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## Buildings and their Integration in Communities: Case study of a Parking Plaza

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### Abstract

The development of projects in isolation and such treatment by urban development authorities can lead to socioeconomic success or failure in projects. This dilemma has its roots in poor initial planning both at the level of individual project, and that of community and neighborhoods. Although the facts like project success or failure are readily determinable in case of socioeconomic sustainability, it is difficult to determine how various variables interact in determining project success. This research is aimed at using system dynamics for investigating the phenomenon of unpopularity of building projects within the urban fabric. An attempt is made to discuss the case study of a parking plaza in its context and for detailed investigation of this building, systems thinking methodology is employed. The research has highlighted various variables that have a role to play in making the case study project an example of success or failure in terms of sustainability. The practice of using systems thinking in case of deeply rooted sustainability analysis has brought some new insight which seems to have a promising role to play.

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### 1. Introduction

With increasing urban expansion, it is estimated that 70% of global population will live in cities by 2050 [1]. Providing inhabitants with a good quality of life in their cities has become a huge challenge for governments. Sustainable urban development plans have been developed by many cities worldwide to lead their urbanization process [2]. Sustainable development in case of buildings only provides a partial image. For a complete picture, buildings need to be considered in their context i.e. communities or neighborhoods, not in isolation. Developing

structures within the urban areas require thorough feasibility studies to match the needs of present as well as the future demands. Feasibility study is the first and foremost activity before undertaking project design and construction leading to project success. Conventionally project client or consultant works out project feasibility study by taking into consideration financial issues including market demand and supply, return of investment as well as risk analysis of market conditions [3, 4]. It is realized that project feasibility study is one of the most easily misunderstood aspects in developing a project. Nevertheless, it is the most important stage, since errors in this stage can impair the project's performance for good. An effective and appropriate feasibility study is hence more than just a set of financial projections that can turn into a market-driven strategic plan as well as a road map for all forthcoming decisions [4].

The purpose of this research is to see if the failure of a building project resulting from poor feasibility studies can be investigated with the perspectives of sustainable development and systems thinking. A case study of parking plaza is developed to observe its footprint on sustainable development. The effort will demonstrate how important it is to integrate built environment within existing communities in order for the new and old structures to share values with the most important ones lying under the umbrella of socioeconomic sustainability.

## 2. Literature Review

### 2.1. Sustainability

Being a multi-dimensional concept sustainability is found to take into consideration different elements of territorial development including wellbeing of population, economic growth, environmental quality, etc. [5]. Sustainable development assessment by making use of specific indicators has been worked upon since early 90s by many nations as well as international organizations [6-9]. For the purpose of assessing and understanding sustainability in built environment, sustainability dimensions are divided into indicators which are further divided into parameters. Indicator approach is of much use in giving information relating sustainability condition of systems under examination particularly in reference to urban areas. It is also useful to make provisions about future sustainability trends [9-12]. Some indicators and parameters related with socioeconomic sustainability in buildings are shown in Table 1. This hierarchy has resulted from many conclusive studies from which an important one is that of Shen et al. [13] in which construction projects were considered for their entire life cycles starting from inception and terminating at demolition. Some key performance indicators (KPIs) used by AlWaer and Clements-Croome [14] for assessment of sustainable buildings are also included in the compilation owing to their role in whole life cycle.

Table 1. Dimensions, Indicators and Parameters of Sustainability

Dimension	ECONOMIC SUSTAINABILITY		SOCIAL SUSTAINABILITY	
Indicator	LCC values	Affordability, Manageability & Adaptability	User comfort and safety	Functional, Aesthetic & Innovative design approach
Parameter	Capital Cost	Adaptability & flexibility of building	Indoor environmental quality	Usability, functionality & aesthetic aspects
			Health and well being	Innovation & design process
	Safety			
	Life Cycle Cost	Affordability and economic performance	Open space availability	Architectural considerations, integration of cultural heritage & compatibility with local heritage values
			No. of facility users	
		Manageability aspects of building	Community amenities provision	
		Accessibility		

## 2.2. System Dynamics

System dynamics (SD) is a methodology as well as a computer simulation modeling technique to frame, understand and discuss the complex issues and problems [15]. SD can be seen as a structural theory of dynamic systems since a set of statements regarding the characteristics of dynamic systems lie at its core [16]. This is based on main hypotheses that dynamic systems consist of stocks and flows, a feedback structure, accumulation processes as well as delays between cause and effect [17-20]. SD is extensively used to understand systems with dynamic, complex and nonlinearly interacting variables. It also helps embody a system as a feedback system [9]. SD research helps depict the reality as precisely as possible. While obtaining a rational picture of reality, attempts are made to gain insight into systems improvement [19].

## 2.3. Sustainability and System Dynamics

A deeper understanding of sustainable development results from use and integration of various approaches employed in simulating and interpreting sustainability problems. As an evaluation tool SD has been broadly accepted in many environmental studies including energy system planning, natural resource management and environmental impact assessment since related works started by Forrester [17, 18, 21]. SD holds the potential to act as a realistic tool for sustainability assessment, and can be of much help in understanding the sustainable development and forecast the future trends [9]. By two possible means SD can influence sustainable development: first by offering a structural theory that makes it possible to appreciate and understand sustainability issues; secondly by providing methods to analyze and improve such issues [19].

Usually the purpose of SD study on sustainability issues is to simulate complex interrelationship among sustainability variables and to seek suitable quantitative solutions for measuring socioeconomic and environmental responses in the whole system. In comparison with other simulation approaches, SD model is more beneficial in explaining the developing trends of dynamic behaviors in the long-term (simulation duration) owing to its feedback structure and capacity to function under different initial inputs and parameter settings. Consequently SD models with the help of simulation results can ease the decision making process and help develop sustainability policies [9].

## 3. Methodology

The methodology of this research involves the case study comprising of two systems with one of them for supporting a pre-existing system. Systems thinking models are developed for these two systems to help identify the variables which lead to reinforcing as well as weakening relationship among the two systems in consideration.

### 3.1. Case Study:

The case study in this research is comprised of a parking plaza (first system) known as Liberty Park and Ride plaza planned to reduce the traffic congestion within a nearby market (second system) known as Liberty Market. These systems are based in Lahore, Pakistan. The published newspaper articles from past few years give an insight into the reasons that led to the failure of this project. It also helps establish the public opinion as well as the outlook of governing body.

For considering the systems in detail, the location of systems i.e. Lahore needs to be established. While being the capital city of Punjab province, second largest metropolitan area of Pakistan and having an estimated population of 11 million as of year 2015 [22], Lahore is the 16th most populous city in the global perspective. With such overwhelming population, Lahore remains a political, economic, entertainment, transportation and educational centre of the country with a remarkably high HDI of 0.806 as compared to rest of country.

The nine-storey parking plaza that opened to public in November 2010 was originally a part of Lahore Development Authority's (LDA) Urban Planning Vision 2015 initiative. According to the concerned authorities all sorts of vehicular parking at roadsides and at the side streets in the area had to be banned, and the space had to be converted into Limited Traffic Zone creating walkable streets only to be used by pedestrians. The then acting Chief Engineer said that plaza construction was a part of LDA's mega plan to create a Central Business District (CBD) in

the city. He said that the project would also help create investment, business and employment opportunities. The plaza opened in the face of utter criticism from traders according to whom it would affect their business being far away from the main market. Traders with businesses near the plaza worried about decline in number of customers as they thought customers would not prefer to park and walk over to the shops. Constructed with a cost of PKR 677.47 million (\$6.5 million) the 'park and ride' plaza has a parking facility for 350 vehicles and 91 shops [23].

It is necessary to see the resemblance of Liberty Park and Ride plaza with the commonly perceived concept of such facilities in global context. In order to deal with the automobile mass adoption trend, nations all over the world are increasingly turning to traffic management systems and from the variety of available management mechanisms park-and-ride stands out [24]. Park & Ride generally comprises parking facilities at transit stations, bus stops and highway onramps, particularly at the urban periphery, to assist Transit and Rideshare use. Parking is generally free or relatively cheaper than in urban centers. Park & Ride facilities are usually implemented by regional transportation or transit agencies. In some cases, existing, underutilized parking (such as a mall parking lot) is designated for Park & Ride use [25]. While being a source of alleviating congestion in urban areas, park and ride facilities need to provide easy transfer as people in uncongested areas park their cars and move to congested urban areas using public transport. Many such facilities are developed in other countries with varying scope and attributes and have seen various degrees of success. It has been recognized that park and ride facilities need to be viewed in terms of a daily activity-travel pattern giving the indication that choice of such facilities is a complex decision making problem in the sense that a large number of factors potentially influence this choice. For appraising preference for such facilities, it seems essential to explore how travelers trade off plenty of potentially influential factors [26]. It appears that Liberty Park and Ride plaza does not comply with the established attributes of park and ride facilities since it is located within a congested urban center rather than away from it. With this concluded, rest of the study will explore this system from the value it was expected to bring rather than probing into the term used for this system by its developers.

The parking plaza that opened to reduce congestion in the adjacent market, according to business owners, made the market less accessible to people using vehicular transport. There were some 75 shops in the market with about 2,500 employees in sales and related positions. Some affectees reported their business to be down as much as 80% since the opening of plaza leading to major downsizing. Business owners were also worried that the government intended to turn one of the streets into a food street and feared that LDA was trying to bring food carts to spaces in front of stores where cars used to be parked. It is feared that vendors selling food might attract a young crowd and such enterprise would damage the business of existing sophisticated restaurants in the street. Since the Park and Ride Plaza has the capacity to accommodate 305 cars, the limited space would be quickly used up, particularly as more shops open within the plaza, resulting into scarcity of parking space compared to capacity for 1,200 vehicles in the past [27].

In line of these events, in May 2011 a petition was filed by six affected shop owners challenging the construction of the Liberty Park and Ride Plaza and alleged closure of public roads to facilitate the plaza. The Lahore High Court (LHC) sought a report and comments from the provincial government and LDA on the petition. While bringing in attention a similar case from past, the claimant cited Lahore High Court (LHC) judgment PLD 2004 in which the establishment of a food street on public streets of The Mall was declared illegal. It was said that the court had also declared that every member of the public has a right to travel in public streets. The public has right over the width and length of the street and each inch of the same and the residents of nearby properties have a right to access such streets. No one has the authority and jurisdiction to curtail this right even by an inch. It was pleaded to the court to let traders, customers and the public at large use the market streets [28]. After two years of the opening of parking plaza, the government finally allowed parking on roads adjacent to it [23].

Employment opportunities which is an important indicator of economic sustainability in urban scenario [2] mostly declined in the nearby market once the parking plaza was operational. Further, the other intended goals of creating investment, business, etc. were not fully realized. Instead it was reported on multiple occasions by primary stakeholders that the plaza as well as governance to increase plaza usage affected both the business and employment within the intended market negatively.

### 4. Results and Discussion

#### 4.1. Application of Systems Thinking on Case Study:

With the help of published literature different variables that link parking with business activities in Liberty Market are identified. To demonstrate the effect of parking and accessibility on business activities prior to Park and Ride Plaza, a systems thinking model is developed as shown in Fig. 1. This model keeps in perspective the regular customers visiting the market. With no parking restrictions, customers can freely park their vehicles in front of shops and if they wish, within the central parking. People also have a certain *accessibility to the market by foot*, though it seems to have a margin of improvement. Visualizing the model from perspective of new parking structure, it appears that the business can benefit from the increase in *parking capacity* as well as *accessibility by foot and cars*.

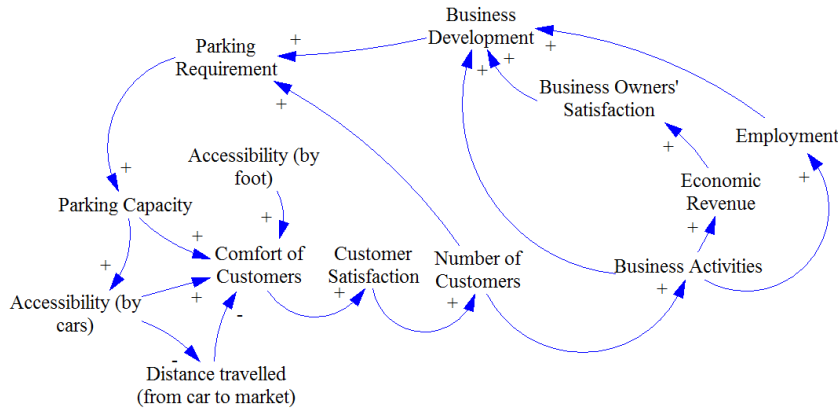


Fig. 1: Systems thinking in case of Liberty Market before the construction of Parking Plaza

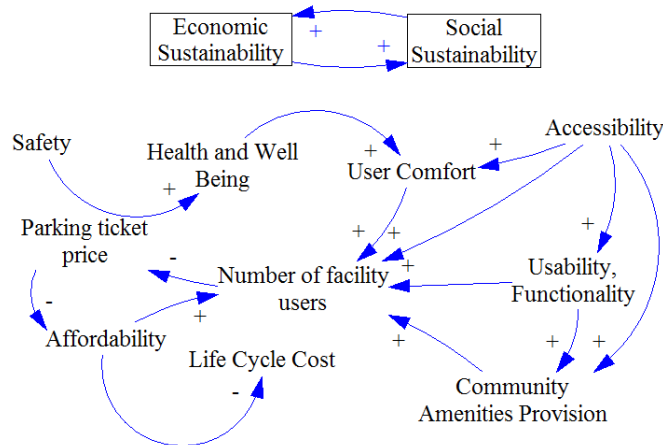


Fig. 2: Relation of various sustainability parameters in case of Parking Plaza

Some sustainability parameters are used in Fig. 2 to act as drivers within the systems thinking model that relate economic sustainability of the parking plaza with that of social sustainability. Except the *parking ticket price*, all the other variables are sustainability parameters. It is quite prominent that there is much of a merging effect in case of the parameter of *facility users* or in other term this is one thing that seems to relate social sustainability with economic sustainability.

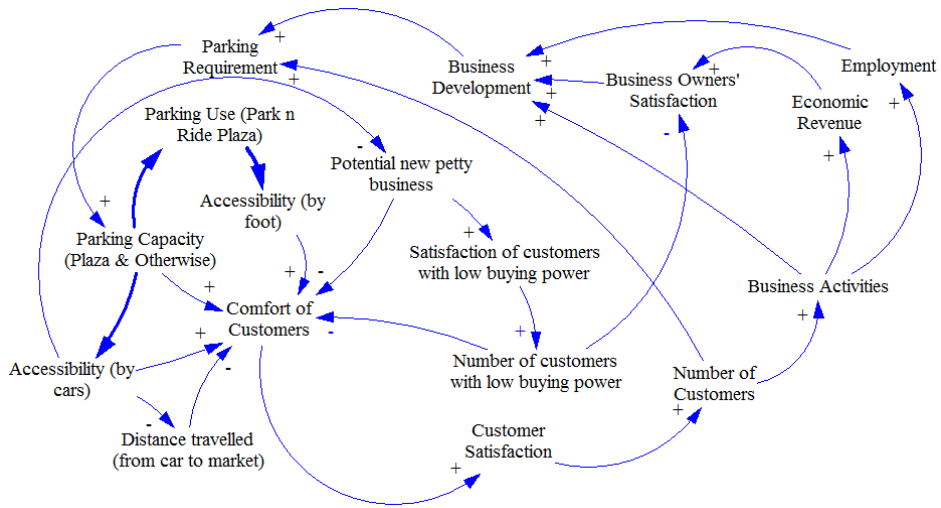


Fig. 3: Systems thinking in case of Liberty Market after the construction of Parking Plaza

The way parking plaza and variation in accessibility to market has influenced or can influence business in the market is shown in Fig. 3. Some arrows in figure are highlighted by increased thickness and have appearance of no polarity in order to show their different role in real world scenario and a possible yet non real scenario. In reality the increase in *parking capacity* by opening of parking plaza to public reduced the *vehicular accessibility* to market since cars were not allowed to park in front of shops and only to be parked within dedicated places. Moreover, the increase in *parking capacity* did not play much role in increasing the *use of parking plaza* and though the conversion of some roads into walkable streets after plaza opening was intended to increase *accessibility to market by foot*, it appears that it did more harm than good.

On the other hand, while thinking of these relationships in ideal terms, *parking capacity* should have increased the *accessibility by cars* and should have increased the *use of plaza* itself which should have helped the *accessibility by foot*. It is one way to determine how the relationship among variables should have been to help business development and it is another to determine methods of ensuring reinforcing relationship among variables. The endeavor of finding the means to reinforce positive links among the variables in case study requires a quantitative approach to this problem which is beyond the scope of this research.

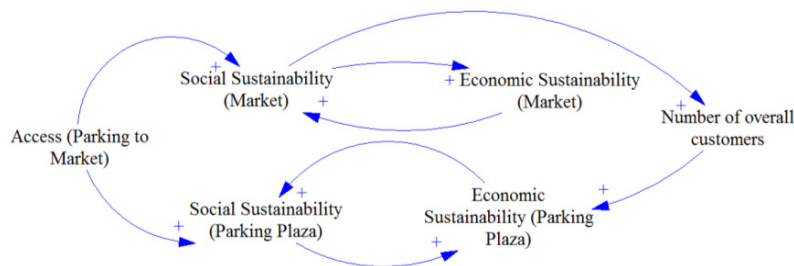


Fig. 4: Relation of Parking Plaza and Liberty Market Sustainability

The conclusive relationship among sustainability of two systems i.e. Liberty Market, and Park and Ride Plaza is shown in Fig. 4. As apparent from the figure and the current matter of affairs, both the structures can coexist while being socially and economically sustainable. Both the structures principally need to be socially sustainable in order

for them to be economically sustainable. The variable of *access from parking to market* can help both the structures coexist independently and sustainably while adding value to each other. So a focus on this aspect can bring about meaningful results. Improving access seems to be one viable option and a far better one in comparison with other options like governance which did not bring fruitful results for both the systems previously.

## 5. Discussion

Not all the parameters of socioeconomic sustainability were kept in consideration by developers and policy makers as the two systems evolved through time. The published literature on this case study has brought to surface the overpowering opinion that poor accessibility from one system to another is the reason the two systems could not get along well. Same criticality is established by systems thinking models and it can be stated that employing systems thinking and system modelling in feasibility study of projects can help see the underlying risks in advance and help make better decisions.

From the various models discussed in this research, it is quite evident that adding to the values of already existing systems with the help of newly built systems is not always a case of success simply because values of one structure do not necessarily add to the values of other structures. For example, while considering the case study in this research it can be realized that social sustainability of parking plaza as well as Liberty Market have the potential to be of support to each other but not without surpassing the need of an appropriate means of access between the two. One of the many ways of increasing the access among the two structures can be in the form of a ramp or staircase that connects the parking plaza with some central location in market. This would mean that in order to make one system sustainable (Liberty Market) another system (Parking Plaza) was built from the ground up and now in order to add to the value of both these systems another support system (special ramp/staircase) is required. This is the kind of progressive reinforcement of values that is used in case all the variables affecting the principle or first system (Liberty Market) or being affected by it are not kept in consideration during the early planning. The case study is the classic example of such scenario as in this case it appears that little, if any, consideration was given to the variables such as customer satisfaction and business owner satisfaction. This eventually kept both the systems separated. Had all these variables been considered while the feasibility of Parking Plaza was being conducted, the failure could have been averted.

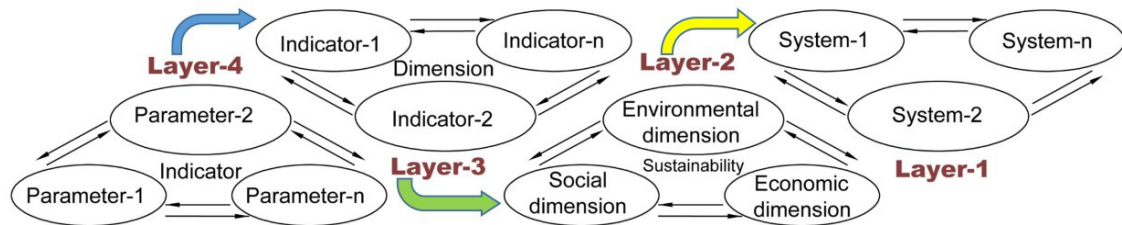


Fig. 5: Various layers that can help understand dynamics of sustainable systems

Fig. 5 can provide a comprehensive understanding of system dynamics concept in sustainability as proposed in this study. As shown in the figure there are various layers that contribute towards sustainability of individual or multiple systems. Within each layer reside its core elements which can be systems, sustainability dimensions, indicators and parameters. These core elements interact and influence other elements of same nature within a layer. An abnormality or anomaly in one of the layers can affect all the subsequent layers. Therefore anticipating a problem or diagnosing the failure of current or future projects is possible by application of system dynamics and systems thinking on the various layers.

The case study in this research involves post construction assessment with major data collected once the systems were operational. Although systems thinking performed at this stage can pinpoint exactly the factors which lead to the failure of newly introduced system, in order to avoid such a failure, systems thinking approach should have been utilized during the conceptual stages. This research points towards use of systems thinking and system dynamics while preparing feasibility studies of projects that are supposed to operate harmoniously with preexisting projects.

## 6. Conclusion

Sustainable development is the need of hour and socioeconomic sustainability is mostly a subject of attention when it comes to the built environment. For even the simple systems comprised of communities, neighborhoods and structures the anticipated results of actions taken may not see the light of day. This is because various values in these systems interact with each other in a complex way and system dynamics stands as a valid methodology to understand, solve and improvise. This research while considering the case study of two systems has attempted to investigate reasons the two structures repelled each other instead of integrating and adding value to one another. For this purpose, systems thinking models were developed which showed the critical relationships among various variables that have a role to play in the success of these systems. Systems thinking is found to be a useful methodology for helping understand such complex systems. The application of this approach on the case study has helped pinpoint variables that can result in success of these two systems while working in unison.

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