



Transformation Dynamics of Societies in Old Industrial Cities from A Global Comparative Perspective

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Abstract: The decline of societies in old industrial cities is evident in numerous cases in developed countries. Cities that once functioned as dominant industrial centers have faced severe population loss and subsequent social and environmental challenges during the process of economic restructuring. This study aims to identify the common patterns of industrial transition and demographic changes at the city level to determine the factors of growth and decline of industrial cities from a global comparative perspective. Statistical data on industry and population from 1950 to 2010 in the US, Japan, and Korea are collected at the city level. Cities are classified according to industrial characteristics (dominance, type, and composition of industries) and demographic change patterns (continued increase, peak, recent decline, continued decline, slowdown, recovery, and steady); a comparative analysis is conducted in each classified group. The results of the study suggest relevant issues between Japan and Korea industrial cities to prepare strategies for imminent industrial transition and management of urban areas with the cooperation of local stakeholders. This should enable past and present industrial cities to achieve sustainable development for future transformation.

Keywords: Industrial societies, urban transformation, population decline, old industrial cities

1. Introduction

The trends of decline in industrial cities in Europe and the US have continued from the 1970s, when local manufacturing industries closed their operations, or moved out their production overseas with the rising international competition in the era of globalization (Hall, 1997; Glaeser, 1998). Cities experienced severe population decline due to loss of major economies accompanied by subsequent social and environmental problems such as unemployment and urban decay (Rieniets, 2009; Power et al., 2010).

The industrial cities, once contributed to national economic development with its prosperous local resources, have now become the least desirable place for living in the developed countries. Recent studies challenge to discover the commonalities in transformations of the industrial cities while elucidating the factors of decline, process, and redevelopment strategies from a global comparative dimension (Vey, 2007; Power et al., 2008). The discussions have been limited to western countries with longer history of industrial development that have previously experienced a decline of industrial cities.

However, the process of de-industrialization is also recognized in countries like Japan and Korea. If the decline of manufacturing industries is an inevitable process of economic restructuring at national and city levels, the question lies in the likelihood of identifying common trajectories of growth, crisis, decline, and recovery of industrial cities (Plöger, 2013). Do industrial cities decline in similar ways? What is the relationship between industrial development and urban transformation? Can common patterns of growth and decline of industrial cities be identified?

This study aims to identify common patterns of industrial transition and demographic changes of industrial cities in the US, Japan, and Korea. This study also validates the relationship with national industrial development and industrial

transition at city level, and determines the relevant factors of the decline and transition of industrial cities. The study is also an attempt to understand the dynamics of industrial city transformation that enable past and present industrial cities to develop sustainable strategies for future transformation.

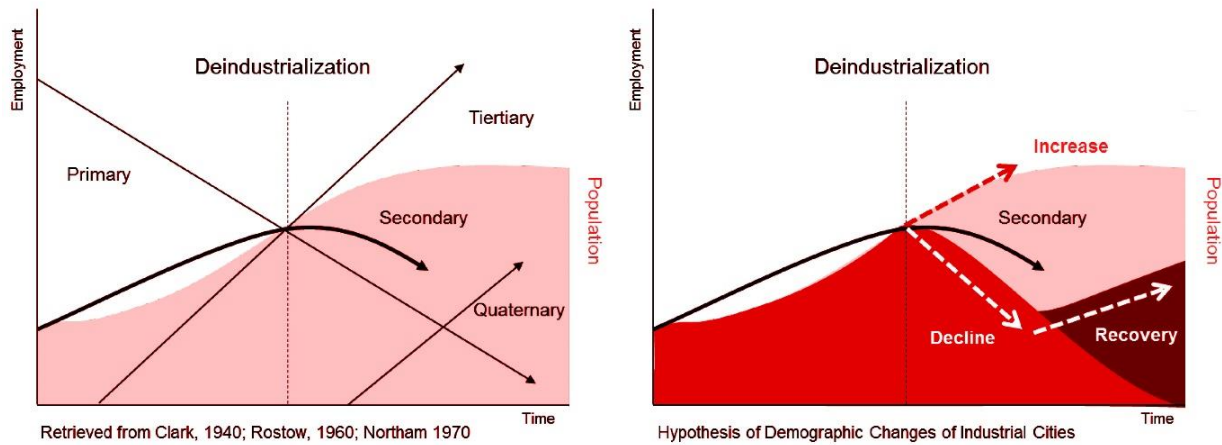


Fig. 1 - Industrial transition and population growth

2. Literature Review

2.1 Industrial Cities

Industrial cities are commonly interpreted as ‘cities with dominant industrial production’¹ often described with the images of massive production factories and utilities concentrated in the areas. The concept of industrial cities covers a very broad range of industrial activities such as mining, manufacturing, and extraction; and includes surrounding towns and areas where the workers live and commute (Zimmerman, 2013). However, the decline of industrial cities in Europe and the US is mostly due to the decline of local manufacturing industries from the 1900s to the early 2000s, especially areas with heavy industries such as steel, chemicals, automobiles, and ship building². The terms ‘older industrial cities’ or ‘weak market cities’ are derived from the trends of decline³. According to urban transformation theory, the city is seen as a transformative system and dominance of manufacturing industries appears at the temporal stage of development (Yang, 2010). Some studies use quantitative measures to differentiate the stage of industrial development and capture the changes over time⁴. In this study, industrial cities are defined by the characteristics of manufacturing industries describing the dominance of industrial activities in their respective cities.

2.2 Industrial Transition and Urban Growth

a) Industrialization and population growth

Conceptual diagrams of industrial transition and population growth at the national level and demographic changes of industrial cities, are shown in Fig. 1.

Theories of industrialization and economic development show changes in different employment sectors in each stage of economic development at the national level. The growth in population is fastest during industrialization and growth rate is reduced at the mature stage of economic development. After deindustrialization, the diversification of tertiary and quaternary sectors occurs including growth in service, retail, information, and technology-related businesses.

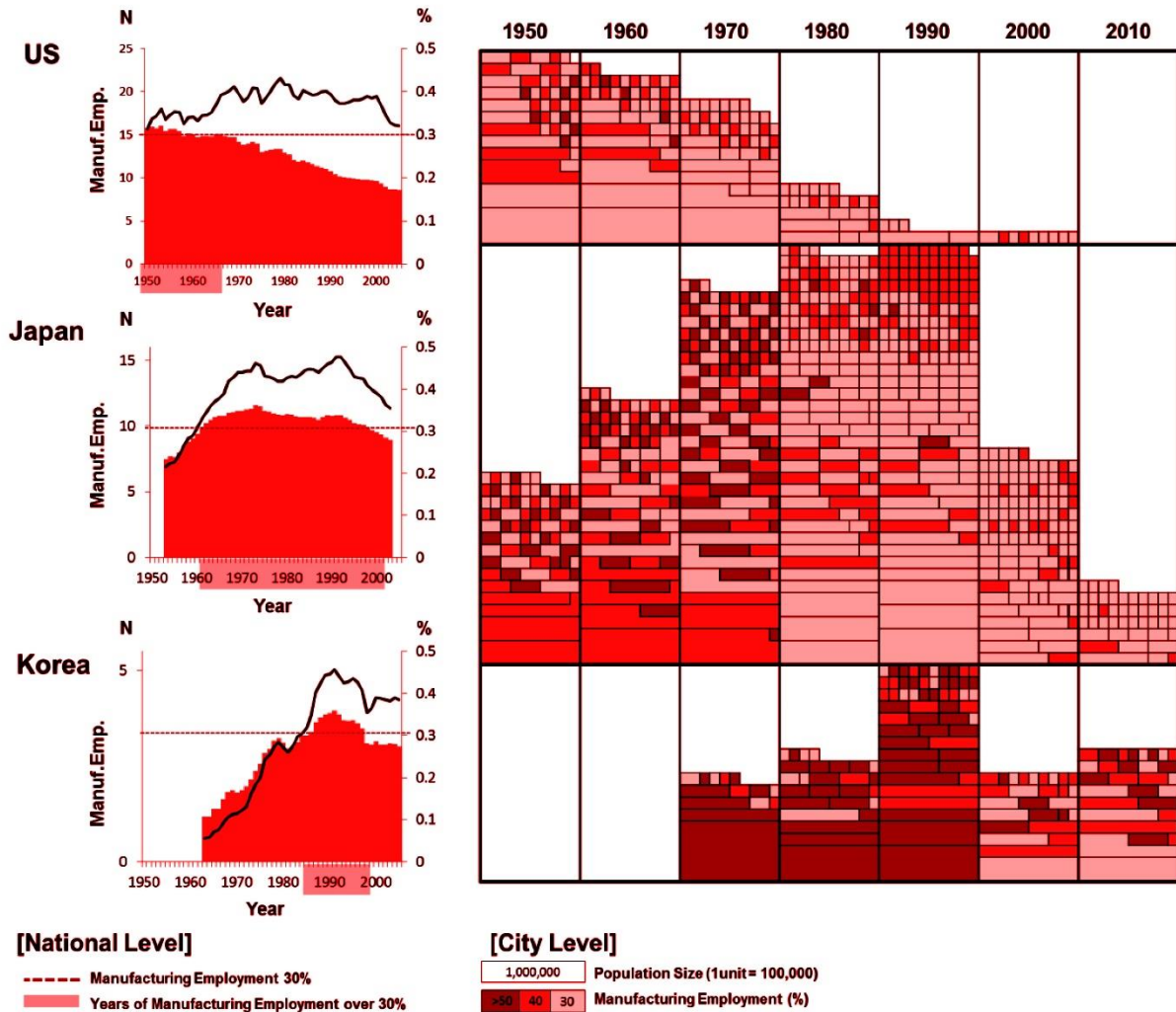


Fig. 2 - Industrial development at national and city level

b) US, Japan, and Korea

The emergence of industrial cities is related to national economic development in which private sector develops industrial production or the government designates industrial agglomeration at a certain location during the early economic growth period. Industrialization brings urbanization together with the growth of employment in the area. Industrial development at the city level shows a peak year gap among the US, Japan, and Korea, with its highest number of active industrial cities during the time of the national industrial peak (see Fig 2).

c) Industrial city transformation

Transformation of industrial cities is defined as the relation between two factors: industrial transition and population change. Industrial transition is shown mainly by a decline of secondary industries and growth in the service sector or other businesses. Industrial cities in which secondary industries are concentrated show different paths of population growth at the point of deindustrialization. This might due to unfavorable conditions of industrial transition into other sectors.

Table 1 - Variables

Category		Variables	Contents
Industrial Characteristics	Dominance	Manufacturing Employment (%)	Number of workers in manufacturing industries / total employment [5]
	Type	Light [6] Heavy High-tech Mixed	Man. Emp. over 60% in type, if not Mixed
	Composition	Singular [7] Diverse	Huff Index DS Index
Population	Size	Metropolitan Large Medium Small	10 (1million or more) 5 (500,000 - 1million) 2 (200,000 - 500,000) 1 (100,000 - 200,000)
	Change	Decline [8] Increase Fluctuate	Percentage change (+/-) of population in 10 year period

Table 2 - Industrial Type - Composition

	Composition		Industry Type			
	S/D	Count	Light	Heavy	H.T.	Mixed
US	S	34	13	20	1	-
	D	61	19	18	1	23
	Total	95	32	38	2	23
Japan	S	36	18	15	3	-
	D	112	16	29	2	65
	Total	148	34	44	5	65
Korea	S	16	5	8	3	-
	D	38	-	12	1	25
	Total	54	5	20	4	25

Table 3 - Population change -size

	Population Group		Population Change		
	100,000	Count	Decline	Increase	Fit./Std.
US	10	8	3	4	1
	5	14	9	2	3
	2	24	9	7	8
	1	49	22	10	17
	Total	95	43	23	29
Japan	10	8	3	5	-
	5	15	4	11	-
	2	67	26	40	1
	1	58	24	32	2
	Total	148	57	88	3
Korea	10	9	2	7	-
	5	9	1	8	-
	2	23	9	13	1
	1	13	5	6	2
	Total	54	17	34	3

Table 4 - Correlation value

Variable1	Variable2	Corr.	Sig.
Country	Industry Type	.225**	0.000
Country	Manuf. Emp. (%)	.597**	0.000
Industry Type	Manuf. Emp. (%)	.199**	0.001
Industry Type	Population Change	-.114*	0.049
Heavy/Light	Singular/Diverse	.354**	0.000

** . Pearson Correlation is significant at the 0.01 level (2-tailed).

* . Pearson Correlation is significant at the 0.05 level (2-tailed).

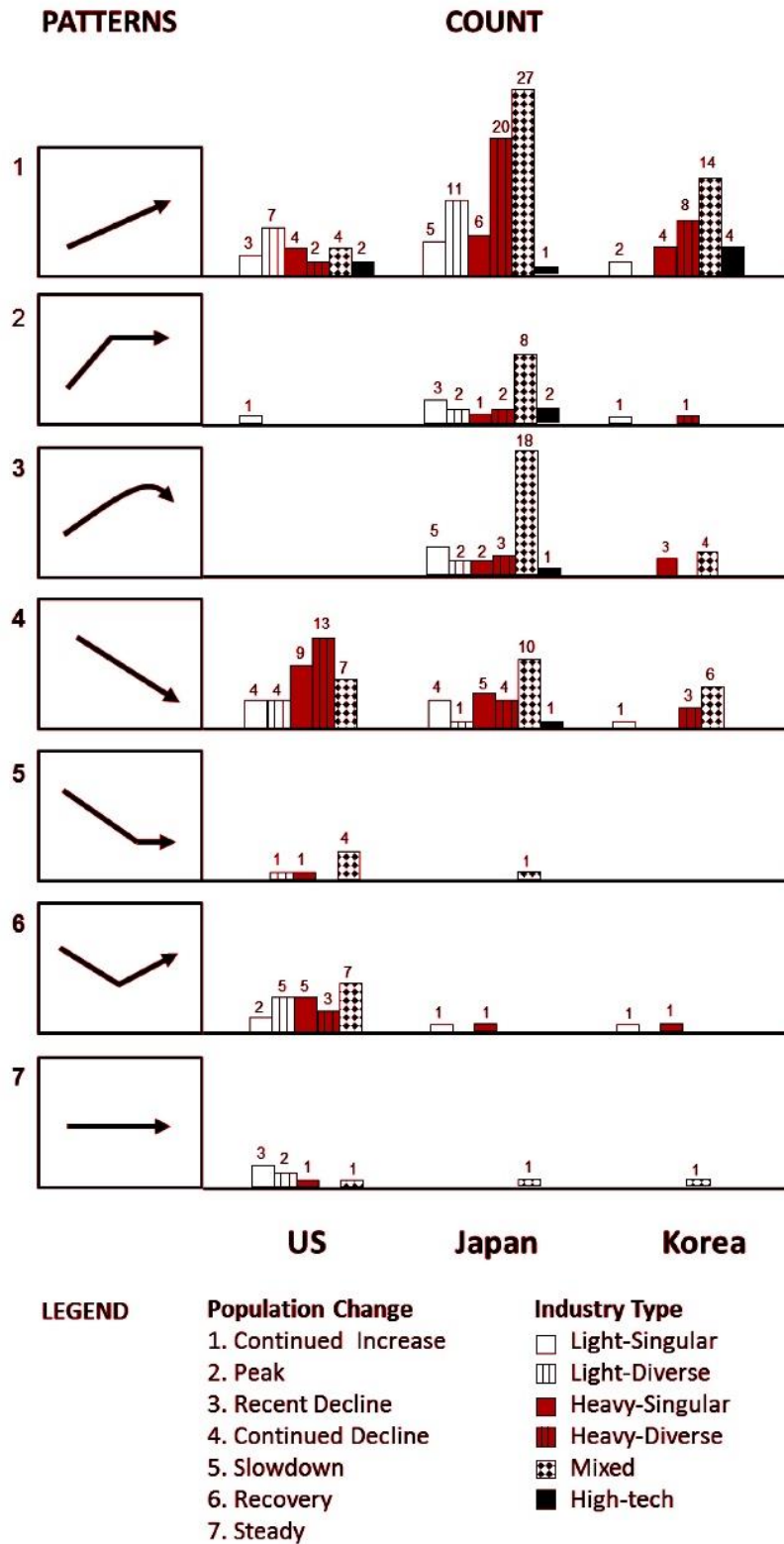


Fig. 3 - Demographic patterns and industry type

3. Methodology and Analysis

3.1 Methodologies & Data

Comparative analysis is done among three countries to identify the demographic trends of industrial cities over time. Statistical data of industrial variables and population are collected at the city level in each country from 1950 to 2010 from available data 5.

Cities are selected based on two criteria: 1) maximum industrial level-the percentage of manufacturing employment-over 30%, and 2) maximum population over 100,000 during the selected time period. Total 297 case cities are selected (US 95, Japan 148, and Korea 54). Industrial characteristics are divided into two different categories: type of manufacturing industry (light, heavy, high-tech, or mixed)⁶, and composition (singular or diversified)⁷. Cluster analysis is used to interpret the trajectory of the percentage change of population over time⁸. Types of pollution changes are divided into three categories: 1) increase (continued increase and peak), 2) decline (continued decline, recent decline, and slowdown), and 3) other patterns (fluctuate or steady). All variables are shown in Table 1⁹.

3.2 Basic Statistics

1) Industrial Characteristics

The number of cities by industry type and composition is shown in Table 2. The US has a greater number of light and heavy industries, whereas Japan and Korea cities dominate in mixed and heavy industries. Light industries show more diverse types in the US, which are old industrial cities in textile industries. In the case of Japan, light-singular type includes agro-food manufacturing and traditional craft manufacturing. In the case of heavy industries, the US shows more of a singular type while Japan and Korea cities include diverse type. This is possibly related to the development of the mixed industrial complex in Japan and Korea.

2) Population Change

Table 3 shows the number of cities by population size and change. In the case of population size, the number of cities is mostly included in small and medium sized groups (population 0.1-0.2 million). Population change shows that the US has the largest number of declining cities, especially in the large population group (population 0.5-1 million) compared to Japan and Korea (US 0.54, Japan 0.34, Korea 0.21). More than half of Japan and Korea cities are still experiencing growth (US 0.26, Japan 0.61, Korea 0.60). Fluctuating and steady types are mostly evident in US cities.

3) Correlation

The percentage of manufacturing level is different among countries (0.597). Industry type and country (0.225), and also with manufacturing percentage (0.199) have small relevance. Heavy industry, in general, has higher levels of industrial concentration.

This is also relevant to the relationship with the higher manufacturing percent and singular industrial composition (0.354). Selected variables have shown a Pearson correlation significant at 0.01 level. Population change and industry type have a relevance significant at 0.05 level.

3.3 Typology

1) Overview

Classification of cities by 6 types of industrial characteristics and 7 patterns of population change is shown in Fig. 3.

A large number of cities are included in continued increase and continued decline. In the increase group, mixed industry type is the highest both in Japan and in Korea; however, light-diverse type in the case of the US. The decline group in the US has the largest number of heavy industrial cities; on the other hand, heavy industry type cities are dominant in the increase groups in Japan and Korea. Two variations of increase group, peak and recent decline, are largely evident in Japan. US cities show the pattern of slowdown, recovery, and steady fluctuation; light-diverse and mixed type is dominant among them.

2) "Increase"

Cities in the continued increase group follow a typical growth model that manufacturing industries decline with relative growth of service sector, and increase in population. Large cities over 1 million in population are mostly in continued increase group in all three countries. In the US, cities newly developed in the 1960s with mixed or high-tech industries are increasing, while the number of heavy or mixed industries types is relatively high in Japan because of the location of the national industrial complex.

'Company cities' in heavy singular type are also increasing in Japan. Korea cities show a similarity with Japanese cities while large cities over 1 million are sustainably growing and smaller cities with heavy and high-tech industrial cities are also in increase. A few cities with a high concentration of light or heavy manufacturing industries maintain their business over time in the US, and also in Japan with food and traditional craft manufacturing.

3) "Peak" or "Recent Decline"

The cities reaching population peak or recently declining are evident in Japan. These cities are mostly a small population group (0.1-0.2 million) in growth, but the growth rate is reduced over time. This reflects Japan's trend of national population decline.

4) "Decrease"

Most dominant declining cities in the US are in heavy-singular type cities declined earlier from the 1950-1960s. Japan's heavy industrial cities have also been in decline since the 1960s also found in mixed and high-tech industries. Korea, heavy industrial cities in decline, while recent decline is detected as well. In Korea, recent

industrial development is seen in the cities that already had a population decline in the past and often developed new manufacturing industries as a strategy to bring new economic benefits in the region. Cities with light-singular type industry are often combined with the fishery or agro-industry with dominant food manufacturing and population decline detected due to decline in primary industries. Cities often have port and shipbuilding industries together in the region.

5) “Fluctuate” or “Steady”

Old industrial cities in the US with dominant textile industries declined in 1950s are included in this group. Most cities have population in 0.1-0.2 million. However, some cities are growing by making the industrial transition from light industries to heavy, and heavy to high-tech industries. This is also the case in Japan and in Korea. Fluctuating of population is only seen in small-sized cities in the US showing a temporal decrease and recovery. Some cities developed critical redevelopment strategies after economic crisis, creating a different focus on culture, education, and tourism.

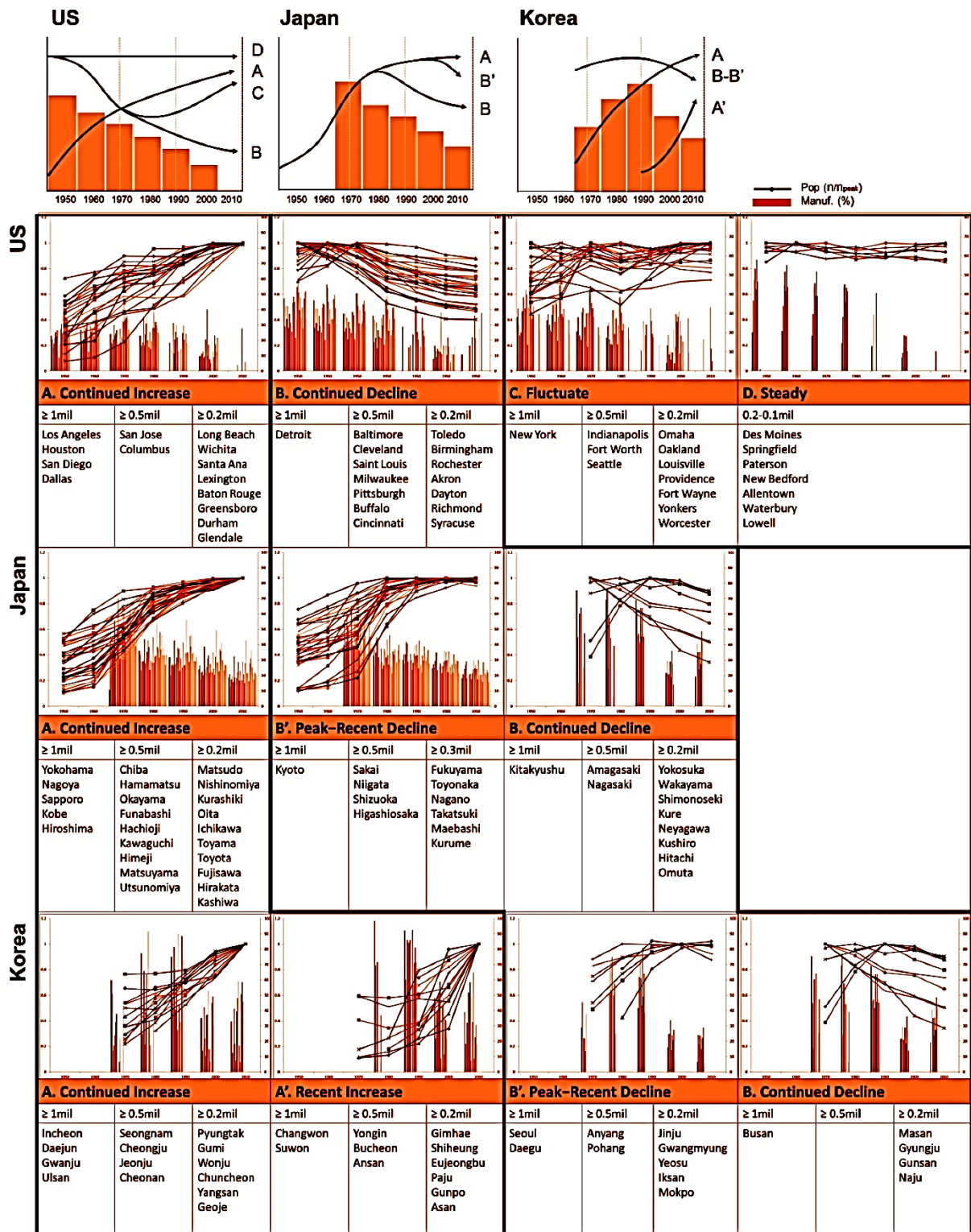


Fig. 4 - Classification of industrial cities in the US, Japan, and Korea by demographic patterns

4. Discussion

Conceptual diagrams of population change patterns (line) and the change of manufacturing industries (bar); and the example of case cities and aggregated graphs of individual cities are shown in Fig 4. Population scale is 0 to 1, the highest level as 1 at the peak year 10. The typology indicates diverse paths of demographic change. Differences among the US, Japan, and Korea are related to the national development of industries, mostly industry type and the period of

development. The similarities are found in the patterns of industrial urbanization with a certain time gap, which the national trends of manufacturing industry peaked in the US from 1950s, Japan in the 1970s, and Korea in the 1990s.

Population growth is also distinctive in these periods. The number of cases of decline in heavy industrial cities in the US is enormous, while only a few cases exist in Japan and Korea after the peak years of industrial development. However, many cities are recently in peak or recent decline, of which transition is expected in the near future.

Population change also relates to urban issues. In the case of US cities, the decline has been accelerated with suburbanization in the 1960s along with the degradation of city center. The trends of suburbanization are also detected in Japan and Korea, with the decline of the large cities and increase in numerous small-sized cities near metropolitan areas known as bed town cities. In this case, industrial area has been developed far from the city center or the development preceded the time of urban expansion. Still, limitations to verifying the direct effect of industrial transition to population changes at the macro level analysis exists, since some cases show that population changes are irrelevant to industrial development.

5. Conclusion

This study is an attempt to capture the dynamics of transformation of industrial cities from a global comparative perspective. The study focused on industrial cities in the US, Japan, and Korea to identify common patterns of industrial transition and demographic changes at the city level. Comparing cities in the US, Japan, and Korea, the demographic typology shows the relevant issues for industrial development and urban transformation.

First is the industrial transition. Inevitable decline in secondary industries affects the future development of industrial cities. Therefore, sustainable development should be considered from long-term perspective. Second, urban management is critical. The long decline of the US cities is not only due to industrial shift, but also from suburbanization and environmental degradation.

Social and physical environments must be considered in the development plan to make the industrial city livable. Third, collaboration among different stakeholders is needed to create local partnerships for transition. The decline of industries is a problem for the private sector and local government's concern that also requires national government support.

Planning transition at a pre-decline stage is needed to find solutions for both private and public sectors. The result of the typology in this study provides clues for the direction of future research; and for verifying the economic, social and physical transformation in each case city.

Notes

1. Gunn (2013) categorized three groups from types of industrial urbanism: classic cities of the first and company towns in the 20th century, and cities where industry was a substantial but not defined as 'industrial'.
2. Power et al. (2008), Kaminer (2009), and Zimmerman (2013) highlighted the severe decline of industrial cities with heavy industries in Europe and the US.
3. Diverse term described as 'older industrial cities' (Vey, 2009), 'older distressed cities' (Mallach, 2010), 'weak market cities (Power et al., 2008)' for its decline and 'Phoenix cities' (Power et al., 2010) or 'Resurgent cities' (Kodrzycki, Y. K. et al., 2009) for its recent redevelopment trends.
4. Clark (1940) defines the industrialization level of 20% employment in secondary industry at the national level. Engle & Longworth (2012) define industrial cities: population at least 50,000; manufacturing accounting at least 25% of the total employment; in the 1960s in the US. The level of 30% of manufacturing employment is set regarding higher average in Japan and Korea at the city level.
5. 'City' is defined by the statistical scope of each country. The US, the term 'city' refers to the incorporated place with a 25,000 or more population as of the survey year (U.S. Census Bureau, County and City Data Book: 2007, pg V). Japan 'Shi' or Korea 'Si' is a place having a population 50,000 or more with the urban form which 60% or more of the houses located in the main built area and 60% or more employees in urban type of business such as secondary and tertiary industries (UN, Demographic Yearbook 2012).
6. Using the classification from ISIC rev4. C. Manufacturing, light industries include food, beverages, tobacco, textiles, apparel, leather, wood products, furniture, paper, and printing (C10-18). Heavy industries include coke and petroleum, chemicals, pharmaceuticals, rubber, plastics, non-metals, basic and fabricated metals, machinery, equipment, motor vehicles, trailers, transport equipment (C19-30) except computers, electronics, and optical (C26) as high-tech industries.
7. Both Huff index and DS index are used for measuring diversity of industries. Huff index measures the weight of employment concentration and the DS index captures the variety and number of industries. With a total number of industries (j), if the Huff index value ($1/j < d < 1$) is close to one means industries are more diverse. On the other hand, DS index ($1 < d < J$) close to one means more concentrated in a single industry.
8. The population change rate is divided into decreases (-) and increases (+) by 10-year periods. Rapidness is defined as the population change rate over 10% in 10 years or over 5% change in 20 years, either decrease or

increase. If the change rate has not been captured from any of the criteria, the city belongs to ‘fluctuate’ and ‘steady (low rapidness)’ groups.

9. Data Source and availability. US: Census, City and County Data Book (1952-2010), Japan: Statistics Bureau online (1980-2010), Census / Establishment and Employment Statistics (1950-1970), Korea: Statistics Bureau Online Census and Manufacturing Statistics (1970-2010)
10. Small cities with population 0.1-0.2 million are showing larger fluctuation due to its relative value to its peak year population.

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