

**Conflict Management Strategies for Real Estate Development:  
Toward A Systems Approach for Decision Making**


by

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1991

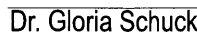
SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE IN  
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE  
OF MASTER OF SCIENCE IN REAL ESTATE DEVELOPMENT  
AT THE  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
SEPTEMBER 1995

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## ABSTRACT

### **Conflict Management Strategies for Real Estate Development: Toward A Systems Approach for Decision Making**

by Jonathan H. Richter

Submitted to the Department of Architecture in partial fulfillment of the requirements for the Degree of Master of Science in Real Estate Development at the Massachusetts Institute of Technology

September 1995

Systems thinking is a tool to make complex conditions more understandable. By providing a structured and defensible basis for decision making a systems approach can enhance conflict management during real estate development. This thesis examines the process used in managing decision making during the *soft* process, the process before construction begins. It builds on the research of Thornton (1992) and Hernandez (1991) who suggest that developers have a learning disability. The developer's ineffectiveness in grasping the complexity is a contributing factor to delay in the real estate development process. The developer of real estate must resolve a number of complex issues before the decision to construct can be made. Interactively linked issues such as acquisition, financing, approvals, design issues, contractual commitments, often have contingent relationships with each other. The developer must also grapple with exogenous economic and sometimes political factors that impact the decision making process. As complexity increases, the lead time required to make decisions increases, which drives up costs, increases delays and creates further inefficiency in the real estate market. Delays have a negative impact on the developer's decision making process, which creates further delays, that can result in conflict. A new model, that can bridge the gap, organize, interpret and communicate, is needed to replace the feeling out style of collaboration among professionals involved in real estate development. Research by others (Wheaton, 1987; Hernandez, 1991; Thornton, 1992; Bakken, 1993; Sterman, 1994) has suggested that time delays in the development of new real estate projects are a contributing factor to the chronic cyclical in the real estate industry. The boom and bust phenomena in the real industry reveals that the developer's decision making process needs reconsideration. It is in this context that a systems approach as a collaborative effort would most useful in the real estate industry. The concepts of systems approach are applied as a tool for understanding the dynamic interaction of variables and as a strategic method for decision making and conflict management.

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Through fieldwork and interviews the decision making structure is defined in terms of the information diffusion process. A conceptual model is composed to understand delays during the preconstruction phase of a development project. Informal research indicates that systems thinking, as a strategic tool for analysis, has been overlooked by the real estate industry. Research findings indicate that developers are able to comprehend the rational behind individual causal relationships but believe the system as a whole is ambiguous. Creating a greater awareness of system analysis through practical examples by professional facilitators can foster the adoption of system dynamics as a new problem structuring and decision making tool in the real estate industry.

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## ACKNOWLEDGMENTS

I would like to extend my deepest thanks and gratitude to the developers and system dynamicists for the time and interest they devoted to my research.

I also want to give a special thank you to Gloria Schuck, my thesis adviser, and Henry Weil, my thesis reader, who helped guide me through this difficult process.

I also want to express a special thanks to Mimi Benjamin-Dupuis whose unquestioning understanding and generosity has made the greatest contribution to my education at MIT.

Most of all I want to thank my *raison d'être*, my wife Raquelle, for her encouragement and support and for unselfishly allowing me to pursue my dreams.

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# 1. Introduction

Almost forty years ago a model was established to analyze the impact of time on an organizations performance by Jay Forrester (1958). Forrester used a systems approach to track time delays and decision rates within a simple business system. He discovered that it was the lengthy delay between the new demand and the receipt of the information that distorted the system. The longer the delay, the more distorted is the view of the market. Those delays reverberate throughout the system producing disruption and inefficiency.

This paper will introduce a systems approach as an analysis tool for decision-making in the real estate development process. Systems theory will be used to understand the key interrelationships that influence behavior in complex systems over time, so that players can see the whole. The objective is to use systems theory to create a better understanding of the complexity in the underlying structure generating conflict in collaborative activities. Analysis gives decision makers a clearer idea of risks and possible losses (Boehm, 1976). The expected result will be better, more defensible, decisions which will reduce conflict and therefore delays in delivering projects to the market.

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All real estate developers are in the business of coordinating real estate development. This usually involves the acquisition of under used property and its conversion to a higher and better use, or more simply, the creation of value in land. The process involves, at the least, an understanding of, if not the actual application of, skills in the areas of land use law, design, planning, finance, construction, and marketing. It also involves the management of the process itself (Bhambri, 1991, p.5).

Real estate development is a complicated process. There are many disciplines to arrange and coordinate. The process is ever changing and thus difficult to capture. The developer must often make decisions without having complete information. Development involves many different players, with individual expertise, who collaborate on specific components of the project. The developer is responsible for integrating the expertise of each of the players. The developer is committed to being involved in the project for the entire length of the development period. Suchman (1987, p. 29) notes, in her interviews with successful developers, that *time is the developer's enemy*. The developer makes a commitment to the project before anyone else does. The developer is the *primary risk bearer* and is exposed to risk in the expenditure of time and money before it is assured the project will be built. The involvement of the other players tends to be over a portion of the development period and, therefore, are less sensitive to risk over length of the development period (Wurtzback and Miles, 1987).

*The terms "complexity", "uncertainty", and "interdependence" might be readily used by any developer to characterize the many tasks in the development process. While each task individually is not technically demanding, the number of tasks, the uncertainty of outcomes at each step, the unknowns, and the interrelatedness can turn a simple series of tasks into a bewildering maze for the uninitiated. (Bhambri, 1991, p.12)*

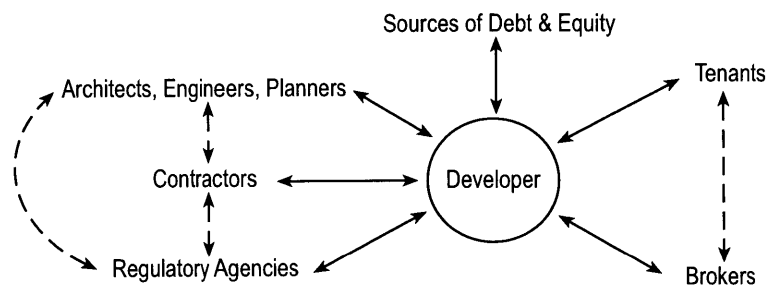
The timely delivery of a project to the market is key to the success of real estate development. A premium is awarded to those whose timing is accurate and a penalty is assessed to those whose timing is poor. By reducing the consumption of time in every aspect of their business, developers can also improve efficiency, lower costs, improve quality, and stay close to their customers. Delays result in inefficiency, they interrupt the actions and results that developers want to achieve. Stalk (1988, p. 41) reports that the way leading organizations manage time represents the most powerful new source of competitive advantage. He goes on to suggest that "as a *strategic weapon, time is the equivalent of money, productivity, quality and even innovation*". Minimizing time delays in the real estate development process is one of the most important ways to improve a developer's competitive advantage.

Graaskamp (1991) describes the real estate process as the dynamic interaction of three groups or cash cycle enterprises, in determining land use and development decisions: space users (consumers), space producers (those with site specific expertise), and public infrastructures (off-site services and facilities).

This paper focuses on the space production group and the real estate development process. "The space production group employs the necessary expertise to convert the space-time requirements to money-time" (Graaskamp, 1991, p. 230-231). The space production group includes all of those players involved in the business of real estate: architects, engineers, planners, contractors, regulatory agencies, tenants, brokers, sources of debt & equity and the developer. Figure 1 shows the relationship of the developer to each of the players. Each of the players will have a primary relationship — a contractual relationship — with the developer and some of the players may have secondary relationships — a functional relationship without contractual obligations — with each other. "The developer is at once a facilitator, a manager, a communicator, a taskmaster, and a liaison, as well as a skilled practitioner in some part of the process. But most important the developer must be able to understand the process and be able to communicate and relate to people at all levels" (Bhambri, 1991, p.12). There is an opportunity for conflict at any one of the interfaces that the developer has with other members of the development team. Nyhart (1987, p. 9) affirms that although *at least two parties are necessary for a conflict though it is often very hard for a single person to evaluate conflicting ideas and come to a decision*.

**Figure 1: Relationship of Players to the Developer**

Primary Relationships are indicated by the solid lines  
 Secondary Relationships are indicated by the broken lines



**Figure 2: The Generic Development Process**  
(Wurtzebach and Miles, 1987)

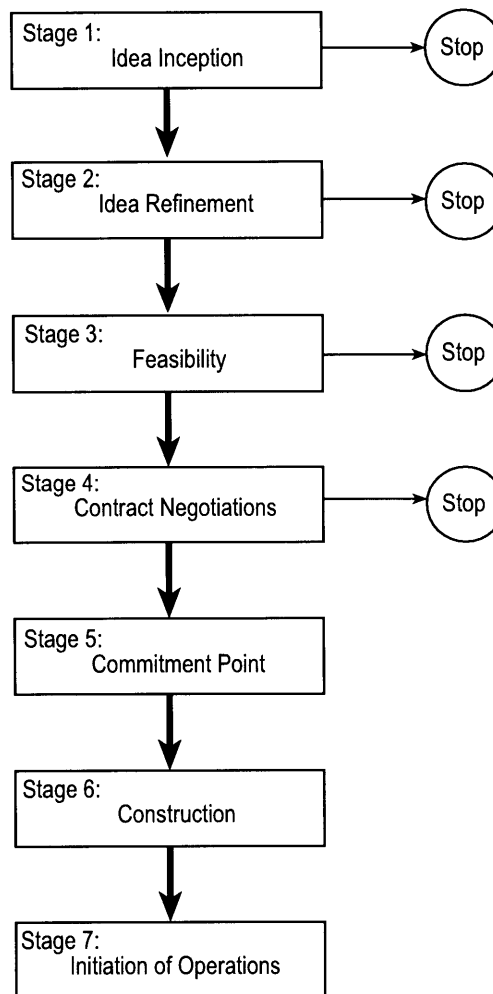
Real estate development has long been portrayed as a linear process. Decisions are made sequentially by developers. The linear model in figure 2 is representative of the generic linear thinking process developers use. This is not to say that the traditional approach is without value; there may be many instances where this approach will provide an optimal solution. However, as project size increases and the associated risks increase there will be a greater number of complex issues to understand before construction begins.

The developer acts as an interface between the property markets, the capital markets and the regulatory agencies and the completed development project. The developers interface consists of two distinct phases, the preconstruction and the construction phase. The preconstruction process of a development project has been described by Sullivan (1994, p. 201-207) as the "siting process". Sullivan (1984, p. 201) describes the "traditional siting process" used by developers as follows:

*A developer acquires a site and completes plans for a potential project. Next, the developer announces the decision and begins applying for the needed federal, state, and local permits. Individuals and groups that desire to participate in the review of the project use public hearings and litigation to express their views. Effective participation requires the use of lawyers. Adversarial interaction between the developer, the regulatory agencies, and the opponents to a project commonly characterizes the process.*

Sullivan (1984, p. 204-207) argues that,

*given economic considerations the siting process should operate in a efficient manner. In particular the siting process should not require large sacrifices of the time of volunteers, or the labor of developers and government agencies. ... It must provide quick, low cost and stable decisions. The traditional process appears to fail to meet this standard. In particular,*





*protracted litigation raises the costs of this decision process, and the uncertainty that it introduces into development planning makes it an unattractive alternative.*

Sullivan (1984, p. 193) states that the current adversarial procedures in development requires that the designers of the process take steps to improve its operation. Developers use a linear decision making process for real estate development which does not capture the complexity inherent in the process. The linear system used by developers can be enhanced to cope with the complex nonlinear behavior of the real estate process by applying the principles of systems dynamics.

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Suchman (1987, p.37) interviewed many successful developers and notes that *"every person interviewed mentioned overbuilding as a primary concern for real estate developers, and a recurrent issue in all of the interviews was how to manage in an overbuilt market"*. In making development decisions developers grapple with trying to match market demand with the supply. Developers have difficulty in accomplishing this, as evidenced by the chronic boom-bust cycle. Research (Grebler and Burns, 1982) shows that cyclicity in the real estate industry can not just be attributed to the general business cycle. Others (Wheaton, 1987; Hernandez, 1991; Thornton, 1992; Sterman, 1994) suggest that a prime contributing factor to cyclicity in the real estate industry is the physical time delay in bringing new projects to the market. Delays between commencing a new real estate project and its completion results in overbuilding in real estate markets and the eventual shake-out. Senge (1990, p.89) notes *"delays between actions and consequences are everywhere in human systems and are often unappreciated and lead to instability. Often delays are either unrecognized or not well understood"*.

This thesis proposes that a systems approach can be used to understand the causal relationship of delays in the real estate development process. Through the use of system dynamics modeling it is possible to compress time and allow retrospective analysis of the causal relationship of a number of interconnected variables in the property market, the capital market and the uncertainty created by the regulatory agency approval process. While this paper does not present a comprehensive dynamic model of the real estate development process it does present a qualitative framework for analyzing the causal interrelatedness of the major variables affecting development decisions and delays.

Research shows that a systems approach to understanding the complexity of the interrelatedness of issues is not utilized by the real estate industry. There has been precious little done to further the work of systems

dynamicists by professionals in the real estate industry. There is a fundamental lack of knowledge of systems dynamics and its applicability to the industry. The qualitative model presented needs validation through more extensive surveys and rigorous quantitative testing. A collaborative effort of all those involved in decision making in the development process is required to build a system dynamics model.

The paper is organized into four sections. The next section outlines systems thinking as a tool for beginning to understand the feedback relationship of interrelated variables that influence decision making. The third section systems thinking is applied to the real estate process, and synthesizes the results of interviews with real estate developers and with system dynamics practitioners into a qualitative systems model. The systems model is applied to a case vignette to show its applicability to understanding interacting problems in the development process. The final section presents suggestions for understanding and managing the delays in the preconstruction process in real estate development.

## 2. Systems Thinking: A Strategy for Decision Making

This chapter outlines systems thinking as a tool for understanding the feedback relationship of a number of interrelated variables that influence decision making. This chapter begins with a brief history and an introduction to systems thinking and system dynamics. Next, it outlines a framework for building systems diagrams, and examples in a real estate context are presented to illustrate the cause and effect relationships between variables. And finally, the role of system dynamics and the affect of lead time and delays in decision making are described.

### 2.1 An Introduction to Systems Thinking and System Dynamics

*An information feedback system exists whenever the environment leads to a decision that results in action which affects the environment. The regenerative process is continuous, in information feedback systems, and new results lead to new decisions which keep the system in continuous motion. (Forrester, 1958, p. 39-40)*

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Information feedback systems were developed to understand the feedback mechanisms of mechanical and electrical systems during World War II. System dynamics, the study of information feedback systems, has a long and successful history in simulating potential outcomes for decision making in complex systems. For many years the study of system dynamics has been an important part of engineering design. It has been applied to dam building, railroad construction, nuclear reactors, shipping, tunnel construction and guided-missile systems. System dynamics has also been successfully applied as method for resolving complex business disputes (Cooper, 1980; Weil & Etherton).

A corner stone of system dynamics research by Forrester (1969), *Urban Dynamics*, explored the complex interaction of a number of factors that contribute to the growth processes of urban areas. Forrester saw that a new method needed to be applied to understand the interaction of industries, housing and people. He adapted the concepts of *industrial dynamics*, later to become *system dynamics* to understand the complexity of urban problems. Forrester (1969, p. 108) interpreted the complex system as follows:

*The complex system is nonlinear. Modern mathematics deals almost exclusively with linear processes. Life and society deal almost exclusively with nonlinear processes. Nonlinearity is necessary to represent the behavior of complex systems. Complex systems bring together many factors which have been compartmentalized into isolated fields. The barriers between disciplines must melt away if one is to successfully cope with complex systems. Within the same system one must admit the interactions of the psychological, the economic, the technical, the cultural, and the political. The interactions among these are often more important than*

*the internal content of any one alone.*

A systems approach to understanding complex interrelationships is comprised of two related but distinct approaches: a qualitative systems approach and a quantitative system dynamics approach. More recently Senge (1990), Richmond (1994) and others have reinterpreted systems dynamics as part of *systems thinking*. Many systems practitioners have argued for a distinction between system dynamics and systems thinking. However, Richardson (1994, p. 96) notes that few inside the field of systems dynamics, or outside in the larger systems thinking community, have definitions of the phrases that all would accept. Wolstenholme and Coyle (1983) have argued for a two stage approach in building systems analysis models. They refer to the first stage as *qualitative system dynamics*, which includes problem identification, qualitative problem analysis and recommendations for change. The second stage is referred to as *quantitative systems analysis*, which includes mathematical modeling, simulation and dynamic analysis for the design of system structure and control. Forrester described the relationship between system dynamics and systems thinking in an interview with Keough and Doman (1992, p. 17):

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*A clear distinction should be made between systems thinking and the discipline of system dynamics. The former, systems thinking, is becoming a popular phrase to describe talking about systems, thinking about systems and observing that systems are important. But, in general it does not refer to the quantitative and dynamic analysis that constitutes real systems dynamics. Systems thinking, for example, includes management games, which can demonstrate the existence of complexity and show people that they can not get the best results from using mere experience or rules of thumb. But, these games rarely, if ever, carry participants into an understanding of why dynamic behaviors occur as they do. Games tend to focus on decision making; system dynamics focuses on the design of policies that guide decisions.*

There is some debate in the system dynamics community over the value of systems thinking versus the more rigorous discipline of system dynamics. There seems to be some consensus however that the conceptualization of a causal diagram will lead to a better understanding of a problem which will lead to more rigorous quantitative simulation experiments.

Senge (1990) observes that in *dynamic complexity*, the cause and effect situations are subtle, and the effects over time of interventions are not obvious. Conventional forecasting, planning and analysis methods are not equipped to deal with dynamic complexity. Mixing many ingredients in a stew, involves detailed complexity, as does following a complex set of instructions to assemble a machine. The construction process once the parameters have been set can be likened to the assembly of a complicated machine. The soft process that

occurs before construction commences is more *dynamic* than the construction process. The boom and bust dynamic of the real estate industry provides a typical example of a dynamic decision-making system (Paich and Sterman, 1992). The decisions made today in a dynamic environment give rise to the information upon which tomorrow's decisions are based. Forrester (1975) argues that it is misleading to think that linear analysis is an adequate representation of industrial and economic systems that in fact almost every factor in the process is nonlinear.

*There is no proof that Einstein's theory is right. There is no proof that Ohm's law in electricity or Boyles's law in gases are right. There is only experimental demonstration that such laws are useful for specific, limited purposes. There is no way of proving that a model or law or theory representing the real world is right. The same is true of a system dynamics model. It is a model of structure and behavior that purports to represent something in real life. (Interview with Jay Forrester, Keough and Doman, 1992, p. 18)*

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Systems approach allows the decision maker to see the process holistically. Samarasan (1987) suggests that such a comprehensive approach results in more optimal solutions than a reductionistic splitting of hairs at every turn. Forrester (1975) reports that feedback theory explains how decisions, delays and predictions can produce good control or dramatically unstable operation. The purpose of an information feedback systems model is to give a better understanding of a system which can lead to improvement in system performance. A model is not, as is sometimes supposed, a perfectly accurate representation of reality that can be trusted to make better decisions than people. *"It is a flexible tool that forces the people who use it to think harder and to confront one another, their common problems and themselves, directly and factually"* (Roberts, 1978, p.6). The role of a systems approach is not to give the right answers, it provides a model for people to probe and question and to allow a retrospective look at how decision affect the system.

## 2.2 The Building Blocks for a Systems Approach

There are four elements that are used in creating a systems model: the rate or variable and level; the linkage; the feedback loop; and the feedback system. (Roberts, 1978)

### 2.2.1 Rate (Variable) and Level

This is a changeable quantity over time. It may be a decision such as a sales rate or a development rate or it may be a quantity that is affected by such a decision such as the level of office building inventory. When a variable is not affected by other variables inside the system being analyzed it is termed **exogenous** or outside of the system. A variable that is subject to other variables inside the system is termed **endogenous**.

Two fundamental types of equations are required. One type is a *level equation*, the other is a *rate or a decision equation*. A level equation is a simple integration which gives the content of a level, such as inventory, by accumulating the net difference between inflow and outflow rates. The rate equations are the decision functions of the of the system and control the rates of flow between the levels. These rates depend only on the levels in the system. There are no simultaneous algebraic equations.

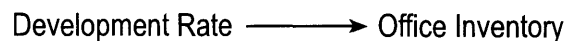
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### 2.2.2 Linkage

This represents the cause and effect relations between two variables. A link is represented by an arrow connecting the causal variable to the effect variable. For example:

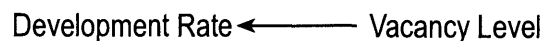
**Figure 3: Linkage**

In figure 3, the development rate causes the office inventory level to change.



**Figure 4: Linkage**

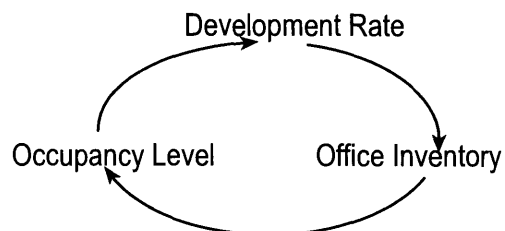
In figure 4, the development rate is effected by the vacancy level.



### 2.2.3 Feedback Loop

The feedback loop consists of two or more linkages connected in such a way that, beginning with any variable, one can follow the arrows around and return to the starting variable. In mapping a feedback system, it is possible that there will be multiple variables which, although connected, can not be followed around in a closed path.

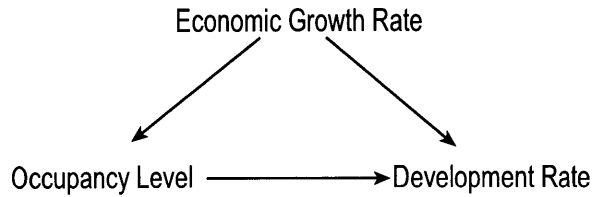
**Figure 5: Feedback Loop**



In a feedback system, as illustrated in figure 5, the system status provides the inputs to a decision process, the decision controls the action, and in turn alters the system status. In figure 5, the *development rate* affects the *office inventory*, which in turn influences the *occupancy level*. The *occupancy level* closes the loop by influencing the *development rate*.

For example, figure 6 illustrates the relationship between variables with multiple linkages but no feedback. The *economic growth rate* is shown to influence the *occupancy level*, which in turn affects the *development rate*. The *economic growth rate* also influences the *development rate*. The three variables in the diagram are connected, but not in a closed feedback loop. The arrows can not be followed around back to a starting point.

**Figure 6: Multiple Linkages No Feedback**



**2.2.4 Feedback System**

A feedback system is defined by Roberts (1978) as two or more interconnected feedback loops. The behavior of each feedback loop can affect the behavior of other feedback loops in the system. “Complex systems are counterintuitive. The complex system has a multiplicity of interacting feedback loops.” (Forrester, 1969, p.56) It is through the study of feedback systems that complex organizational problems can be analyzed.

**Figure 7: Interconnected Feedback Loops**

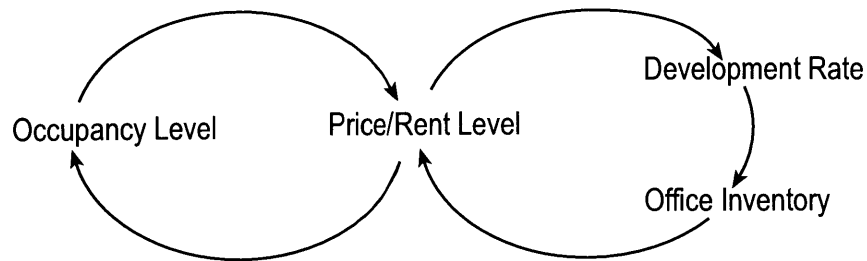


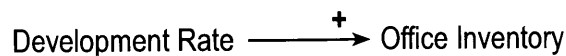
Figure 7 illustrates how the interconnection of feedback loops can lead to the creation of a feedback system. The *occupancy level* which will influence the *rent/price level*. This loop interacts with another loop. The *rent/price level* in the first loop has a impact on the *development rate* which adds to the *office inventory*.

### 2.3 Causal Loop Diagrams: The Building Blocks of Feedback Systems

The method for modeling the major cause and effect links in the system under investigation are causal loop diagrams. The model should include explicitly only the dynamically important components of the system, unnecessary detail obscures important facts; however, care must be taken to include all of the important components (Carlson, 1964).

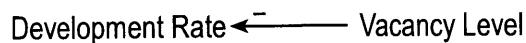
Each link in the diagram is directional, that is it is either a positive or negative link.

**Figure 8: Positive Link**



In figure 8, an increase in the development rate will cause an increase in the level of office inventory.

**Figure 9: Negative Link**

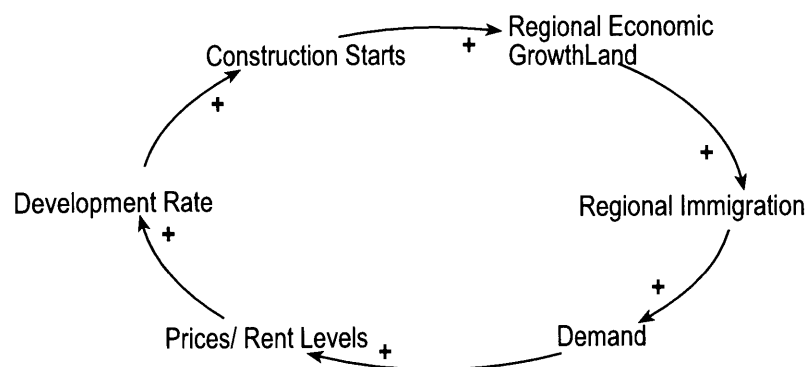


The linkage in figure 9, illustrates that an increase in the vacancy level will cause a decrease in the development rate. Conversely, a decrease in vacancy will cause an increase in the development rate.

Causal loop diagrams like the links are also directional. A **positive feedback loop** in figure 10 acts to reinforce variable changes in the same direction as the change, contributing to sustained growth or decline of the variables in the loop. This feedback loop suggests that as regional immigration increases, the demand for real estate also increases, leading to an increase in price/rent levels. As price/rent levels begin to increase the incentive to develop increases the development rate, which increases the number of construction starts which contributes to regional economic growth that makes the area more attractive as a destination for immigration. The positive feedback loop never regenerates endlessly. *The positive feedback loop is always imbedded in negative feedback loops that in time can exert predominant control* (Forrester, 1964).

**Zero or an even number of negative links indicates a positive feedback loop.**

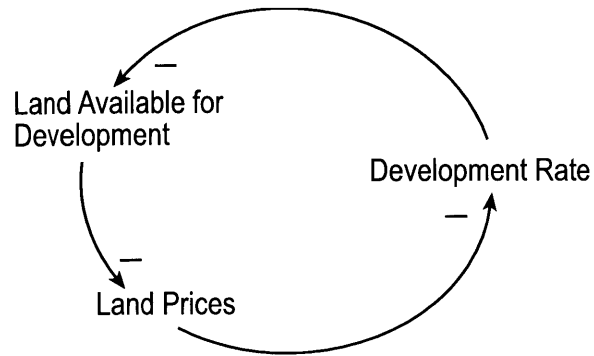
**Figure 10: Positive Feedback Loop**





**Figure 11: Negative Feedback Loop**

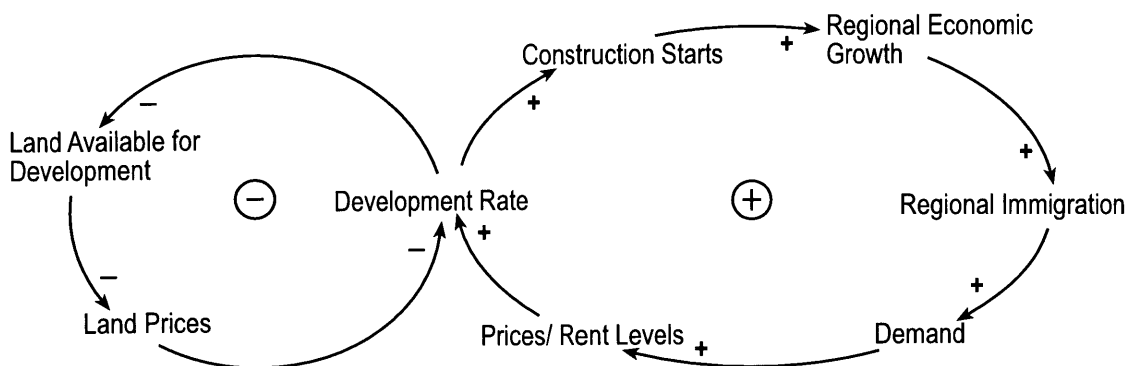
A **negative feedback loop**, as in figure 11, resists or counters variable changes, thereby pushing toward a direction opposite to change, contributing to fluctuation or maintaining the equilibrium of the loop. The increase in the *development rate* causes a decline in the *land available for development* which creates an increase in *land prices*. As land prices increase the development will decrease.



**An odd number of negative links indicates a negative feedback loop.**

In the example shown in figure 12, **coupled positive and negative loops**, the positive feedback loop of figure 11 has been coupled with the negative feedback loop of figure 12. This example suggests that the land available for development is the limiting factor to growth.

**Figure 12: Coupled Positive and Negative Loops**



## 2.4 A Systems Approach to Decision Making

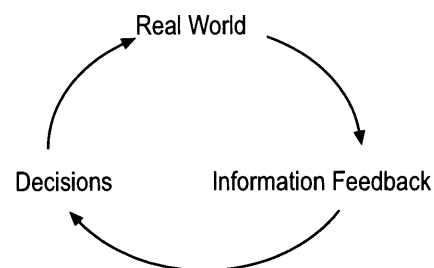
*It is misleading to think that human decision making is obscurely subtle and impenetrable. The major factors to which a decision is responsive are relatively few in number. They are usually subject to clarification if properly approached. Once one has dealt with a relatively few properly selected factors, the remaining can be relegated to a noise and uncertainty category. (Forrester, 1975, p.50)*

Successful completion of a real estate development project requires action based on sound decision making by the people involved in the process. “Decision making is a consequence of attaching meaning and significance to the events that occur around us” (Eden, 1994, p. 236). There are a number of interrelated factors that the developer must synthesis when deciding on the best course of action. The complexity can be confounding. Fallon (1990, p. 12.2) notes that “conclusions and recommendations for a site or land use may ultimately be based on gut level knowledge or feel.” Developers often rely on gut instincts, past experience, deeply ingrained assumptions and generalizations when making decisions. Often outmoded practices fail to change because they conflict with powerful, tacit *mental models*.<sup>1</sup> Forrester (1975, p. 234) states that “the great uncertainty with mental models is the inability to anticipate the consequences of interactions between parts of the system.” Roberts (1978) suggests that systems dynamics can provide a better understanding of the human decision making process.

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**Figure 13: Decision Feedback System**

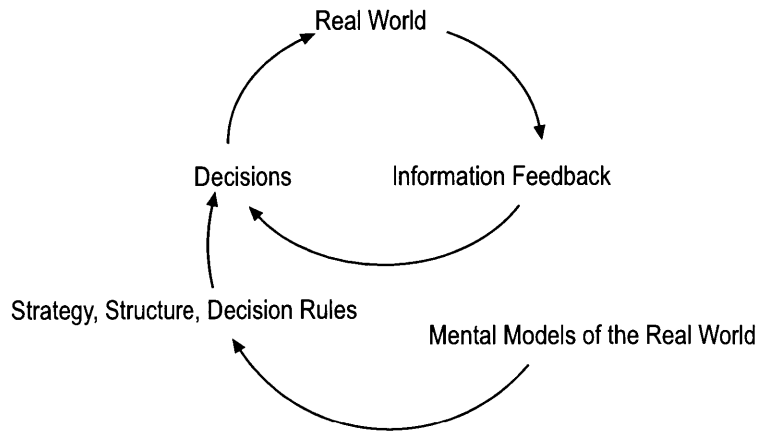
The classic feedback system, in figure 13, decisions alter the real world which in turn alters the qualitative and quantitative information that decision makers use. This feedback structure is the context in which all human decisions and all control systems operate. Sterman (1994) suggested that this view of learning in the decision making process leaves out the tacit mental models that influence the decision process. In figure 14 Sterman



adds the mental models that influence strategy, structure and decision rules to the feedback loop. In this feedback system whenever new information is presented the decision will be altered without questioning or altering the mental models that influence how the decision is made. This is the *single loop learning* process as referred to by Argyris (1992, p.8).

**Figure 14: Mental Models not Altered: Single Loop Learning**

Sterman (1994) asserts that it is through the development of a systems approach that the mental models which influence the decisions can be altered to create a broader more dynamic understanding that will lead to new decision rules, not just new decisions. The systems approach to problem solving and decision making that



creates new paradigms is what Argyris refers to as *double loop learning*.<sup>2</sup> Figure 15 Sterman illustrates his assertion in figure 15 and closes the loop. Argyris (1992, p. 10) contends that “double loop actions control the long-range effectiveness, and hence, the ultimate destiny of the system.”

**Figure 15: Mental Models Evolve: Double Loop Learning**

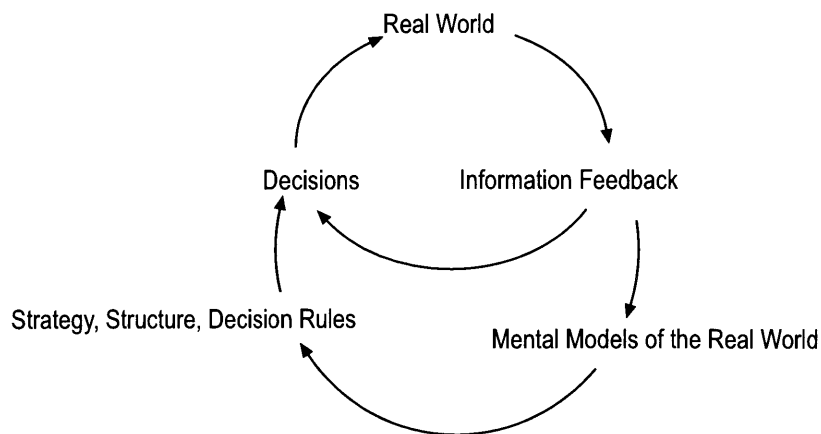
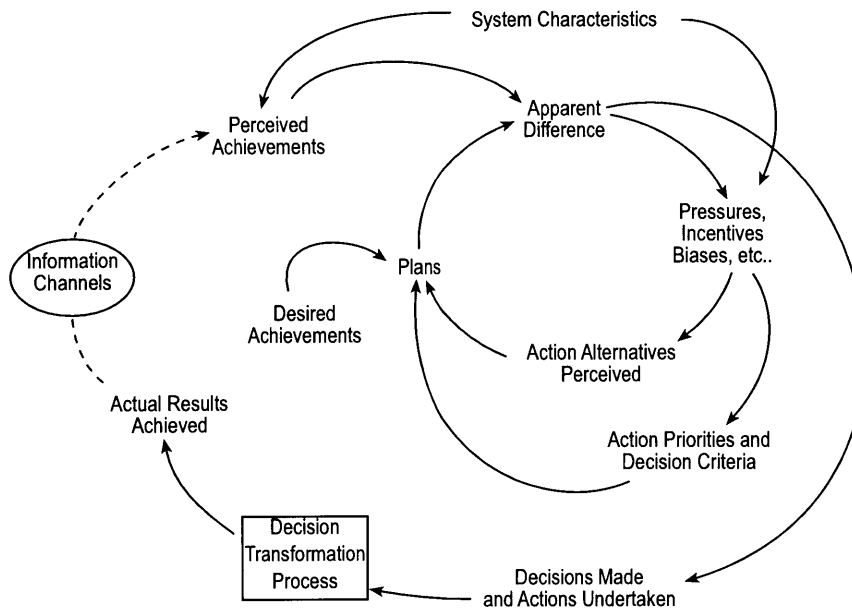


Figure 16 illustrates the complexity of the interrelationships involved in making decisions makes it difficult to determine what incentives and pressures are driving the decision making process and how the system is impacted as a whole. Weil (1978, p. 461-462) describes this best:

*Many people, at different levels, making many decisions about what activities will be undertaken and how, and taking actions based on these decisions. The decisions they make and the actions they choose to take*

are significantly influenced by the incentives, pressures, and perceptions existing in the organization. The relationships involved are very complex. One must assess the effect of systems characteristics singly and in various combinations on overall organizational performance. And one must do this within the context of an environment that is in a continual state of flux. It is well beyond the ability of intuition, experience, or ordinary analysis to deal with such a degree of complexity.

**Figure 16: Impact of Systems Characteristics on Decision Making (Weil, 1978)**



The application of systems dynamics is a valuable test bed for evaluating the consequences of alternatives. Winch (1993, p.287) observes that where particular strategic options have already been identified but strongly divergent views exist as to which might be most effective, building and using a systems dynamics model can help teams to reach consensus and to mobilize around a preferred option. Sullivan (1984, p. 136 - 137) suggests that by breaking large issues into a series of steps small risks can be taken instead of large ones and reduce the perceptions of the absolute level of risks. Ancona (1986, p. 24-25) asserts that the “*objective is not arriving at the best decision in some abstract sense, but rather involving people in the decision-making process in order to gain their input in molding the decisions of others and their cooperation in implementing it.*”

Samarasan (1987) suggests that by allowing the decision maker to consider the expected rewards and costs

associated with each available option, and the multiple probabilities or probability distributions associated with each random variable, it is possible to determine the expected values for each possible combination of option and outcomes. Samarasan goes on to suggest that it is especially useful to have the subsequent ability to analyze quickly the sensitivity of the optimal set of decisions to changes in assumptions. The more complex the substantive system, the less intuitive will be its behavior. Forrester (1969) and others have shown that this failure of intuition can be discovered in a group setting through the process of jointly building a simulation model, and including within it the policy goals and structure of the group.

*In many negotiations, the interactions between parties are complex. Even a meager understanding of the issues is contingent on acquiring a depth of arcane and technical knowledge that is beyond the reach of all but the specialist. When decisions have to be made in these cases, parties nominate and depend on technical experts who require a wide variety of information on which to base their calculations. Such information is often difficult to define, and even more difficult to collect. A greater part of the decision making must then deal with the management of risk and uncertainty. The high cost of litigation, and the sometimes higher cost of waiting around for litigation, have given a shot in the arm to the alternate dispute resolution movement. In short, these three features — technical complexity, a need for quick and careful disposition, and the absence of unquestioned decision-making authority — are common to today's conflicts, and emphasize the need for a new approach. (Nyhart and Samarasan, 1989, p. 43-44)*

If systems approaches can be used to solve disputes then they can also be used to avoid them and to monitor the project. Qualitative system diagrams and the quantitative computer modeling associated with system dynamics are not presented as a panacea but as a tool. Simulation is a laboratory in which the consequences of various actions can be explored without risk. A simulation using a quantitative dynamic model can compress time and allow retrospective analysis of the decision making process. Models and modeling can assist in probing inequalities of power, influence and access to data and assess the impact of uncertainty and change. Samarasan (1987) suggests that the potential to experiment with creative solutions by asking what-if questions, by performing comprehensive sensitivity analyses, and by conjuring up scenarios and pursuing them through systematic simulation experiments enhances considerably the level of understanding with which decision makers approach contextual problems.

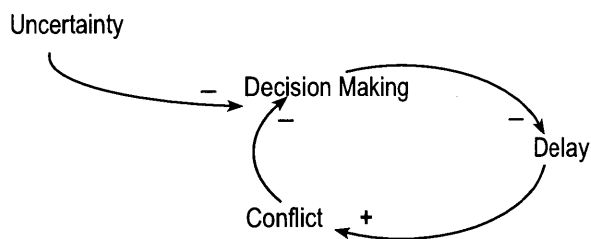
## 2.5 The Effect of Lead Time and Delays on Decision Making

*"The problem is not that decision makers fail to see the relevant information but that they fail to see its ramifications for decision making."* (Kleinmuntz 1993, p. 226). Sterman (1989a, 1989b) found that decision makers exhibit seriously dysfunctional performance in the presence of delayed feedback. Sterman's (1989a, p. 329) experiments indicate that *"many subjects fail to account adequately for delay between a control action and its effect, and fail to understand the feedback between their own decisions and the environment. The "open-loop" character of their decision making exacerbates instability"*. Sterman's experiments required subjects to manage simulated economies in which there were causal loops from previous decisions back to the environment. Significant time delays occurred between each action and the subsequent changes in the environment. Subjects generally acted as if they were insensitive to the implications of the feedback structure, in the sense that their behavior appeared to conform to rules that would be more appropriate for tasks where feedback is either immediate or not present at all. Sterman (1994, p.297-299) asserts that delays are the cause of instability in dynamic systems and that the effect of delays on negative feedback loops is an increased tendency for the system to oscillate. He affirms that the *"oscillation and instability reduce our ability to control for confounding variables and discern cause and effect, further slowing the rate of learning."*

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Figure 17 illustrates the affect of uncertainty on decision making. Figure 17 is a positive feedback loop where, delays exacerbate the antagonism between the parties, which has a negative impact on the decision making process that results in further delays. An exogenous influence on the system is uncertainty. Uncertainty has a negative impact on the decision making process.

**Figure 17: The Affect of Uncertainty on Decision Making**



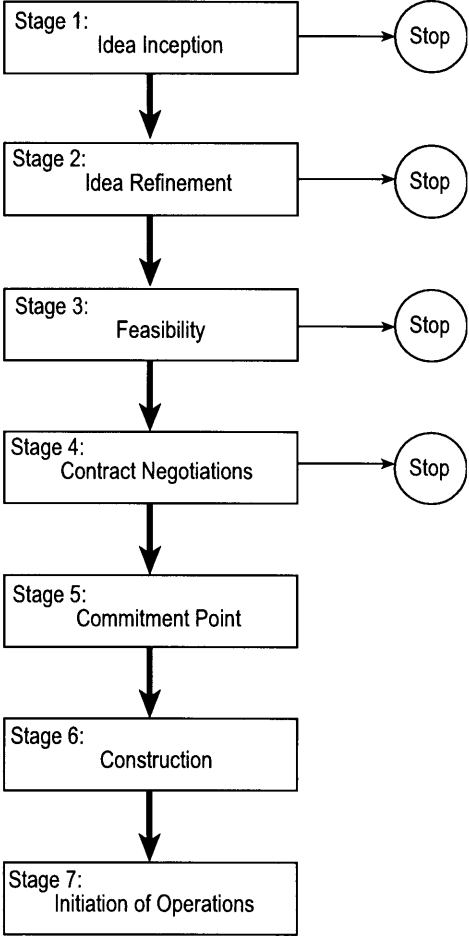
Sullivan (1984, p. 137) asserts that as uncertainty increases *"only new information and the passage of time can resolve the uncertainties over future events"*. Stalk (1988, p. 46) reports that traditionally long lead times have been necessary to resolve conflicts between various activities. He contends that the need for longer lead times ex-

pands the planning loop, reduces the accuracy of forecasts, drives up costs, increases delays and creates system inefficiencies. Sullivan (1984, p. 88) maintains *"that developers would benefit from quicker and more predictable decisions that would be less likely to be challenged. It seems silly to have developed a siting process that necessitates the expenditure of millions of dollars before getting a final decision to construct a project."* A systems approach can allow one to take a retrospective look at the impact of delays on decision making.

### 3. Qualitative Problem Analysis

**Figure 18: The Generic Development Process**  
(Wurtzebach and Miles, 1987)

The linear real estate process model, in figure 18, used by real estate developers is an open system. This model does not take into account the interactive and multi-disciplinary process of development. As the size of the development project increases and as the development issues become more complex the generic development model clearly needs enhancement. There are a number of dynamically complex issues that will impact the long term success of the project. These issues will influence what idea the developer refines, how the feasibility is determined, and the way issues will arise as the parties negotiate their commitment to the development project. Kenneth Cooper, President of PA Associates, (personal interview, June, 1995) confirms that in the current generic development model "each task is portrayed as having a definable beginning and an end with the work to be done or in process or done. No account is taken of the quality of the work done, the release of incomplete or imperfect tasks, or the amount of rework that will be required." Cooper feels that this is particularly inappropriate for development projects, in which there is a naturally iterative process. Cooper believes that developers need to be more cognizant of this rework process and need to more explicitly anticipate it and monitor it.



The inherent complexity of the real estate development process means that conflicts, due to uncertain exogenous and endogenous factors, will occur. Uncertainty is created when developers must make a decision without having complete information. As Bhambri (1991, p. 15) explains "the cost associated with collecting information is often prohibitively expensive and the time required excessive. Pressure to process information is increasing as environmental and political issues complicate the development approval process and increase the risks associated with the development process." Sullivan (1984, p. 15) writes about the uncertainty that developers face:

*Uncertainty often arises from the large number of permits and reviews required for many projects. These add to the complexity of the review*

*process and can make the final outcome uncertain. Unfortunately to the degree that a process possesses uncertainty, it will prove impossible for the developer to take actions that would screen out unacceptable projects before committing resources to detailed design studies and permit applications. For an unsuccessful project, these resources become sunk costs, lost to the developer, but fundamentally altering the cost of producing new facilities. If some projects fail to gain approval after heavy investment, then those projects which are completed must carry the costs spent in the planning and design of those disapproved.*

Exogenous uncertainty, primarily economic condition and market condition, contributes to conflict players face. Endogenous factors, the ability to manage, to unfreeze old mental models and refreeze new ones, the influence and power of players, are the internal contributors to conflict.

In this section a systems approach is applied to the real estate development process. The structure of the preconstruction phase, the phase where developers grapple with putting the “deal” together, is analyzed with assistance of real estate developers and systems dynamicists. A hypothesized qualitative systems model was introduced and its evolution is traced. A case vignette of an apartment project in New York City is also provided to illustrate the applicability of the model to the real estate development process.

Modeling is a complex business and this research takes small steps towards creating an understanding of the interrelationship of a number of the major variables that influence the development of real estate. The hope is that this will provide a context for further inquiry into understanding the depth of the complexity in the process of real estate development.

### **3.1 Real Estate Decision Models: Towards a Systems Framework**

The real estate development process is not as simple as the figure 18 may make it seem. A number of complex interrelated issues must be synthesized at each stage before the decision to move ahead can be made. Developers linear map of the development process would benefit most from a systems approach.

In analyzing projects developers breakdown project costs into *hard* costs, the physical building, and *soft* costs, all other costs not associated with the physical building. Paralleling costs, are two processes in real estate development, a soft process before construction begins and the hard process of construction. The hard process of construction is a more tangible process and as Boehm (1976) suggests optimization methods such as program *evaluation and review techniques* (PERT) and *critical path method* (CPM) have been successfully applied in describing how to best schedule and phase the parts of a complicated tasks such as building a



skyscraper. By virtue of *computer assisted design* (CAD) architects and engineers also have an optimization process in which they are able to simulate a virtual environment. Through the use of computer simulation architects and engineers are able to model the cause and effect relationships of design decisions long before a shovel ever hits the ground. Unlike the use of PERT and CPM methods for the hard process and CAD in the design process a generic method for managing the soft process has not yet been adopted for real estate development.

There are many intangible factors that arise in the preconstruction stages of a development project which make the soft process the most complex to comprehend. The developer's ad hoc optimization technique in the end amounts to a linear cash flow representation of the expected performance of a development project years before it will actually operate in the market. The developers financial models is also do not explicitly consider the behavioral aspects of decision making. As Sterman (1989, p. 307) contends "*the modern theories of investment solve the problem of ad hoc decision rules, they do so by invoking assumptions about the motives and cognitive capabilities of managers which are in direct conflict with a vast body of experimental work in behavioral decision theory, cognitive psychology, and administrative science.*" Modern investment theory often requires that a large number of factors be statistically unscrambled in order to make sense of seemingly related issues. Adequate statistical representation of the entire real estate industry would be a very large task. It would be fruitless to try and statistically unscramble the relationship of all the factors. In fact, Rosen (1984) suggested that a market model of key variables (office space stock, flow of new construction, vacancy rates, and rental rates) in a nonlinear model representing space market supply and demand was more appropriate. However, Rosen had disappointing results when he attempted to use an equilibrium econometric model. The inherent high volatility in office construction made the use of an equilibrium econometric model difficult.

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The reasons for the existence of conflict in the development process are several. Sullivan (1984) states that there are four major sources of conflict in real estate development. Sullivan (1984, p. 16) explains that the there can be disagreement over:

1. *The relevant weights granted to competing policies and values;*
2. *The new distribution of costs and benefits that arise from a project;*
3. *The appropriate level of protection from the environment and health harms, and;*
4. *The use of fixed resources.*

Conflict can result when there is a misalignment of players' goals, where goals are incongruent. There could be miscommunication or non-communication of information, which creates obstacles for the players in the process. Leinberger (1986) observes that one of the major issues relating to efficiency is the ability to manage

conflict. Conflict can be characterized as the mismatch of decisions. This decision mismatching can be exacerbated by carelessness and unreasonable expectations on the part of one or more players in the process. Sullivan (1984, p. 204 - 205) suggests a development project "should be negotiated in such a way that the interests of the parties leaves no mutual opportunities for further gains. In particular the participants must ensure that there is no other way that all the participants are better off through some alteration of the project or some alternate package of compensation."

Creating a systems model is a highly collaborative effort requiring openness and cooperation. A wide range of views can be included in a systems model and simulations can demonstrate how the decisions made can reverberate throughout the system. A complex dynamic develops between the shared goals of the group and the aspirations of the individual players. Weil & Dalton (p.11) declare:

*there must be an unusual degree of openness and cooperation among the multiple parties involved in complex development projects: the customer, the various contractors, the regulators, the financiers, the labor unions, and the public interest groups. Macho, success-oriented, 'it's your problem not mine', confrontational posturing is guaranteed to lead to disaster. These are complex endeavors, with complex problems, requiring complex solutions. Such solutions result from a shared strategic view of the situation and a commitment to constructive resolution of conflicts.*

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Current dispute resolution mechanisms used by developers include negotiation, mediation and arbitration. In a rational setting these alternate methods will be utilized when the benefits exceed the costs. Large development endeavors can remain vulnerable to relatively minor disagreements. Sullivan (1984, p.83) reports that unless opposition groups and developers can design an enforcement and grievance mechanism short of litigation, developers may decide that the best policy is to wait for a final judicial resolution of issues before making a major commitment to construction. Obviously the judicial resolution process is one that will exacerbate delays and cyclicalities in the real estate industry. Clearly a new approach is needed.

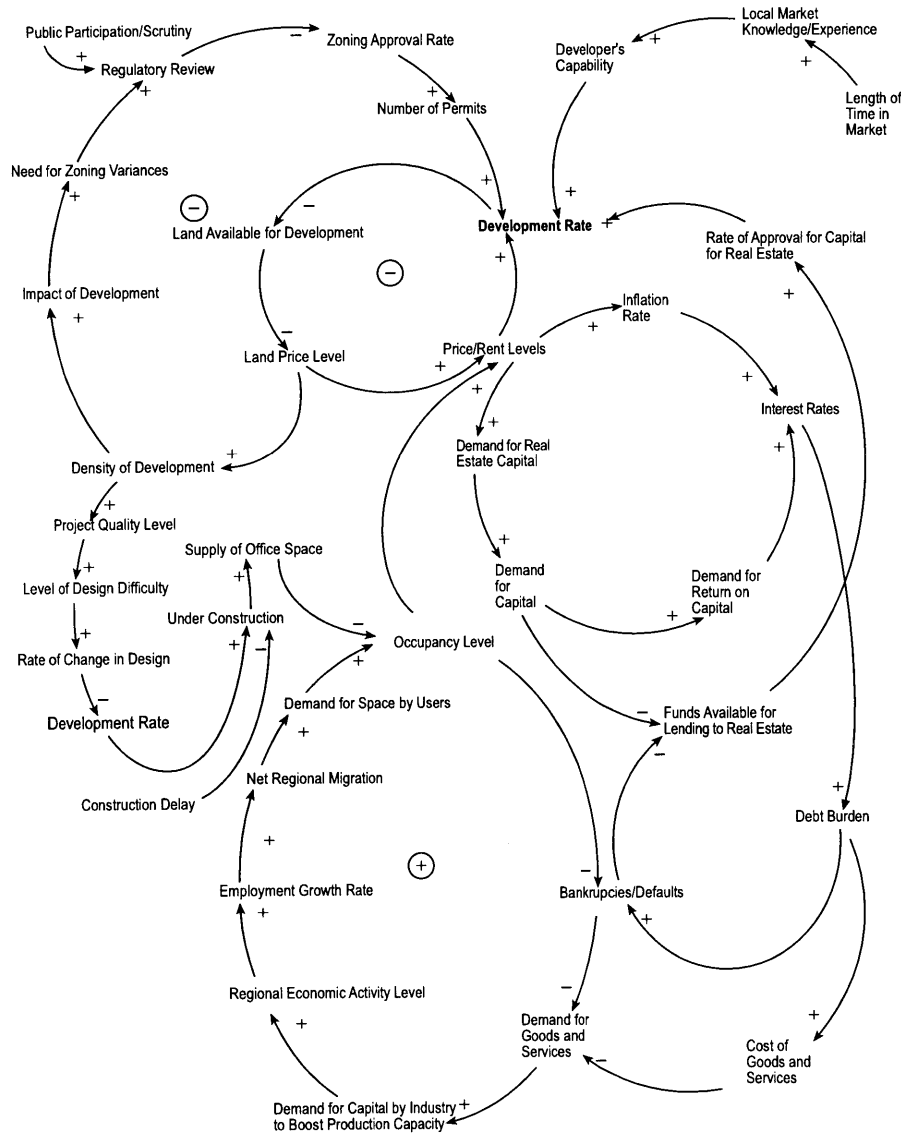
System dynamics is not only for understanding the market conditions and how it effects development decisions, it is also a tool for understanding problems in the development process and how problems and conflict can be managed and disputes resolved. Systems modeling can provide a mechanism for developing rational strategies and tactics to maximize the net benefits to each of the players using one of the dispute resolution mechanisms. A systems approach is a way to formalize the ad hoc nature of conflict management and perhaps encourage alternative paths or provide a wider variety of available choices. A formal systems approach can enable decision makers to identify what elements are critical to the system, what limitations exist and how well decisions may work. Winch (1993, p. 287) reports that building and using systems dynamics models can help build consensus when strongly divergent views exist. In applying a systems approach, the multilateral process can be modeled without necessarily knowing the exact position of the other party. Consensus does not neces-

sarily have to viewed as a compromise solution.

Research by others (Wheaton, 1987; Hernandez, 1991; Thornton, 1992; Bakken, 1993; Sterman, 1994) points to time delays in the development rate of new projects as a contributing factor to cyclical in the real estate industry. This research focuses on the analysis of delay in the development rate of an individual project. Specifically, delay during the preconstruction process will be analyzed. As defined earlier the development process is made up of two processes the *soft* preconstruction process and the *hard* construction process. There is little that can be done to eliminate the structural time required for construction, however the preconstruction process could benefit from an optimization technique. There are a number of interacting factors that contribute to creating delay in the preconstruction process.

The dynamic nature of the factors creates complexity that can lead to conflict. The preliminary systems model in figure 19 was created to illustrate the causal relationships that influence the development rate. As Vennix (1990) suggests that it is better to approach people with a preliminary model in hand than to approach them unprepared. The model was created under the presumption that there may be five primary areas where delay can occur in the development rate: the rate of regulatory approval, the complexity of the project, the rate at which capital flows to real estate and the ability of the developer. The causal relationships in these areas were hypothesized and incorporated into the model below. The model was intended to act as stimulator for discussion about the factors that create the problem of delay in the development rate during the preconstruction process.

**Figure 19: Preliminary Real Estate Development Systems Model**



Unnecessary delays are injected into the development process by conflicts that are not well anticipated, that are potentially avoidable and certainly could be dealt with more effectively than they typically are. In the short term these delays add expense and risk to the development project as well as cost time. Expense because time is money, the project ends up costing more and if it is slowed down it may not hit the market as originally intended or compromises may have to be made near the end that undercut the effectiveness of the development. When the developer has to compensate others on the development team for being behind schedule and

over budget it makes the project less appealing. In the longer term delays contribute to cyclical and the boom bust dynamic of the real estate industry.

The objective of this research is to suggest that a systems approach, to get at the underlying complexity, can be effective as a conflict management strategy. A systems approach allows developers to challenge both their own mental models and those of the other players. This paper will build a conceptual systems model that qualitatively analyzes the source of delays in the preconstruction phase of a development project. The goal is to begin to compose a model that can help the individual developer anticipate and deal with conflict that would increase risk and reduce the success of the project.

### **3.2 Research Methodology: Field Work and Interviews**

The research method involved conducting taped face to face and telephone interviews with two real estate developers and three system dynamicists. Also, feedback from the *System Dynamics Society electronic mail bulletin board*<sup>3</sup> was incorporated. Empirical research through interaction with a reference group of systems dynamicists and developers, the defined problem was analyzed and an initial conceptual model was built. The individuals were interviewed to get their feedback on delay in the development process and on the potential of applying a systems approach to the development process.

#### **Developer 1**

This individual is the most senior level executive in a Northeastern United States office of a major international developer. Although the firm's primary focus is commercial and retail development projects, it has also been active in industrial and luxury high rise residential projects. The firm is fully integrated with enough in house expertise to carry a project from inception through to long-term management.

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#### **Developer 2**

This individual is a successful New England based developer with over 25 years of experience. This developer also lectures occasionally, has written a number of articles and books on real estate, and sits on the board of directors of a national development firm. This person has undertaken a number of significant development projects in and around the Boston area.

Systems dynamicists, who have applied systems dynamics were interviewed to determine the potential for success and the obstacles in applying a systems approach to the real estate industry. They were asked to provide comments and feedback on composing a systems model to understand the decision making process in the real estate development process.

#### **System Dynamicist 1**

This individual has been associated with a Cambridge-based consulting firm for over 25 years. This individual's professional specialization involves applying computer simulation modeling to business strategy, market analysis, resolution of complex business disputes, and design of management systems. This person has consulted for the financial services, aerospace, telecommunications, chemical, shipbuilding, and transportation industries.

## **System Dynamicist 2**

This individual has been a vice president at a system dynamics consulting firm for 15 years and is a graduate of the MIT Sloan School of Management. This person has worked on a wide variety of projects many involving the use of system dynamics for conflict resolution and avoidance, a number of these involving the aircraft industry. This individual has also been involved in issues surrounding the deregulation of telecommunications.

## **System Dynamicist 3**

This individual has had a career in the real estate industry for a number of years. This person has worked for one of the nations largest retail developers, a number of contractors and for an engineering design firm. This person has been involved in systems research in industries other than real estate at MIT and holds a system dynamics faculty position at a university in Europe.

The interviews were approached as a three step process:

1. Context and Background Preparation
2. Composition of a Conceptual Model
3. Evaluation of a Systems Approach

### **3.2.1 Context and Background Preparation**

Background information regarding the premise of the research were provided to each individual being interviewed. The context is described in Appendix A. The real estate developers were given the necessary background to understand systems thinking and system dynamics. Appendix 2 illustrates the diagrams which were presented and explained to the developers to introduce the building blocks of a systems approach in a real estate context. The information explained to both the real estate developers and the system dynamicists was intended to sensitize them to the interacting issues in decision making the real estate industry.

Appendix C provides the text of a message that was placed on the *System Dynamics Society* electronic mail bulletin board to inquire about other attempts to apply a systems approach to the real estate industry. The System Dynamics Society is an international, non-profit organization devoted to encouraging the development and use of system dynamics in over 35 countries around the world. The purpose of the System Dynamics Society bulletin board provides a forum to promote discussion around issues in building and using System Dynamics models.

### **3.2.2 Composition of a Conceptual Model**

The preliminary model introduced in figure 19 (see p.28) was used to elicit feedback from systems dynamicists and real estate developers on the application of a systems approach to understand the factors that affect the development rate. The approach taken was expected to elicit the knowledge required to build a conceptual model of the real estate development process. Interviews with developers to bring out their mental models of the relationships between various factors that influence the development process were developed into a set of causal relationships. The interrelationships act as an introduction to the components of the real estate development system. Particular attention was paid to decision making and delays in the preconstruction phase where the developer must grapple with a number of interrelated issues that affect the development rate.

### **3.2.3 Feedback on a Systems Approach**

The participants were asked to provide feedback on the advantages and disadvantages of applying a systems approach to the real estate development process. The participants were asked to make suggestions on how the real estate professionals can begin to use systems as a tool for decision making. Developers were also asked about the challenges they feel a systems approach will face in creating a convergent thinking process.

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## **3.3 Results**

The message on the System Dynamics Society electronic mail bulletin board to elicit resources for system dynamic applications to the real estate industry brought ten responses, half of which were from the MIT community. Response on applying a systems approach to the real estate industry was strongest from the MIT community. There was interest from others around the country and one respondent from Europe. There was little knowledge of practical application of a systems approach in the real estate industry. Other than work by graduate students (Hernandez, Thornton, and Bakken) and faculty (Sterman) at MIT there appear to be few other applications of a systems approach to the real estate industry. There does not appear to be any recent collaborative work done with real estate and systems experts. Most who responded to the message on the bulletin board expressed an interest in learning about systems research as it relates to real estate.

The following paragraphs outline how the preliminary model was modified through interviews with system dynamicists and developers. The preliminary model was too broad in scope. Described below is its evolution culminates in a model that is narrower in scope and more aptly describes the development of an individual project is described below.



### 3.3.1 Towards a Systems Model

The preliminary model introduced in figure 19 (see p.28) was intended to draw out the mental models developers have of the factors in the preconstruction process that influence the development rate, and generate comments and criticism on the model structure from system dynamicists. Using comments and feedback from developers and systems dynamicists the following traces the evolution of the original preliminary model introduced in figure 19. First, the preliminary model incorporates feedback from system dynamicists and is brought to an appropriate level of aggregation by eliminating those factors that are exogenous to the development of an individual project. Second, once the scope of the preliminary model has been narrowed the individual relationships are explored, incorporating feedback from the developers. The model is broken into two parts and the composition of a new model is presented. Finally, a new model, which builds on the original model and incorporates feedback from developers and system dynamicists, is presented

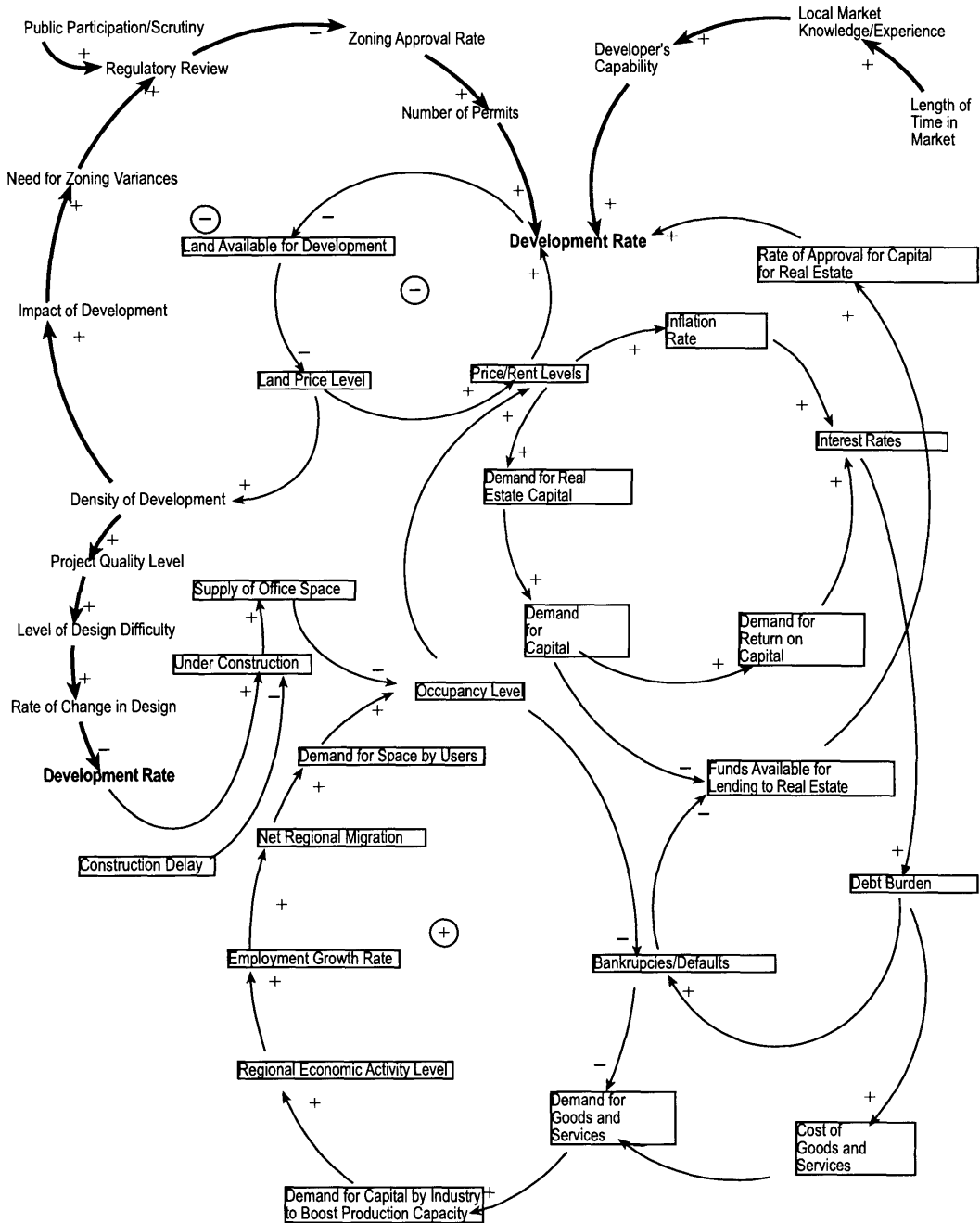
#### **Narrowing the Scope of the Preliminary Model**

All of the system dynamicists commented on the levels of aggregation in the preliminary model. System dynamicist 1 stated that it is important to be clear when deciding what the focus of the model is. As system dynamicists 3 states: *"you must be clear about what level you are building the model at. Is the model supposed to represent the industry, the firm, or the individual development project?"* System dynamicists 2 and 3 find the use of boundaries helpful in determining what to include in a systems model. Boundaries help to define the level of aggregation used when modeling a problem. For example, there would be boundaries that would distinguish an industry-level-model from a firm-level-model from a project-level-model.

In figure 20, the factors that have been highlighted with a box, influence the development rate but are exogenous to the development of an individual project and operate at a much higher level of aggregation. It is also worthwhile to note that the developers did not look to the boxed factors as a source of delay and conflict during the preconstruction process.

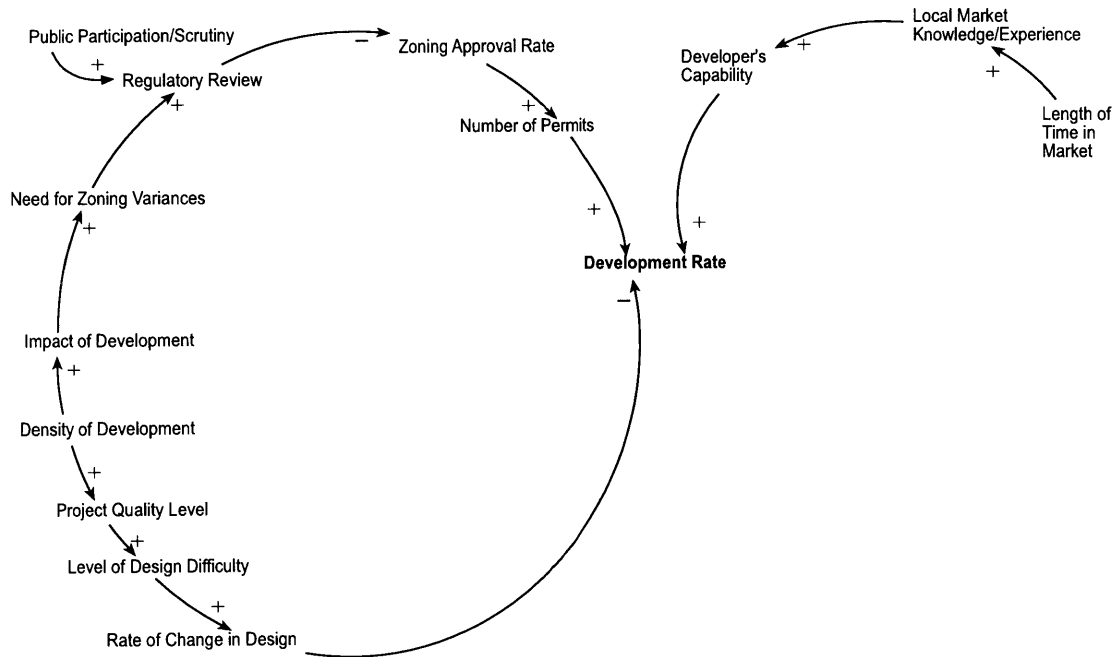
Clearly, the preliminary model was inconsistent in its multiple levels of aggregation and the boxed factors illustrated in figure 20 were dropped out resulting in the model shown in figure 20a. The factors dropped from figure 20 represent factors that would be used at a level of aggregation higher than that of an individual project, for example, if looking at the firm level or at the industry level. The factors eliminated include all factors that influence interest rates, occupancy levels and the rate of approval of capital for real estate. While these components play an important role in the development of real estate their impact is external to the individual development project.

**Figure 20**



The heavy arrows indicate what is to remain in the model and the boxed factors indicate what is to be omitted.

**Figure 20a**



System dynamicist 3 contends that *developer's capability*, *local market knowledge or experience* and the *length of time in the market* probably operate at the firm level and while they will influence the development rate these factors probably operate outside the boundaries individual development project. In figure 21 the factors at the firm level and the relationships that influence the developer's capability have also been eliminated from the initial model. The simplified model can be seen in figure 21a.

**Exploring the Interrelationship of the Factors**

Figure 21a represents the second evolution of the model. Figure 21a includes the components necessary to analyze the endogenous causal relationships that cause delay in the development rate of an individual real estate project. Figure 21a was broken into the two paths that influence the development rate. There are two paths which begin at the *density of the development* that influence the *development rate*. Figure 22 identifies the two paths that influence the development rate. Path 1 encompasses the components in the regulatory approval process that influence the development rate. While path 2 encompasses the components in the design process that influence the development rate.

Figure 21

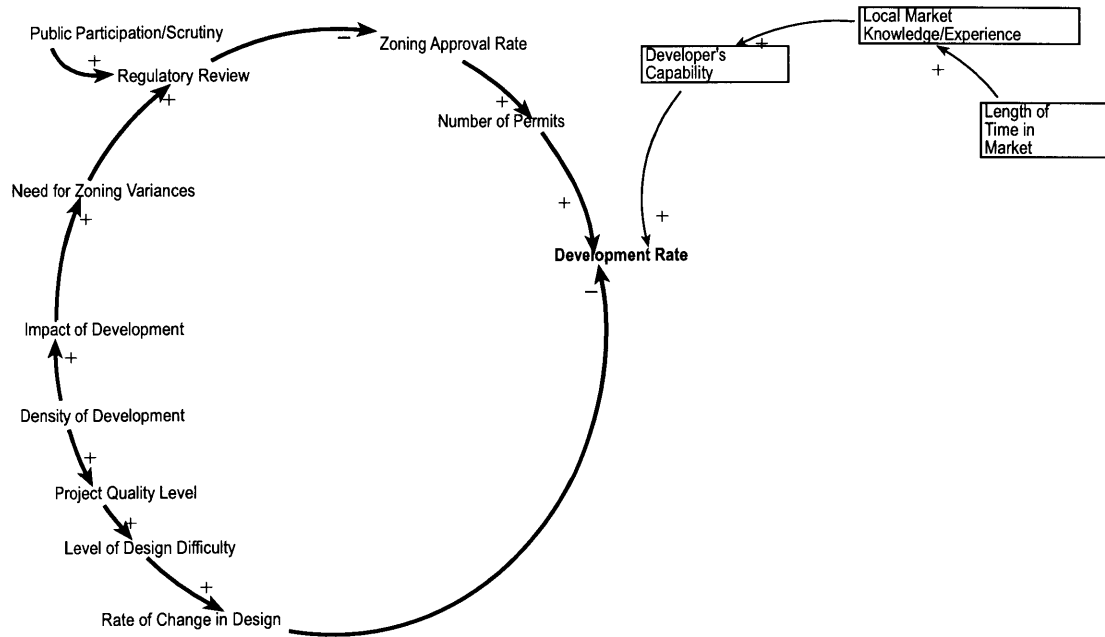
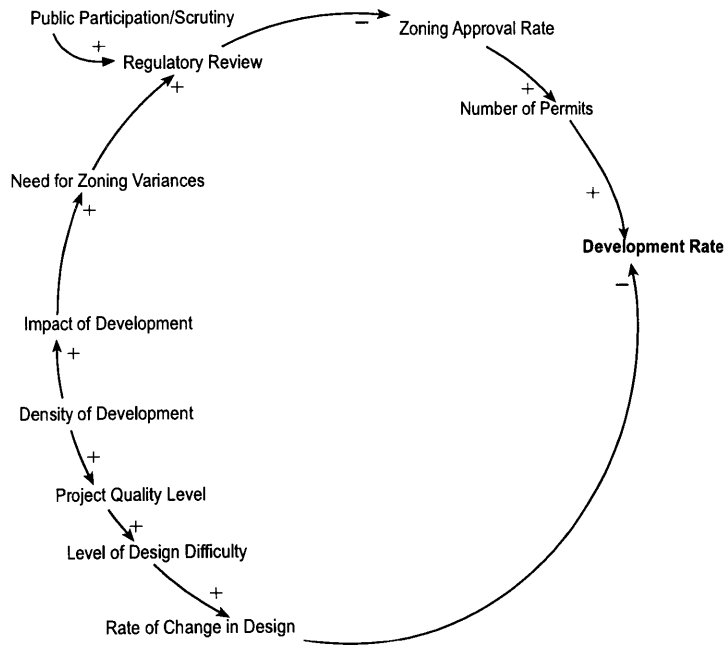
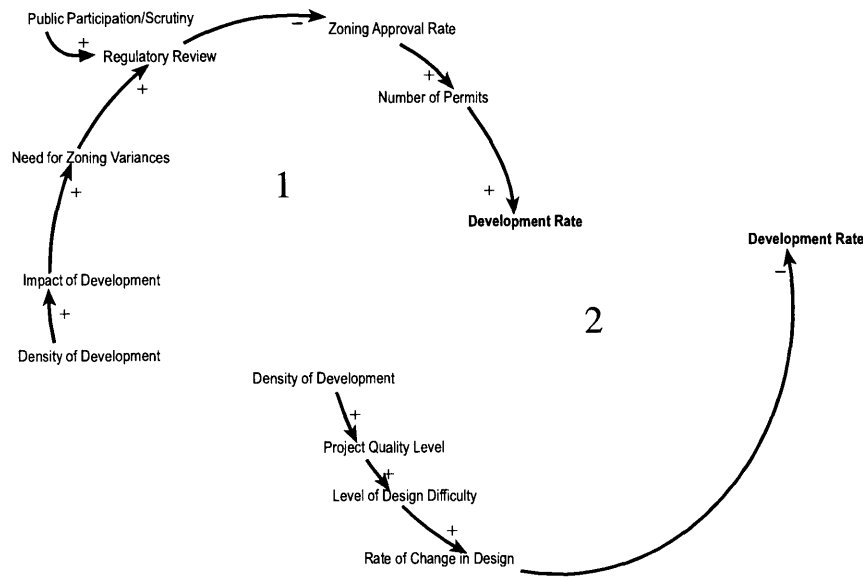


Figure 21a



## Evolution of Path 1

Figure 22



### The Effect of Public Participation on the Regulatory Review Process

In figure 22, path 1 outlines the causal relationships of the size of the project and public participation in the regulatory review process. This path was analyzed first and was modified to incorporate feedback from developer 1 and developer 2.

Developers are resource dependent. The regulatory agencies regulate the use of one of the most important resources in the development process: land. The regulatory agencies regulate development to address the needs of their constituents. Ancona (1986) explains that the resource dependence perspective asserts that interdependence with, and uncertainty about, the actions of those outside creates uncertainty. Developer 1 alludes to this dependence the developer has on the regulatory agencies that approve development projects:

*Before you buy a piece of land you want to know what you'll be able to do with it, because that affects the price of the land. Whether that helps the major make the decision depends on what that agenda of the mayor is. Perhaps the mayor doesn't want to make a decision. Clearly it depends on what that mayor's agenda is. If he is running on a business platform then yes it would be useful, however if he is running on a different platform. If the mayor is in office when business is good and is trying to get*

*reelected the agenda may not be aligned with business. The mayor may in fact be looking for ways to delay and therefore uncertainty is a good thing if that is his agenda.*

*The real delay comes from the uncertainty of knowing what the game rules are. Changing game rules make it tough. 'What is this mayor going to do?' This holds up the developer more than anything. The inconsistent pattern causes developers to throw up their hands, clearly. For example, the process in Boston in the mid eighties, was an arduous process at best. Today, Boston still makes you go through it, but you can go through it a lot quicker because Boston wants development. Back in the 80's they wanted to regulate development. In the 80's they used this process as a delay tactic or as a controlling tactic. Today the spigot is on, if you are willing to build they are willing to help you. It would be interesting to let the regulatory agency's see how their indecision effects what you'll be able to do.*

Developer 2 discusses the effect of participatory public review process in regulating real estate development.

*With respect to delays who knows what is going to happen. The public can make some irrational demand that will hold up a project for longer than you ever imagined.*

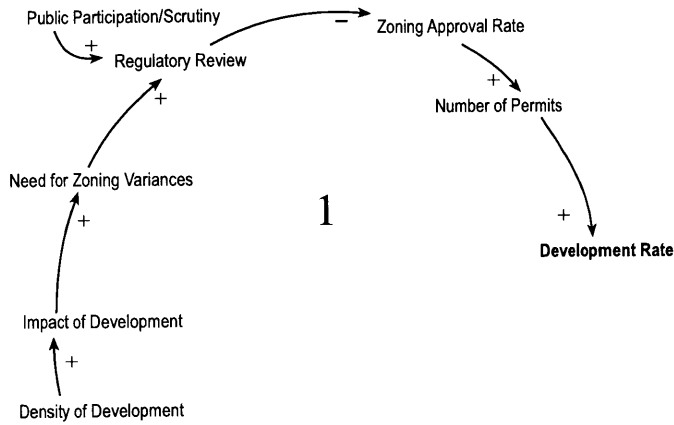
Developer 1 makes reference to the changing nature of the public's perception of a development project. There is also an indirect reference made to an exogenous factor, the strength of the economy, that will influence the public's scrutiny of the project.

*The public sees the project as the golden goose. This is an alternate form of taxation. During economic booms the politicians look for ways to extract dollars for their agendas. There is uncertainty created by how the politicians will react to the project and by how the special interest groups will react. The special interest groups have diminishing marginal utility for say extra parks or trees but will find something else to attach their interests to. The agenda of the special interests groups keeps shifting to extract more from the development project. On the other hand once you can't sit around and enjoy the sunlight and drink your cappuccino and you just want a job then the agenda changes again and those burdens go away.*

While it seems that exogenous factors such as the strength of the economy may also have an impact on the rate of public participation and scrutiny. This has not been included since it is an exogenous factor that oper-

ates at a higher level of aggregation and is left out for clarity in the model.

**Figure 23**

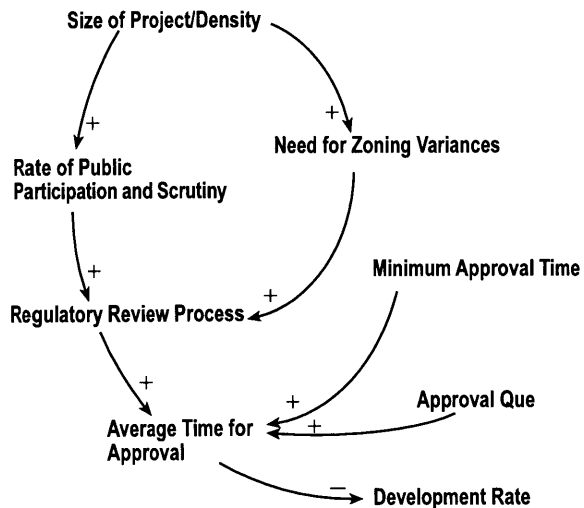


The *density of development* was restated as the *size of the project or density*. The *size of the project* more directly affects the *public participation/scrutiny*. As suggested by system dynamicist 3 the *zoning approval rate* was restated as the *average time for approval* and the *number of permits* was redefined as the *approval que*. As suggested by system dynamicist 2 the relationship between the *density of development*, *impact of development* and the *need for zoning variances* was streamlined by eliminating the *impact of the development*. This allowed the *density of development* to have a more direct relationship with the *need for zoning variances*.

relationship between the *density of development*, *impact of development* and the *need for zoning variances* was streamlined by eliminating the *impact of the development*. This allowed the *density of development* to have a more direct relationship with the *need for zoning variances*.

**Figure 24**

The causal relationships of the public's participation in the regulatory approval process are restated in figure 22. Figure 24 illustrates the affect of the *rate of public participation and scrutiny* on the approval process. As the *size of the project* increases the *rate of public participation and scrutiny* will increase, which will increase the *regulatory review process*. The *average time for approval* will increase as the *regulatory review process* increases and as the *minimum time for approval* increases.



## The Effect of the Regulatory Approval Process on Quality and Cost

There is a relationship between delays in the regulatory approval process and the quality and cost of a project that was not included in the preliminary model. Developer 1 elaborated on the effect of the regulatory approval process on the quality level and cost of development projects.

*I think there is a relationship between the what is spent during the approvals process and the quality of the project. All of a sudden if the government comes in and says I have to spend half a million dollars to build this park, the market rate hasn't changed - not immediately, it will eventually, but immediately it didn't change. That means I have to take some money out of the architecture in order to pay the regulatory agents. If you go to a market like Houston you'll see some of the best design, you'll also see some of the worst. In Houston there are developer's who say that instead of putting my money into architecture I'll just put that money into my pocket. 'I won't do more, I'll just make more'. What regulatory agencies do is extract those dollars in the form of time delay. So rather than getting your grandest buildings you get more mediocre buildings. If you are looking for mediocre architecture you can go to Boston or you can go to San Francisco. The aesthetics of course are a matter of opinion. Cities that are highly regulated extract more value from the quality of the architecture because you have to pay for that regulation. You have to pay for that delay somewhere and after a point you won't absorb it in your profit margin.*

**Figure 25**

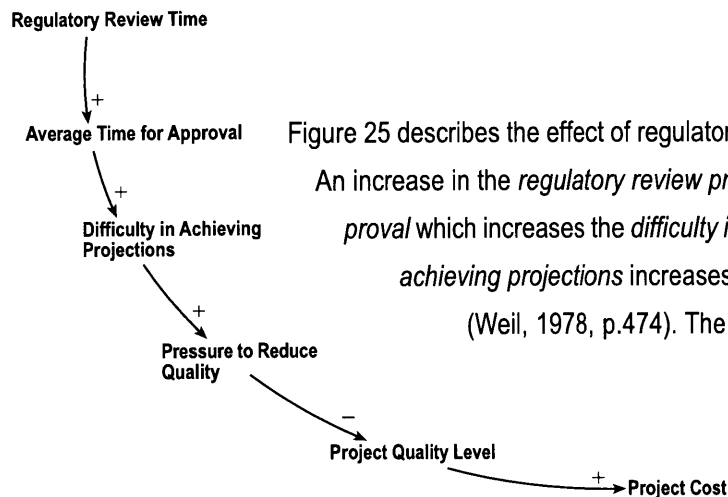


Figure 25 describes the effect of regulatory review on project quality level and cost. An increase in the *regulatory review process* increases the *average time for approval* which increases the *difficulty in achieving projections*. As the *difficulty in achieving projections* increases the *pressure to reduce quality* increases (Weil, 1978, p.474). The rise in the *pressure to reduce quality* will



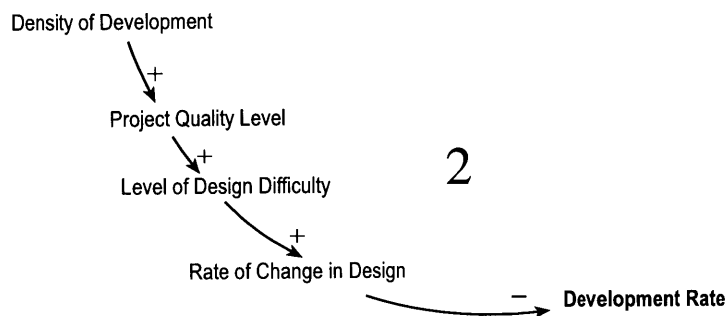
cause the *project quality level* to decline which reduces the *project cost*.

## Evolution of Path 2

### Delay in the Design Process

Path 2 in figure 26 outlines the causal relationships in the design process.

**Figure 26**



System Dynamicist 1 commented on the use of computer assisted design and the delays that can result due to the freedom with which design changes can be made. As projects become more complex the uncertainty in the design will increase. System dynamicist 1 explains:

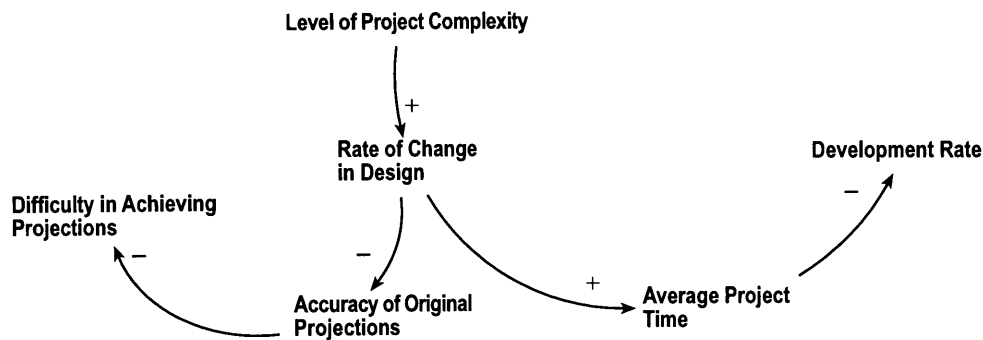
*The computer assisted design methods used in architecture and engineering have created a less inhibited design process. Architects and engineers are now able to incorporate design changes much later into the process. There is a relationship between this freedom in the design process and the opportunity for conflict before even before construction begins. At what point should the design process stop. The pressures of time and money have led to the development of a fast-track system of design and construction, where the project is still being designed while under construction. This concurrency leads to the discovery of design mistakes, however too much concurrency can lead to ambiguity.*

Systems dynamicist 1 also comments on the propensity to make changes to the design in a changing market.

Once the construction phase is reached it is the last chance to adapt to a changing market. There is an interplay between the soft preconstruction process and the hard construction process. The completed development project will reveal inconsistencies in the preconstruction process.

Figure 27 illustrates the causal relationships in the design process that influence delays in the project. As the level of project complexity increases the rate of change in design will also increase. As the rate of change in design increases the accuracy of the original projections will decrease and the average project time will begin to increase.

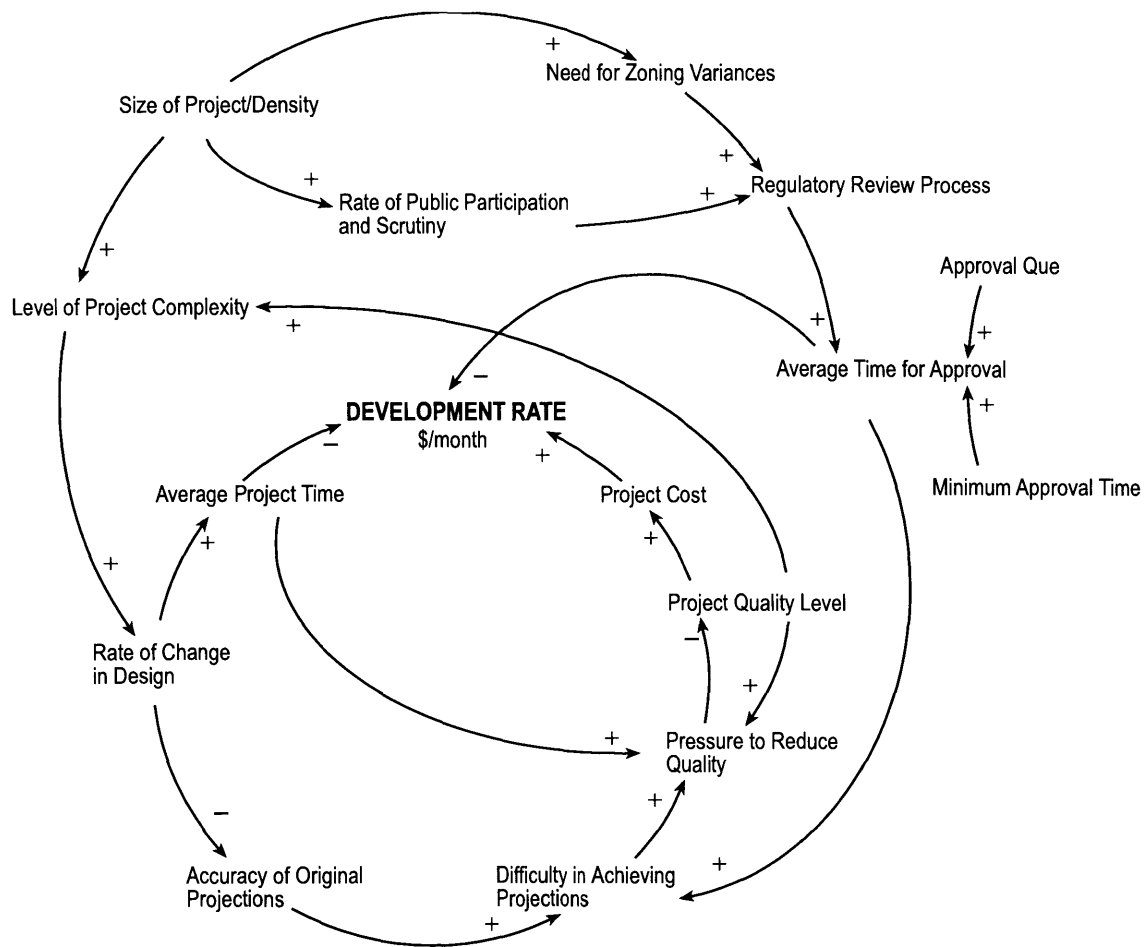
Figure 27



### 3.4 Synthesis: A Systems Model for Real Estate Development

In order to understand the problems causing delay this research moves to a lower level of aggregation, and looks to the lowest common denominator in the process, the real estate development project. The model in figure 28 represents a synthesis of the comments and suggestions made to recompose the preliminary quantitative systems model. This qualitative model examines the variables during the preconstruction phase that will influence the development rate.

**Figure 28: Synthesis of a Causal Real Estate Decision Diagram**



The *development rate*, measured in dollars per month, during the preconstruction process is influenced by the *average project time*, *project cost* and the *average time for approvals*. The *average project time* is influenced by the *rate of change in design*. As the *rate of change in design* increases the *average project time* will increase

which decreases the *development rate*. An increase in the *rate of change in design* will decrease the *accuracy of the original projections* which will increase the *difficulty in achieving projections*. As the *difficulty in achieving projects* begins to rise the *pressure to reduce quality* will begin to rise causing the *project quality level* to drop. A drop in the *project quality level* has three effects. First it reduces the *project cost* which reduces the *development rate* as it is measured in this case by the dollars spent per month. Second it reduces the *pressure to reduce quality*. Finally it reduces the *level of project complexity* which creates a negative feedback loop.

The *size of the project or density* will have a positive impact on the *level of project complexity*. That is as the *size of the project* increases the *level of project complexity* will also increase. The *size of the project* will also increase the *rate of public participation and scrutiny* and the *need for zoning variances* which will both increase the time required for the *regulatory review process*. An increase in the *regulatory review process* will increase the *average time for approval*. The *average time for approval* will rise as the projects in the *approval queue* increases and as the *minimum time required for approval* increases. As the *average time for approval* rises the *difficulty in achieving projections* will increase and the *development rate* will decrease.

### 3.5 CASE VIGNETTE:

#### **Court Backs New York City's Right To Order Building's Top Razed**

This vignette, assembled from an articles in the New York Times by Lueck (1988) and Lyons (1988), illustrates the power of a regulatory agency in the development process and the effect of the agency's responsibility to its constituents. It also shows the importance of aligning the developer's interests with those of the regulatory agency during the preconstruction phases. This vignette illustrates the application of the conceptualized model. While the conceptual model may be a simplistic representation of the dynamics of the preconstruction process, it can explain the interaction of some of the key issues in this vignette.

Regulatory agencies regulate real property development as a mechanism to address the needs of some portion of the population. Conflicts frequently arise between the private goals in land development and the social interest of the community. Whose interests should govern, vary with time and circumstances. Generally, no problems arise as long as the developer puts the property to use for some socially acceptable purpose. However, conflicts arise when a developer decides to maximize personal profits or satisfactions by shifting to a use that damages or exploits the interests of neighbors or the community at large.

## Vignette

On February 10, 1988 New York's highest court forced a developer of a 31 story apartment building to tear down the top 12 stories. Parkview Associates of Manhattan began construction of the apartment building at 108 East 96th St. just off Park Avenue in 1985. The building vastly exceeded its allowable height limit because city employees and the development company made a series of mistakes that got out of hand.

The developer was granted a building permit based on an erroneous map published by the city. The zoning map published by the city, erroneously included Parkview Associates site in the area — delineated on the map by a dotted line — where bigger buildings were allowed. The map had a dotted line in the wrong place and was missing the numerical notation to indicate the width of a district in which buildings taller than 19 stories were banned.

The court found no evidence of illegal action by Parkview associates when it applied for and received the building permit. In ruling in favor of the city, and upholding lower court decisions, it was said that the developer should have realized earlier that the building permit was based on erroneous zoning information, and called it to the city's attention.

If there is any hardship it is self-induced said Charles Smith the city's Commissioner of Buildings. "I warned the developer three years ago that the structure was too tall. This is a clear case where the developer brought these troubles on himself." The estimate of the total bill for the changes to the project including interest on construction loans, legal fees and other soft costs will be about \$20 million.

"The importance of this ruling lies in its reaffirmation of the fact that the city can not be barred from enforcing the law even though it has made a mistake.", said Robert S. Davies, an attorney representing Civitas — an organization of residents of Manhattan's East Side that had opposed the 96th Street building since its inception. Civitas pointed out the error in the approval of the building to the City Department of Buildings in 1986.

## Applicability of the Model

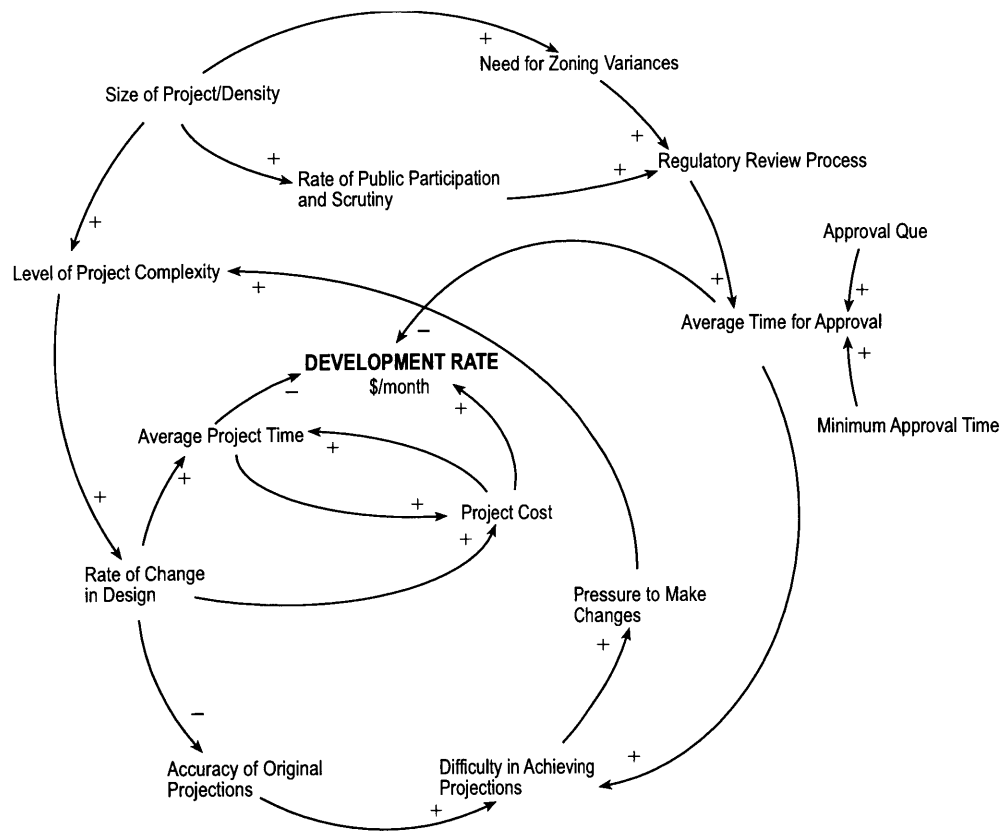
This case illustrates the power of the regulatory agencies and is probably the most dramatic example of a penalty for a zoning violation. The City of New York exercised its power to have the developer conform with existing zoning height limitations. The unusual twist to this case is that the city stepped in after the developer had completed construction of the exterior of the building. The case illustrates the accountability of government to its constituents and is an example of government wielding its power to reverse an action already completed by a developer. Government agencies in the development process will almost always act in a preemptive fashion. Had Civitas not pointed out the violation to the city, the 12-story truncation may have been avoided and the top 12 stories may have been occupied today.

Figure 29 illustrates how the general relationships in the model are applicable to this vignette. With a minor modification to eliminate the quality components the model can be applied to the vignette. In this case the *size of the project or density* caused the *rate of public participation and scrutiny* to increase. The raised concern of the

special interest group Civitas caused an increase in the *regulatory review process*. While construction of the project was already near completion the *time for approval* of the occupancy permit was increased which increased the developer's *difficulty in achieving the original projections*. The pressure to reduce the quality, or in this instance the *pressure to make changes*, clearly had a significant impact on the *level of project complexity*. The *size of this project*, its density greater than allowable, also contributed to the complexity.

The *project costs* escalated but the *development rate* decreased due to an overriding increase in the *average time for approval* and the *average project time*. The *average project time* also had a positive feedback relationship with the *project cost*. As the *project time* increased the *project cost* increased which created rework of the original plan causing the *project time* to increase.

Figure 29



At the outset, had the developer reduced the *size of the project*, the *public scrutiny* and the *need for zoning variances* would have been reduced or eliminated. The time required for the *regulatory review process* would

have been reduced, increasing the *development rate* and reducing the *difficulty in achieving projections*. The pressure to make changes would have declined reducing the level of project complexity and the rate of change in design. A reduction in the *rate of change of design* would lower average project time and also increase the *development rate*. *Project cost* would also have declined thereby reducing the pressure to finish the project faster lowering the *development rate*. The effect of lower *project cost* on increasing the *development rate* is far outweighed by the reduction in *average project time* and in the *average time for approval* that lower the *development rate*.

One can not come to a conclusion about this case without interviewing the developer. Had the developer known that the project would have raised the concern of the public if the project was built as originally planned, perhaps a decision may have been made earlier in the process to make a change to reduce the scale of the project. A systems approach is instructive in understanding the dynamics of this case and, in retrospect, may have been useful for the developer in avoiding the expense of delays and conflict.

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### 3.6 Lessons Learned

Building a systems model that accurately represents the dynamics of a problem is difficult. Two of the three system dynamicists did point to the difficulty in creating a model that accurately describes the system being studied. One of the system dynamicists explained that people will often be intimidated by the systems approach and will dismiss it because it does not accurately represent all the factors that need to be considered.

*Often people will look at the diagram and say 'this is far too complex, but your still not catching the crux of the problem.' [Systems Dynamicist 3]*

Systems dynamicist 2 elaborates,

*Most people will look at a system diagram and space out. A disadvantage of system dynamics is that it is very difficult to put together a good model. In getting people to understand, it is important to break the diagram down into its major pieces and that puts them in the right frame to give them something that they understand at a total level and then they can look at the detail later. [Systems Dynamicist 2]*

*In introducing a systems approach it is important to look at most central issues first or else people's eyes will glaze over. (Systems Dynamicist 3)*

## Reluctance to Change

Both developers saw the systems approach as an interesting way to get a picture that illustrates the problems in the development process. However, developer 2 felt that it could not take into account the behavioral aspects, "the judgement part or the interpersonal nature of the real estate industry."

Perhaps developer's suspicion about a new methodology causes them to cling to their established methods. The systems modelling approach may be intimidating and developers with more experience are probably most resistant to change. As Bakken (1992) has observed, the more experience or "context familiarity" that a person has will require a greater amount of cognitive resources to relearn, which will create interference with performance of the task at hand. Bakken's findings may provide insight into the reason why developers were generally uninterested in the systems approach or in new ways of approaching their problems.

Perhaps the developers expect a panacea and do not see the value of change. Developers may operate in a somewhat instinctual manner. Systems dynamicists 1 has spent a lot of time consulting for the shipping industry and observes some parallels in personality traits: "Shippers and real estate developers may have similar personalities. They use their experiential mental models for decision making." Perhaps the perception that too much effort is required for introspective evaluation in the short term prevents developers from unfreezing their exiting mental models for decision making. Developer 2 was forthcoming in his appraisal of a systems approach:

*The problem I have with MIT is that they try to boil everything down to numbers and models. Numbers and models are secondary to the interpersonal nature of the real estate development process. There is a judgement part when you talk about the future. To me it seems that in trying to apply a systems approach you are trying to create a fixed box solution for a fluid environment. The variables are always changing. How can you know what is going to be the next variable that impacts your decision making process.*

*To think that developers just make their projections and then use their intuition to make the decision is naive. Developers don't believe their own numbers, it's not a quantitative decision. There is a judgement part in deciding how much TI allowance do I need to give and what other concessions will be required.*



System dynamicist 1 asserts that "*the individual player wants to know 'how can I avoid problems', 'how can I beat my competition'.*" To make a systems approach appealing to developers practical examples are necessary. Systems dynamicist 1 feels that a systems approach can gain acceptance as a collaborative effort if:

*the developer can act as an educator, a persuader, to get systems thinking across. The models used must be understandable and credible. However, the model can not be too simple and it must be objective. It is important not to simplify the model to the extent that it is not realistic.*

Consensus between the system dynamicists and the developers on the application of a systems approach was not reached. Obviously the system dynamicists could see practical application, but the developers did not feel the same way. Real estate developers had a difficult time seeing how they could rely on a systems approach. Developer 1 was skeptical:

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*The question in applying it to real estate is the number of loops and variables that must be taken into account. The number of variables to try and tie together is quite a few.*

The individual developer may feel like a quark in the universe of real estate. Developers may be of the opinion that any action taken individually is not going to have a significant impact on the system as a whole. This may not be entirely true since the actions of one developer can change the perception of other developers or players in the industry. For example, if one developer begins to run into financial difficulties it can injure the perceived financial standing of not only that developer, but of other developers, causing the sources of debt and equity to take a much more aggressive posture. Sterman (1989a, p. 328) explains:

*For any individual firm in a competitive economy, the environment may appropriately be viewed as exogenous. Yet the interactions among these individual firms create strong feedbacks, which cause locally rational decision-making procedure to produce results which are not only unintended but globally dysfunctional.*

There is difficulty in making appropriate decisions without considering the overall systematic outcome. The real estate industry has long exhibited a pattern of weak behavior. Kleinmuntz (1993, p. 223) reports that recent studies indicate that a pattern seems to be emerging: "*Decision makers have exhibited systematic patterns of poor performance that suggest that they are insensitive to the implications of feedback in these dynamic environments.*" Developers are guilty of *groupthink* (Janis 1982, qtd. in Sterman, 1994, p. 313) as evidenced by the congregative mentality of the real estate industry. This creates a conflict ripe environment

once the market begins to sour and each player attempts to limit their individual losses. Thornton (1992) contends that developers are not open to having their mental models challenged and often relied on intuition and searched for information that supported their predetermined mental models. Sterman (1994) supports that such defensive routines often lead to groupthink. As a group developers tend to "*mutually reinforce their current beliefs, suppress dissent, and seal themselves off from those with different views or disconfirming evidence*" (Sterman, 1994, p. 313). When the market makes a turn for the worse developers and others in the industry begin the conflict ridden process of damage mitigation. Each player will attempt to minimize the losses they face due to *unexpected* circumstances. The propensity of developers and other players in the development process to place the blame on others must change. Senge (1975, p.79) explains:

*In using a systems approach it is important to give up the thinking that there must be an individual, or an individual agent, responsible. The feedback principle of systems dynamics suggests that everyone shares responsibility for problems generated in the system. It does not however imply that everyone can exert equal leverage in changing the system. But it does imply that the search for scapegoats is a blind alley.*

The linear nature of the current real estate development model does not explicitly allow for feedback. Developers have mental models of how this feed back occurs, but the complexity in the process does not lend itself to the use of mental models. Senge (1975) reports that the complexity of the process can easily undermine confidence and responsibility. Developers who view development as simply a shopping list of tasks are not understanding the dynamic complexity of the causal relationships within the system. A systems approach is a mechanism for getting at the underlying dynamic complexity.

## 4. CONCLUSIONS

This thesis proposes that an optimization technique is needed for the preconstruction phase of development projects. Many have observed that feedback delays in decision making are the cause of oscillation or cyclical-ity in the system. There is a lot of time spent by developers and their capital sources analyzing what will offer the best return on their investment. Traditionally the approach has been somewhat ad hoc. Development has been considered to be sequential - single tasks performed with ad hoc interfacing among the members of the project. The members of the development team traditionally specialize in the disciplines of architecture, engi-neering, finance or law. The vertical specialists view of the horizontal linkages is serendipitous. The vertical orientation does not necessarily motivate an individual to comprehend. A new model is needed to replace the feeling out style of collaboration among professionals involved in real estate development. A model that can bridge the gap, organize, interpret and communicate. The globalization of markets has created a much more competitive and complex economic, political, social and environmental climate for developers to operate in. Senge (1975, p. 69) observes that:

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*Today, a systems approach is needed more than ever because we are becoming overwhelmed with complexity. Perhaps for the first time in his-tory, humankind has the capacity to create far more information than any-one can absorb, to foster far greater interdependency than any one can manage, and to accelerate the change far faster than anyone's ability to keep pace. The scale of the complexity is without precedent.*

The real estate development process suffers from the lack of tool for creating a new body of knowledge. It is in this context that a systems approach as a collaborative effort would prove most useful in the real estate industry.

The intent of this paper is not to focus solely on managing delays and conflict during the preconstruction phase of a real estate development project but to use the development process as a starting point. The real estate industry functions by employing a broad range of process oriented collaborative activities. A systems approach could be used to break the issues into a series of steps, allowing the players involved in each activity to gain a better insight into the dynamics of the process. Activities such as acquisitions, development of new buildings, adding value to existing buildings, restructuring ownership and the financing of the real estate asset could all benefit from a systems approach.

This section suggests recommendations for change in the preconstruction phase of a real estate development project.

#### 4.1 Recommendations for Change

During the *soft* preconstruction process of a development project process there exists a feeling out style of collaboration used among professionals. What this research aspires to promote is the adaptation of a new paradigm for the soft process. This new model for the soft process is a systems approach to decision making and conflict management. A systems approach is a way to bridge the gap between the players and a new way for the real estate industry to organize, interpret and communicate information. A way to understand the dynamic interaction of a number of interrelated issues.

The notoriously chronic cyclicity in the real estate industry indicates that real estate developers need to reevaluate their current strategy for decision making in bringing new projects to the market. The problems with the strategies currently used in real estate development creates conditions of undiscussability and escalating error. As Argyris (1992) suggests these conditions reinforce vagueness and lack of clarity in the process.

The decisions a developer makes in assessing project viability are important long after the development is complete. A system dynamics approach can lead to less risky gambling in making decisions with long lasting effects. It is a tool for decision making and risk analysis. Developers do have tools for analyzing the risk and attempt to diversify the risk associated with real estate by undertaking different types of projects in different locations. However, the ability to increase the likelihood of success can be enhanced by employing a systems approach. It is not entirely impossible to imagine how a systems approach could become pervasive throughout the real estate industry as many of the problems faced are of a dynamically complex nature.

The developer's spreadsheet models and forecasts can't model the dynamic complexity of the real estate industry. Sullivan (1984, p. 207) contends that "*no process is really effective if it fails to provide a good precedent for the future.*" The spreadsheet based forecasts and models while useful in some instances have obviously proved to be ineffective in decision making in a dynamically complex environment.

The use of simulations of the real environment can become an integral part of a conflict management strategy. As Sterman (1994, p.317) suggests "*decisions that are dangerous, infeasible, or unethical in the real system can be taken in the virtual world.*" There are currently two real estate specific simulation games available that can stimulate thinking about systems and sensitize real estate developers to the system dynamics approach. The Real Estate Management Flight Simulator (Bakken, Sterman & Oliva, 1993) and Maxis SimCity 2000<sup>4</sup> (Wright and Haslam, 1993) are both fun and instructive simulations that require decision making in a dynami-

cally complex environment. Both allow the players to play with variables that interact dynamically with each other. An informal survey indicates that few real estate industry professionals are aware that an analysis tool such as system dynamics exists and fewer have attempted to apply it.

A more rigorous approach to research in the virtual world of decision making in the real estate industry is necessary. Application of system dynamics to the real estate industry may reveal inconsistencies in the mental models of not only developers but also the sources of capital and the regulatory agencies. Sterman contends that:

*without simulation, even the best maps can only be tested and improved by relying on the learning feedback through the real world. As we have seen, this feedback is very slow and often rendered ineffective by dynamic complexity, time delays, inadequate and ambiguous feedback, poor reasoning skills, defensive reactions, and the cost of experimentation. In these circumstances simulation becomes the only reliable way to test the hypotheses emerging from elicitation techniques and others problem-structuring methods. (1994, p. 321)*

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Forrester also asserts the need for a more rigorous systems dynamics model:

*Systems thinking can, of course, be a door opener for systems dynamics. The danger lies in people believing that systems thinking is the whole story. It is not. It is just a sensitizer — something that call attention to the existence of systems. Some people feel they have learned a lot from systems thinking, but they have gone less than 5 percent of the way toward a genuine understanding of systems. The other 95 percent lies in the rigorous systems dynamics-driven structuring of models and in the simulations based on those models. Only these simulations — and nothing else — can reveal deep inconsistencies within our mental models. [Keough and Doman (1992, p. 17) an interview with Jay Forrester]*

To gain more confidence and formalize the conceptualized relationships of the model composed in this paper it is necessary to validate the behavior's. The system dynamicists interviewed all pointed to the difficulty in creating a good model. The creation of a good model requires professional skill in order to create a useful model it will require the effort of a wide range of players on the real estate industry to collaborate. Through group discussions, Delphi surveys experts can be confronted and through knowledge elicitation further validation of the conceptual model can be achieved. Vennix (1990) suggests such a methodology for building conceptual models. Senge (1992, p. xviii) reports on the difficulty in creating and implementing systems models:

*efforts to eliminate the “soft stuff” and concentrate on the practical appli-*

*cation of "the systems tools" to analyze and improve organizational systems invariably run up against implementation problems. People discover that the best systematic insights don't get translated into action when people don't trust each one another and cannot build genuinely shared aspirations and mental models. Conversely, for years social scientists and team building consultants have attempted to foster greater trust and openness in management teams, only to discover that ultimately change is limited unless people have new ways of understanding their practical business issues — not just better ways to interact.*

There also needs to be more work done in this regard to understand the dynamics of group decision making in collaborative activities in the field of real estate. Real estate is a collaborative venture and there are many points of interface between the players that create the opportunity for misunderstanding or conflict.

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Thornton (1992, p.79) found that "*the cause of the cyclical behavior of real estate markets is internal to the development system.*" The developer reacts to external pressures without considering the internal effects. As a consensus building model, a collaborative systems approach can allow the sources of external pressure to understand how their decisions affect the entire system. Through retrospective analysis a more stable system may be achieved. Perhaps there is a perverse relationship in the industry - the inefficiency in the industry incentive system creating opportunities and allowing the natural selection process to operate - the best developers survive the swings in the market and others become extinct. Developer 1 referred to the greater fool dilemma that plagues the real estate industry, "*there are a lot of people who understand some of the best projects you do are the ones you don't. However there is always somebody out there who is willing to do it, because they see things differently.*" This is an inherently conflict ridden mentality that causes developers to take on risky projects. Sterman (1994, p. 317) explains that "*rather than leading to stability, evolution may select against conservative investors and increase the prevalence of speculators who destabilize the industry*". The incentive structure in the real estate industry, the pressure to 'do the deal', may be a source of the problem in the real estate industry. Thornton (personal interview, June 1995) expressed his frustration with the boom and bust phenomena:

*It's a deal driven system. Some one once asked me "How do you compensate someone for not doing the deal?" . The technical issues are not the problem it's the inability of people to make the effort to do something about the problem.*

Real estate development is an industry with long lead times but developers take a short term view in making decisions. Perhaps Forrester described it best (Keough & Doman interview, 1992, p. 9) *"an intuitive approach to adjusting production level is apt to be counterproductive. People usually react too quickly and do too much. They forget that the right advice is, 'Don't just do something, stand there!'"*

There must be awareness created that cyclicalities are a costly problem not only for the developers but for society as a whole. Once developers are able to identify the problems in the industry they can begin to address them. A new approach is needed to optimize the decision making and begin to create some clarity in the process. There needs to be a serious advancement in the understanding of the system in which real estate is brought to the market. The decision to develop real estate projects has an impact on the benefits to society and all players involved in the process should strive to increase those net benefits. The effects of the current deal making structure has a ripple effect throughout the entire industry and the economy. Argyris (1992, p.26) suggests that *"human nature is significantly alterable."* Once developers and other players on the development team realize that they are part of the problem only then will they become enthusiastic and inquisitive about the study of system dynamics. A systems approach offers developers a chance to learn from past mistakes, create new paradigms for the future and ultimately contribute to an increased standard of living as Argyris (1976) suggests.

## 5. Appendix A: Preparatory Interview Information

The following introduction was provided to both systems dynamicists and real estate developers.

The boom and bust phenomena in the real estate industry reveals that the developer's decision making process needs reconsideration. It is in this context that a systems approach as a collaborative effort would be a novel technique for the real estate industry. The concepts of systems approach are applied as a tool for understanding the dynamic complexity of the interaction of variables and as a strategic method for decision making and conflict management. Informal research indicates that systems thinking, as a strategic tool for analysis, has been overlooked by the real estate industry.

Uncertainty is apparent in the property market, the capital markets and the way real estate development is approved by the regulatory agencies. There is also uncertainty in the determinants of demand for real estate. The uncertainty on many fronts is a confounding experience; for developers who create the property, for the capital markets that finance it, and for the government bodies that regulate it. As complexity increases, the lead time required to make decisions increases, which drives up costs, increases delays and creates further inefficiency in the real estate market. Delays have a negative impact on the developer's decision making process, which creates further delays that can result in conflict. By breaking the development process into its component parts a systematic approach can be developed to define the interconnected causal relationships of the risks associated with uncertainty and delays. Research by others has shown that cyclicalities in the real estate industry can be explained, in part, by the delays in bringing new projects to the market. The hypothesis is that there are two general processes that create delays when attempting to increase supply of space to meet the demand. The physical or *hard* process of construction and the more intangible or *soft* process prior to construction. The assumption is that there is little that can be done to further enhance the structural delay of construction. The hard process has adopted a generic optimization technique in the form of CPM and PERT diagrams. There is however no optimization technique that has been adopted for the soft process. Therefore, the focus of this research is on understanding the soft process.

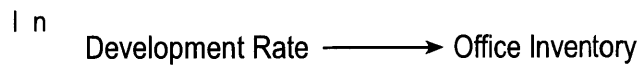
In the soft process there exists a feeling out style of collaboration used among professionals. What this research aspires to promote is the adaptation of a new paradigm for the soft process. This new model for the soft process is a systems approach to decision making and conflict management. A systems approach is a way to bridge the gap between the players and a new way for the real estate industry to organize, interpret and communicate information. A way to understand the dynamic interaction of a number of interrelated issues.



## Appendix B

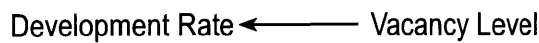
The following diagrams are provided to lay preparatory ground work for applying a systems approach to the real estate industry. Examples are given in a real estate context.

### Linkage



this example of a **linkage** the development rate causes the office inventory level to change.

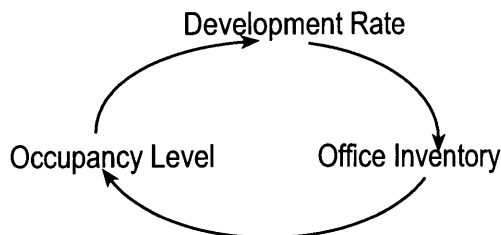
### Linkage



This **linkage** depicts the development rate as being affected by the vacancy level.

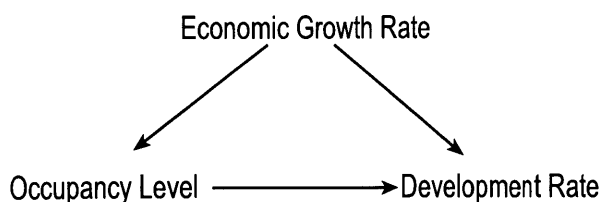
57

### Feedback Loop



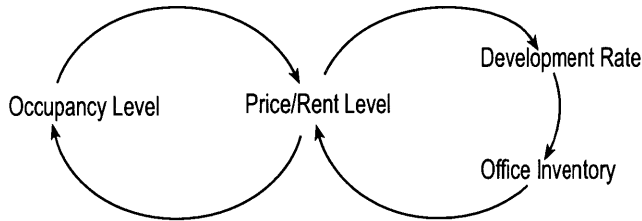
This is an example of a **feedback loop** where the *development rate* affects the *office inventory*, which in turn influences the *occupancy level*. The *occupancy level* closes the loop by influencing the *development rate*.

### Multiple Linkages No Feedback



In this diagram, **multiple linkages no feedback**, the *economic growth rate* is shown to influence the *occupancy level*, which in turn affects the *development rate*. The *economic growth rate* also influences the *development rate*. The three variables in the diagram are connected, but not in a closed feedback loop. The arrows can not be followed around back to a starting point.

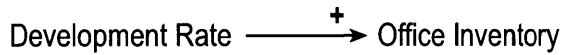
## Interconnected Feedback Loops



The **interconnected feedback loop** illustrates how the interconnection loops can lead to the creation of a feedback system. The *occupancy level* which will influence the *rent/price level*. This loop interacts with another loop. The *rent/price level* in the first loop has an impact on the *development rate* which adds to the *office inventory*.

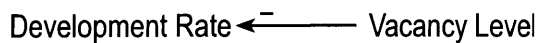
58

## Positive Link



The **positive link** illustrates how an increase in the development rate will cause an increase in the level of office inventory.

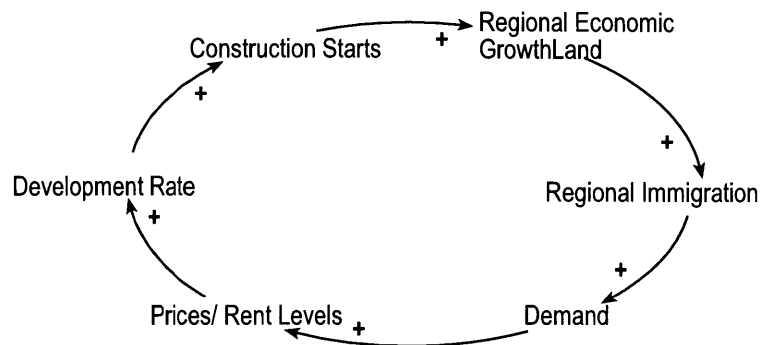
## Negative Link



This **negative linkage**, illustrates that an increase in the vacancy level will cause a decrease in the development rate. Conversely, a decrease in vacancy will cause an increase in the development rate.

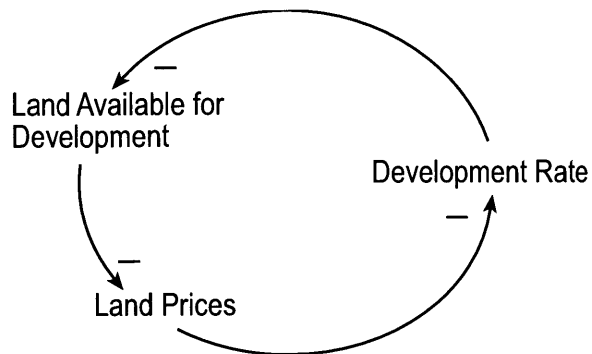
## Positive Feedback Loop

Causal loop diagrams like the links are also directional. A **positive feedback loop** acts to reinforce variable changes in the same direction as the change, contributing to sustained growth or decline of the variables in the loop. This loop suggests that as regional immigration increases, the demand for real estate also increases, leading to an



increase in price and rent levels. As price and rent levels begin to increase the incentive to develop increases the development rate, which increases the number of construction starts which in turn contributes to regional economic growth that makes the area more attractive as a destination for immigration.

**Zero or an even number of negative links indicates a positive feedback loop.**



### **Negative Feedback Loop**

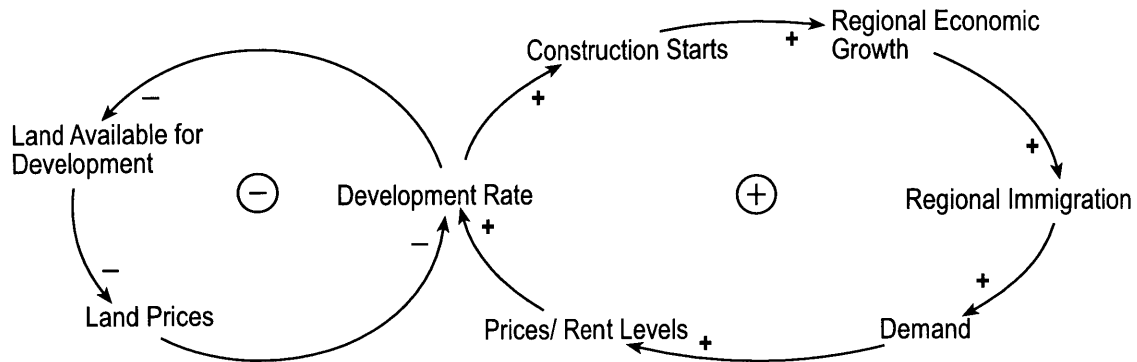
A **negative feedback loop** resists or counters variable changes, thereby pushing toward a direction opposite to change, contributing to fluctuation or maintaining the equilibrium of the loop.

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In this example an increase in the development rate will cause the land available for development to decrease. As the land available for development decreases upward pressure is put on land prices which decreases the development rate.

**An odd number of negative links indicates a negative feedback loop.**

## Coupled Positive and Negative Loops



In the example shown, **coupled positive and negative loops**, the positive feedback loop above has been coupled with the negative feedback loop above. This example suggests that the land available for development is the limiting factor to growth.

### Positive Loop Symbol



This symbol, found in the middle of a positive feedback loop informs that the loop acts to reinforce variable changes in the same direction of the change to sustain growth or decline in the feedback loop.

### Negative Loop Symbol



This symbol, found in the middle of a negative feedback loop informs that the loop acts to counter change in the opposite direction of change contributing to fluctuation or to maintain the equilibrium of the loop.

## Appendix C: Message on System Dynamics Society Bulletin Board

To: system-dynamics@world.std.com  
From: jrichter@mit.edu  
Topic: Application of system dynamics to the real estate industry

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To the System Dynamics Community,

I am a graduate student at the MIT Center for Real Estate and am hoping to get direction on resources for my thesis topic:

Conflict Management Strategies for Real Estate Development:  
Toward a Systems Approach for Decision Making

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I believe that there is a positive relationship between uncertainty, delays and conflict. It is in this context that I feel a systems approach as a collaborative effort would be most useful in the real estate industry.

As I have delved deeper into the real estate development process I have observed that delays in the process are a contributing factor to cyclicity in the industry. Much of the focus has been on delays in construction. I feel this needs refinement. Construction already has optimization techniques such as PERT and CPM diagrams, and I don't believe there is much that can be done to shorten the hard process of construction. However, I feel that investigation of the 'soft' process, the preconstruction stage, has been neglected as a contributor of delay. Also, I don't know of any successful optimization techniques used for this soft process. There is a great deal of uncertainty and a number of interrelated issues that must be resolved before construction can commence. I feel that this uncertainty and complexity is a contributing factor to conflict and delays.

I am new to the discipline of system dynamics. What I want to accomplish in my thesis is a synthesis of a stage 1 systems model ( I don't believe I have the necessary background or experience to create a quantitative system model or 'stage 2' model, yet.) I want to introduce a the interrelationship of a number of issues that create complexity in the preconstruction stage of a development project.

I have found the work of Thornton (1992) and Hernandez (1991) to be useful but am having trouble finding other applications to the real estate industry. If anyone has applied system dynamics to the real estate industry, has examples of systems models that pertain to the real estate industry or is willing to provide comments, criticism or suggestion on my thesis I would very much appreciate it.

Thank you very much for you help.

Jonathan Richter

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## Endnotes

<sup>1</sup>Senge, (1990, p.8) describes *mental models* as deeply ingrained assumptions, generalizations, or even pictures or images that influence how we understand the world and how we take action. Very often we are not consciously aware of our mental models or the effects they have on behavior, instead we naively believe our senses reveal the world as it is.

<sup>2</sup>A more complete treatment of single and double loop learning can be found by referring to Argyris (1976, 1993)

<sup>3</sup> Messages can be posted at the System Dynamics Society Bulletin Board at the following address:  
system-dynamics@world.std.com

<sup>4</sup> Maxis and SimCity are registered trademarks and SimCity 2000 is a trademark of Sim-Business.