Dynamic Changes in Creative Manpower and R&D Technology Level in the Culture Industry

Man-Hyung Lee, Ph.D
Professor
Department of Urban Engineering,
Chungbuk National University
410 Seong-Bong Ro, Heungduk-Gu, Cheongju, Chungbuk, 361-763, Korea
Tel: 82-43-261-2369/Fax: 82-43-276-2369
E-mail: manlee@cbnu.ac.kr

and

Hae-Ok Choi
Graduate Student
Department of Urban Engineering,
Chungbuk National University
410 Seong-Bong Ro, Heungduk-Gu, Cheongju, Chungbuk, 361-763, Korea
Tel: 82-43-261-2369/Fax: 82-43-276-2369
E-mail: choeok@hanmail.net

Abstract

Based on various employment and technology data in the cultural sector from the mid-1990s to the mid-2000s in Seoul, Korea, this research examines whether technology- and human resource-oriented programs exert significant impact on creative manpower and R&D technology level. After briefly introducing Seoul's trends in the culture industry, it tries to explain major reinforcing and balancing loops. The stock-flow diagram of the culture industry in Seoul is applied to estimate relative effectiveness of major cultural programs.

Judging from a series of simulated experiments, technology-oriented cultural programs are essential to increase creative manpower and R&D technology level in the short term. For the first half of research period, this research finds that human resource-oriented cultural programs put forth minimal impact, if they even exist at all. The trends, however, are reversed in the long term: Both size of creative manpower and R&D technology level absolutely depend on human resource-oriented cultural programs in the second half.

I. Introduction

This research examines the status quo and policy alternatives of the culture industry using various employment and technology data from the mid-1990s to the mid-2000s in Seoul, Korea. Applying the system dynamics methodology, furthermore, it puts emphasis on divulging the dynamic relationships among cultural policies, creative manpower, and technology level. Here, the basic concept of creative manpower is borrowed from Richard Florida's works on the creative class (2002, 2005). Florida asserts that the creative class is especially attracted to places that are characterized, among other things, by an urban climate of tolerance that is open to new ideas and to newcomers. In other words, he focuses on socio-cultural underpinnings of urban development. Therefore, urban cultural artifacts are judged in terms of their economic utility (Peck 2005). His ideas on the creative class have drawn international attention, by scholars as well as by policy makers and civic leaders (Lang and Danielson 2005, Boschma and Fritsch 2007). For example, Shea (2004) views that civic leaders are seizing on the argument that they need to compete not with the plain old tax breaks and redevelopment schemes, but on the playing fields of what Florida calls "the three T's [of] Technology, Talent, and Tolerance (quoted from Peck 2005).

This research accepts Florida's creative class as a basic premise. But it prefers creative manpower to the creative class as the former is rather a value-free concept. This research also attempts to analyze implied meanings of simulated values and examines policy effectiveness of various technology- and human resource-oriented cultural programs in order to expand the volume of creative manpower and improve R&D technology level. Furthermore, it tries to suggest specific policy guidelines for the culture industry in Seoul.

II. Literature Review

A series of studies have highlighted the economic significance of the creative industry in capitalist societies (Pratt 1997, Florida 2002 and 2005, Markusen and Schrock 2006). As mentioned above, Richard Florida expects that cities or regions with higher concentration of the creative class would be definitely preferred. His books, *The*

Rise of the Creative Class (2002) and *Cities and the Creative Class* (2005), have provoked a spiral of pros and cons. The urban lessons of Florida's books are that cities that want to succeed must aim at attracting the creative who are, Florida argues, the wave of the future. According to Florida, jobs will follow people, instead of people following jobs. Florida explicitly takes a critical stand against Putnam(2000), who stresses the positive effect of social capital for urban development.

After analyzing the regional distribution and the effect of people in creative occupations based on data for more than 450 regions in eight European countries, Boschma and Fritsch (2007) reconfirm Florida's arguments: The creative class is not attracted to highly urbanized regions per se, but rather a climate of tolerance and openness seem to be rather important factors. Modeling the 1990 share of employment in the arts at the country level, Wojan et. al. (2007) support the hypothesis that an unobserved creative milieu that attracts artists increases local economic dynamism in the United States. In a similar vein, if it is in fact the case that artists attract the creative class of knowledgeable workers, as Rushton (2006) suggests, a virtuous circle arises, since clustering in particular locations allows workers to communicate their ideas freely and hence find it productive and profitable to live in such communities.

On the other hand, Lang (2005) insists that Florida could be criticized for glossing over 'the chicken and the egg' problems of whether artists and bohemia attract other creative workers or the other way around. Specifically, a number of critics question to what extent the creative class is different from educated and skilled people. For example, Glaeser (2004) claims that in the long term it has been productivity alone, and not quality of life, that has caused the higher growth rates in skilled cities. According to Glaeser, skilled people, not the creative class, are the key to urban success, even though creativity matters. Furthermore, some authors take the criticism of Florida a step further: Most of the empirical works based on Florida's ideas has remained rather descriptive and Florida's argument would rest on suggestive correlations rather than causality (e.g. Peck 2005, Markusen and Schrock 2006). Scott (2006) insists that the idea of the creative city provides at best a rather one-sided view of actual trends and latent possibilities in urban development. Malanga (2004) also points out the fact that Florida doesn't provide any data deomonstrating that his creative cities actually have vibrant economies that perform well over time. Finally, Rantisi, Leslie and Christopherson (2006) evaluate that the marketing of the city as a creative space reflects how the urban space economy is being reconstructed to better serve global markets.

III. Status Quo of the Culture Industry in Seoul

Yusuf and Nabeshima (2005) evaluate that cities in East Asia will need to compete fiercely for services related to the creative industry, as they are notoriously footloose, having very few assets other than their highly talented and knowledgeable workers. Seoul, the capital city of Korea, is no exception. Based on empirical studies conducted by Lee (2001) and Kwon (2002), the culture industry in Korea primarily prefers locations within CBD areas and specially commercialized areas, backed up by high-quality culture, transportation, and education facilities. Goo (2005a) and Choo (2006) examine locational characteristics of the creative industry in Seoul. Goo observes that the creative industry tends to accumulate only in a handful of specific regions within downtown Seoul. Choo emphasizes the fact that the creative industry prefers areas provided with an informal network of professionals.

According to government documents distributed by the Ministry of Culture in Korea (2004c, 2006), as of 2004, the size of the Korean culture market reached approximately 49 billion dollars. The Korean government expects that this figure will double in a few years. The total number of cultural, that is creative, manpower in Korea was 0.53 million people in 2004. Comparing the numbers in Figure 1, we can see that Seoul alone occupies almost 40 percent of cultural employment in Korea, symbolizing the monopolistic status of Seoul as the culture capital of Korea.

Year	Culture Industry (Number)	Creative Manpower (People)
1995	37,259	197,954
1996	35,931	194,205
1997	35,340	189,962
1998	37,453	186,333
1999	40,013	190,221
2000	41,365	215,322
2001	40,699	217,725
2002	39,252	217,964
2003	39,567	220,557
2004	38,183	209,941
2005	38,242	214,974

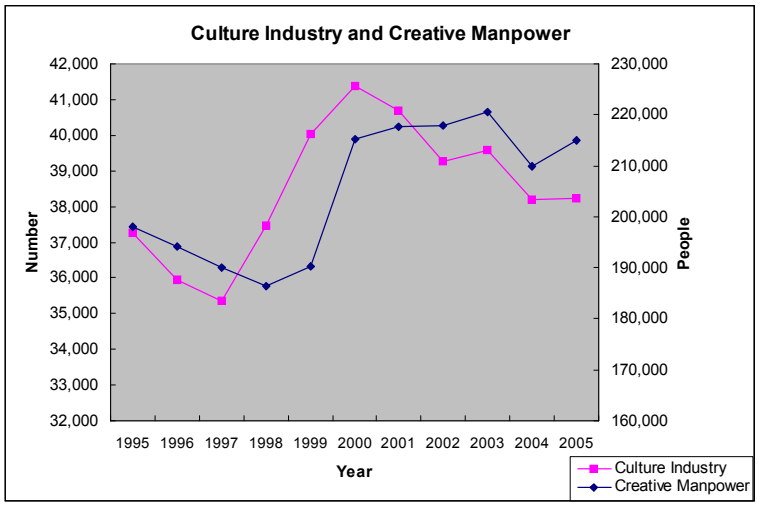

Figure 1. Trends in the Culture Industry and Creative Manpower in Seoul

As shown in Figure 1, both the culture industry and creative manpower in Seoul present similar trends from 1995 to 2005. That is, even though the culture industry and creative manpower substantially dwindled in the late 1990s, they have recorded a gradual recovery since then.

IV. Causal Loops and Stock-Flow Models

Figure 2 presents key reinforcing and balancing loops of the culture industry and creative manpower. Their theoretical concepts come from diverse sources including J. D. Sterman's book(2000), *Business Dynamics*. Loop R1 indicates that cultural product attractiveness would yield a positive impact on the market share of a cultural product. Furthermore, this market share would increase sales and expand expected market size which would lower unit fixed cost and price of cultural product. In contrast, loop R2 stresses the fact that cultural product attractiveness would create culture industry demand which would again increase sales. Loop R3 exemplifies the typical WOM(Word of Mouth) pattern. That is, word of mouth would increase relative attractiveness level, sales volume, market share, all of which would contribute to increasing brand awareness. As presented in loop R4, brand awareness is positively related to relative attractiveness level of cultural product. Loops R5 and R6 emphasize investment loops on human resource- and R&D technology-oriented cultural programs, respectively. The former explains how investment on human resource-oriented cultural programs would demonstrate meaningful impact on the volume of creative manpower and market size. The latter explains the reinforcing pattern, in which technological investment programs in the culture industry would render to expanding creative manpower. Lastly, loop R7 echoes the fact that creative manpower is basically attracted to places that cultivate an urban environment of tolerance that is open to new ideas and to newcomers.

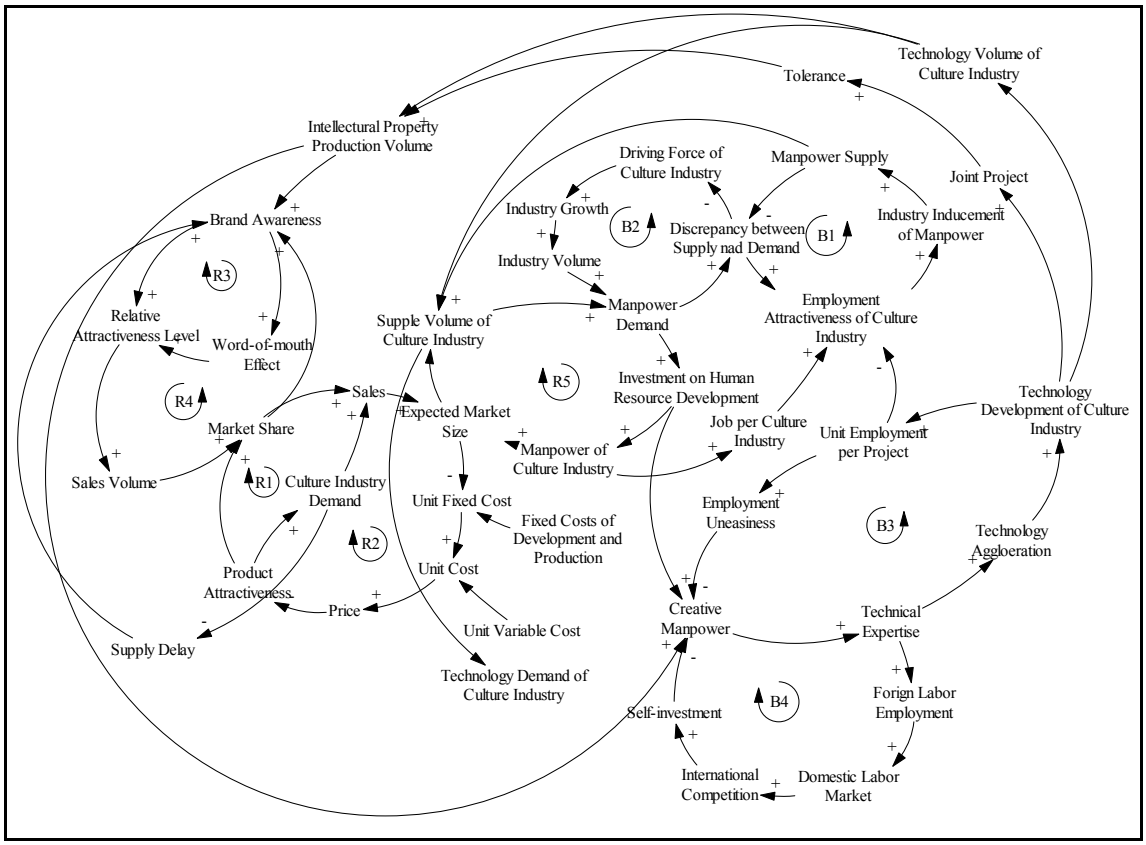

Figure 2. Causal Loops of the Culture Industry

In contrast, the balancing loop B1 means that the employment attractiveness of the culture industry would induce people to work in the area and so supply manpower demands. As mentioned above, however, the actual supply would depend on the discrepancy between supply and demand. In the similar vein, loop B2 suggests that undue discrepancy between supply and demand would even reduce the driving force of the culture industry. In addition, loop B3 indicates that creative manpower in the culture industry would contribute to enhancing technical expertise, technological agglomeration and technology development, all of which would rather increase employment per project, not to mention labor forces. Nonetheless, employment uneasiness derived from increased employment per project would exercise negative impact on the volume of creative manpower. Lastly, as foreign labor force with special technical expertise joins the domestic cultural market, international competition towards the domestic cultural market would be strengthened over time. Confronted with these circumstances, as shown in loop 4, creative manpower becomes under heavier pressure to improve his or her self-image.

Based on the causal loops, Figure 3 presents the stock-flow diagram of the culture

industry in Seoul. This stock-flow diagram is used to analyze behavioral changes of key cultural variables and apply a series of simulated exercises. Using stock-flow diagram, this research intends to compare the relative effectiveness of major culture-oriented policies. As creative manpower and R&D technology level bear feedback relationship to the culture industry, this research is primarily interested in these variables.

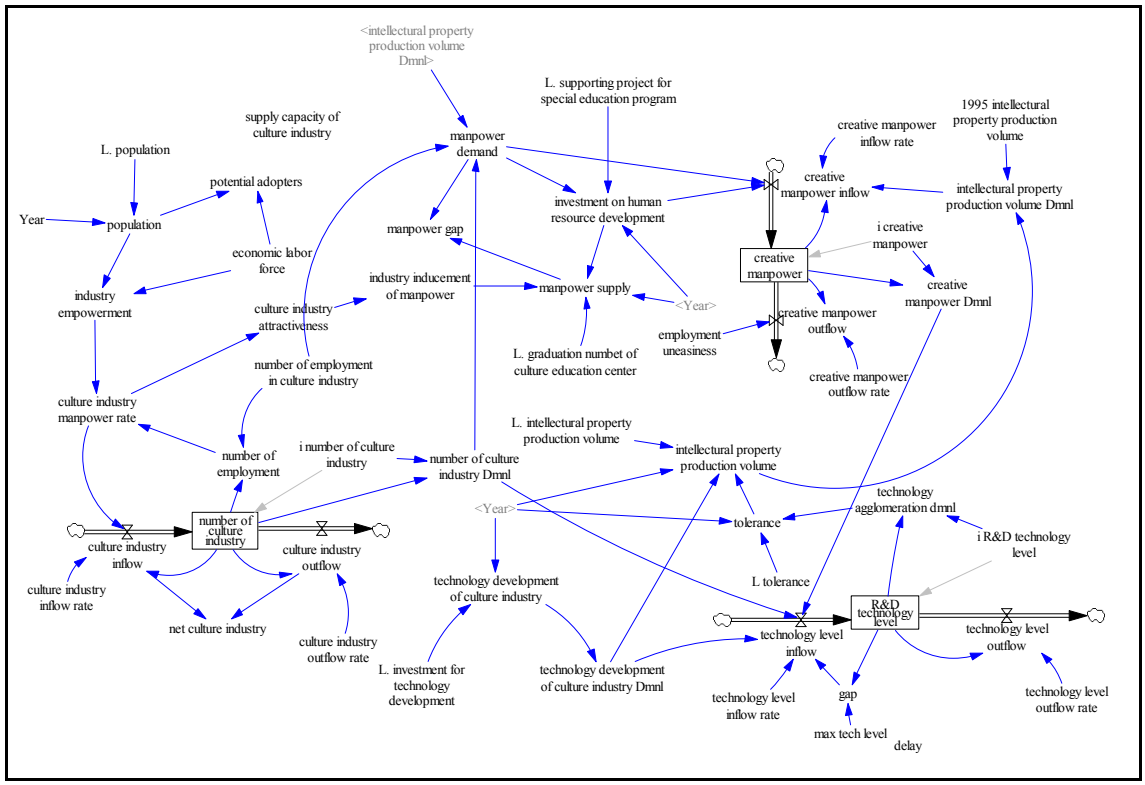

Figure 3. Stock-Flow Diagram of the Culture Industry

V.Simulation Results and Policy Implications

1. Base Run

Figure 4 and 5 present key results of the base run, meaning cases without any policy incentives. In general, the amount of creative manpower sharply decreases in the initial decade. After that, the movement is reversed, steadily increasing over time.

Founded on the existing theories and practices, this research presupposes that the R&D technology level yields the typical hyper curve pattern, as shown in Figure 5. If brand-new technology is imported, on the one hand, it may contribute to increasing the

overall R&D technology level. On the other hand, it seems inevitable for R&D technology level to experience collapse-and-overshoot patterns in the initial stage. Under these circumstances, it may never recover its peak level recorded in the initial period without appropriate supporting policies, even though competitive R&D technology which has survived over time may yield upward trends.

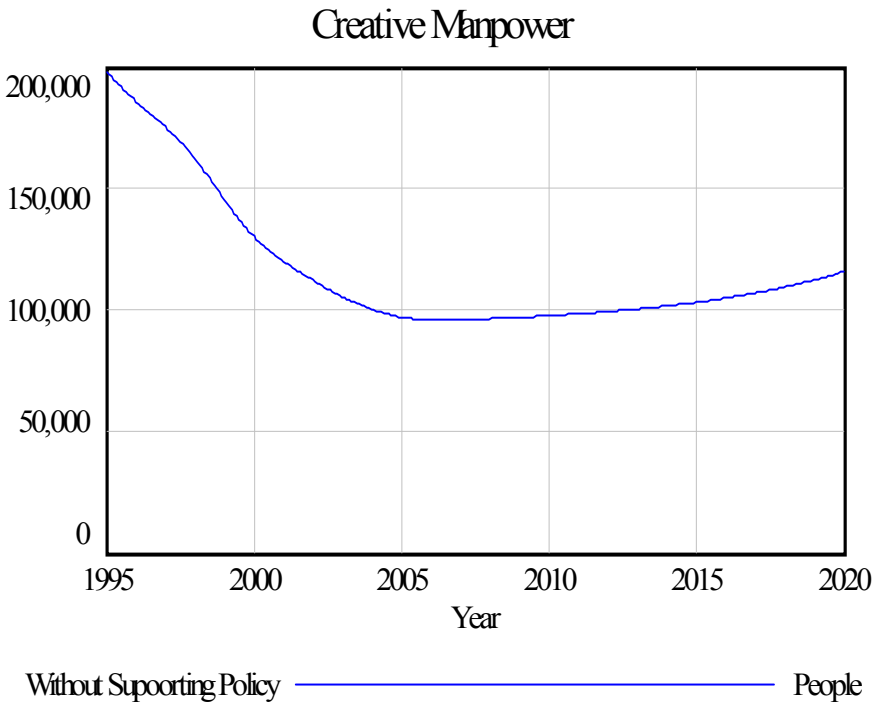

Figure 4. Creative Manpower without Supporting Policy

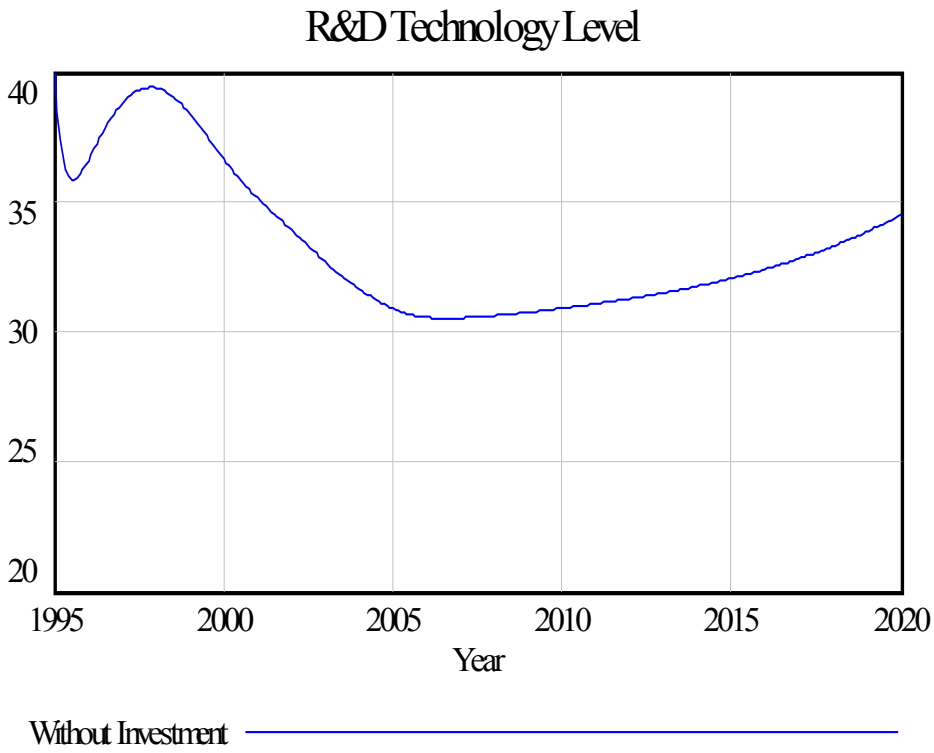

Figure 5. R&D Technology Level without Supporting Policy

2. Effect of Technology-Oriented Cultural Programs

Figure 6 and 7 show major changes in the creative manpower and R&D technology level if the City Government of Seoul applies a series of technology-oriented cultural programs. Compared with the base run, these results imply that the total volume of creative manpower would also dwindle in the beginning period, but recover its losses, approximately 5 years ahead of the base run.

However, R&D technology level supported with technology-oriented cultural programs experiences turbulent changes. It records two relatively steeper overshoot-and-collapse patterns in the first decade. Furthermore, it overpasses its peak level in the base run.

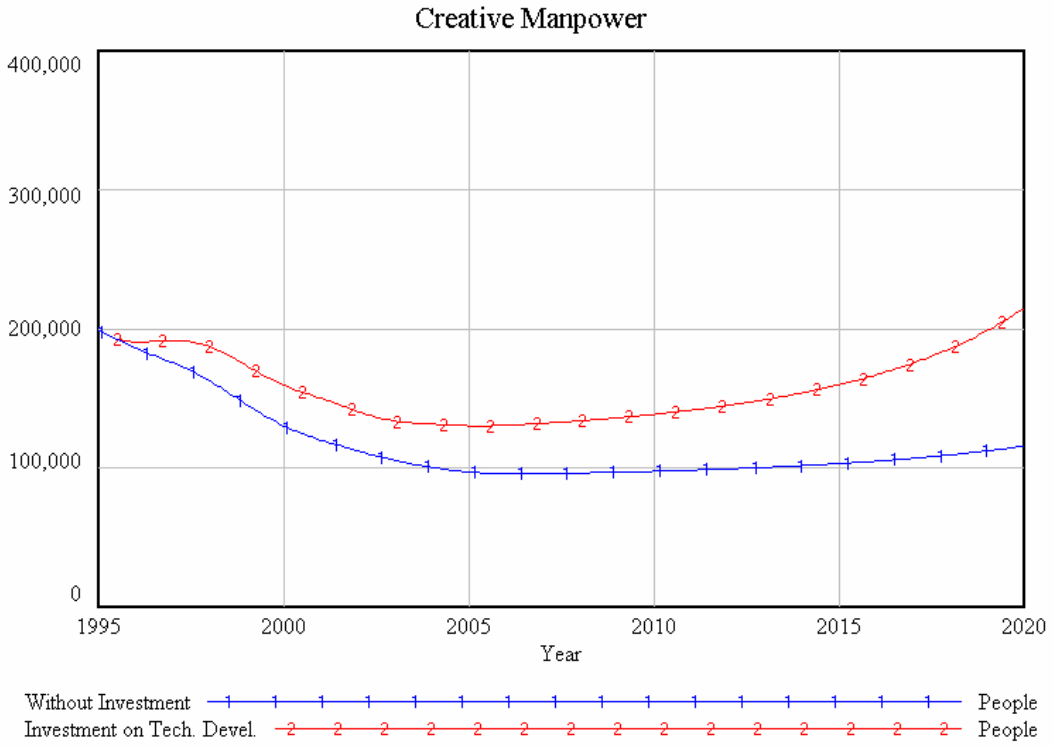

Figure 6. Creative Manpower with Technology-Oriented Cultural Programs

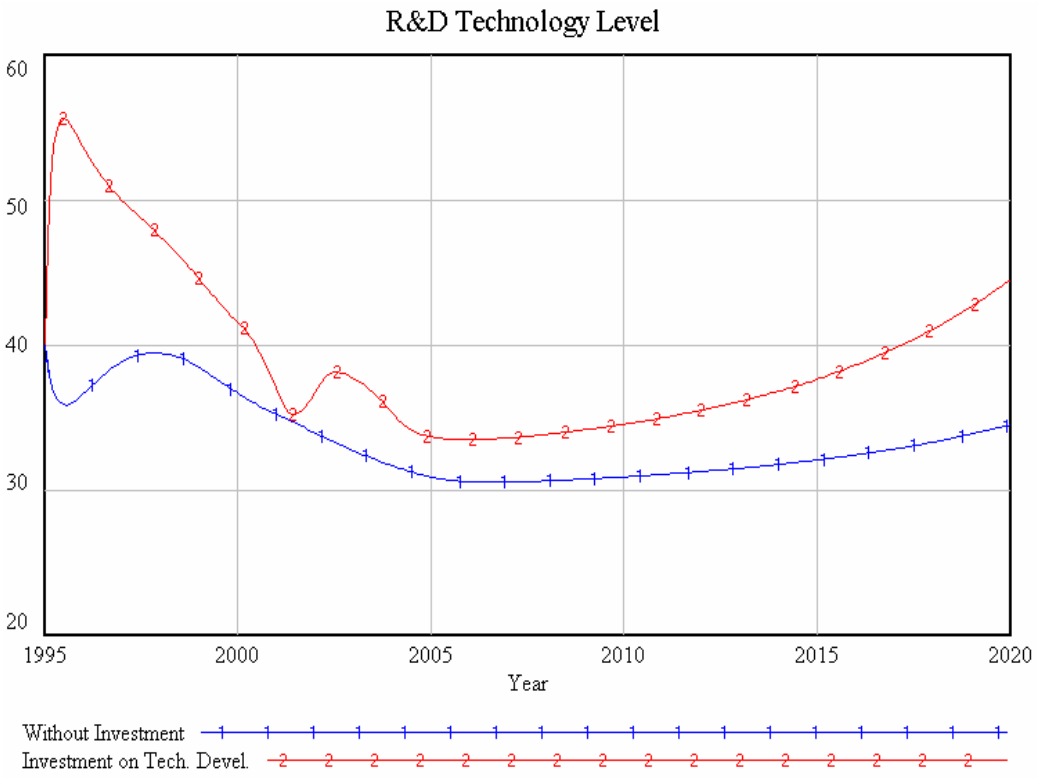

Figure 7. R&D Technology Level with Technology-Oriented Cultural Programs

3. Effect of Human Resource-Oriented Cultural Programs

As shown in Figure 8 and 9, the simulated values based on human resource-oriented programs are quite different from cases with technology-oriented ones. Even if the City Government of Seoul applies various human resource-oriented incentives, the simulated values are almost the same as those derived from the base run, at least in the first 10 years. These results imply that human resource-oriented programs are not effective in enlarging the volume of creative manpower and enhancing R&D technology level in the short run. Owing to considerable time lags originated from human resource-oriented cultural programs, nonetheless, this experiment presents that a series of incentives geared towards human resource-oriented programs are effective in the long run.

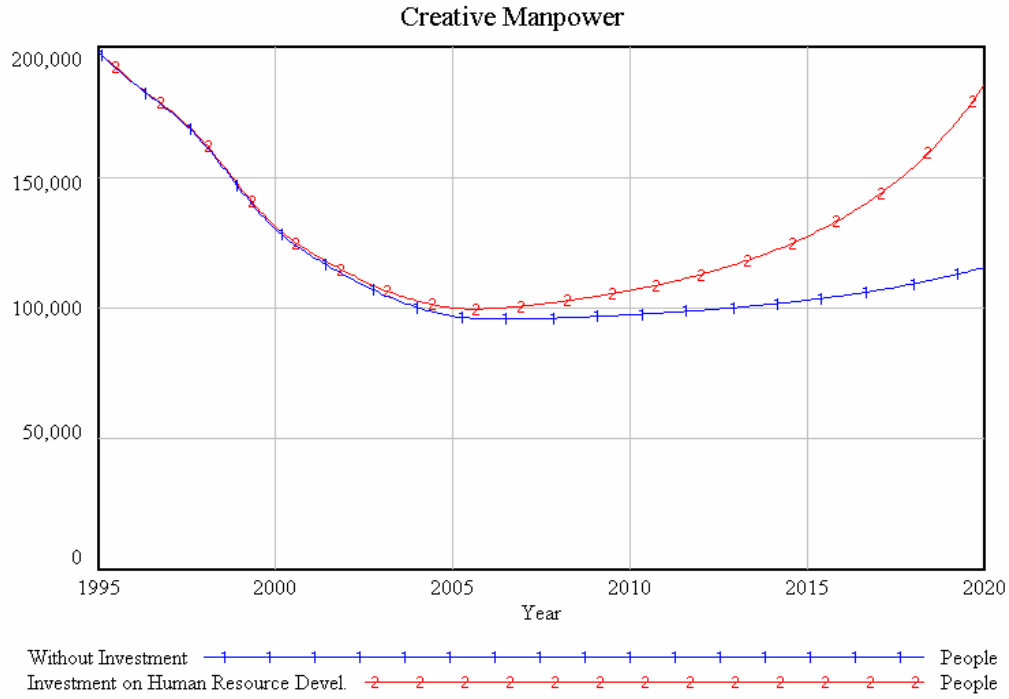

Figure 8. Creative Manpower with Human Resource-Oriented Cultural Programs

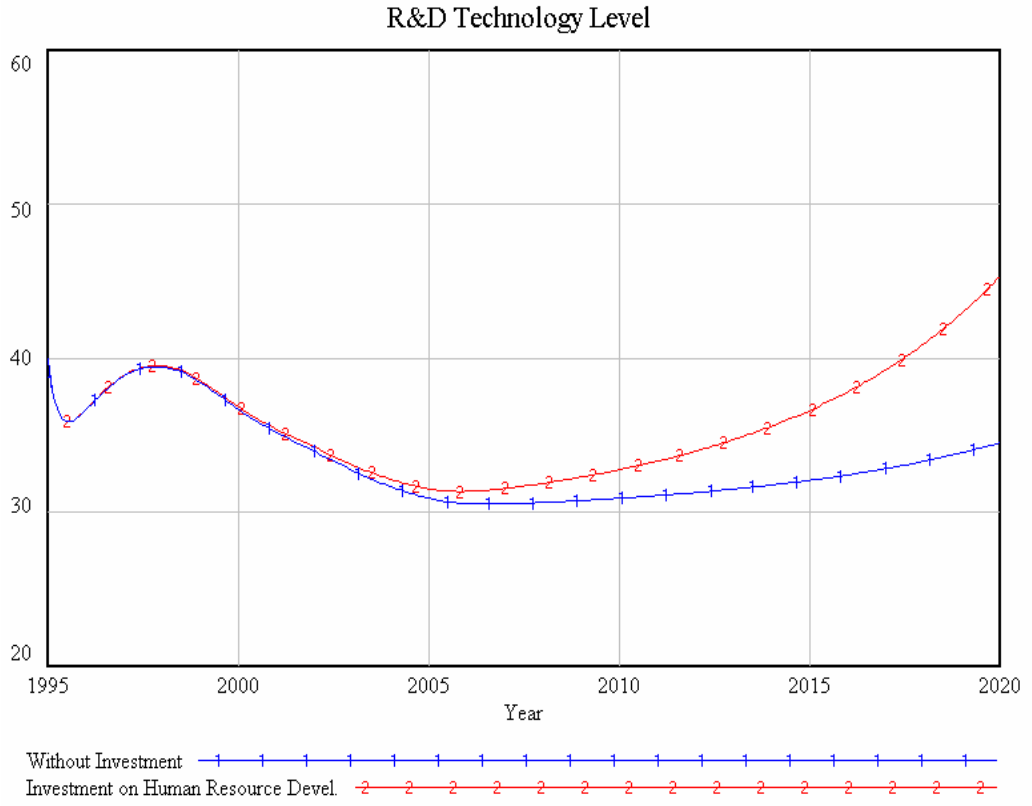

Figure 9. R&D Technology Level with Human Resource-Oriented Cultural Programs

4. Combined Effect of Technology- and Human Resource-Oriented Cultural Programs

The combined effect of technology- and human resource-oriented cultural programs on creative manpower is shown in Figure 10. Here, its effect on creative manpower in the first 10 years is almost meaningless. The combined effect becomes more vivid after approximately 15 years later. In the second half of research period, nonetheless, the combined incentives produce relatively stronger influence on the movement of creative manpower.

Concerned with R&D technology level, similar trends are observed in Figure 11. The combined effect of technology- and human resource-oriented cultural programs on R&D technology level is not so significant in the first decade: Rather, it seems that R&D technology level solely depends on investment on technology-oriented cultural programs. After that period, the combined programs would significantly contribute to increasing the overall R&D technology level.

In sum, these simulated values indicate that the City Government of Seoul should

dichotomize policy guidelines based on the necessary time spans involved. First of all, investment on the technology-oriented cultural programs is essential in order to keep the overall competitiveness of both creative manpower and R&D technology level in the short term, whilst minimizing investment on human resource-oriented cultural programs.

In contrast, the combined effort of technology- and human resource-oriented cultural programs is crucial in expanding the volume of creative manpower and upgrading R&D technology levels in the long-term perspectives. However, this does not necessarily indicate which variable is more urgent.

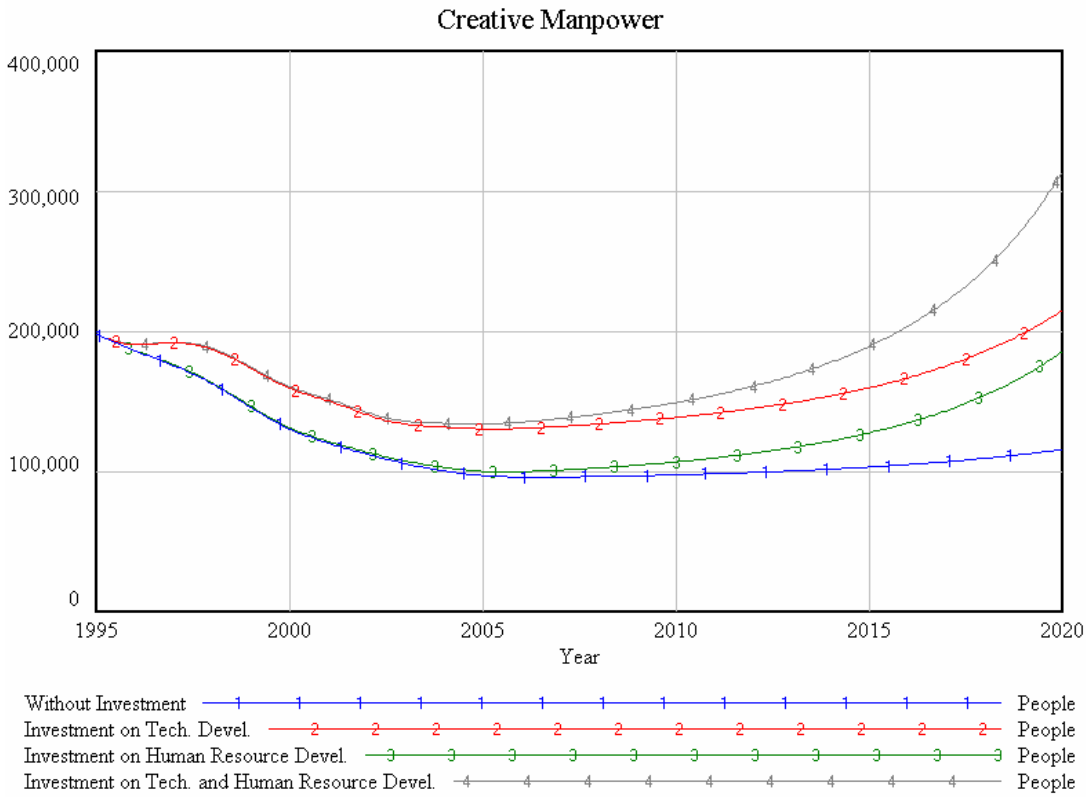

Figure 10. Creative Manpower Combined with Technology- and Human Resource-Oriented Cultural Programs

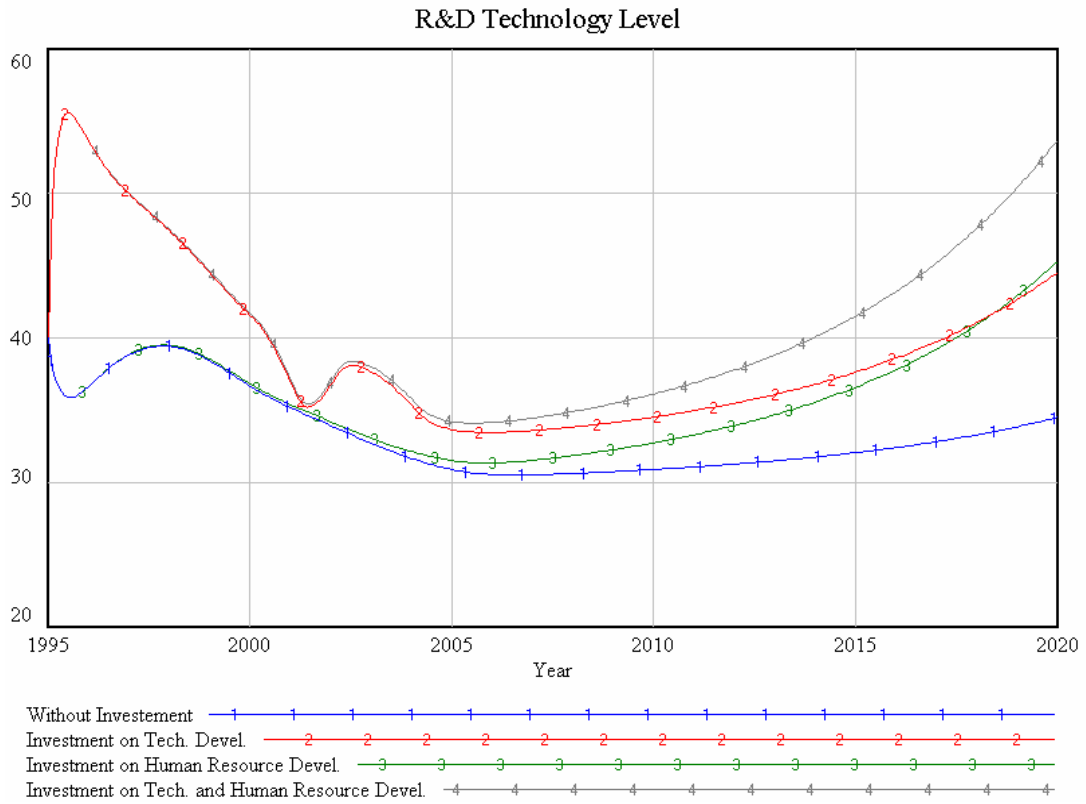

Figure 11. R&D Technology Level Combined with Technology- and Human Resource-Oriented Cultural Programs

VI. Summary and Discussions

Florida (2002) proposes the need for urban policies centered on 'quality of place' dimensions, especially stressing roles of creative manpower—the creative class in his own terminology. Feser (2003) and Rushton (2006) also repeat similar suggestions: Urban government should now target occupations rather than firms, as economic development policies aimed at luring large firms through tax breaks and land deals are not sufficient or necessary any longer. Even though creativity matters, nonetheless, several critics evaluate that Florida's ideas are not so effective or prescriptive enough to guarantee vibrant urban economies that function well over time (Glaeser 2004, Malanga 2004, Peck 2005, Markusen and Schrock 2006).

Based on various employment and technology data in the cultural sector from the mid-1990s to the mid-2000s in Seoul, Korea, this research examines whether technology- and human resource-oriented cultural programs exert significant impact on creative manpower and R&D technology level. After briefly introducing Seoul's trends

in the culture industry, it tries to explain major reinforcing and balancing loops. The stock-flow diagram of the culture industry in Seoul is applied to estimate relative effectiveness of major cultural programs.

Judging from a series of simulated experiments, technology-oriented cultural programs are essential to increase creative manpower and R&D technology level in the short term. For the first half of research period, this research finds that human resource-oriented cultural programs exercise minimal impact, if they even exist at all. The trends, however, are reversed in the long term: Both size of creative manpower and R&D technology level absolutely depend on human resource-oriented cultural programs in the second half.

These results implicitly denote that Florida's ideas should be applied step by step with an appropriate time dimension. In the first half, not like Florida's assertion, investment on the human resource-oriented cultural programs may not produce any meaningful results for the overall creative manpower and R&D technology level. During this period, it seems that technology-oriented cultural programs are essential to upgrade creative manpower and R&D technology level. In the second half, however, both creative manpower and R&D technology level solely depend on what types of human resource-oriented cultural programs the City Government of Seoul puts forth, even though the effect derived from technology-oriented cultural programs becomes minimized. These findings, nonetheless, do not necessarily mean that human resource-oriented cultural programs are useless or even time-consuming in the short run. Rather, it underlines the fact that relatively longer time span should be allotted to deal with human resource-oriented cultural programs.

References

Boschma Ron A., and Michael Fritsch(2007), Creative Class and Regional Growth: Empirical Evidence from Eight European Countries, Jena Economic Research Papers, 2007-066.

Choo, Sungjae(2006), "Development of the Korean Film Industry and Its Spatial Characteristics: Gangnam Region of Seoul as a New Cluster in a New Renaissance?," *Journal of the Korean Geographical Society*, 41(3): pp.245-266.

Feser, E. J.(2003), "What Regions Do Rather than Make: A Proposal Set of Knowledge-based Occupation Clusters," *Urban Studies*, 40(10): pp.1937-1958.

Florida, R.(2002), *The Rise of the Creative Class*, New York: Basic Books.

Florida, R.(2005), *Cities and the Creative Class*, New York: Routledge.

Glaeser, Edward L.(2005), "Review of Richard Florida's The Rise of the Creative Class," *Regional Science and Urban Economics*, 35(5): pp.593-596.

Goo, Moon-Mo(2005a), "An Analysis on the Economic Performance of Creative Industry and Clustering in Seoul," *Journal of Korean Regional Development Association*, 17(1): pp.197-223.

Goo, Moon-Mo(2005b), "Economic Contributions of Creative Industries and Some Policy Implications for Seoul Metropolitan Area," *Research on Seoul & Other Cities*, 6(4): pp.101-120.

Jeon, Jae-Ho(2003), "A Dynamic Analysis on the Relative Effectiveness of Promoting Policies for Information Security Industry," *Journal of Korean System Dynamics Society*, 4(2): pp.5-44.

Jeon, Yoo-Shin, and Tae-Hoon Moon(2005), "Establishment of the Measurement Model about the Adequate Urban Development Density Using System Dynamics," *Journal of Korean System Dynamics Society*, 4(2): pp.71-94.

Kim, Kwang-Sun(2007), The Organization of Production and Industrial Clustering of Cultural Content Industries, Seoul National University, Ph.D Dissertation.

Kwon, Oh-Hyuk, and Hong-Suk Kim(2000), Regional Culture Industry Promoting Alternative, Korea Research Institute for Local Administration.

Kim, Eui-Joon, and Kab-Sung Kim(2004), Economical Impact of Cultural Content Industry, Korea Content Export Information System.

Kim, Hyo-Jung(2004), Promotion Alternatives of Culture, Korea Culture & Tourism Institute.

Kim, Suk-Hee(2006), Innovation of Administration Processes Based on Ubiquitous Information Technology, Yonsei University, Master Thesis.

Korea Content Export Information System(2004), Economical Impact of Cultural Content Industry.

Korea Institute for Industrial Economics & Trade(2001), Culture Industry and Urban Development.

Korea National Statistical Office(1995 to 2005), *Basic Business Statistics*.

Landry, C.(2000), *The Creative City: A Toolkit for Urban Innovators*, London: Earthscan.

Lang, R., and K. Danielsen(2005), "Review Roundtable: Cities and the Creative Class," *Journal of the American Planning Association*, 71(2): pp.203-220.

Lee, Ho-Young, and Ji-Yeen Ryu(2005), Socio-Cultural Impact of Ubiquitous Telecommunication Environment, Korea Information Development Institute.

Lim, Keung-Soo(2004), "The Development Measures for Local Cultural Industry as a Regional Development Strategy," *Journal of the Korean Regional Development Association*, 14(1): pp.69-90.

Markusen, A.(2004), "Targeting Occupations in Regional and Community Economic Development," *Journal of the American Planning Association*, 70(3): pp.253-268.

Markusen, A., and Schrock G.(2006), "The Artistic Dividend: Urban Specialization and Economic Development Implications, *Urban Studies*, 43: pp.1661-1686.

Ministry of Culture(2002), Adjustment and Supporting Criteria of Regional Culture Industry Cluster Measurement

Ministry of Culture(2003), *White Paper of Culture Industry*.

Ministry of Culture(2004a*), Report of Global Cultural Content Business*.

Ministry of Culture(2004b), *Report of Culture Industry*.

Ministry of Culture(2004c, 2006), *Culture Industry Statistics*.

Park, Sang-Hyun, Seung-Joon Yeon and Sang-Wook Kim(2003), "The Application of SD for Supply & Demand Plan of Manpower in Case of Information Security Industry for the UIT Environment," *Journal of Korean System Dynamics Society*, 4(1): pp.98-119.

Peck, J.(2005), "Struggling with the Creative Class," *International Journal of Urban and Regional Research*, 29(4): pp.740-770.

Pratt, A. C.(1997), "The Cultural Industries Production System: A Case Study of Employment Change in Britain, 1984-91," *Environment and Planning A*, 29: pp.1953-1974.

Putnam, Robert D.(2000), *Bowling Alone: The Collapse and Revival of American Community*, New York: Simon & Schuster.

Rantisi, Norma M., Deborah Leslie and Susan Christopherson(2006), "Placing the Creative Economy: Scale, Politics, and the Material," *Environment and Planning A*, 38: pp.1789-1797.

Rushton, Michael(2006), "The Creative Class and Urban Economic Growth Revisited," Paper Prepared for the 14th International Conference of the Association for Cultural Economics International, Vienna, Austria, July 6-9, 2006.

Ryu, Jae-Youn, and Young-Ho Jin(2002), "Urban Culture Industry and Urban Policy, " *Urban Information Service*, pp.3-16.

Sasaki Masayuki(1998), "Market Economies and Tradition in the East Asia: Perspectives of Global and Creative City," *Han Lim Japanese Research*, 3: pp.88-96.

Scott, Allen J.(2006), “Creative Cities: Conceptual Issues and Policy Questions,” *Journal of Urban Affairs*, 28(1): pp.1-17.

Shea, C.(2004), “The Road to Riches?,” *Boston Globe*, February 29, D1.

Shin, Sung-Hee(2007), “Urban Regeneration in the View of Creative City Index and Creative Group's Distribution Characteristics,” *Seoul Economic Focus*, February: pp.23-38.

Sterman, J. D.(2000), *Business Dynamics: System Thinking and Modeling for a Complex World*, Boston: Irwin McGraw-Hill.

Wojan, Timothy R., et. al.(2007), “Emoting with Their Feet: Bohemian Attraction to Creative Milieu,” *Journal of Economic Geography*, 7: pp.711-736.

Yeon, Seung-Joon(2003), System Dynamics Approach to Building an Integrated Diffusion Model Combining Expectation Management and Customer Satisfaction, Chungbuk National University, Ph.D Dissertation.

Yusuf, Shahid, and Kaoru Nabeshima (2005), “Creative Industries in East Asia,” *Cities*, 22(2): pp.109-122.

[Equation]

creative manpower inflow=creative manpower*creative manpower inflow rate*intellectural property production volume Dmnl + manpower demand+ investment on human resource development (People/Year)
Employment Uneasiness=0.6374
net culture industry=increase in culture industry-decrease in culture industry
investment on human resource development="L. supporting project for special education program"(Year)+ manpower demand
culture industry attractiveness=culture industry manpower rate
manpower demand=(number of culture industry Dmnl*number of employment in culture industry+ intellectual property production volume Dmnl*number of culture industry Dmnl)
manpower supply=investment on human resource development+ ("L. graduation number of culture education center"(Year)) + industry inducement of manpower
creative manpower outflow=creative manpower*creative manpower outflow rate*Employment Uneasiness
manpower gap=manpower demand-manpower supply
industry inducement of manpower=culture industry attractiveness
technology level inflow=(technology development of culture industry Dmnl/number of culture industry Dmnl)*increase in technology level rate*gap*creative manpower Dmnl
intellectual property production volume=SMOOTH(("L. intellectural property production volume"(Year)*tolerance*technology development of culture industry Dmnl), 12)
culture industry inflow=culture industry manpower rate*culture industry inflow rate*number of culture industry
creative manpower inflow rate=0.034
max tech level=100
gap=max tech level-"R&D technology level"
population="L. population"(Year)People
"L.population"([(1995,1.01e+ 007)-
(2005,1.1e+ 007)],(1995,1.05959e+ 007),(1996,1.04699e+ 007),(1997,1.03215e+ 007),(1998,1.03215e+ 007),(1999,1.03214e+ 007),(2000,1.03732e+ 007),(2000.12,1.03732e+ 007),(2001,1.03312e+ 007),(2002,1.02805e+ 007),(2003,1.0277e+ 007),(2004,1.02878e+ 007),(2005,1.0297e+ 007))
technology development of culture industry Dmnl=technology development of culture industry/1771
creative manpower Dmnl=creative manpower/i creative manpower
number of culture industry Dmnl=number of culture industry/i number of culture industry
supply capacity of culture industry=100
delay=2
economic labor force=0.7
tolerance=L tolerance(Year)*technology agglomeration dmnl
technology level outflow="R&D technology level"*technology level outflow rate
technology level outflow rate=0.15
technology level outflow rate=0.22
technology agglomeration dmnl="R&D technology level"/ "i R&D technology level"
technology development of culture industry=SMOOTH("L. investment for technology development"(Year),2)

culture industry manpower rate=(industry empowerment/number of employment)
(People/Job)
number of employment in culture industry=5.62(Job)
culture industry outflow rate=0.032
number of culture industry= INTEG (culture industry inflow-culture industry outflow,i number of culture industry)
culture industry inflow=culture industry outflow rate*number of culture industry
culture industry outflow rate=0.034(1/Year)
industry empowerment=population*economic labor force*0.05(People)
"1995 intellectual property production volume"=28529
creative manpower= INTEG (creative manpower inflow-creative manpower outflow, i creative manpower)(People)
creative manpower outflow rate=0.032 |
potential adopters=economic labor force*population
number of employment=number of culture industry*number of employment in culture industry(Job)
intellectual property production volume Dmnl=intellectual property production volume/"1995 intellectual property production volume"
i number of culture industry=37259
i creative manpower=197954
"i R&D technology level"=40 |
L.tolerance([(0,0)-
(2,1)],(0,0),(0.161404,0.0438596),(0.266667,0.0877193),(0.385965,0.144737),(0.477193,0.236842),(0.519298,0.337719),(0.568421,0.45614),(0.666667,0.561404),(0.792982,0.618421),(0.933333,0.640351),(1.05965,0.583333),(1.13684,0.5),(1.18596,0.403509),(1.24211,0.315789),(1.3193,0.22807),(1.4386,0.219298),(1.54386,0.245614),(1.65614,0.289474),(1.7614,0.337719),(1.85965,0.385965),(2.00702,0.425439),(2.16842,0.447368))
"L. investment for technology development"
([(2000,0)-(2004,2000)],(2000,1771),(2001,1441),(2002,1957),(2003,1889),(2004,1674))
"L. graduation number of culture education center"(
[(2003,0)-
(2010,40000)],(2003,8644),(2004,10882),(2005,12387),(2006,21600),(2007,23800
"L. supporting project for special education program"
([(1995,0)-(2020,40)],(2002,10),(2003,33),(2004,26))
"L. intellectural property production volume"
([(1995,0)-
(2005,60000)],(1995,28529),(1996,34468),(1997,25439),(1998,16575),(1999,19960),(2000,32839),(2001,32391),(2002,32813),(2003,38944),(2004,42261),(2005,51013))
"R&D technology level"= INTEG (+technology level inflow-technology level outflow,"i R&D technology level")
Year= TIME BASE (1995, 0.0833333) [1995,0.0833333]