Heritage, Handicraft and Tourist Organization)

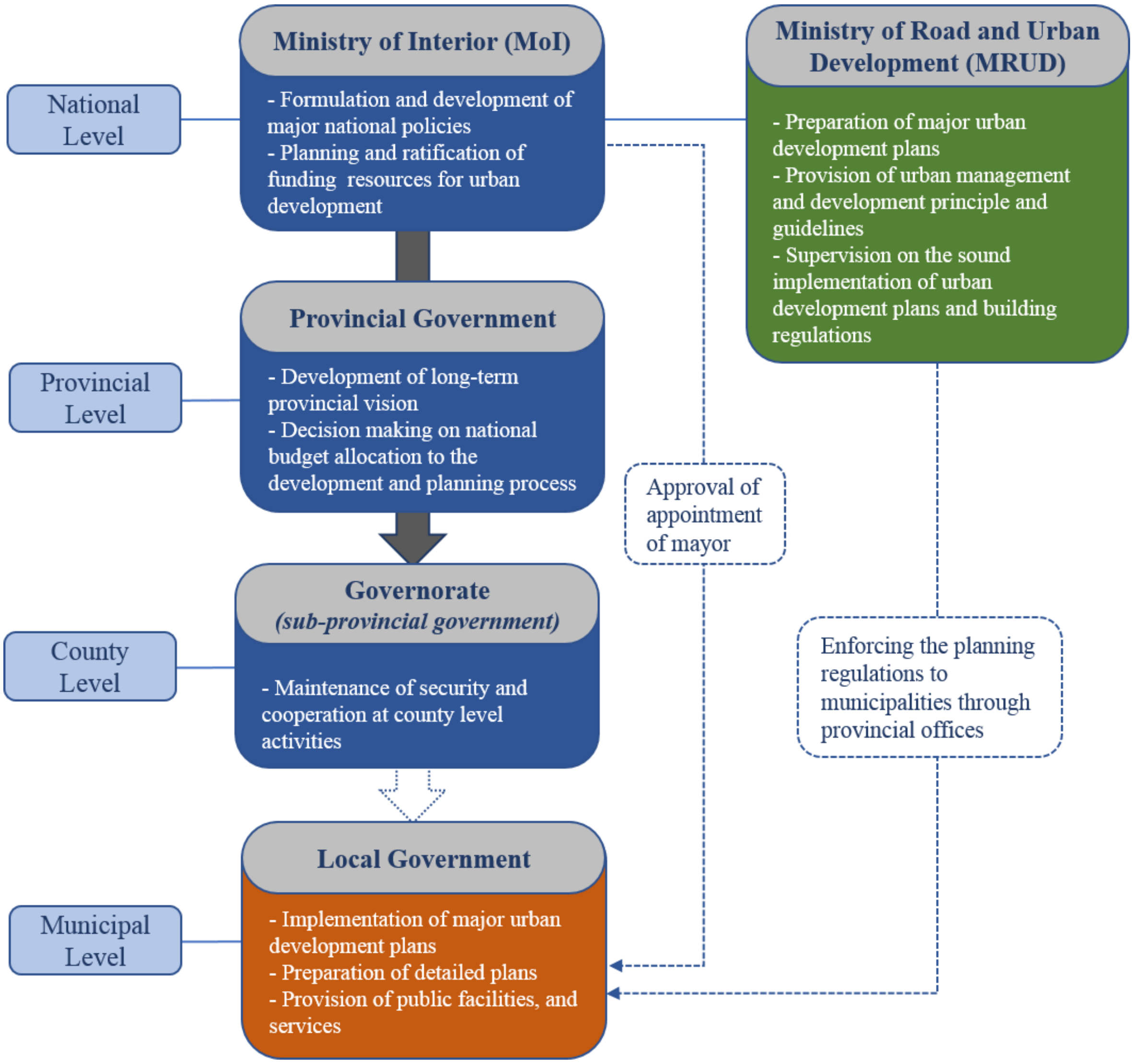
10.2.2 Local municipalities

Under the administrative oversight of MRUD, the municipalities are the most important executive bodies in Iranian urban management and development regulation. Their principal role is to implement the urban master plans providing required public facilities, services and infrastructure. It is essential to note that the municipality in Iran is institutionally and legally disconnected with upper levels of government, including MoI and MRUD. The municipalities act as public and paid officials that operate independently from other governmental sectors (Farzaneh 2011, Javadi 2017; Participant 03-IR). This is more pronounced in major metropolitan cities, e.g. Tehran, Isfahan, Mashhad and Shiraz, where the local municipalities are given an increased degree of autonomy with little or no supervision from the upper levels of government (Participant 02-IR).

At the moment, MoI is solely responsible for the approval of mayor's appointment with no direct involvement in management and administration of cities, whilst the relationship between MRUD and local municipalities is restricted to the enforcement of development plans and regulations to municipalities for implementation through MRUD's provincial offices. Following significant change in the local government system in Iran in the late 1990s, the municipality's authority is now granted by the city council which is staffed by the elected representatives of the people (Javadi 2017). This system of urban management was designed based on the council-manager model adopted from the US and some European countries (Barakpour & Asadi 2010). Following this model, the city council in Iran acts as a planning and decision-making organization responsible for the appointment of mayor, approval of annual municipal budget and supervision on the performance of municipalities.

As mentioned above and depicted in Figure 10.2, within the Iranian urban management structure, the local municipality is viewed as a public and self-run entity authorized and supervised by the city council. Although municipalities are institutionally subcategorized under the MoI, they receive their major planning ordinances from the MRUD's provincial offices. Based on the existing urban planning and management system in Iran, MoI has no control over the activities of the local governments and its role is solely limited to the approval of the appointment of mayors.

Figure 10.2 The structure of urban planning and management system in Iran *(Source: the author)*



As discussed earlier, the urban development plans are designed through collaborative supervision and management of key government sectors. However, in practice, serious conflicts often arise between the MRUD and municipalities, especially when it comes to the application of CDPs as the reference planning documents. Furthermore, the central government has given the municipalities' full economic autonomy and independence, which, in most cases, leads to financial difficulties at the local level of urban governance. According to the Budget Law of 1984, municipalities are obliged by MoI to finance development projects and municipal services with their own capital (Farzaneh 2011). The main source of revenue for municipalities is supplied through the land taxes, issuing land-use change permits, charging for varying planning regulations (e.g. Floor Area Ratio), as well as penalties for infringements and violations from urban development rules and regulations (Participant 03-IR).

10.3 Review of current urban regeneration policies in Iran

10.3.1 Related national laws

- ***National Development Plan***

As shown in Table 10.1, National Development Plans are considered as the first tier of strategic development plans in Iran which are prepared by the central government, ratified by the parliament and notified to the relevant organizations for implementation. These plans are developed every five years and are essentially intended to map out broad structural development strategies for the whole country. Since the 1979 Islamic Revolution in Iran, six development plans have been formulated thus far. It was not until the fourth edition of the National Development Plan (2005-2010) that the government, for the first time, addressed the basic issues associated with distressed urban areas (including informal settlements and deteriorated urban fabric), being much elaborated within the Fifth Development Plan (2010-2015). Under Article 171, the Fifth Development Plan outlined obligations for different responsible administrations to take necessary measures for regeneration of abandoned, obsolete and inefficient areas in or around cities in Iran. The content of this article of law has been fully retained in the Sixth Development Plan, which will remain in force until 2021. According to Article 61 of the Sixth Development Plan (ICA 2018a):

- MRUD, and especially SCUPA, is required to prioritize the redevelopment of special areas in two categories of projects:
    1. Projects that need to be implemented urgently due to public interest;
    2. Projects that can be implemented over time through the formulation of rules and regulations with sufficient support from the government and municipalities as well as the participation of the people.
- The relevant executive agencies are required to take measures to improve the productivity of the land and ensure the rehabilitation of deteriorated rural areas.

- In order to encourage the involvement of private sectors in redevelopment projects, MRUD and municipalities are required to adopt incentive policies within the established administrative framework and in accordance with approved budget;
- MRUD and municipalities are required to revive and rehabilitate at least 10 per cent of deteriorated urban fabric annually through strategic programs. The required budget for redevelopment projects will be granted to the MRUD, municipalities or executive agencies introduced by municipalities.
- MRUD is required to prioritize the organization and rehabilitation of the cities affected by the eight-year war, particularly regarding the appropriate reuse of abandoned lands and buildings left over in inner-urban areas.

➢ ***Municipalities Law***

The Municipalities Law was regulated in 1966 in order to draw up guidelines and criteria for the establishment of municipalities and their key responsibilities in the management of Iranian cities. Within the content of this law, the government introduced two legal articles- including Article 110 and Article 111- which provide the municipalities with important managerial roles in dealing with deteriorated urban areas. According to Article 110 of the Municipalities Law, the municipality is responsible to identify dilapidated or abandoned land and structures in urban neighbourhoods that endanger the health and safety of citizens (ICA 2018b). After the identification of such sites, with the approval of the City Council, the municipality must warn the land-owner to take adequate measures. In case of non-response or ineffective action within two months, the municipality can take necessary actions (mostly demolish or repair the building) and recoup the costs from the owner.

Moreover, Article 111 of the Municipalities Law provides the municipalities with an institutionalization role for revitalization and rehabilitation of deteriorated urban areas. The identified duties will be performed by the municipalities, city councils and MoI respectively. According to this Article, each municipality is authorized to establish temporary institutions with its own capital or in partnership with the private sector to develop regeneration projects. These municipal-led institutions can purchase land or properties and sell them following regeneration (ICA 2018b). It is important to acknowledge that both of these two Articles are being implemented for redevelopment of small-scale and privately-owned urban sites, in most cases for abandoned or dilapidated housing structures and for commercial development purposes.

- ***Urban Development and Renovation Law***

The Urban Development and Renovation Law was enacted by the Iranian parliament before the revolution, in 1968, but reviewed and re-regulated by the new government a few months after the revolution, in 1979. At Present, the Urban Development and Renewal Act, along with the Municipalities Law are considered as the legal basis of intervention for local municipalities in Iran (Javadi 2017). According to this law, the municipalities are given the principal authority in terms of renovation of distressed neighbourhoods and development of basic infrastructure and pubic services in such urban areas. This could have been made even through compulsory acquirement and purchase of land (Niami 1970). In addition, municipalities were obliged to pursue the fundamental principles underlined by CDPs for any development and renovation projects. The most important feature of this national law was, however, associated with the new potential revenue it brought in for local municipalities in Iran. The Urban Development and Renovation Law, for the first time, made provisions for a capital tax on land, so that a small proportion of land or property value must be paid annually to the municipalities (Niami 1970).

- ***The Law on the Organization and Protection of the Housing Production and Supply***

This law was regulated in 24 articles by the parliament and notified to the government in 2008. The central objective of this national law is to protect and facilitate housing investment, in respect of which two articles (articles 12 and 16) deal with the improvement and revitalization of informal settlements and deteriorated urban fabric. Under article 12 of the law, the Central Bank of the Islamic Republic of Iran is responsible to grant long-term loans for new housing construction or refurbishment of existing structures of areas located in informal settlement zones and deteriorated urban fabric (ICA 2018c). In addition, according to article 16, all housing development and refurbishment projects in such areas are subject to a discount of at least 50 per cent of the total costs in terms of construction and density taxes (ICA 2018c).

Following the Law on the Organization and Protection of the Housing Production and Supply, the government also introduced a statutory regulation in 10 chapters. Based on Chapter 8 of this regulation, in order to accelerate the implementation of renovation, rehabilitation and revitalization of deteriorated urban fabric and informal settlements, it is required to establish renovation service offices by the non-governmental sector under the supervision of the municipalities for each targeted neighbourhood (ICA 2018c). This regulation also provides partial exemptions for land-owners or developers of these areas in terms of infrastructural services, e.g. water, gas and electricity, and issuance of ownership documents.

- ***The Law on the Protection of Revitalization, Rehabilitation and Renovation of Underutilised and Deteriorated Urban Fabric (the Law of 2011)***

This law is considered the latest and most comprehensive law in relation to the regeneration of distressed urban areas in Iran. The central government enacted the law under 17 Articles in 2011 to create coherence in the process of revitalization, rehabilitation and renovation of underutilised and deteriorated urban areas. In addition, for the first time, the law of 2011 provided concise definition for targeted areas protected by this law, as well as for the identification maps and development plans. Some of the key components of the law of 2011 are outlined as follows (MRUD 2018d):

- *Article 2a;* Underutilized and Deteriorated Urban Fabric (UDUF) refer to city areas that have become deteriorated and inefficient over years due to their infrastructural, structural, and accessibility problems and their inhabitants deal with numerous economic, social, cultural and physical challenges. The term UDUF has been developed based upon another term Deteriorated Urban Fabric (DUF) that was first introduced in SCUPA's legal guideline in 2005. The identification criteria for DUF and UDUF areas within the Iranian urban regeneration policy system are discussed comprehensively in Section 10.5.
- *Article 2b;* The map of the underutilised and deteriorated urban fabric is referred to a map being prepared based on the indicators adopted by the SCUPA, MRUD -Urban Development and Revitalization Organization of Iran (UDRO)- or municipalities.
- *Article* 2c; The Improvement, Renovation and Reconstruction Plans (Regeneration Plans in Table 10.1) are referred to those plans being prepared in the framework of the urban development plans (CDPs and DPs) based on the architectural, technical and planning principals. These plans consist of the new land uses within the identified boundaries of the underutilised and deteriorated urban fabric, whose implementation

demands for the provision or improvement of public services and urban infrastructure, e.g. road networks, and green spaces.

- *Article 4;* MRUD and municipalities are the responsible executive bodies for preparation, ratification and implementation of regeneration plans. They are, however, authorized to delegate some of their legal responsibilities to affiliated organizations, companies, individuals or entities with technical and financial qualifications approved by UDRO.
- *Article 7;* In cases where land-owners' reluctance to follow the land-use determined by development plans or their property prevents the plan from being implemented, the relevant organizations shall intervene and sell the land through a public auction.
- *Article 8;* In order to encourage the land-owners, investors and developers and to facilitate the regeneration process according to the identified plans, the municipalities and MRUD are required to follow the legal guidelines developed in 2008, under *The Law on the Organization and Protection of the Housing Production and Supply*.
- *Article 15;* The Central Bank of the Islamic Republic of Iran is required to allocate at least 25 per cent of its low-interest loans and grants for housing to the revitalization, rehabilitation and renovation of UDUF.

Under Article 16, the law of 2011 mandated MRUD (UDRO), in coordination with MoI, and the Iran Cultural Heritage, Handcraft and Tourism Organization (ICHTO), to prepare a support document to ensure the sustainable regeneration of UDUF in Iranian cities. This legal document was introduced in 2014 as "*The National Strategy Document on Revitalizing, Upgrading, Renovating and Enabling Deteriorated and Underutilised Urban Fabric*". The document is considered "the main reference for common definitions, goals/objectives, principles, strategies, and policies of Iran concerning urban revitalisation, rehabilitation and renovation as well as regularisation of informal settlements" (UDRO 2014). Following the legal and regulatory framework established by the national strategy document, two nation-wide and state-wide regulations were introduced and enforced by UDRO in 2015, namely *'Regulations on the Activities of the National & Provincial Headquarters regarding Sustainable Regeneration of Targeted Areas of Urban Rehabilitation and Renovation Programs'*. These two documents were primarily aimed to clearly define the targeted areas of urban regeneration policies across the country and also provide supporting tools in achieving the strategic objectives set by the national strategy document.

10.4 Responsible organizations for urban regeneration

From the legal point of view, there are three statutory bodies authorized to intervene in distressed and deteriorated areas in and around cities in Iran including:

1. *Iran Cultural Heritage, Handcraft and Tourism Organization (ICHTO)*; that solely deals with the improvement and renovation of sites with historical or cultural value;

2. *Urban Development and Revitalization Organization of Iran (UDRO)*; that operates under the administrative supervision of MRUD. Within the existing legal and regulatory framework in Iran, URDO acts as the main body responsible for intervention in non-historical fabric. The Improvement, Renovation and Reconstruction Plans (Regeneration Plans) are prepared and implemented by URDO or its affiliated organizations. The regulations, principles and guidelines of plans are approved by SCUPA. In almost all provincial headquarters, URDO's activities are predominantly focused on individual renewal projects of deteriorated residential neighbourhoods in inner-urban areas, coupled with informal settlements at the margins of the cities. In most cases, the provincial organizations purchase the land and properties and regenerate them via the national budget allocated under the law of 2011.

3. *Municipalities (Urban Renovation Organization);* that are authorized to contribute to urban regeneration projects under the Municipalities Act and Urban Development and Renewal Act. It is important to note that, unlike CDPs and DPs, municipalities are not officially involved in the preparation, ratification and also implementation of Regeneration Plans (see Table 10.1). However, in several cities, most notably in Tehran, the Urban Renovation Organization of the municipality has developed individual plans for identification of deteriorated neighbourhoods accompanied by their operational frameworks. In general, municipalities, as the executive body, are obliged to engage in regeneration projects through development of basic infrastructure and public services in identified areas according to the fundamental principles underlined by the UDRO's Regeneration Plans. This is done by the municipalities in small or medium-sized cities or Urban Renovation Organizations that are acting under the supervision of the municipalities in several major cities in Iran, e.g. Tehran, Mashhad, Isfahan and Shiraz. Some of the executive responsibilities of municipalities are delegated to their affiliated entities- namely Renovation Services Offices- being established in targeted deteriorated neighbourhoods.

10.5 Targeted areas of urban regeneration policies in Iran

Targeted areas within the legal and regulatory framework of urban regeneration policies have been changing over the past two decades or so. Having reviewed the national development plans, it is clear that until around the mid-2000s the central focus of government in Iran was predominantly placed on the improvement and conservation of old urban fabric with cultural and historical background (Participant 03-IR; Participant 16-IR; Participant 17-IR). As discussed earlier, the Fourth Development Plan (2005-2010) initially addressed issues regarding distressed urban areas, however superficially, being more elaborated in following plans. Before 2005, the scope of urban regeneration policies in Iran was narrowed down to intervention in historic buildings or urban sites, as outlined in the content of the Third Development Plan. The main authority responsible for this was the Iranian Cultural Heritage Organisation (ICHO), which has been merged with the Iranian Tourist Organisation, being renamed as the Iranian Cultural Heritage and Tourism Organisation (ICHTO). This organizational change has shifted the focus of ICHTO from urban revitalization and conservation to mostly tourism activities (Farzaneh 2011).

Following the Fourth Development Plan, MRUD was given the major authority in dealing with distressed urban areas in Iranian cities. In 2005, SCUPA gave a wide interpretation of targeted areas for urban regeneration policies in Iran being introduced as a term; *Deteriorated Urban Fabric (DUF)*. According to SCUPA's interpretation, DUF was deemed as inefficient urban neighbourhoods that have social, economic, and cultural complexity. These neighbourhoods have, on the one hand, invaluable residential roots with strong cultural, social and architectural background (MRUD 2014). At the same time, DUF is often subject to serious structural and infrastructural problems owing to the lack of proper access to urban and health services, social and security problems, and vulnerability to earthquakes, floods and fires, as well as inconsistencies with modern urban environment (MRUD 2014). In 2005, SCUPA outlined three main criteria for identification of DUF (MRUD 2005):

1. *Instability:* 50 % of the buildings in the block are physically and structurally unstable.
2. *Inaccessibility:* At least 50 % of block passages have a width of less than 6 meters.
3. *High density of horizontal constructed blocks:* At least 50 % of the buildings in the urban block have an area of less than 200m^2.

Having met the triple criteria mentioned above, DUF is divided into three following types of urban sites (MRUD 2005):

- **Type I**- *Deteriorated urban fabric with no historic and/or cultural value;* as areas of the city, mainly residential, that have become deteriorated and inefficient over years in terms of infrastructure, buildings, and accesses and their inhabitants suffer from numerous economic, social, cultural and physical problems (Figure 10.3).

Figure 10.3 District plan of a deteriorated urban fabric *(Type I)* in Abiverdi neighbourhood, Shiraz *(Source: UDRO's headquarter in Fars Province).*

- **Type II-** *Historic-cultural urban fabric;* as urban areas that reflect the cultural-historical value of the city and are distinguishable from other parts of city in terms of from and structural features. These areas are determined by the Iran Cultural Heritage, Handcraft and Tourism Organization (ICHTO) that makes a sectoral intervention in historic buildings or urban fabric with cultural heritage value.

- **Type III-** *Informal settlements and suburban slum areas;* referred to deprived residential areas located within or at the margins of the cities and metropolitan areas with no or limited access to urban services and infrastructure (Figure 10.4). Most of these settlements have been constructed illegally and do not have official ownership documents.

Figure 10.4 Informal settlements in Eslamaabad neighbourhood in Tehran (foreground) adjacent to a newly-developed area (background)
(Photo was taken by the author in June, 2018)

Following the criteria for the identification and classification of DUF, MRUD has attempted to portray the scale of these sites across Iranian cities. According to the government's report (UDRO 2018), nearly 30 per cent of the total urban area in Iran are recognized to be DUF areas, encompassing almost 19 million people (see Figure 10.5). SCUPA obliged its secretariat to put forth appropriate solutions for such areas. In order to do so, three types of interventions were defined, as follows (MRUD 2005):

1. *Renovation:* In this type a flexible approach is often taken, ranging from partial intervention to total regeneration subject to each case. It is aimed at restoring proper living conditions and establishing a dynamic balance in targeted urban areas through renewal, rehabilitation, revitalization, adaptation and conversion.

2. *Rehabilitation:* This type of intervention is based on the preservation of authenticity and integrity of physical environment with loyalty to the past. It mainly focuses on the improvement of old buildings through protection, maintenance, conservation, restoration, consolidation and repair which must be done according to regulations set by ICHTO.
3. *Reconstruction*: Under this approach, there is not only no obligation to maintain the former identity, but also it is aimed to create new physical-spatial environments through the full demolition of damaged property, clearance and constructing new buildings.

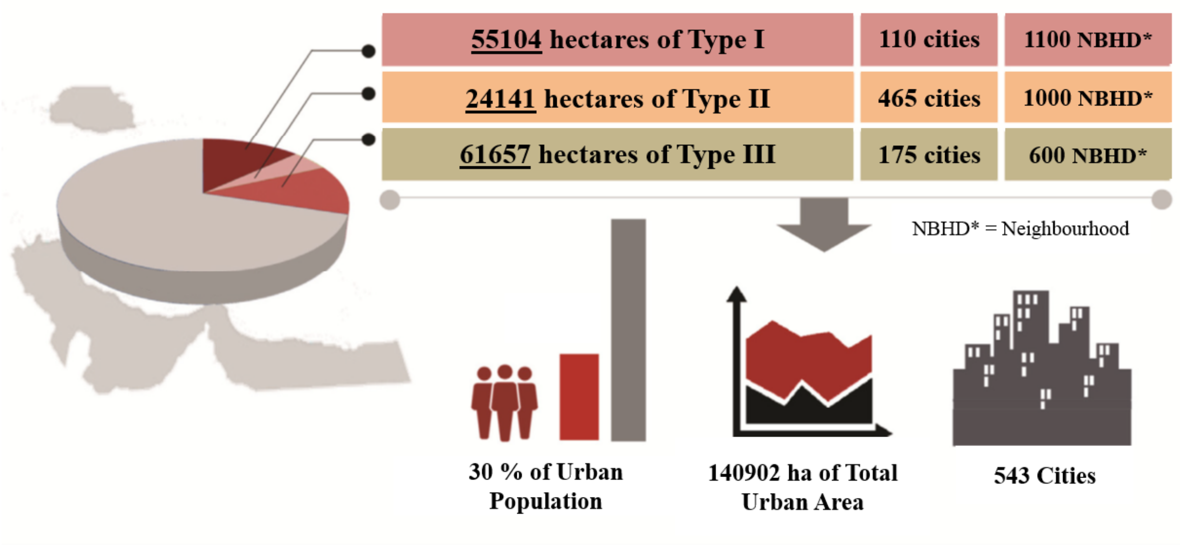


Figure 10.5 The scale of deteriorated urban fabric in Iranian cities
(Source: UDRO 2018; translated and elaborated by the author)

The Iranian government attempted to expand the scope of urban regeneration policies from Deteriorated Urban Fabric (DUF) to Underutilised and Deteriorated Urban Fabric (UDUF) under the law of 2011. Following the national strategy document of 2014, the government came to the realization that, apart from three categories of DUF, there were other distressed areas within Iranian urban fabric which were entirely ignored by the urban regeneration system (Participant 06-IR; Participant 07-IR). As a result, in 2015, UDRO identified two types of sites added to the previous category of DUF, including (MRUD 2015):

1. *Irregular urban zones with rural background;* known as former rural areas that are now located in urban areas given the steady growth of cities. These sites still have a rural structure and are not effectively adapted to urban texture.

2. *Incompatible urban areas;* these areas are generally regarded as inefficient, but non-residential, urban spaces relatively in a large scale, such as abandoned factories, barracks, and prisons.

10.6 Conclusion

This chapter is essentially dedicated to a discussion of urban governance and regeneration policy in Iran. Under the current urban management and planning system, MRUD and local municipalities act as the main bodies authorized for formulation and implementation of policies, respectively. This is done via series of development plans either by these two legal bodies or other national and local organizations. Amongst these development plans, CDPs supplemented by DPs are considered as the most important planning reference documents in the Iranian urban system. Given several reasons, e.g. institutional inconsistency and misconnection amongst the national and local levels of government, financial limitations of municipalities, and also the obsolescence of development plans, CDPs in most Iranian cities are not fully achievable. For example, in the city of Sari, it is estimated that only 10 per cent of land-use changes occur in accordance with the CDP's principles (Participant 26-IR). In addition, the development plans are relatively old and infrequently updated (the latest version of CDP for Sari, for example, was formulated in 2000). On the plus side, developers or land-owners often exploit the legal articles (predominantly the Commission of Article No. 5 and partially the Commission of Article No. 100) to impose their desired future land-use, in case that it does not fall into the CDP's framework (Participant 03-IR). The Commission of Article No. 5 plays a critical role here. According to this commission, the local municipalities are authorized to re-examine and modify the CDPs in certain circumstances. By this means, the land-owners or developers are provided with some exemptions, mostly in forms of land-use change permit or extra FAR, which also generates greater profits for municipalities.

When it comes to the regeneration of urban areas, the Improvement, Renovation and Reconstruction Plans (Regeneration Plans) act as the reference agenda in the Iranian urban system. The decision-making and implementation procedures for CDPs and DPs differ strongly from Regeneration Plans. The former are collaborative development and management plans established by MRUD and municipalities, whilst the latter are prepared and implemented by MRUD alone. This institutional inconsistency often poses serious challenges during the execution of Regeneration Plans.

From the legal points of view, the targeted areas for regeneration have been changing constantly over the past two decades. Until around the mid-2000s, targeted regeneration areas were predominantly limited to the old urban fabric with historical value and accordingly the Iranian Cultural Heritage Organisation (ICHO) was authorized as the central organization to identify and deal with those areas. Following the introduction of the Fourth Development Plan in 2005 further authorities have been provided for MRUD and the municipalities. Having reviewed the relevant laws and legislative system, it is clear that presently UDRO, operating under the direct supervision of MRUD, at the national level and municipalities at the local level act as the main bodies authorized for formulation and implementation of urban regeneration policies. However, their central scope of regeneration activities has been strongly narrowed down to the intervention in residential neighbourhoods, either formal or informal, with inappropriate structural and physical conditions. Even within this narrow scope, abandoned and dilapidated housing structures do not get enough attention by the current policy, as much as the active and in-use sites do. These former housing areas often suffer from long-term abandonment in central cities mainly due to serious conflicts between the municipalities and private land owners and/or developers over the future use of land (see Figure 10.6). As discussed earlier, following the expansion of urban regeneration policy scope in 2015, two categories of 'irregular rural areas' and 'incompatible non-residential urban areas' have been added to form UDUF. However, of all the laws, organisations and plans, there is no form of review that identifies whether the Iranian government's recent policy approach is successful; and to what extent the new two categories have been responded in urban regeneration practice.

Figure 10.6 Former residential site having been left dilapidated and abandoned for many years in an inner-urban area in Shiraz *(Photos were taken by the author in May, 2018).*

CHAPTER 11

Discussion II;

Brownfield Regeneration in Iran

11.1 Introduction

Despite numerous studies (e.g. Flipse 2007; Simeonova & Van der Valk 2009; Runhaar et al. 2009; Pelzer et al. 2013) as well as policy initiatives to address EPI in the urban land-use planning context, no comprehensive framework for the implementation of EPI in relation to brownfield regeneration has yet been developed. Therefore, this study contributes to this body of knowledge by systematically assessing how brownfield regeneration may be assessed and influenced using the principles of EPI. As reflected in Chapter 3, EPI is discussed in three stages, including 'an introduction to EPI', 'the development of EPIB tool, and 'the application of the tool' (Figure 3.2). Building on the introductory discussion of EPI approach in Chapter 3, Chapter 8 integrated various factors influencing the uptake of brownfield-related policy and governance in four international case studies establishing an analytical tool. The tool was thereafter referred to as the Environmental Policy Integration for Brownfields (EPIB). The EPIB tool represents a comprehensive framework to analyse and explain brownfield regeneration, capable of being applied in different political or regional contexts (Figure 8.1). As the final stage of contribution of this framework to the research, this chapter discusses the utility of EPIB in explaining brownfield regeneration situations in all the cases previously discussed including Iran. This comparative analysis helps to identify where Iran is in its brownfield regeneration process and what its policy and practice response has been to date.

The chapter is divided into two major sections. The first section, i.e. Section 11.2, highlights the regeneration challenges and barriers to both policy and practice in Iran. To help address the existing challenges, two Iranian site-based cases, the former site of the Nassaji Mazandaran Factory in Qaemshahr and the former site of the Khoshnoosh Factory in Sari, are briefly discussed. Section 11.3 examines the applicability of the EPIB tool through an analysis of brownfield regeneration pathways and processes in four case studies as well as Iran. Under three key dimensions of EPIB, this section explains brownfield-related legislative drivers, policy actors and domains, as well as key regeneration tools and elements in each international case with an application to Iran.

11.2 Existing challenges to brownfield regeneration in Iran

The existing situation in relation to land use planning and environmental protection in Iran presents a series of challenges to the brownfield regeneration process. In order to be able to examine the brownfield situation, it is necessary first to recognize these challenges and then minimise uncertainties surrounding them. In the case of Iran, the situation is complicated as the stakeholders, e.g. policy makers, investors, and land-owners, are not acquainted with these challenges due to the low profile of brownfield-related issues in Iran. Hence, one of the key objectives of this research has been to identify the existing challenges and problems associated with brownfield regeneration at the level of policy and practice in the Iranian context.

11.2.1 Institutional inconsistency across disparate policy sectors

At the moment, there is a serious disconnect between the urban development and environmental policy sectors in Iran. This institutional inconsistency and lack of cooperation between government organizations manifests itself in two ways; (1) inconsistency between land-use planning policy agencies (a vertical disconnect), and (2) inconsistency between the environmental protection and land-use planning policy sectors (a horizontal disconnect).

The first point is justified on the grounds of disconnection between local municipalities and upper levels of government within the existing urban management system and policy framework in Iran. As discussed in the previous chapter, municipalities in Iran operate autonomously and independently from MRUD and its subcategorized organization in charge of urban regeneration, UDRO. This vertical disconnection is even stronger in the larger Iranian cities where the municipalities are given even more autonomy, particularly in implementing urban development plans. Owing to the fragmentation of policy structure and disparities of planning objectives at the local and national levels of urban governance, brownfield and underutilized areas are often left undeveloped or ineffectively developed across Iranian cities.

The second point concerns the strong inconsistency and lack of cooperation between the land-use planning and environmental protection organizations and agencies in Iran. The Ministry of Roads and Urban Development (MRUD) and the Iranian Department of Environment (DoE). DoE, as two ministerial sectors responsible in this regard, are completely disconnected and, thus, the environmental problems of urban areas are not explicitly and mutually addressed across spatial-environmental policy domains and governance scales. Given the lack of communicative and cooperative approach, the DoE operates individually and its organizational framework does not address any issues pertinent to urban planning and land redevelopment. DoE's administrative structure does not support the development of area-specific environmental ambitions and values into urban planning (discussed further in Section 11.3).

11.2.2 Conflicts between local municipalities and land developers

One of the most significant challenges to brownfield regeneration in Iran is concerned with the constant conflict of interest between local authorities and land developers over the application of development plans. As discussed in Chapter 10, municipalities in Iran have the statutory duty to implement urban development plans, i.e. CDPs and DPs. It was argued that mainly owing to the financial problems of municipalities, organizational limitations and the obsolescence of planning regulations, these development plans are not capable of implementation in many cases. These issues often create serious conflicts between municipalities and developers, particularly during the land-use transfer process. These conflicts are further accentuated when the land is assigned to public services under the development plan, since developers and land-owners are unwilling to comply with such regulation given the higher profitability of commercial and housing development. In order to manage land-use conflicts, the Iranian government has established the Commission of Article No. 5 which enables local municipalities to modify planning regulations and offer land-use change permits to developers in certain circumstances. However, the government's attempts have not been entirely successful in alleviating this pervasive problem across Iranian cities. There are still a great number of brownfield sites that have been left unused and abandoned in inner-urban areas for several years, largely because of conflicts between local governments and developers about their future use. The long-term abandonment of brownfield land of Nassaji Mazandaran Textiles Factory No II in Qaemshahr, in Mazandaran Province, presents a good example in this regard (see Box 11.1).

Box 11.1 Abandonment of brownfield site; *the case of former site of Nassaji Mazandaran Textiles Factory No. II in Qaemshahr*

The Nassaji Mazandaran Textiles Factory No. II was established in 1930s and ceased its full operation in the early 2000s following an economic downturn driven by the massive decline in light manufacturing activity in post-revolutionary Iran. This large-scale brownfield site, with a total area of around 12 ha, has been left abandoned for over 15 years in the central city of Qaemshahr. It is not clear whether the site contaminated or not. Interviews with different stakeholders (Participant 20-IR, Participant 21-IR, Participant 23-IR; Participant 24-IR; Participant 28-IR) suggest there are two major driving forces behind the long-term abandonment of this brownfield site, including:

- Strong disagreement between the local municipality, as the implementation agency of development plans, and the private developer in regard to the future land-use of the site. The developer is reluctant to follow the land-use change procedure determined by the urban development plans, i.e. CDP and DP. Under the development plans, the Municipality of Qaemshahr is obliged to allocate parts of the site to public services (e.g. public park and cultural spaces), whereas the developer emphasises commercial and residential development given the much higher profitability of such development types in Iran.
- The lack of monetary and non-monetary incentives to encourage the contribution of private entities and non-profit organizations

Note: The Photos were taken by the author in May, 2018.

11.2.3 Scope of urban regeneration activity in Iran

As was argued in the previous chapter, the urban regeneration policy system in Iran is exclusively focused on residential neighbourhoods with inappropriate structural and physical conditions. At present, urban planning and regeneration regulations do not address any issues regarding the identification, redevelopment and reuse of brownfields or contaminated sites. The central scope of regeneration policy and practice in MRUD (UDRO) and local municipalities, as the responsible bodies, has been restricted to the intervention in Deteriorated Urban Fabric (DUF), including historic areas, informal settlements and deteriorated neighbourhoods. This is justifiable considering the actual extent of the DUF problem across Iranian cities. As discussed in the previous chapter, MRUD's official report (UDRO 2018) shows that DUF areas account for almost 30 per cent of the total urban area in Iran, involving nearly 30 per cent of population living in cities. This statistic implies that the problem of non-contaminated sites, particularly housing sites, is acute enough for the government to ignore contaminated sites. In other words, the regeneration challenge to greyfields, as inefficient but non-contaminated urban areas, in Iranian cities has focused decision makers' attention to the detriment of the bigger picture and this has greatly impeded the remediation of brownfield sites in Iran. Due to the ongoing economic and geopolitical pressures faced by the Iranian government, accompanied and fuelled by the limited cultural awareness, 'soil pollution and remediation issues' receive less attention in policy and practice, in comparison with water and air pollution.

11.2.4 The lack of legislation regarding brownfield remediation

Presently, there is no legislation or national policy framework regarding the remediation and redevelopment of brownfields in Iran. This includes the identification, assessment, monitoring and clean-up process of contaminated sites. There is, to date, no national land registration system to assist in identification of contaminated land across the country. No monitoring and assessment of soil contamination in Iran is occurring voluntarily by the environmental departments and agencies. Clean-up is rarely demanded by municipalities, land-owners, developers or other responsible stakeholders. In almost all cases, when soil analysis by the DoE takes place it is a result of complaints from local residents or reported incidents, for example the releases of hazardous substances or pollutants from an accident such as a fuel tanker spill.

It is clear that the Iranian government has not yet come to the recognition of soil contamination issues for urban brownfields sites, since sites which are not in any productive use are not covered by the regulations described above. As a result, no information is today available to the general public in terms of the scale and nature of soil and groundwater contamination and, consequently, developers and land-owners are not fully aware of this issue. Therefore, industrial, military or mining brownfield lands or properties with a high probability of having soil and groundwater pollution tend to be developed in Iran without any environmental consideration or remedial treatment. A good example in this regard is the redevelopment project of the former site of the Khoshnoosh Carbonated Drinks and Plastic Packaging Factory in Sari (see Box 11.2).

Box 11.2 Redevelopment of contaminated site; *the case of former site of Khoshnoosh Carbonated Drinks and Plastic Packaging Factory in Sari*

The Khoshnoosh Manufacturing was a food processing factory located in Sari, in Mazandaran province. This manufacturing company was founded in the early 1970s and shut down in 2014 as a result of the bankruptcy of the company. Two years after the closure of the factory, clearance started, and the site is currently under redevelopment as low-rise commercial project by the private sector. The former activity of the factory comprised the production and processing of carbonated drink, beverage, soda extract and edible CO_2, as well as manufacturing units of wastewater treatment and plastic packaging. Given the nature of previous activities, the soil and particularly the groundwater system of the former site of the Khoshnoosh factory are likely to be contaminated. However, due to the lack of legislation on soil contamination in Iran, there is a great deal of uncertainty about the basic characteristics and extent of contaminants on this particular site. Following several personal interviews with the project developer, and local and state authorities in Sari (Participant 22-IR; Participant 23-IR; Participant 25-IR; Participant 26-IR; Participant 27-IR), it was acknowledged that, prior to and within the construction phase, no remediation measures had been taken for the prevention, control and treatment of contamination.




Note: The Photos were taken by the author in June, 2018.

11.2.5 The SQSG and related challenges

As noted in the previous point, there is no legislation regarding soil and groundwater contamination in Iran. However, in 2013, DoE established a national standard and guideline for contaminated soil, namely “Soil Quality Standards and Guidelines (SQSG)”. To date, the SQSG acts as the only technical support for contaminated sites in Iran, offering general information about the soil contamination threshold levels for different land-uses. Based on the acidic ($pH<7$) and non-acidic ($pH>7$) characteristics of soils, the SQSG takes account of 88 pollutant parameters in five groups of organic compounds (21 parameters), polycyclic aromatic compounds (16 parameters), chlorine hydrocarbons (22 parameters), pesticides (7 parameters) and heavy metals (22 parameters). The central focus of SQSG is on identification and assessment of total concentrations of polluting heavy metals (e.g. zinc, arsenic, lead, cadmium and copper), organic compounds and hydrocarbons in soil layers. According to this standard, soil assessment must be undertaken through discrete subsample collections from soil with depth intervals of up to 150 cm. In order to monitor and ensure soil quality, the analysis of collected samples is conducted either in DoE laboratories in each state or in certified private laboratories.

The central scope of soil treatment activity in Iran is strongly narrowed to the assessment and monitoring of agricultural land in terms of soil texture and microbiology, pH, humidity level as well as the percentage of heavy metals in soil. Since the regulation of the SQSG in 2013, however, this scope has gradually expanded. SQSG addresses the environmental quality standard for contaminants and corresponding limits for five categories of land-uses including; (1) residential land, (2) commercial land, (3) public park, (4) agricultural land, (5) forest and pasture. For example, under the SQSG, the standard threshold of Zinc (Zn) in acidic soil is 200 ml/kg for residential land, agricultural land, public park, forest and pasture, whereas this figure is 2000 ml/kg for commercial land. At present, the application of the SQSG is focused on the monitoring and assessment of soil pollution for the land uses noted above, particularly for agricultural land. In a few cases, however, individual soil sampling measures are implemented for operating industries and mining areas (Participant 13-IR).

In addition to technical standards, the SQSG has provided broad guidelines regarding the investigation, monitoring and clean-up of contaminated sites under three appendices of the document, namely:

- Compilation of quantitative and qualitative indicators of soil resources and assessment of the environmental risk and quality of soil,
- Guidelines for determining the maximum allowable load of contaminated pollutants to be released to soil resources,
- Guidelines for estimating the costs of soil contamination and remediation.

It is significant to recognize that the SQSG is still in its infancy and has been yet unable to be effective in dealing with common brownfield issues. Some of the critical factors that may have hindered the practical use of this national document are discussed as follows:

- *Vagueness of document in terms of the application of the SQSG.* It is not completely clear whether the standard has been designed for the existing or future use of land. This is critical because if the SQSG is only meant to address existing land uses, then the application is not necessarily dealing with the redevelopment issue of brownfields. In contrast, a future-oriented standard could take a post development approach which could open a constructive policy dialogue regarding the risk-based remediation approach. Relying on the contextual language of the document and personal interviews with governmental professionals (Participant 13-IR; Participant 14-IR; Participant 15-IR), the SQSG appears to be more a preventative standard than a forward looking one. In other words, this standard is primarily focused on the protection and conservation of soil resources in existing conditions, not for planned development. Over the past two years, the DoE in the Fars Province, for example, has used the SQSG's technical standard in only a handful of soil pollution assessment of agricultural lands, operating mines, oil refineries and petroleum industry cases (Participant 13-IR).

- *The lack of reference to the figures and information of date.* The SQSG seems to be a compound of information borrowed from such countries as the US, the Netherlands, England, Canada and Australia that have valid soil contamination standards and guidelines in place (Pasandideh 2014). The lack of references to sources in the existing document may have led to erroneous interpretation of original standards. The possible mistranslation of information has caused vagueness in technical language of the document.

- *The lack of information regarding groundwater contamination.* At present, the scope of SQSG is confined to soil pollution and quality, whereas contaminated soil and groundwater systems are often treated simultaneously. The standard provides no information about the assessment and clean-up of contaminated groundwater. However, the groundwater system and geological basin are vulnerable to pollution due to the flow and dispersion of water within the aquifer. Hence, groundwater treatment often requires further attention and technical assistance.

- *The lack of explicit guidelines.* The SQSG is viewed as a standard that offers a set of environmental quality conditions, rather than a guideline that produces practical solutions for remediation of contaminated soil. Not surprisingly, given the absence of a forward-looking approach, the SQSG provides very general and superficial instructions on the assessment and implementation of contamination clean-up. Nevertheless, several countries (e.g. the US, Japan, and China) have not emphasized the necessity for application of the risk-based approach within their brownfield statutory framework, but developed technical guidelines for the remediation practice.

11.3 Analysis of brownfield regeneration using EPIB

Having highlighted the existing challenges to brownfield regeneration activity in Iran, this section demonstrates the applicability of the EPIB tool. It draws out a range of issues which contrast the governance and policy response to brownfields across the four international case studies and the situation in Iran. Figure 11.1 summaries this discussion in the light of the EPIB tool. As the Figure shows, this comparative analysis is undertaken using the three formative phases of the EPIB - i.e. policy driver, actors and critical regeneration elements-, each of which are demonstrated in distinct but inter-related dimensions. The following sub-sections discuss these dimensions of the EPIB tool in more detail.

11.3.1 EPIB - Dimension I; policy and legislative drivers

As discussed in previous chapters and comparatively analysed in Chapter 8, there is an ingrained linkage between the understanding of brownfield-related problem and the legislative response to it. Building on the critical issues presented by EPIB in the global context, the first analytical dimension is to acknowledge the legislative drivers to relevant policies. As discussed previously, the EPIB tool identifies four drivers of brownfield policy- namely economic viability, spatial planning, public health and safety as well as environmental protection. As shown by Figure 11.1, the brownfield policy drivers differ significantly across different regimes, being imposed with varying strength. For example, in the US and to some extent in Japan, although the spatial and economic motives were clear through anti-sprawl and land reuse policies, such factors as environmental protection, health and public safety are seen as the major policy drivers to brownfield regeneration. By contrast in Europe, brownfield polices and legislative actions have been predominantly driven by land-use planning regulations and the necessity of spatial reorganization of cities.

It is important to take note of the fact that brownfield policy, in many countries, has been essentially adopted in response to an environmental pollution incident or a number of related incidents. For example, brownfield-related legislative decision in the US originated from the Love Canal Disaster in 1980s, and accordingly the Love Canal Area Revitalization Agency (LCARA) was formulated as the first brownfield policy initiative. Following this incident, the US government has placed a strong emphasis on identification, assessment and remediation of environmentally contaminated sites over the past 4 decades or so. Similar to the US experience, soil contamination and resulting public safety issues initially came to the recognition of policy-makers in China in 2004 when a poisoning incident occurred during the construction of Songjiazhuang Metro Station in Beijing (Xie & Li 2010). However, unlike the US case, it seems that the environmentally-driven brownfield policy in China has gradually shifted its prime focus towards economic aspects of development. Today, the marketability of brownfield sites is paramount in stimulating the Chinese government and stakeholders, whereas in the US, environmental treatment of contaminated sites still remains the leading driving force to brownfield-related legislative policy decisions and action.

Given the limited understanding of brownfield phenomena and associated environmental and planning risks, it is difficult to identify any policy that stimulates brownfield regeneration in Iran. At present, environmental protection and public safety issues are not explicitly and comprehensively addressed within the housing or relevant urban development policies in Iran. MRUD and municipalities- as the responsible authorities for urban development in Iran- have not fully appreciated the vital role of brownfield land reuse in alleviating the pressing problems caused by the steady growth of urban areas. In a broader sense, the problems associated with urban sprawl have not been grasped and comprehensively addressed within the Iranian legal and regulatory framework. Furthermore, soil contamination pertinent to brownfields has not yet alerted the public and policy attention to the grave risks to human health and environment. Unlike the US and Chinese cases, there has been no major pollution incident reported in Iran that has served to raise public awareness and thus call for the government to frame coherent policies on identification, assessment and clean-up of contaminated sites.

The economic benefits derived from brownfield regeneration are widespread and could be justified predominantly on the grounds of land value and marketability of development in Iran. Triggered by ambiguous government policies as well as strong national market forces, land has become a valuable asset in Iran presenting strong market opportunities for land owners and developers. This is particularly the case for old post-industrial brownfields since they are often large in size and located in economically valuable inner-city areas (see Figure 9.11 in Chapter 9). Similar to the case of China, the economic viability of development plays a dominant role in stimulating the brownfield decision-making process in Iran. However, the significance of land value does not necessarily mean that the environmental and spatial aspects of brownfield redevelopment are recognized to motivate legislative decision and actions. As EPIB demonstrates, better outcomes, especially in respect of site clean-up, are achieved when all four driving factors are in play. This does not seem yet to be the case in Iran.

Figure 11.1 Comparative analysis of brownfield regeneration in Iran and four international cases through the lens of EPIB *(Source: the author)*

Dimension I

Policy drivers to brownfield decisions and actions in Iran and four international cases.

Countries

Drivers	US	EU	Japan	China	Iran
Economic Viability	++	++	+	+++	+++
Spatial Planning	+	+++	+	-	+
Public Health & Safety	+++	++	+++	+	+
Environmental Protection	+++	++	+++	++	-

Dimension II

Policy actors and domains for brownfield development in Iran and four international cases *(Cross-sectoral Communication & Action).*

Countries

	US	EU	Japan	China	Iran
Policy	+	++	-	-	-
Practice	-	+	-	-	-

- Non-existence + Existence

++ Strong +++ Very Strong

Dimension III

Critical elements in brownfield development process in Iran and four international cases

Countries

Critical Elements			US	EU	Japan	China	Iran
Legal Definition			++	+++	+	-	-
Land Registration System			+++	+++	+	-	-
Monetary Tools, Programs, & Incentives			+++	++	-	+	-
Non-monetary Tools, Programs, & Incentives	Technical Assistance	S*	+++	+++	++	++	++
		G*	+++	+++	++	++	+
	Environmental Liability Programs		+++	+++	+	-	-
	Environmental Insurance		+++	++	-	-	-
Remediation Approach in Policy and Practice	Risk-based Approach		-	+++	-	-	-
	Total Clean-up Approach		+++	-	+++	++	-

** S= Standard, G= Guidelines*

11.3.2 ***EPIB - Dimension II;*** *policy actors and domains*

Brownfield regeneration presents a dual challenge for both land-use planning and environmental protection policies. In response to such challenges, it is necessary to enhance spatial-environmental collaborative decision-making and action. The second dimension of EPIB focuses on the relationship between environmental community safety and spatial planning agencies in both policy and practice (see Figure 11.1). Apart from the European Union's policy initiatives, the strategic objectives of EPI have not yet been recognized and clarified in other nations, including Iran. As was formerly argued in Chapter 3, the principles of EPI have focused policy makers' attention in Europe from the late 1980s onwards. Since then, the EU has been, and still is, the principal driving force behind the formulation of EPI and political commitment to it. However, when it comes to the implementation of policy integration at lower levels of management, a large number of European member states have not yet adopted a communicative approach to 'achieve EPI across brownfield regeneration process'.

According to the second dimension of EPIB, two principal actors and domains can be found in disparate phases of brownfield-related policy-making and practice, including '*spatial planning organization*' and '*environmental protection organization*'. Looking at the brownfield situation in different countries, we can clearly observe a need to foster communication across different domains of environmental protection and land-use planning. In several cases, most notably in Japan, miscommunication or ineffective communication of these policy actors has caused serious conflicts during the brownfield decision-making and implementation processes. In managing such conflicts, the location of power and accountability of environmental and spatial agencies in both vertical and horizontal dimensions are critical in regeneration of brownfield sites, as represented by VEPIB and HEPIB (see Figure 8.1). As in several international cases, the environmental and spatial sections of governance in Iran are institutionally and legally disconnected. The disconnection has become even more pronounced bearing in mind the ongoing organizational challenges across the urban development agents. Accompanied by the broken environmental-spatial linkage, the lack of cross-sectoral communication and action across the spatial planning organizations at national and local levels of governance has become a major impediment to the process of brownfield policy and practice in Iran.

11.3.2.1 Spatial planning organization

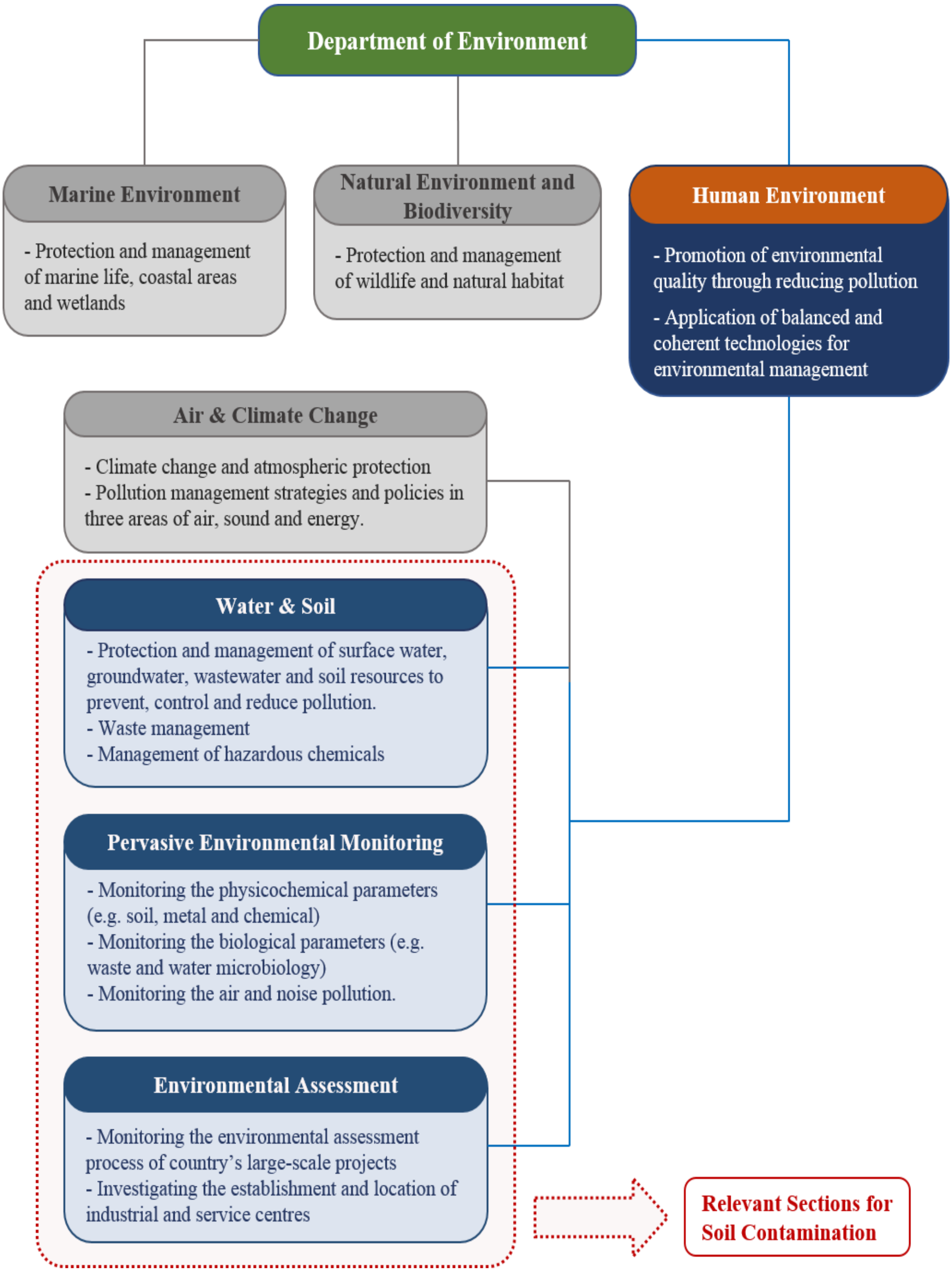
Under the existing urban management structure in Iran, there are two ministerial sectors that have the potential to be given legal authority regarding the regeneration of brownfield sites, namely (1) *the Ministry of Roads and Urban Development (MRUD)*, and (2) *the Ministry of Interiors (MoI)*. These two ministries are regarded as the principal spatial planning actors at the highest level of governance in the Iranian urban system. As discussed in Chapter 10, MRUD is an important body accountable for the development of planning strategies and associated legal instruments. Under the administrative oversight of MRUD, the Supreme Council of Urban Planning and Architecture of Iran (SCUPA) acts as the most powerful legislative body responsible for formulation and revision of urban development plans. Furthermore, the Urban Development and Revitalization Organization of Iran (UDRO) is another important sector authorized for regeneration of urban areas under the direct control and supervision of MRUD. At present, UDRO's activity is highly focused on the revitalization of deteriorated residential neighbourhoods in central cities, and of informal settlements in suburban areas.

In addition to MRUD and its affiliated organizations, EPIB suggests that local municipalities would be principal legal actors for regeneration of brownfield sites across Iranian cities. Despite the fact that municipalities in Iran are officially and institutionally subcategorized under the MoI, they operate independently with little or no administrative influence and control from this ministerial sector. As previously discussed and depicted in Figure 10.2 (in Chapter 10), municipalities play the leading executive role in managing and administrating Iranian cities, being responsible for implementation of major development plans and provision of public facilities and services. This operational authority does not extend to regeneration of brownfields. Similar to UDRO, the current scope of urban regeneration activity by municipalities in Iran is restricted to Deteriorated Urban Fabric (DUF).

11.3.2.2 Environmental protection organization

One of the essential dimensions to brownfield policy-making and practice in every country is associated with the accountability of environmental protection organizations and agencies. Bearing the EPIB integrated approach in mind, such environmental protection policy actors play a critical role in various phases of evaluation, negotiations, decision-making and regeneration of brownfields or contaminated sites. In the context of Iran, the soil and groundwater contamination issue has not been yet recognized within the urban management and development system. However, this issue has been addressed by the national environmental protection organization, *the Iranian Department of Environment (DoE).* DoE was established in 1956 for matters associated with environmental protection. DoE has three main organizational divisions, including: (1) Human Environment, (2) Natural Environment and Biodiversity, and (3) Marine Environment. Having analysed the organizational structure of DoE, it can be acknowledged that soil and groundwater contamination issues are addressed within three sections of the DoE's Human Environment Division, including the Soil and Water Section, Pervasive Environmental Monitoring Section and Environmental Assessment Section (see Figure 11.2).

Figure 11.2 The organizational structure of DoE, with key responsibilities of each section *(Source: the author)*



11.3.3 EPIB - Dimension III; *regeneration elements*

The third dimension of the EPIB makes a comparative analysis of policy and practice approaches to the brownfield regeneration in four international cases and in Iran. Through the analytical lens of the EPIB tool, this research has identified certain regeneration elements and examined them within a disparate international context in Chapter 8 of this thesis. Now, it is necessary to observe how these elements can be used to inform the decision-making and implementation process in Iran.

11.3.3.1 Legal definition

As has been argued in Chapters 1-7 and reflected in the EPIB's framework in Chapter 8, there are multiple definitions for brownfields in the world. Over the past 2 decades or so, the issue over brownfield definition has received widespread political and scientific impetus. This led in turn to a debate in a handful of developed nations particularly in the early 2000s, when there was rapid movement in addressing the phenomenon of brownfield. The seminal contribution to the analysis of brownfield definition was made by Alker et al. (2000) and Yount (2003). As stated by Alker et al. (2000), *"it is important that a new [Brownfield] definition should be understood, transparent and acceptable to all stakeholders who have a legitimate interest in the subject. This suggests that the task of arriving at an agreed and acceptable definition is by no means straightforward, as it is inevitable that certain vested interests may not be entirely satisfied".* Yount (2003) also suggests that "*a conceptual definition of brownfields should contain terms that are unambiguous, and should allow policy makers and practitioners wide latitude in addressing the dual nature of brownfields as both environmental and economic problems*". In respect of Yount's conceptual characterization, the legal definition needs to satisfy three aspects of brownfields, i.e. environmental degradation, physical deterioration and economic instability of sites. As was widely argued in Chapter 8, these three defining terms are influenced by the characteristics of brownfields, i.e. soil and groundwater contamination, coupled with dereliction, vacancy, and long-term abandonment of sites (see Figure 11.3).

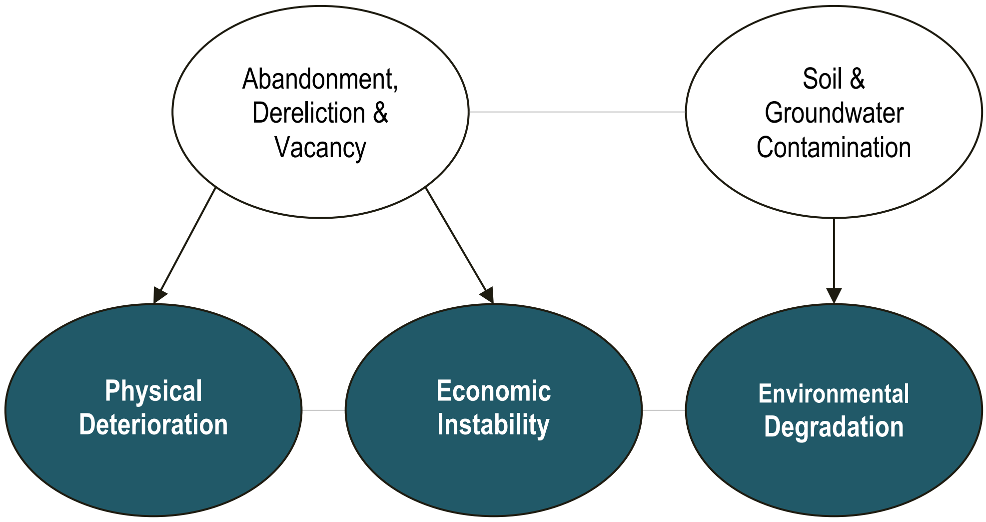


Figure 11.3 The characteristics of brownfield
(Source: the author)

As discussed in Chapter 8 through the analytical lens of the EPIB tool, different countries have developed different terminologies for brownfield sites. In some countries (e.g. US, Japan, Italy, and Spain) brownfield sites are recognized by the presence of contamination, while in some (e.g. UK, Germany, and France) they are defined in a broader scope as the vacant, derelict or PDL. The diversity of legal definitions can be predominantly justified on the grounds of cultural differences across various world regions, especially when it comes to debates surrounding contamination issues. As discussed in Chapter 8, an ingrained linkage between the cultural recognition and regulation of brownfields can be acknowledged. In other words, the legal response to brownfield largely depends on how brownfield-related challenges have arisen and been recognized in different countries with different cultural and socio-economic characteristics. Using the EPIB tool also underlined the fact that brownfield decisions and actions in different regimes have been essentially driven by four major factors- i.e. economic viability, spatial planning, environmental stewardship and public health- pursuing social well-being as the common objective. However the relative weight of each factor varies between regimes. For instance, in Europe, the spatial dimension of brownfield regeneration has played a principal role in establishing the legal and regulatory framework. However, in the US, environmental pollution and public health risks have been paramount. In China, the economic value of land has predominantly focused the policy makers' attention in taking legal decisions and actions associated with brownfields.

In the case of Iran, there is presently no definition for brownfields to be used for legislative purposes. In other words, the term brownfield is completely unknown in both the urban or environmental vocabulary of Iran. As was noted in Chapters 9 and 10, urban management and regeneration policy development in Iran has been triggered by the existence of a large number of underutilized and deteriorated residential areas within and at the margins of cities. This issue has significantly narrowed the scope of regeneration understanding and activity in Iranian policy and practice, which has ultimately lead to the nation-wide blindness to environmentally contaminated sites across various levels of governance, policy actors and stakeholders.

Using the EPIB tool and the comprehensive analysis of different countries' experience, it is clear that brownfield sites in each regime are either characterized by environmental protection agencies (e.g. EPA in the US) or spatial planning organizations (e.g. The Ministry of Housing, Communities, and Local Government in the UK). In Iran, at the highest level of governance, DoE and MoI have not yet provided any definition for brownfields. The closest concept was, however, framed by MRUD as the lead urban planning and development organization. As noted formerly, MRUD has, thus far, developed two defining terms for inefficient and distressed urban areas, namely Deteriorated Urban Fabric (DUF) and Underutilised and Deteriorated Urban Fabric (UDUF).

As noted in Chapter 10, under the new urban regeneration agenda in 2015, the Iranian government expended its definitional scope from DUF to UDUF having added two categories of irregular rural zones and incompatible urban areas (including abandoned factories, barracks, and prisons) to DUF. If we consider the expanded version of DUF as the potential policy-based term for brownfields in Iran, this can somehow resemble the situation in many European member states (e.g. UK, Germany and France) where brownfields are broadly known as derelict and unused PDL. However, unlike these European countries, MRUD's new definition fails to address environmental contamination and economic instability issues that are often attached to brownfield sites. Despite the definitional expansion, DUF areas (i.e. deteriorated residential neighbourhoods and informal settlements) or greyfields still remain the target for regeneration at both national and local levels in Iran. Therefore, industrial and military brownfields fall out of the scope of Iranian urban regeneration policy and practice at present.

11.3.3.2 Supporting tools, programs and incentives

As emphasized by the EPIB tool, an effective brownfield regeneration process demands a group of policy tools and programs to reduce the uncertainties created for investors, private organizations and entities, and, thus, stimulate their participation. Having analysed different international case studies, EPIB considers these supporting policy tools and incentives under two general categories of monetary (i.e. tax relief, loans, grants and credits) and non-monetary (i.e. environmental insurance, liability programs and technical assistance) (see Figure 11.4).

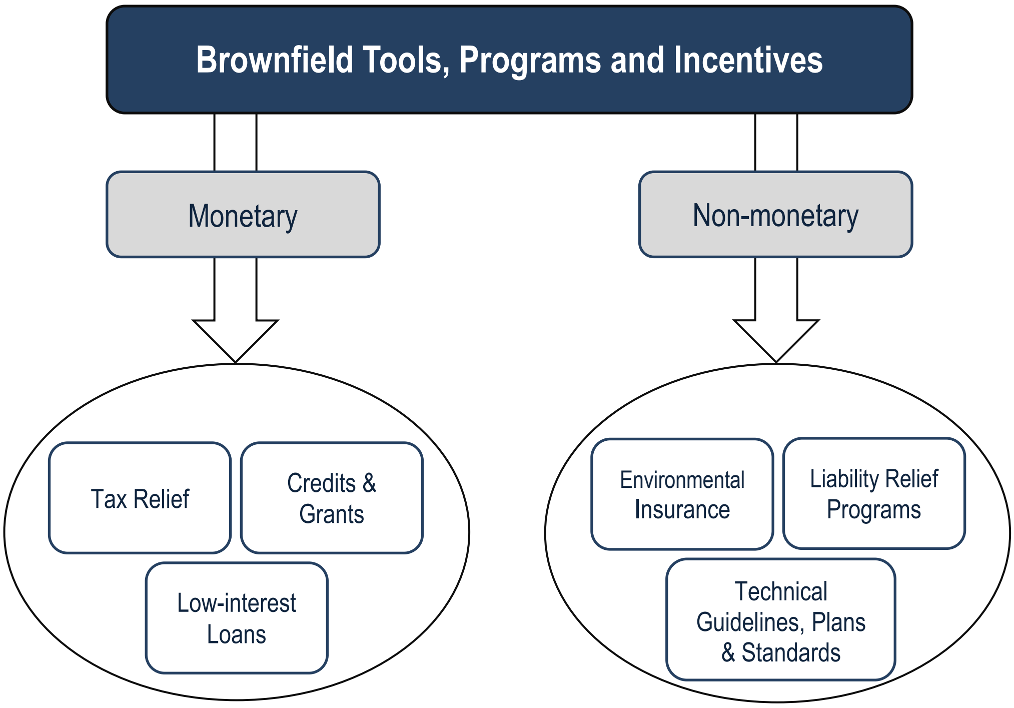


Figure 11.4 Tools and incentives associated with brownfield regeneration *(Source: the author)*

In respect of brownfield regeneration programs and incentives, the US and EU experiences provide a useful benchmark against which to compare Iranian policy and practice. From the late 1970s onwards, the US federal and state governments have been actively developing pioneering initiatives and programs to help rectify the pressing and pervasive environmental problems associated with contaminated sites. The EPA's Brownfields Program, Superfund, and VCPs are today widely accepted approach to brownfield regeneration and reuse, resulting in growing market demand for contaminated sites across the US. At the moment, these programs offer extensive monetary and non-monetary incentives to brownfield land owners, developers and prospective purchasers that include clean-up subsidies, liability relief programs, technical assistance, environmental insurance, and tax incentives. In doing so, the US federal government substantially increased the state oversight in brownfield audits and clean-up activities. This has created direct authority and accountability of state governments or their designated agencies over removal, remediation and redevelopment phases of contaminated sites.

In addition to the US experience, the EU government has framed effective planning policies for area-wide brownfield recycling and reuse over the past 15 years or so. In response to the growing spatial and environmental concerns in Europe, the EU and EEA developed significant structural funding programs (i.e. ESIF) and a liability framework (i.e. ELD) that have encouraged brownfield regeneration across European member states. It is important to recognize that apart from the EU-wide supportive tools and incentives, several European countries (e.g. the UK, Netherlands, France and Germany) have developed their own brownfield strategies within national policy specific to protection, management, and sustainable use of soil. In addition to brownfield-specific strategies, a handful of European countries have formulated broad spatial-environmental integration policies and planning frameworks offering invaluable tools for land-use management especially at the state and local level of governance. The Dutch development plans and environmental assessment tools, most notably LOGO and MILO, are good examples in this regard (see Table 3.1 in Chapter 3).

In Iran, given the lack of legislation on contaminated sites, there are no exclusive funding programs and technical products to facilitate clean-up and enforcement actions on brownfields. However, amongst the tools and incentives depicted in Figure 11.4, there are two brownfield-related guidelines and development plans under the existing environmental protection and land-use planning policies in Iran- i.e. the DoE's SQSG- and MRUD's development plans- i.e. the CDP, DP, City Guidance Plan, Regeneration Plan and Land Preparation Plan (LPP)-. Apart from LPP, different aspects of urban development plans and SQSG have been comprehensively discussed earlier in Chapter 10 and this chapter.

Furthermore, Land Preparation Plans (LPPs) are important plans that lay down fundamental principles for land preparation and management, particularly at the local level of urban planning and development in Iran. These plans are prepared and ratified by MRUD and implemented by local municipalities, and are essentially meant to facilitate pre-development site analysis. LPP is regarded as the only development plan type in compliance with the CDPs and DPs that addresses land preparation and site analysis. In the case of cities that lack the CPs and DPs, LPPs are prepared and approved by SCUPA (MRUD). At present, the scope of LPPs is limited to infrastructural activities (e.g. land readjustment and levelling, electricity networks, sewerage system and determination of densities) and municipal services (e.g. administrative, commercial, health, educational and recreational services). Meanwhile, the principal focus of LPPs has been placed on the physical and infrastructural preparation of land for housing construction and development, being less attentive to environmental aspects of land development or redevelopment.

11.3.3.3 PPP and environmental liability issues

The Polluter-Pays Principle (PPP) has been heralded as an important aspect of environmental law in many countries in the developed world to prevent and remedy environmental damage. The EPIB tool suggests that the effective application of the PPP is an imperative within brownfield regeneration process. In the US and EU, legal liability for associated costs of any residual or new contamination has been widely addressed within environmental management policies and relevant regulatory systems. Triggered by the Love Canal incident in the late 1970s, the US federal and state governments have assigned various legal programs, e.g. Superfund, RCRA, SARA, and the Brownfields Law, to impose liability retrospectively on developers or owners who caused site contamination. In order to protect innocent land owners or new purchasers, the EC has also developed ELD providing European member states with extensive liability or regulatory relief for remediation and reuse of environmentally contaminated sites. It is important to recognize that before the enactment of ELD in 2006, several European countries had enacted their own legal liability framework. For example, the UK government introduced the Environmental Protection Act 1990 in an attempt to define different categories of polluters, so that the liability for remediation under certain circumstances could be determined or transferred between responsible parties.

The PPP is not enunciated in policy in Iran. At present, the DoE's legal and regulatory framework lacks comprehensive legislative resources, tools and statutes that could reflect a growing understanding of the extent of the environmental liability issue and direct the attention of public and involved stakeholders towards it. The current environmental system in Iran does not hold site polluters liable for environmental harm they may cause. Findings from the field-survey suggest that land-owners and developers in Iran are not well acquainted with the phenomenon of soil pollution. Meanwhile, given the lack of a regulatory scheme and viable mechanism in place, there is no liability regulation that can oblige the relevant stakeholders to negotiate about possible clean-up. As a consequence of this situation and as exemplified in Box 2, contaminated sites in Iran are being redeveloped without any risk assessment or application of clean-up measures.

11.3.3.4 Redevelopment approach in policy and practice

The EPIB tool views the site redevelopment approach as a key element in brownfield policy and practice. As previously discussed in Chapter 8, two remediation approaches have been, thus far, practiced in different regimes for contaminated sites, namely the "total clean-up approach", and "risk-based approach". The former is regarded as a common approach in a handful of countries, e.g. the US, Japan and China, where the site is fully remediated irrespective of the proposed end use, whilst the latter aims to secure soil and groundwater remediation by reference to the proposed end use and likelihood of human exposure as well as available resources for the task.

The total clean-up approach implies complete removal of contamination by numerous different techniques. The risk assessment, evaluation and remediation techniques to manage uncertainty and variation in this traditional approach are prohibitively costly, resulting in poor adoption in most nations (Kuppusamy et al. 2017). The risk-based approach is, however, less costly by tailoring the extent of removal and remedial actions required to the level of risk suitable for prospective land-use. Given the economic feasibility of the risk-based approach and increasing development costs especially in inner-city areas, this more cost-effective approach is today receiving growing attention amongst policy-makers and practitioners. For the same reason, the EC, for example, has mandated European member states to establish a proportionate risk-based approach to the challenge of soil contamination within a binding regulatory framework until 2020.

In the context of Iran, given the growing marketability of land and the significance of development costs, the risk-based approach may be more effective for brownfield activities as it considerably brings down the investigation and remediation costs. The national environmental organization in Iran recognizes the risk-based approach. Outlined by the SQSG, the DoE identifies soil contamination threshold levels in five distinct categories. However, despite such legislative attempts, it appears difficult to achieve cost-effective development goals under the risk-based approach due to the lack of methodological principles, as well as insufficient infrastructural support and experience with techniques for soil and groundwater remediation in Iran.

Having considered different countries' experience and the existing institutional arrangements in Iran, it is clear that DoE and MRUD -or their certified agencies- lack a coherent framework under which the relevant stakeholders can be acquainted with different remediation techniques and their potential implications. At present, neither the environmental protection nor urban planning policy frameworks assist in identification, remediation and redevelopment of contaminated sites in Iran. This is explained by the lack of a cross-sectoral system supporting the feasibility analysis of clean-up process and assessment of associated risks, as well as the identification of appropriate remediation technologies for developers.

11.3.3.5 Contamination label and land registration

There is a bilateral relationship and responsibility between policy-makers and the public in tackling brownfield issues. This shared responsibility is of great importance for redevelopment of contaminated sites. In order to facilitate the site identification, investigation, assessment and remediation processes, many governments are obliged to establish a land registration platform and carry out a comprehensive and systematic national survey on the identification of contaminated sites. A national land registration system enables authorities to accurately quantify contaminated sites, providing such helpful information as the location and size of sites, land value, nature of former uses, periods of idleness, and types of contamination as well as degrees of risk. By publicly revealing these records, prospective purchasers and developers are also acquainted with the real or perceived presence of soil contamination. It is important to note that many countries have not yet envisaged quantitative standards or a statistical database for identification of contaminated sites, and in some countries, such as China, the government only offers a very general overview of soil contamination through a national joint bulletin survey without detailed site-specific information.

From a public safety perspective, it can be argued that land-owners have a responsibility to register their contaminated site on national platforms. However, the land registration process can encounter difficulties owing to significant environmental and socio-economic complexities. Brownfield sites often carry a stigma risk and a negative image resulting from potential environmental contamination. As suggested by EPIB, such cultural-social stigma poses formidable obstacles to quantifying the extent of brownfield problems in many countries. In some countries, most notably in Japan, this issue is highly pronounced due to strong social concern and cultural discontent over contamination issues. Having considered the economic aspects of development and high remediation costs, developers are reluctant to register their contaminated land, further adding to the stigmatization problem. In fact, they attempt to avoid associating contamination with their land. This also poses a grave communication risk between land owners, developers or new purchasers. However, having been well practiced in the context of US, the government's funding action programs and supportive tools have significantly helped to minimise this risk. Indeed, policy incentives and initiatives coupled with the transparency of the system may not only remove brownfield-related stigma, but also give developers great economic advantages over other locations.

In Iran, there is limited recognition by the general public of soil contamination and associated risks. Overall, the public and policy culture fails to recognize land contamination as an important issue. The upside of this perspective suggests that there is not an issue of stigma attached to brownfields and therefore the institution of a contaminated site register may prove easier than in many other regimes. To put it bluntly, the existing unfamiliarity with brownfield phenomena might be employed as both a market and policy opportunity rather than a structural problem. However, significant challenges remain in respect of public education and awareness raising across the private sectors and disparate level of governance in Iran.

11.4 Conclusion

Having examined and compared different regimes' approaches to brownfield issues and following a comprehensive analysis of urban, industrial and policy structures in Iran, this chapter has explored various aspects of brownfield regeneration in policy and practice using EPIB as an analytical tool. The chapter tried to achieve this on the basis of three inter-related dimensions presented by the EPIB tool (see Figure 8.1 in Chapter 8). In spite of a large number of environmental and spatial problems, the analysis suggests that currently land value and economic aspects of development are the most powerful legislative and policy drivers to brownfield decision and actions in Iran. This is mostly justified on the grounds of the growing recognition of land as a valuable asset in Iran which can provide the stakeholders with strong incentives to address brownfields. However, relying solely on this driver is problematic since it usually does not stimulate any demand for clean-up when sites are contaminated. Concerns over legal liability for soil contamination coupled with the risk of profitable returns might impede brownfield redevelopment in this scenario. Perhaps, as a result, there appears to be little government enthusiasm to develop concepts such as PPP.

Relying upon the EPIB tool and having considered the organizational structures in Iran, the analysis identifies three potential policy actors and agencies for brownfield regeneration, including two spatial planning organizations *(i.e. MRUD and local municipalities)* coupled with an environmental protection organization *(i.e. DoE)*. As presented in this chapter, there are currently numerous challenges facing brownfield-related stakeholders, including policy-makers at all levels, land-owners, operators and developers. These challenges are widespread in Iran due to many factors, such as the limited knowledge about soil contamination issues, the narrow scope of urban regeneration activity, absence of definition and legislation on brownfields, as well as strong institutional and operational inconsistencies. It is suggested that the existing command and control approach to policy in Iran, using only top-down legal mechanisms, is not entirely effective in response to the extensive brownfield challenges faced, and demands a cross-sectoral collaboration and arrangement across multiple levels of government.

The field-survey and interviews provide no evidence of any brownfield sites in Iranian cities that have undergone soil/groundwater treatment prior to reuse. Urban brownfield sites with a high probability of having soil and groundwater pollution are redeveloped without taking any risk assessment and clean-up measures. In spite of the growing recognition that post-industrial lands can be recycled and reused to an extent as it becomes available, there is no soil and groundwater clean-up taking place in Iran. The redevelopment project of the former site of the Khoshnoosh Carbonated Drinks and Plastic Packaging Factory in Sari may be viewed as a typical example in this respect. Furthermore, despite the establishment of the soil quality standard (SQSG), this document seems to be just a set of threshold figures attached to certain types of contamination with no detailed discussion about their applicability. Therefore, due to such reasons as the vagueness of the document and the lack of practical guidelines, the SQSG has so far been ineffective in addressing and resolving brownfield-related issues in Iran. At present, there is no mechanism in Iran to facilitate the regeneration of brownfields given the lack of legal definition, liability protection programs, funding sources and registration system for contaminated sites.

CHAPTER 12

Conclusion

12.1 Introduction

This thesis has investigated the process of brownfield regeneration in terms of both policy and practice across various world regions. Through an extensive review of literature, content analysis of policies, and case studies, this research has provided a substantive contribution to understanding the structural formation of brownfield sites and associated policy-making process in Iran. The study has addressed the following four objectives:

1. To explain the process of brownfield emergence and frame it in the context of urban change
2. To highlight and examine international examples of brownfield regeneration
3. To examine the scope for brownfield land recycling and reuse in Iran
4. To construct a tool that analyses and explains the legislative and policy situation in respect of brownfields in Iran

To achieve these objectives, the study was structured in three phases (as explained in Chapter 3). These phases include:

1. Exploration of multiple international case studies
2. Development of the EPIB tool in the light of the international case study analysis
3. Explanation of the Iranian situation through the lens of EPIB

The first phase of the research analysed brownfield emergence and policy development across four international case studies, namely the US, EU, Japan, and China, (in Chapters 3-6). Essentially, this phase of the study addressed two fundamental questions, namely *what are the rooted causes of brownfield emergence in different countries?,* and *what different types of regulatory framework have been used to encourage brownfield redevelopment?* Through the review of academic literature, policy documents, and field-surveys, the study first explored the driving factors behind the formation of brownfield sites in an urban context, and then examined how different nations and political regimes, at different stages of urban and socio-economic development, have addressed the regeneration of such sites. The analysis explained the concept of brownfields and their structural relationship with spatial-industrial change. It also helped to demonstrate how brownfield regeneration has become an integral part of policy and action across the developed and developing world.

The second phase of the study answers another key question, namely, *how effective have different policies been towards regeneration of brownfields?* In this phase, the study employed an established framework, namely the Environmental Policy Integration (EPI), and its guiding principles to develop an analytical tool, namely Environmental Policy Integration for Brownfields (EPIB). Through the analytical lens of EPIB, the study examined the brownfield situation within and across the multiple international case studies. In doing so, the study defined three key analytical dimensions in development of the EPIB tool, i.e. policy driver, actors and critical regeneration elements. On the basis of these dimensions presented by the EPIB tool, the variables and critical development factors in brownfield policies and practices were identified and comprehensively analysed in the different national contexts. This comparative analysis laid a theoretical foundation for the final phase of the study.

Drawing on the multiple-case study analysis, the final phase of this thesis has used EPIB to analyse brownfields in the context of Iran. This phase sought to answer two important questions, namely *can policies from other countries be translated to Iran?*, and *what is the current level of understanding and policy response to brownfield issues in Iran?* Having presented a broad overview of urban and industrial development processes during the pre- and post-revolutionary years, the study investigated how brownfield sites have appeared in Iranian cities (in Chapter 9). It then reviewed Iranian urban management and regeneration policies to examine how the land-use planning system operates, and how regeneration policies are framed within that system (in Chapter 10). Building on this narrative, the EPIB tool was applied to analyse the current state of brownfield recycling and reuse in Iran and related policy responses to date (in Chapter 11). Both primary data (interviews and field surveys) and secondary data (review of policy documents and literature) were used throughout the final phase of the study.

Put together, the key objectives of this study have been achieved through the comprehensive analysis in the three phases of the thesis. Key findings emerging from the study are summarized in Section 12.2 of this chapter. Drawing on these findings, Section 12.3 discusses the original contribution to knowledge, and finally Section 12.4 concludes with recommendations for further research.

12.2 Summary of key findings

Using a multiple-case study approach, this study aimed to examine how brownfield emergence is framed under strategic city planning and growth issues, and then how existing governance instruments to regulate and support brownfield land regeneration are employed in different regimes. Lessons drawn from the international case study analysis have assisted in interrogating the brownfield situation in Iran. The following sub-sections highlight the key findings arising from the study.

12.2.1 Strategic urban change

Brownfield emergence has been generally driven by two underlying trends across different regions of the world, namely 'industrial restructuring' and 'urban change'. As argued in a large body of literature, many cities across the advanced economies have witnessed a powerful wave of industrial restructuring as a result of economic globalization, international competition and concentration of service industries in central cities. Such structural changes in manufacturing industries have served as strong driving forces behind the emergence of post-industrial brownfields in the fabric of cities. Industrial restructuring of cities has been exemplified in different international case studies in Chapters 4-7 and further discussed in Chapter 11.

From a review of the existing literature on the US, Europe, Japan and China, this study also found an ingrained linkage between the ongoing transformation of urban areas and occurrence of brownfield sites. The growth of cities, formed and driven by disparate political and socio-economic forces in different regions worldwide, has left many derelict brownfields in inner cities. The review was supported by two field-surveys and analysis of two site case studies in China and Japan. The review and analysis of citywide geographic trends and urban land-use change suggested different models and stages of urbanization in different world regions. US cities, for example, provided a typical example of brownfield emergence driven by the outward low-density expansion of urban areas. Although urban growth takes many forms across Europe, the European case generally exemplified the densification and compaction pattern of city development. Meanwhile, in China, urban sprawl has proven to be the dominant development pattern albeit at high density, whereas the growth of Japanese cities has been transport-driven followed by a strong re-urbanization trend since the mid-1990s. In respect of the urban growth pattern, the transition process of industrial activity varies strongly between different cases because of their socio-economic, cultural and political disparities. The study examined the strategic pattern of urban change in each of four international case studies (in Chapters 4-7) and then highlighted the critical periods when brownfields began to appear using a comparative approach (in Chapter 8). As shown in Table 8.2, the periods of the 1950-1970s in the US, the 1960-80s in Western Europe, the 1950-90s in Japan, and the post-1990s in Eastern Europe as well as in China, are critical turning-points when the structural growth of urban areas has stimulated the creation of inner-city brownfields.

The review of literature made a specific reference to the re-urbanization trend in many cities across the developed world, as exemplified in the cases of Europe (in Chapter 5) and Japan (in Chapter 6). Promoted by both government policy and the market, several cities have experienced recentralization of population, infrastructure and services in inner-city areas which favored the recycling and reuse of urban land. As discussed in Chapter 2, debates surrounding revitalization, rehabilitation, redevelopment and/or regeneration of derelict land all nest under the concept of Regenerative Cities which places an emphasis on the nexus between urban systems and ecosystems. This study explains brownfield land regeneration, setting it in the broader context of urban development. It also suggests that increasingly, the recycling of urban brownfields needs to be viewed as a key component of the sustainability agenda and as an important feature of regenerative cities since it represents sustainable utilization of a key natural resource, namely land.

12.2.2 Variations in brownfield regimes

Over the past few decades, brownfield regeneration has been promoted through various government policy programs across the developed and developing world. One of the key objectives of this thesis was to examine such programs in order to provide practical references for understanding the policy-making process in Iran. Having reviewed the key policy documents and academic literature across four international case studies including two field-surveys in Japan and China, the study highlighted how diversely brownfields have been acknowledged and, accordingly, dealt with in policy and action. Given fundamental definitional, socio-economic, and institutional differences, brownfield policy and development industry responses vary strongly across different nations and political regimes.

As demonstrated by the different international cases studies, there are certain building blocks which are variously applied depending on the way each regime is designed. This study argues (in Chapters 8 and 11) that public understanding of the brownfield phenomenon and the resulting legal responses to it vary significantly in different countries and city jurisdictions. As largely reflected in the case of Japan, cultural disquiet over contamination issues has imposed restrictions on government policy approaches to regeneration of contaminated sites. The Japanese experience essentially shows that a stigma resulting from environmental contamination is often attached to brownfields and this can hinder land registration, environmental assessment and remediation processes. Stigma represented a problem in the UK in the 1990s since labelling a site contaminated impacted on its market valuation. This stigmatization problem has been largely rectified in the US and in many European countries given the decades-long public awareness and government policy development in respect of soil and groundwater contamination.

12.2.3 Is Iran typical?

Based on the narrative constructed from the review and analysis of international cases, the study examined the urban-industrial transformation process in Iran (in Chapter 9). It has become evident that, over the last century, Iran has undergone strong changes in its political and socio-economic structure. The structure of Iranian cities has also changed significantly since the late 20th century, when strategic policies on population growth and urban structures faced significant changes after the revolution in 1978. Urban areas in Iran have been growing steadily due to rapid population growth, rural-urban migration and political transitions. As in many international cases, the steady process of urbanization has been accompanied by the shrinkage of manufacturing industries against the growth of services in Iran, however at different time periods and at a different scale. Moreover, restrictions on the procurement imposed by economic sanctions have produced dramatic effects on manufacturing production and employment, particularly on light manufacturing sector. As a result of financial difficulties as well as post-revolutionary land ownership conflicts, many factories shut down or relocated to outer suburbs or smaller cities leading to the creation of many urban industrial brownfields within the Iranian urban fabric (see Figure 9.11 in Chapter 9).

In general, due to a combination of geographical, socio-economic and geopolitical factors, cities around the world at different stages of urban development may present different types of brownfield sites. For example, brownfields in Japan seem to be predominantly waterfront, albeit their recent manifestation in inland areas (as exemplified by the case of Musashi Kosugi Area in Chapter 6). In Iran, the majority of industrial brownfields belong to the light manufacturing sector, e.g. textiles and food industries, located in inner-urban locations (see Boxes 11.1 and 11.2). The field-survey and interviews also accounted for the emergence of another type of brownfields within Iranian cities, referred to as institutional sites, including former military sites and prisons. Regarding military brownfields, the European experience seemingly reflects a similar situation, as discussed in Chapter 5.

As discussed in Chapter 10, the environmental aspect of urban regeneration has not yet been recognized as an issue in Iran, whereas rehabilitation of post-war areas, deteriorated residential neighborhoods and informal settlements have been of paramount importance in the urban management and planning system. As discussed in Chapter 3 and exemplified by the case of Detroit, land and recycling policy in the US has been strongly biased towards brownfields exerting a disproportionate effect on the regeneration of greyfields. To date, under the existing framework in the US, contaminated sites receive preference over non-contaminated infill sites in the race for monetary and non-monetary development support. Quite differently in the context of Iran, the pervasive problems associated with greyfields, notably deteriorated and abandoned housing areas, have narrowed the existing scope of urban regeneration policy agenda, to the detriment of contaminated sites.

Whilst the brownfield situation in Iran shares some common aspects with other international cases, it is not typical. Its political isolation and the imposition of sanctions has made Iranian cities and Iranian brownfields a special case. This study was essentially motivated by the lack of a systematic and holistic approach to the regeneration of brownfields, as contaminated sites, in Iran. Although brownfields have been widely studied in several developed and developing countries, this subject area has remained virtually untouched in Iran to date. Iran is now at the stage of policy development which several developed countries have already passed many years ago. For example, the US government’s brownfield policy initiatives and action programs can be traced back almost four decades when the Superfund Law was regulated in response to growing concern over environmental protection and public safety issues. Despite continuous development and refinement, the land recycling and reuse policy system in the US has not been fully successful in addressing the pressing problems of abandoned, but non-contaminated, urban sites or greyfields. Therefore, as in several international cases, any future brownfield policy in Iran, were it to be instituted, is not expected to work flawlessly during its initial stages.

12.3 Original contribution to knowledge

This research attempted to develop an understanding of brownfields in Iran in the light of the outcome of international practice elsewhere. It has reviewed the academic literature and policy documents in four international contexts, including the US, Europe, Japan and China. Given the lack of easily accessible English language literature on Japan and China, the study collected primary data through intensive field-surveys and interviews in those nations. Having undertaken semi-structured interviews and case study site visits in several Iranian cities, the research has enabled the collection and analysis of original empirical data collection relating to brownfield formation and regeneration in Iran. This quantitative case-study research approach has provided new insights into the barriers, challenges and opportunities facing different policy systems in formulating and implementing initiatives in respect of land recycling and reuse. The outcomes of this thesis contribute to knowledge about the brownfield phenomenon in an urban development context and can lay a strong foundation for future policy development in Iran.

In order to understand and examine brownfield-related policy from different political and regional perspectives, this study developed an analytical tool, namely EPIB. EPIB contributed to the study in two phases of the development and application of the tool (as shown in Figure 3.5 in Chapter 3).

12.3.1 Development of EPIB in the light of international experience

As discussed in Chapter 3, this study employed EPI as a guiding framework. Originating in Europe in the late 1980s, EPI was developed as an effective approach to the development of area-oriented environmental policy in a range of political and scientific contexts. However, no research and policy debates have so far developed to articulate EPI in the context of brownfield regeneration. Building on the international case study analysis, this study adapted EPI's guiding framework to develop an analytical tool, referred to as EPIB, to assess brownfield governance in different domains. The study has framed the EPIB tool in three analytical dimensions, including the (1) policy and legislative drivers, (2) policy actors and domains, and (3) critical elements in brownfield development process (as depicted in Figure 8.1).

In the first dimension of EPIB, the study suggests that the policy and legislative drivers to brownfield decisions and actions vary strongly across different regimes. The factors driving the development of brownfield policies can be justified on the grounds of strong relations between environmental protection/public safety and economic growth/spatial planning issues. Countries, such as the US and Japan, have recognized the concept and significance of brownfield recycling and reuse from an environmental standpoint, whereas several policy initiatives, e.g. in many countries in Europe, were predominantly driven by land-use planning and sustainability priorities when considering brownfield regeneration.

The primary objective of both EPI and EPIB is to increase environmental awareness across disparate phases of policy-making and implementations. Achieving this objective heavily relies upon coherent cross-sectoral communication and action at different levels of government, including the national (central or federal), state (provincial) and local levels. The second dimension of EPIB addresses this organizational relationship, considering ‘environmental protection organization’ and ‘spatial planning organization’ as major policy domains and actors in brownfield regeneration. Often, as in the case of Iran, these domains appear to act as silos. As demonstrated by the second dimension of EPIB, a successful brownfield governance model should be capable of being translated and implemented both horizontally (HEPIB; at the national level of government) and vertically (VEPIB; across various ministerial sectors and their composite departments).

The third dimension of EPIB elaborates on a series of elements associated with the brownfield regeneration, i.e. ‘legal definition’, ‘land registration system’, ‘monetary and non-monetary tools, programs and incentives’, as well as ‘remediation approach in policy and practice’. These elements proved useful in exploring the critical success and failure factors resulting from different legal and regulatory frameworks (Table 8.3). As part of the overarching framework represented by the EPIB tool, the study provided an in-depth analysis of brownfield policy and practice across the four international case studies, pulling out the key development factors, shortcomings, and challenges facing different nations or political regimes.

12.3.2 *Application of EPIB to Iran*

In Chapter 11, the study took a step further and looked at how the EPIB tool could be employed to improve the situation in Iran. The current state of brownfield policy and practice in Iran was explained using three analytical dimensions of EPIB. This comparative analysis presented practical references for future policy development in Iran, highlighting challenges and shortcomings stemming from the spatial-environmental policy structure.

In the absence of a regulatory system for brownfields, it is difficult to thoroughly address the first dimension of EPIB in Iran. However, evidence from the field-survey and interviews suggests that economic aspects of development and marketability of land may have significant effects on future policy development regarding brownfield sites in Iran, as such issues are of paramount importance for both policy-makers and developers. The potential implications of the concentration on marketability in Iran are that were a comprehensive brownfield policy regime to be put in place there would most likely be concern at stigma affecting land values and push back from the development industry.

Under the second dimension of the EPIB tool and from the empirical analysis of urban and environmental policy structures (in Chapter 10-11), three sectors were found to present a major source of leverage for prospective brownfield policy development in Iran, including two urban-related sectors (MRUD and municipalities) and one environmental-related sector (DoE). At present, much of the resources and power in Iranian urban management and regeneration lies in the hands of the local municipalities. Thus, the role of the municipal government is critical to address brownfield-related issues. As in several international cases, most notably in Japan, the urban and environmental sectors of governance in Iran are institutionally disconnected within and across different levels. Yet as this study has shown, brownfield regeneration is inextricably bound up with broader strategic urban policy especially as we move towards more regenerative city agendas. It is clear from this research that the governance models in Iran, using only top-down legal mechanisms, do not provide a satisfactory organizational arrangement to meet the increasing need for regeneration of brownfield sites and the shift to a more sustainable urban agenda.

It has become evident from the outcome of the final analytical dimension of the EPIB tool that relevant stakeholders, e.g. policy-makers, developers, and land-owners, are not fully acquainted with the phenomenon of brownfield regeneration in Iran. Based on the field-survey and interviews, there is no evidence of a single brownfield site in Iranian cities that has undergone environmental treatment prior to reuse. The case of the former site of ‘Khoshnoosh Carbonated Drinks and Plastic Packaging Factory’ provides a good example for this argument (Box 11.2). Using a comparative analysis of situations in different countries, the third dimension of EPIB accounts for the lack of legal definition, supporting programs, funding mechanisms and insufficient infrastructural support and experience with soil/groundwater remediation techniques in Iran (Figure 11.1). Despite the policy recognition of soil quality issues, the existing national standard (SQSG) does not address and respond to brownfield-related challenges in Iran due to various reasons, such as the vagueness of the document, the lack of future-oriented and practical guidelines, and the absence of reference to groundwater contamination and remediation. In summary, the EPIB tool has greatly assisted in demonstrating that Iran lags behind all the other case study nations reported on here. It also helps identify exactly where and how the Iranian government might begin to address its undoubtedly significant brownfield problems.

The explanatory analysis provided by EPIB suggests that there are a number of key considerations which need to be addressed in any successful brownfield regeneration regime. Whilst these may be tempered by political, cultural and economic factors, any attempt to reform a nation’s approach to brownfield regeneration would need to include the following:

- Recognition of the importance of environmental sustainability in the context of future strategic urban planning
- A clear definition of brownfield land
- Comprehensive data on contaminated sites
- Clear policy frameworks which identify trigger points in recognizing contaminated sites
- Clear lines of communication and share of responsibilities between levels and departments of government within both top-down and bottom-up regimes
- Clear lines of communication and share of responsibilities between governments, industry stakeholders and public communities
- Comprehensive tools, programs and funding mechanisms
- Clear policy on a range of site-specific redevelopment aspects, such as risk management or total cleanup

- Clear policy directions, technical knowledge and expertise in respect of soil and groundwater remediation
- Application of the PPP through legislation along with liability protection for subsequent land-owners
- Clear policy frameworks which address potential stigma risks associated with land contamination and registration

It is important to recognize that although Iran is an atypical case because of the profound economic effects of sanctions, this atypicality mainly relates to brownfield formation. In urban regeneration policy terms, Iran is at an immature stage compared to the four international case studies. However, the list suggested above could prove useful as a guide to policy development in Iran, or in any developing country which has an immature or poorly functioning brownfield policy system in place.

12.4 Further research recommendation

The most radical possibilities for future research that arise from this thesis relate to the further development and application of EPIB. This analytical tool was developed to analyze brownfield decision-making and implementation but there are improvements that could be made. From the outcomes of the development and application of the EPIB tool and its analytical dimensions, further research needs have been identified:

- As suggested by EPIB, the existing development challenges and conflicts that may arise through brownfield regeneration process have necessitated the integration of environmental objectives into land-use planning policy. This demands political will to promote capacity improvement at various levels of urban policy and environmental protection. Further studies could specifically investigate the applicability of brownfield policy integration both vertically (VEPIB) and horizontally (HPIB) in different countries with different governance models.

- EPIB could potentially serve as a future-oriented tool that highlights potential shortcomings and suggests solutions to problems that might be presented during the brownfield regeneration or redevelopment process. To facilitate this, the utility of EPIB has to be further evaluated in more countries worldwide.

- The EPIB tool also suggests further research on the cultural aspects of remediation of contaminated brownfield sites in both policy and practice. Further quantitative and qualitative research is needed to explore how the public stigma relating to contaminated sites could be specifically addressed within brownfield-related statutory frameworks in different nations with different socio-cultural characteristics.

- An opportunity exists to further study the long-term implications of policy initiatives on the status of both contaminated sites (i.e. brownfields) and non-contaminated sites (i.e. greyfields). Further extensive investigation is needed to examine how land recycling and reuse systems can be enhanced in policy and action so that both contaminated and non-contaminated sites are effectively dealt with without one having a knock-on effect on the other.

- There is a need for a deeper exploration of different governance approaches to promoting open access pathways to environmental auditing and land registration.

- Novel pieces of research are required to explore the evidence of harm to environment and human health from contaminated sites in Iran and other developing countries.

Appendices

Appendix A-1: **Ethics Approval Letter** (for field-surveys in Japan and China)

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The University of Adelaide Human Research Ethics Committee
Low Risk Human Research Ethics Review Group (Faculty of Arts and Faculty of the Professions)

ETHICS APPROVAL No: **H-2016-288** **App. No.: 0000022141**

APPROVED for the period: **09 Feb 2017 to 29 Feb 2020**

Thank you for your responses, dated 24.01.17 and 07.02.17, to the matters raised. It is also noted that this project involves PhD student Armin Mehdipour.

DR JOHN TIBBY **Co-Convenor** **Low Risk Human Research Ethics Review Group (Faculty of Arts and Faculty of the Professions)**	**DR ANNA OLIJNK** **Co-Convenor** **Low Risk Human Research Ethics Review Group (Faculty of Arts and Faculty of the Professions)**

Appendix A-2: Amended Ethics Approval Letter (for field-survey in Iran)

THE UNIVERSITY of ADELAIDE

RESEARCH SERVICES
OFFICE OF RESEARCH ETHICS, COMPLIANCE AND INTEGRITY
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CRICOS Provider Number 00123M

Our reference 0000022141

02 March 2018

Professor Jon Kellett
School of Architecture & Built Environment

Dear Professor Kellett

ETHICS APPROVAL No:	H-2016-288
PROJECT TITLE:	Achieving the sustainable development of brownfield sites; an application to the Iranian context

Thank you for the emails and amended ethics application provided by Armin Mehdipour on the 16.02.2018, 26.02.2018 and 27.02.2018 with details of the Iran component of the research project.

The ethics amendment for the above project has been reviewed by the Low Risk Human Research Ethics Review Group (Faculty of Arts and Faculty of the Professions) and is deemed to meet the requirements of the *National Statement on Ethical Conduct in Human Research (2007)* involving no more than low risk for research participants.

You are authorised to commence your research on:	09/02/2017
The ethics expiry date for this project is:	29/02/2020

NAMED INVESTIGATORS:

Chief Investigator:	Professor Jon Kellett
Student - Postgraduate Doctorate by Research (PhD):	Mr Armin Mehdipour
Associate Investigator:	Dr Elisa Palazzo

Ethics approval is granted for three years and is subject to satisfactory annual reporting. The form titled Annual Report on Project Status is to be used when reporting annual progress and project completion and can be downloaded at http://www.adelaide.edu.au/research-services/oreci/human/reporting/. Prior to expiry, ethics approval may be extended for a further period.

Participants in the study are to be given a copy of the information sheet and the signed consent form to retain. It is also a condition of approval that you immediately report anything which might warrant review of ethical approval including:

- serious or unexpected adverse effects on participants,
- previously unforeseen events which might affect continued ethical acceptability of the project,
- proposed changes to the protocol or project investigators; and
- the project is discontinued before the expected date of completion.

Yours sincerely,

Dr Anna Olijnyk
Convenor

Dr Jungho Suh
Convenor

The University of Adelaide

Appendix A-3: Consent Form (for field-surveys in Japan, China and Iran)

THE UNIVERSITY of ADELAIDE

Human Research Ethics Committee (HREC)

CONSENT FORM

1. I have read the attached Information Sheet and agree to take part in the following research project:

Title:	**Achieving the Sustainable Development of Brownfield Sites; an Application to the Iranian Context**
Ethics Approval Number:	**H-2016-288**

2. I have had the project, so far as it affects me, and the potential risks and burdens fully explained to my satisfaction by the research worker. I have had the opportunity to ask any questions I may have about the project and my participation. My consent is given freely.

3. Although I understand the purpose of the research project, it has also been explained that my involvement may not be of any benefit to me.

4. I agree to participate in the activities outlined in the participant information sheet.

5. I agree to be:
   ☐ Audio/video recorded
   ☐ Photographed

6. I have been informed that the information gained in the project may be published in a book/journal article/thesis/news article/conference presentations/website/report etc.

7. I have been informed that in the published materials I will not be identified and my personal results will not be divulged.

8. I agree to my information being used for future research purposes limited to publication in book/journal article/conference papers/news article and report.
   Yes ☐ No ☐

9. My information will only be used for the purpose of this research project and it will only be disclosed according to the consent provided, except where disclosure is required by law.

10. I am aware that I should keep a copy of this Consent Form, when completed, and the attached Information Sheet.

Participant to complete:

Name: ____________________ Signature: ______________________ Date: __________

Researcher/Witness to complete:

I have described the nature of the research to ______________________________________
(print name of participant)

and in my opinion she/he understood the explanation.

Signature: _________________ Position: ______________________ Date: __________

Version 2018 Date: 27/02/2018

Appendix A-4: Participant Information Sheet (for field-survey in Iran)

PARTICIPANT INFORMATION SHEET

PROJECT TITLE: Achieving the Sustainable Development of Brownfield Sites; an Application to the Iranian Context

HUMAN RESEARCH ETHICS COMMITTEE APPROVAL NUMBER: H-2016-288

PRINCIPAL INVESTIGATOR: Professor Jon Kellett
STUDENT RESEARCHER: Mr. Armin Mehdipour
STUDENT'S DEGREE: PhD in Architecture

Dear Participant,

You are invited to participate in the research project described below.

What is the project about?

This PhD research project focuses on policy and practice aspects of brownfield land regeneration. There is no worldwide interpretation for brownfield lands. However, brownfields are generally recognized as abandoned, idled or underused properties and lands with fixed infrastructure and developed surface on site. In other words, brownfield is a previously developed land that its existence has perceived negative influences on the coherence of the surrounding land. In many countries, e.g. the United States and Australia- brownfield means an under-used industrial and commercial property, the redevelopment of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant, but in several countries, e.g. UK and Germany- land should not be necessarily contaminated to be considered a brownfield.

The research is concerned with urban development and planning and aims to provide an in-depth understanding of the concept of 'sustainable brownfield regeneration'. It examines and highlights multiple international cases in order to set some findings suited to the scope for brownfield land recycling and policy framework in Iran. To achieve this, four cases- including the U.S., Europe, Japan and China- have been selected and accordingly the variables and critical development factors of each case will be collected. The initial objective of this research project is, indeed, to shed light on how the concept of brownfield land regeneration has been conceived and applied into urban policy and legislations in different countries, from the early stages of decision-making to the later stages of site development. Then the ultimate objective of the project will be pursued by recommending a local brownfield development model suited to the physical, political and environmental context of Iranian cities.

Who is undertaking the project?

This project is being conducted by Mr. Armin Mehdipour.

This research will form the basis for the degree of PhD in Architecture at the University of Adelaide under the supervision of Professor Jon Kellett and Dr Elisa Palazzo.

The PhD research project is funded by 'Adelaide Scholarships International (ASI)', and 'Australian Housing and Urban Research (AHURI)'

Why am I being invited to participate?
You are being invited to participate in this interview as you have a certain number of years of experience, directly and indirectly relating to (re)development processes in cities and sub-study projects in Iran.

What will I be asked to do?
Participants will be asked to participate in a semi-structured interview where some questions will be close ended and some are open ended. The interviews questions are mainly about the experiences of the participants about urban development and planning process of Iranian cities as well as participants' perception about brownfield land regeneration and its associated challenges. This will allow for an analysis of how current Iranian policies can characterize and practice regeneration of industrial cities utilizing brownfield sites and vacant lots. With consent the interview will be audio recorded and photographs will be taken (as indicated in the consent form at dot point 5).

How much time will the project take?
Interviews will last approximately 60 minutes. Transcripts will be sent to interviewees for verification, clarification and approval. A follow-up may be done in person or by telephone where necessary.

Are there any risks associated with participating in this project?
No potential risk is present to participants when conducting the interviews.

What are the benefits of the research project?
The study will be important in gaining a better understanding from researchers, policy makers and developers in tackling brownfield activities in different countries. The research highlights the scope for the reintegration of brownfield areas into spatial and economic structures in Iran and demonstrate how regeneration insight can be applied in practice. It is hoped that this research project helps providing solutions for improving the planning system associated with brownfield redevelopment in Iran.

Can I withdraw from the project?
Your participation is voluntary. You may withdraw from the interview whenever you desire by simply advising the researcher of your intention to do so.

What will happen to my information?
All details will be kept confidential. Interview data will be transcribed and replaced by a code. Your participation and information form part of the doctoral research project, which will be used strictly for academic purposes. Interview participants will receive a summary and interpretation of the interview before being included in the thesis and any publication. Collected data and information might be used in further research projects and academic papers. Participants can review and approve interview transcripts and quotes prior to publication

Who do I contact if I have questions about the project?
For any further information, please do not hesitate to contact us:

Sl. No	Name	Position	Contact no	E-mail
1	Professor Jon Kellett	Principal Supervisor	Ph: +61 8 8313 0683 Fax: +61 8 8313 4377	jon.kellett@adelaide.edu.au
2	Dr. Elisa Palazzo	Co-Supervisor	Ph: +61 8 8313 5512 Fax: +61 8 8313 4377	elisa.palazzo@adelaide.edu.au
3	Mr. Armin Mehdipour	PhD Researcher	Ph: +61 8 8313 3052 Fax: +61 8 8313 4377	armin.mehdipour@adelaide.edu.au

What if I have a complaint or any concerns?

The study has been approved by the Human Research Ethics Committee at the University of Adelaide (approval number H-2016-288). If you have questions or problems associated with the practical aspects of your participation in the project, or wish to raise a concern or complaint about the project, then you should consult the Principal Investigator. If you wish to speak with an independent person regarding a concern or complaint, the University's policy on research involving human participants, or your rights as a participant, please contact the Human Research Ethics Committee's Secretariat on:

Phone: +61 8 8313 6028

Email: hrec@adelaide.edu.au

Post: Level 4, Rundle Mall Plaza, 50 Rundle Mall, ADELAIDE SA 5000

Any complaint or concern will be treated in confidence and fully investigated. You will be informed of the outcome.

If I want to participate, what do I do?

Please contact the researcher if you are interested in participating/being involved in the study.

Yours sincerely,
Professor Jon Kellett, Dr. Elisa Palazzo, Armin Mehdipour

Appendix A-5: Interview Questions (in Japan & China)

1. How has the overall structure of Japanese/Chinese been changing over past years? Has the urbanization or suburbanization (if exists) process led to emergence of underutilized land within the fabric of cities?
2. How have the inner-city problems been created and accordingly responded by different types of policies? Are there any urban revitalization initiatives in Japan/China?
3. Is the term "Brownfield" recognized in Japanese/Chinese urban vocabularies? Is contamination the main issue in recognition of brownfield sites?
4. What are the main causes of land contamination in Japan/China?
5. Is there any national or lower land legislations or policy regarding brownfield sites?
6. What is the estimated quantification of brownfield sites in Japan/China?
7. Where are the majority of sites located (nation-wide, state-wide and city-wide)? Are they mostly positioned in urban areas or suburbs?
8. What is the extent of brownfield problem in Japanese/Chinese cities (environmentally, socio-economically and/or physically)?
9. What different types of regulatory framework have been used to encourage brownfield redevelopment?
10. How has the current policy responded to the challenge of contaminated and non-contaminated lands?
11. How effective have Japanese/Chinese urban policy been towards regeneration of brownfields?
12. What are the key success and failure factors in brownfield redevelopment policy and practice in Japan/China?
13. What specific case study do you suggest that well demonstrate the relationship between the Japanese/Chinese policy and practice relating to brownfield redevelopment?

Appendix A-6: Interview Questions (in Iran)

1. Is the term "Brownfield" recognized in Iranian urban and environmental vocabularies?
2. Is there any recognition of soil contamination issues within the existing legal system?
3. How brownfields (including both contaminated and non-contaminated sites) are often dealt with?
4. Where are the majority of potential brownfield sites located in Iran? Are they mostly positioned in urban areas or suburbs?
5. What are the main drivers of brownfield occurrence in Iranian cities?
6. How has the overall structure of Iranian cities been changing over past years?
7. Has the urbanization or suburbanization (if exists) process led to emergence of underutilized land within the fabric of cities? How is typology of urban growth pattern in different cities in Iran? (Northern cities, Desert Cities, Mountainous cities, etc.)
8. Have Iranian cities experienced deindustrialization or any forms of industrial relocation? How has been the structural adjustment of manufacturing industries in Iran?
9. Is there any inner-city problem accordingly within Iranian urban fabrics?
10. How has the current policy responded to the challenge associated with the redevelopment of underutilized sites?
11. How effective has the policy been towards regeneration of underutilized land?
12. Is there any understanding of environmental and legal liability issues in Iran?
13. Is there any collaboration at different level of land-use planning governance, including the national, state and municipal levels?
14. Having considered the existing structure of planning policy in Iran, what do you think about the effective approach that can adopted for redevelopment of brownfield sites?
15. What case study sites do you recommend? Including; (1) those underutilized sites (whether contaminated or not) that have been left unused for many years, and (2) sites that have been redeveloped?

Appendix A-7: List of Interview Participants (in Japan)

List of interviewees in Japan and their details		
Code	Profession (Expertise)	Position / Affiliation
Participant 01-JP	Urban planner, researcher and academic	- Professor / Faculty of Engineering, the University of Tsukuba
Participant 02-JP	Urban planner, researcher and academic	- Professor / Department of Urban Engineering, the University of Tokyo - President, City Planning Institute of Japan (CPIJ)
Participant 03-JP	Urban designer and researcher	- Researcher / Joint Centre for Urban Design, Oxford Brookes University, UK
Participant 04-JP	Urban designer, researcher and academic	- Associate Professor / Department of Architecture and Urban Design, Kyushu University
Participant 05-JP	Urban Planner, Landscape planner, researcher and academic	- Professor / Faculty of Engineering, the University of Tsukuba
Participant 06-JP	Urban planner, researcher and academic	- Associate Professor / Department of Urban Engineering, University of Tokyo
Participant 07-JP	Urban planner and researcher	- Researcher / Department of Urban Engineering, The University of Tokyo
Participant 08-JP	Municipal government official	- Head of the Department / Kawasaki City Urban Improvement Bureau, Establishing Promotion Department
Participant 09-JP	Municipal government official	- Head of the Department / Kawasaki City Planning Office, Establishing Promotion Department
Participant 10-JP	Municipal government official	- Coordination Division Manager / Kawasaki City Planning Office, General Management Affairs Department
Participant 11-JP	Municipal government official	- Manager in charge / Kawasaki City Planning Office, Establishing Promotion Department
Participant 12-JP	Municipal government official	- Head of the Department / Kawasaki City Environment Bureau, Environmental Control Department- Soil Division
Participant 13-JP	Architect, urban planner	- Senior Manager / Nihon Sekkei, Architectural Company, Tokyo, Japan
Participant 14-JP	Architect	- Architect / Nihon Sekkei, Architectural Company, Tokyo, Japan
Participant 15-JP	Landscape architect	- CEO / Landscape Plus, Landscape Architecture Company, Tokyo, Japan

Appendix A-8: List of Interview Participants (in China)

List of interviewees in China and their details		
Code	Profession (Expertise)	Position / Affiliation
Participant 01-CN	Researcher and academic in sustainable development	- Professor / Research Centre for Sustainable Development, Shandong University
Participant 02-CN	Researcher and academic in treatment of industrial water	- Dean / School of Municipal and Environmental Engineering, Shandong Jianzhu University
Participant 03-CN	Environmental engineer in soil and groundwater remediation	- Director / Shandong Jinxingyuan Environmental Protection Technology Co.
Participant 04-CN	Landscape architect, researcher and academic	- Professor / Department of Landscape Architecture, School of Architecture, Tsinghua University - Vice-president, Beijing Tsinghua Tongheng Urban Planning & Design Institute
Participant 05-CN	Landscape architect, researcher and academic	- Associate Professor / Department of Landscape Architecture, School of Architecture, Tsinghua University
Participant 06-CN	Urban planner, researcher and academic	- Director / Urban Planning Department, Shandong Jianzhu University

Appendix A-9: List of Interview Participants (in Iran)

List of interviewees in Japan and their details		
Code	Profession (Expertise)	Position / Affiliation
Participant 01-IR	Urban planner and designer, researcher and academic	- Assistant Professor / School of Urban Planning, University of Tehran
Participant 02-IR	Urban planner, researcher and academic	- Associate Professor / Faculty of Architecture and Urban Planning, Shahid Beheshti University
Participant 03-IR	Urban planner and geographer, researcher and academic	- Associate Professor / Faculty of Management and Accounting , Shahid Beheshti University
Participant 04-IR	Urban designer, researcher and academic	- Associate Professor / Faculty of Architecture and Urban Planning, Shahid Beheshti University
Participant 05-IR	Municipal government official	- Deputy of the Department / Coordinating and Planning Department, Urban Renovation Organization of Tehran Municipality
Participant 06-IR	Central government official	- Board of Directors / Urban Development and Revitalization Organization of Iran (UDRO)
Participant 07-IR	Central government official	- Manager in charge / Urban Development and Revitalization Organization of Iran (UDRO)
Participant 08-IR	Urban planner	- Project Coordinator / Naqsh-E Jahan Pars Consulting Firm, Tehran
Participant 09-IR	Urban Planner, researcher and academic	- Professor / Faculty of Art and Architecture, Shiraz University
Participant 10-IR	Municipal government official	- Deputy of the Organization / Organization of Urban Industries and Businesses Co., Shiraz Municipality
Participant 11-IR	Municipal government official	- Head of the Department / Department of Polluting Businesses, Organization of Urban Industries and Businesses Co., Shiraz Municipality
Participant 12-IR	Architect	- Architect / Tar-o Pood Museum Project (Development of the former site of the Shiraz Textiles Manufacturing in Shiraz, Fars Province)
Participant 13-IR	State government official	- Technical and Environmental Officer / Division of Soil & Water, Department of Environment (DoE) in Fars Province
Participant 14-IR	State government official	- Technical and Environmental Officer / Division of Environmental Assessment and Monitoring, Department of Environment (DoE) in Fars Province

Participant 15-IR	State government official	- Technical and Environmental Officer / Division of Environmental Assessment and Monitoring , Department of Environment (DoE) in Fars Province
Participant 16-IR	State government official	- Manager in charge / UDRO's Department in Fars Province, MRUD
Participant 17-IR	State government official	- Head of the Department / UDRO's Department in Fars Province, MRUD
Participant 18-IR	State government official	- Officer / UDRO's Department in Fars Province, MRUD
Participant 19-IR	Urban Planner, researcher and academic	- Assistant Professor / Faculty of Art and Architecture, Shiraz University
Participant 20-IR	Municipal government official	- Deputy of the Department / Urban Development Department, Qaemshahr Municipality in Mazandaran Province
Participant 21-IR	State government official	- Head of the Department / Department of Roads and Urban Development in Qaemshahr, Mazandaran Province, MRUD
Participant 22-IR	State government official	- Officer / UDRO's Headquarter in Mazandaran Province, MRUD
Participant 23-IR	State government official	- Head of the Department / UDRO's Department in Mazandaran Province, MRUD
Participant 24-IR	Residential builder and developer	- Office Manager / Headquarter office in Juybar, Mazandaran Province, Iran Construction Engineering Organization (IRCEO)
Participant 25-IR	Project manager and developer	- Project Manager / Pars Centre Development Project (Development of the former site of the Khoshnoosh Factory in Sari, Mazandaran Province)
Participant 26-IR	Municipal government official	- Deputy of the Department / Urban Development Department, Sari Municipality in Mazandaran Province
Participant 27-IR	State government official	- Technical and Environmental Officer / Department of Geotechnics, Technical and Soil Mechanics Laboratory (TSML) in Mazandaran Province, MRUD
Participant 28-IR	State government official	- Urban Planning Officer / Department of Roads and Urban Development in Qaemshahr, Mazandaran Province, MRUD
Participant 29-IR	State government official	- Technical and Environmental Officer / Department of Chemistry, Technical and Soil Mechanics Laboratory (TSML) in Mazandaran Province, MRUD

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