

## **Role of Infrastructure in Success of Urban Housing Developments**

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### **ABSTRACT**

The infrastructure is an important part of the success of any residential development, but it takes on a critical role in the case of urban housing developments, both new and redevelopment projects. This research reviewed literature and several case studies nationwide to define supporting infrastructure for residential redevelopments. The review led to defining thirteen categories of infrastructure systems and each system was then divided into subsystems leading to a total of forty infrastructure subsystems. The infrastructure systems and subsystems required for the success of an urban residential redevelopment were separately prioritized with the help of structured interviews with six developers and four municipal/state government officials in Michigan. The data from each group was collected in the context of their perspective on development success criteria such as Company/Municipal Success, Profitability, Primary and Secondary Project Success Aspects and Branding. ELECTRE III, a multi-criteria decision-making model that effectively helps in prioritization or optimized ranking of alternatives, was used for data analysis. The results reflect that the top five priorities for developers are Digital Infrastructure, Utilities, Education, Transport and Green Infrastructures whereas the Municipal Officials' preference list includes Digital, Employment, Utility, Transport, Retail in order of priority. Infrastructures like Renewable Energy and Green Space are yet to gain widespread popularity in the real estate industry. The authors believe that this analysis will be valuable in guiding the developers and municipal officials in prioritizing the infrastructure options for a given budget to get the most impact on the success of a residential redevelopment project.

### **INTRODUCTION**

According to the recent trends, both developed and developing countries witness an unprecedented growth and movement of population in urban regions (Farid, 2011). This situation is accompanied with the emergence of a new pattern of developing centralities towards the periphery of the cities, coined as the 'Urban Sprawl'. To facilitate the demand of habitat, triggered by the urban sprawl, new housing developments appear in the scenario. Consistent with the massive surge of population, communities witness rise in the land acquisition cost and time. Hence, to deliver maximum values to the customers, the developers need a solution besides the new development projects. 'Urban Redevelopment' with its salient features provide such an alternative.

Complete Community Toolbox (2018) adapted from International City/county Management Association (ICMA) to describe redevelopment as modification of a pre-existing structure or previously developed property for a new purpose, often different from its original one. The idea ranged from refurbishing an existing building/housing to reusing a contaminated brownfield to develop new housing. The redevelopment projects effectively build on the remnant framework of basic infrastructures of the earlier development with necessary additions and refurbishment to suit the customers' requirement. Hence, such projects provide livability of a quality equivalent to new developments. Thus, by opting for feasible urban redevelopment projects alongside the new developments, developers can streamline their product offerings and meet the diverse demand surge emanating from the burgeoning urban population.

This paper begins with a brief overview of the literature studied and several case studies investigated, outlining the categories and sub-categories of infrastructure required in a residential redevelopment. It emphasizes the importance of infrastructure, points out the benefits and discusses the factors of success in a residential redevelopment.

## **LITERATURE AND CASE STUDY REVIEW**

### **1. Infrastructure**

After establishing the requirement of redevelopment as a way out to develop housing projects, the next step is to understand the role of infrastructure in its success. U.S.-EPA (2019) summarized in three points, the necessity of redevelopment projects and effect of existing infrastructure on its development and success.

- Redevelopment changes discarded sites into community features such as parks and plazas, mixed-use developments, and homes.
- Policies play an important role in shaping ease and cost of redevelopment.
- “Sites are often in infill locations with existing transportation and utility infrastructure. Redevelopment in infill locations can use vacant buildings, parking lots, or other underused sites for new amenities, homes near existing neighborhoods. When infill development occurs near transit or employment centers, it can reduce the distance people need to drive and give them other transportation options.”

A review of single-family, multi-family and mixed-use type of residential redevelopments across the United States assisted this study in defining key infrastructure for successful residential developments. The determination of the success of these case studies is based on the analysis conducted by Urban Land Institute (2004), various government commissions and Municipal Development Authorities of several states.

Based on the case studies and the literature review, the infrastructure required to support a residential development can be split into thirteen broad categories and then can be further divided into forty sub-categories, as shown below (Bracknell Forest Council, 2012).

- Transport Infrastructure
- Waste Management
- Utilities
- Renewable Energy
- Education
- Community Infrastructure
- Social Infrastructure
- Emergency Services/ Safety
- Health
- Green Infrastructure
- Digital Infrastructure
- Retail
- Employment Infrastructure

## **2. Stakeholders and Associated Parameters of Success**

It is very crucial to understand the success of the redevelopment project to be able to relate it with availability or absence of infrastructure. Since a project has various stakeholders associated, each will have its own definition of measuring success. The same project is mapped differently by the developers and the government officials who are the two primary stake holders of the project from its conception stage. The private developers who actually invest in the project generally show profit seeking and risk-taking characteristics to achieve cost effective outcomes. However, the same project can be used by the government and municipality to promote community development, remove blights and contamination and bring taxpayers into the city. Because of these different perspectives, the requirements of the different stakeholders from a project often varies distinctively. After an extensive literature review for definition of success, the following measures of success for different stakeholder's perspective was found in a research conducted by Wai et. Al (2012). According to the research, success can be classified into five categories:

- Company Success
- Profitability Success
- Primary Project Success
- Secondary Project Success
- Branding Success

### **DATA COLLECTION**

The primary stakeholders for the project in terms of the investment and project quality are private developers and government officials respectively. Government officials can include city councils, county commissioners, planning and zoning board members and other elected officials (Novak,1996). As the purpose of this research is to develop a ranked list of infrastructures, which may contribute to the success of a residential

redevelopment, the authors found it necessary to utilize the perspectives both developers and officials in determining the list. Hence data is collected from both the groups.

In person interviews were conducted for data collection and discussions. Ten local developers and nine city officials from Michigan were contacted to collect data. Out of the ten developers and nine city officials contacted, the author could successfully communicate with six developers and four city officials. All the interviews took place in Michigan. The Government officials are members of Department of Environmental Quality (DEQ), Michigan Economic Development Corporation (MEDC), Lansing Economic Area Partnership (LEAP) and Brownfield Redevelopment Authority (BRA), Lansing, all of which are under state authorities of Michigan. The interviews lasted between 30-45 minutes. All developers interviewed have extensive experience in Single-family, Multi-family and Mixed-use residential developments in Michigan. One of the developers has done multiple projects in North Carolina, South Carolina, Texas, Ohio and Florida. The data collected was analyzed to obtain ranking of different categories of infrastructure.

A structured interview was employed at this phase of the study to find the overall and relative importance of infrastructure categories in the success of a residential redevelopment for key stakeholders. The project scope focused on the developers and the municipal officials while both groups were asked to also keep in mind the future residents' perspective when answering the interview questions.

The questionnaire developed for interviewing the developers and the municipal officials, was divided into three sections:

Section 1: Background of the Developer/ Municipal Official

Section 2: a. Prioritization of sub-categories

b. Prioritization of broad categories

Section 3: Incentives and Barriers to Redevelopment

The open-ended questions in the final sections of the questionnaire was to account for the difference in perspectives of developers and municipal officials. A reference scale of 0-10 was used, with 0 being extremely unimportant, 5 being neutral and 10 being extremely important.

## **DATA ANALYSIS**

Considering the limitation of inadequate sample size, the authors ruled out quantitative data analysis and investigated qualitative methods. The lookout was for a method which reflects the preferential analysis ability of a human mind and after a thorough research of different methods, results were narrowed down to two methods, Analytical Hierarchy Process (AHP) and ELECTRE III. AHP, developed by Saaty (1980), helps in analysis of decision-making problems. It builds in the preference modelling by comparing two categories at a time; however, the condition of analyzing the impact of

all five success criteria together made the process extremely cumbersome. Alternatively, ELECTRE III (Velasquez & Hester, 2013) proved to fit the bill with its simple procedures.

ELECTRE III is a multi-criteria decision-making model that effectively helps in prioritization or optimized ranking of alternatives. The underlying principle for outranking in ELECTRE III is the preference of a decision-maker for a given set of alternatives. An alternative a is said to outrank an alternative b, if the decision-maker's preference supports the conclusion that a is at least as good as b. The authors created a decision matrix to determine the ranks of various categories in ELECTRE III. The matrix is meant to establish a relation between the alternatives (i.e., 13 categories) and the criteria (i.e., five categories of success). Once a matrix is developed with these variables, participants' evaluations were inserted in the model. The final ranks calculated for each participant is tabulated and the mean is calculated as the final rank.

## **RESULTS**

Two different sets of results are obtained for the ranking of the broad categories, the sub-categories. Results are compiled separately from the perspective of the developers, the municipal officials, followed by combined results. These results are presented in the sections below.

### **a.1 Ranking of Broad Categories**

The ranking of the broad categories of infrastructure obtained through data analysis in ELECTRE III considering the opinions of the developers and the government officials respectively are listed below. Also, shown below are the combined rankings.

#### **A. Ranking of Broad Categories of Infrastructure from a developer's perspective**

- Digital Infrastructure
- Utilities
- Education
- Transport Infrastructure
- Green Infrastructure
- Retail
- Emergency Services/ Safety
- Waste Management
- Health
- Social Infrastructure
- Employment
- Community Infrastructure
- Renewable Energy

## **B. Ranking of Broad Categories of Infrastructure from a Government Official's perspective**

- Digital Infrastructure
- Employment
- Utilities
- Transport Infrastructure
- Retail
- Renewable Energy
- Emergency Services/ Safety
- Green Infrastructure
- Community Infrastructure
- Education
- Waste Management
- Health
- Social Infrastructure

## **C. Combined Ranking of Broad Categories of Infrastructure**

- Digital Infrastructure
- Utilities
- Transport Infrastructure
- Education
- Employment
- Retail
- Green Infrastructure
- Emergency Services/ Safety
- Waste Management
- Community Infrastructure
- Renewable Energy
- Health
- Social Infrastructure

### **a.2 Observations**

Since these results are based on expert opinions who know their market well, these ranks can be considered a reflection of the infrastructure needs currently prominent in a residential redevelopment.

The ranks provided for developers and municipals show that both stakeholders agree with the importance of most of the categories except a few. Both Developers' and Government officials have ranked Digital Infrastructure as of topmost importance.

Since the people today heavily rely on internet access and cable access for working and staying connected, Digital Infrastructure has become as basic a requirement as Utility Infrastructure, i.e., gas and electric lines, which is ranked 2<sup>nd</sup> by the developers and 3<sup>rd</sup> by the government officials. Transport Infrastructure and Emergency services also gains equal importance to both the stakeholders and ranked 4<sup>th</sup> and 7<sup>th</sup> among the thirteen. Among the differences, education is considered very important (ranked 3) by developers whereas government officials ranked it 10. According to developers well rated schools in neighborhood attract families more for purchasing the redeveloped residential. Hence it is very profitable as they really do not have to invest anything to build or maintain a school in the neighborhood. Similarly, Employment is ranked

by the municipal people and 11 by the developers. Municipal people want to bring more population to the neighborhood and increase the count of taxpayers. Hence having employment sources near the residential is beneficial as it restricts the population from spreading out to the suburbs. It's interesting to see that both the stakeholders are trying to attract customers/population but using two different means. It seems there is a requirement to strike a balance between these two infrastructure provisions to reduce the gap between the requirements of both stakeholders. It's a good thing that developers are paying more importance to the environmental aspects like green infrastructure, green spaces, etc. for their projects, whereas the renewable energy provisions hold more importance with the government officials as they are trying to promote bio energy consumption in the industry. It may take some time before it becomes widely popular with the private developers and residents also.

Social Infrastructure and Community Infrastructure holds lower ranks meaning that this type of infrastructure comparatively holds less importance in a development. It can be inferred that the availability of banks, restaurants, grocery stores and social/religious spaces is not of prime importance but can be an added advantage to a development.

### **b.1 Ranking of Sub-categories**

The ranking of the sub-categories shows a similar trend as observed from the ranking of broad categories. Lists below show the top ten ranks from a developer's and Government official's perspective, respectively. Also listed is the combined ranking of sub-categories.

#### **A. Ranking of Sub-categories from a developer's perspective**

- Internet Access
- Water Supply
- Electricity Network
- Wastewater Management
- Gas Network
- Primary Education
- Telecommunications
- Local Road Network
- Secondary Education

- Early Years

### **B. Ranking of Sub-categories from a government official's perspective**

- Water Supply
- Electricity Network
- Gas Network
- Telecommunications
- Wastewater Management
- Employment potential
- Internet Access
- Local Road Network
- Open Space
- Footpaths & Cycle ways

### **C. Combined Ranking of Sub-categories of Infrastructure**

- Water Supply
- Electricity Network
- Gas Network
- Wastewater Management
- Internet Access
- Telecommunications
- Local Road Network
- Fire & Rescue Service
- Police Service
- Primary Education

### **b.2 Observations**

The final rankings of the sub-categories are shown above. The sub-categories at the top 10 ranks all belong to the broad categories of Utilities, Education Infrastructure and Digital Infrastructure and employment. Internet Access that is a part of Digital Infrastructure obtained Rank 7, which suggests that Internet Access is given more value than cable access in recent times. The most critical amenities are water supply, electricity and gas network, wastewater management, education infrastructure except colleges, and telecommunications. Local Road Network at Rank 8 indicates that the availability of well-connected roads is valued in a development. The ranks at the bottom are achieved by religious spaces, libraries and pools. These infrastructure can be given less importance if the development project has time or budget constraints.

A prominent difference in the views of the developers and the government officials shows the inclination of the Developers towards Education infrastructure. Primary and secondary education holds rank 6 and 9, respectively for Developers' ranking however, it is not listed in top ten ranks by the government officials.



## **DISCUSSION**

There are multiple purposes for developing this paper. It defines the requirement and benefits for housing redevelopment and provides a prioritized list of infrastructures to make the project successful. But who are the probable audience for this pitch? This section will discuss the potential audience who in view of the authors may be benefitted directly and indirectly from the results.

i) Housing developers - Though redevelopment is a practical option beside new development, an analysis is required to gauge feasibility and ensure success of the proposed work. The preferred infrastructure distance from the project location forms an important guideline to Site selection for a revitalization project. The site with access to the major surrounding infrastructures will have an advantage in this case. Additionally, the priority list of infrastructures will also help developer to select infrastructures of absolute necessity in case of a limited budget project.

ii) Financing Organizations - Developers team up with financing organizations for financing development works. These results may serve as a guide to financial organizations to decide on the viability of funding a project.

iii) Civic Authorities - The civic authorities may play a crucial role in developing awareness about the necessity of redevelopment. The existing difference in opinion on the ranks of infrastructure between developers and officials need to be eliminated through early collaboration and mitigations. Also, the results of the government officials can be used to promote redevelopment initiatives. The distance of infrastructures can be used in potential neighborhood revitalization planning by the municipality.

iv) Customers/Buyers - The customers/buyers will benefit from the overall impact of the redevelopment work. If properly planned and executed, redeveloped project will bring in functioning infrastructures and updated facilities into a community.

v) Environmentalists - Without the option of redevelopment, the existing site would have been a source of unhealthy contaminations, blights, source of pollutions and environmental degradation. Ensuring redevelopment works hence definitely adds value from an environmentalists' perspective. Moreover, one redeveloped site may be equivalent to one less new development.

vi) Auxiliary and Ancillary trades - A redevelopment project opens the route for several auxiliary and ancillary works to support the redevelopment. Hence it generates more employment, revenue and helps developing the economy of a region.

## **LIMITATIONS & FUTURE RESEARCH**

The research is not without any limitations. The decision-making model ran in ELECTRE III has some limitations which may tamper the results to some extent. There are 13 alternatives in the matrix and the score assigned is in a range of 0-10. This range is restricting the differentiation in scores to some extent and hence generating clubbed ranking.

The developers participating in the survey have experience all over the country, and they have brought the geographical diversity in their results, however the municipal and state officials are restricted to certain counties of Michigan only. The survey results for government officials will vary depending on locations and changes in geographic conditions.

The results reflect only the mindset of developers and government officials only. The customer's views on the workability and appropriateness of the infrastructure provided to them is not considered in the scope of research.

These results are strictly limited to redevelopment projects for single family, multifamily and mixed-use housing in urban areas. The results will definitely vary for specialty housings, economic housings or projects in rural or suburban areas.

This research can be expanded more by incorporating the opinions of the customers and comparing the results. The residents are the end users and one of the important attributes of the projects. The final success of the project finally depends on the customer satisfaction to a great extent. Provision of infrastructures is discussed in this research but the scope and importance of maintaining the infrastructures is excluded from scope. During the project life, how the performance of the infrastructures is defining the success of the project, can form a good research question in future.

## **CONCLUSIONS**

This research deals with two crucial aspects of the urban development, redevelopment and infrastructure. While each holds its own importance, an ideal relation between the two can also bring improvements to the well-being of a society. For years, experienced developers and real estate builders have provided successful residential projects to the society. This is an attempt to recognize the priority of the different infrastructures and their contribution towards success of a redevelopment project in a residential area. The results also try to bridge the gap between the requirements of a developer and a municipal authority and come up with a solution which includes expertise from both the stakeholders. The authors are positive that the results will provide useful information to developers and government officials to collaborate for urban redevelopment projects that are needed in many urban centers in the USA.

## **REFERENCES**

Bracknell Forest Council . (2012). "*Infrastructure Delivery Plan- Post Submission Site Allocations Development Plan Document*", [www.bracknell-forest.gov.uk](http://www.bracknell-forest.gov.uk), Visited site on June 18, 2019.

Complete Community Toolbox-University of Delaware, "What is infill and redevelopment?", <http://www.completecommunitiesde.org/planning/landuse/what-is-infill/>, Visited site on June 18, 2019.

Complete Community Toolbox. (2018). "Adaptive Reuse of Underutilized Buildings and Sites", University of Delaware,

<https://www.completecommunitiesde.org/planning/landuse/adaptive-reuse>,  
Visited site on June 18, 2019.

Farid, K. (2011). "Urban sprawl Vs urban renewal: What role for Town and Country planning instruments in ensuring sustainable cities? Case of Algeria." *Procedia Engineering*, 21, 760-766.

Novak, L. R. (1996). *Market and Feasibility Studies: A How-to Guide*.  
<http://pages.uoregon.edu/rgp/PPPM613/downloads/How%20to%20do%20a%20Market%20Analysis.pdf> , Visited site on June 18, 2019.

Saaty, T. L. (1980). *The Analytic Hierarchy Process*, McGraw-Hill, New York (1980).

[United States-Environmental Protection Agency. \(2019\). "Smart Growth, Brownfields, and Infill Development"](https://www.epa.gov/smartgrowth/smart-growth-brownfields-and-infill-development), <https://www.epa.gov/smartgrowth/smart-growth-brownfields-and-infill-development>, Visited site on June 18, 2019.

Urban Land Institute-ULI (2004). *ULI Development Case Studies: The Yards*. Retrieved from <https://casestudies.uli.org/the-yards-5/>, Last Accessed June 18, 2019.

Velasquez, M., Hester, P.T. (2013) An Analysis of Multi-Criteria Decision-Making Methods, *International Journal of Operations Research*, 10(2): 56-66.

Wai, S.H., Yusof, A. M., Ismail, S. (2012). Exploring Success Criteria from the developers' perspective in Malaysia, *International Journal of Engineering Business Management*,4(33), 1-9.