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Lascelles Adams
University of Central Florida

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AN INFORMATION SYSTEM DESIGN RESEARCH FRAMEWORK SUPPORTING THE DESIGN, DEVELOPMENT AND DELIVERY OF MORE EFFECTIVE INFORMATION SYSTEMS

by

LASCELLES A. ADAMS
M.S. University of Central Florida, 1987
MBA, University of Central Florida, 1980

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Major Professor: James F. Courtney

ABSTRACT

Many IT systems fail to realize their objectives because not enough attention has been paid to the business context in which the system functions. One reason expressed - an emphasized technical focus which tend to omit business and organizational issues germane to the organization's and the system's success. When an organization's information system is in line with, and provides support for its business strategy – strategic alignment – superior business performance is often the result.

Within the Requirements Engineering (RE) community there has been several attempts to develop and utilize approaches which can illuminate business and organizational informational needs. In this dissertation, the DAGS framework is used to develop an integrated web-based requirements elicitation system which is based on Critical Success Factors (CSFs), Jackson's problem diagrams and organizational strategy analysis technique to represent and model an organization's IT requirements.

This research employs the DAGS (multi-methodological approach consisting of ***D***esign Science, ***A***ction Research, ***G***rounded Theory and ***S***ystem Development research methodologies) framework for Information System (IS) design to assist the Information Technology (IT) department in developing a collaborative user requirements system to assist in designing and constructing more effective information systems by incorporating the needs of various stakeholders in support of organizational goals while satisfying these varied needs.

Top management's field of vision is represented in the CSFs which provide a compelling clarification of what is important to the organization. Failure to achieve a CSF directly affects the

organization’s ability to accomplish its mission; Research shows that alignment of IT systems with business strategy leads to superior organizational performance. Industry professionals have consistently considered alignment of IT with business strategy essential to their success thus requirements for an organization’s information systems need to be aligned with the objectives of the business strategy that its stakeholders intend to support.

This dissertation contributes to the literature on validating an organization's IT and Business Strategic alignment. It has also provided an example of research, grounded in theory but which is nevertheless relevant to business.

"**The systems approach begins when first you view the world through the eyes of another.**"

– C. West Churchman

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TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

CHAPTER ONE: INTRODUCTION

The implementation of an information system within an organization represents the efforts of its primary stakeholders to leverage the organization's resources – information system capabilities, organizational characteristics, its processes, its people, and its development and implementation methodologies – to improve organizational efficiency and effectiveness in accomplishing its mission. Information systems (IS) research involves the study of the application of information technology (IT) to organizations and society (Keen 1980). The goals of IS research are to promote the acquisition of knowledge about, and the documentation of, how individuals, groups, organizations and society can use information systems and the technology embedded in such systems more efficiently and effectively, i.e., improve the effective planning, design, implementation and utilization of information technology. Hence, it is essential that IS researchers produce knowledge that assists in the productive application of information technology in the management and administration of human organizations. Put simply, IS research should be theoretically grounded but relevant to practice (Benbasat and Zmud, 1999).

According to March and Smith (1995) the acquisition of IS research knowledge is derived from two complementary but distinct paradigms: behavioral-science which has its roots in natural science research methodology and seeks to develop and validate theories that explain human and organizational phenomena pertaining to the analysis, design, implementation, management, and utilization of information systems; and design-science which has its roots in engineering methodology and seeks to create innovations that depict the ideas, practices, capabilities, and products through which the analysis, design, implementation, management and utilization of information systems can be effectively and efficiently accomplished (Hevner et al.,

2004). According to Markus et al. (2002) and Walls et al. (1992) the designed artifacts rely on existing behavioral-science kernel theories that are applied, tested, and modified to extend the boundaries of problem solving and organizational capabilities.

In this context, IS research should be regarded as more an *applied* discipline rather than a *basic/pure* research discipline (Moody and Buist, 1999). Applied disciplines have two primary objectives, one theoretical and one practical (Phillips, 1998). The theoretical objective is to increase (theoretical) knowledge. The practical objective is to understand why things happen in a particular context, and to improve practice by conducting research that will ultimately yield useful social and organizational benefits. As a class, applied research disciplines often use theory from other disciplines and apply it to solve practical problems. In information systems' case, this trend (reliance on reference disciplines) will almost surely continue into the future; however, the evidence indicates: (1) information systems is emerging as a key reference discipline itself, and (2) a new research doctrine, multi-paradigm research, is emerging and gaining acceptance within the IS community (Vessey et al., 2002).

This approach to research has spawned a controversy concerning its legitimacy. Advocates of the multi-paradigm approach such as Daniel Robey (1996) argue that it is the nature of multi-disciplinary studies that creates these disputes and also the opportunity to examine or resolve them by including different perspectives. It is Robey's belief that IS requires *disciplined methodological pluralism*, a phrase coined by Landry and Banville (1992) to convey their belief in "a diversity of methods, theories, even philosophies." Kaplan and Duchon (1988) proposed merging the quantitative and qualitative methods and perspectives to a single research paradigm that would allow researchers to gain insights that a single methodology or method cannot provide (Kaplan and Duchon, 1988).

Proponents of the behavioral-science paradigm such as Benbasat and Weber (1996), not only dispute Roby's assertions, but also propose the establishment of a central paradigm for IS research. These authors believe that "Theories are the fundamental factors that shape the course of a discipline. IS needs a core (to the discipline) that gives it identity" (1996, p. 393). In many respects, the concerns with multi-disciplinary research methodology expressed by many is the latest re-embodiment of the long running debate concerning "positivist" versus "intrepretivist" approaches, quantitative versus qualitative methods, and "has almost transformed IS research methodology into a research area itself" (Moody and Buist, 1999).

Despite the contention of many about the possible detrimental effects of diversity in IS research, it may be the traditional hypothetic-deductive approach which has produced unintended consequences. The focus on the hypothetic-deductive research method has "resulted in research which, although highly rigorous from a methodological point of view, addresses research questions which are either trivial or irrelevant" (Moody and Buist, 1999). Or, as Galliers asserts, "While rigorous in methodological terms, it may be argued that little knowledge of practical value is produced as a result" (1994). From their survey of IS design literature, Wynekoop and Russo (1997) concluded that there was a "lack of serious empirical research into the efficacy of methods in practice" and "a need for validation of methods in organizational contexts using real practitioners."

If reductionism and "rigor" have led to irrelevancy as claimed then such a development ignores the wider objectives of IS research within the domain of IS practice and of society in general - to contribute to the development of improved practices. We need to focus on improving the contributions of IS research to professional practice since as an applied discipline "practical

credibility is at least as important as, if not more important than, academic respectability" (Moody 2000, p. 352).

Expanding the Knowledge Base

The IT industry with its wide range of products and services provides a smorgasbord of opportunities for academic research (Westfall, 1999). This opportunity can be exploited to contribute and expand the foundation upon which knowledge claims in the field are based and to expose problems and identify opportunities via "research of interest" to practitioners (Roby and Markus, 1998; Davenport and Markus, 1999). Within this sphere are problems which have potentially large economic or societal impacts but despite extensive research remain unsolved (Westfall, 1999). These types of problems are very appropriate for the theories, tools and techniques associated with rigor. Examples of such seemingly unsolvable problems are: expert systems, electronic meeting systems, and the long-standing general information system development failures.

Nunamaker et al. (1990) argue that system development is a central part of a multi-methodological approach to IS research. This pivotal role of system development stems from the fact that the developed system serves both as a proof-of-concept for the fundamental research and theoretical underpinnings and provides an artifact that can become the focus of other research projects. Nunamaker et al. (1990) proposed a research process for the system development approach that consists of five stages:

1. Construct a conceptual framework,
2. Develop a system architecture,

3. Analyze and design the system,

4. Build the system, and

5. Experiment, observe, and evaluate the system.

Systems development is not simply developing a piece of software. However, the synthesis and expression of new technologies and new concepts in a tangible product can act as both the fulfillment of the contributing basic research and as an impetus to continuing research.

While building a system does not necessarily constitute research, Nunamaker et al. (1990) argue that the synthesis and expression of new technologies and new concepts in a tangible product can contribute to both basic and applied research and act as an impetus to continuing development of an IS knowledge base. The use of system development (SD) as a research methodology has been argued and defended by many IS researchers (Nunamaker and Chen, 1990, Nunamaker et al., 1991, Gregg et al., 2000, Burstein and Gregor, 1999). System development has been classified as constructive research method (Iivari et al. 1998). Gregg, et al. (2000), proposed the Software Engineering Research Methodology (SERM), which is described as "an approach that allows the synthesis and expression of new technologies and new concepts in a tangible product that can contribute to basic research and serve as an impetus to continuing research"(Nunamaker et al., 1991). SERM includes "proposing, formalizing and developing software systems to improve the effectiveness and efficiency of processes at the individual and organizational level (Gregg et al., 2001).

IS research has been criticized for the lack of the artifact in subject studies (Weber, 1987, Orlikowski and Iacono, 2001). Orlikowski and Iacono (2001) strongly propose that the IT

artifact, by itself, should be a central phenomenon to focus on. However, DeSanctis (2003) argue that the shifting boundaries of scholarly attention away from the IT artifact may be reflective of the field's maturity. A reasonable argument can be advanced that technological transformation within the IT industry and the ubiquity of computing technology are altering the focus afforded the IT artifact. Today, IT managers and practitioners are increasingly viewing technology as a commodity whose value lies less in the specifics of design than in the ingenuity of its use (DeSanctis 2003). The transformation of IT into a strategic business partner requires new roles and competencies for IT leaders and practitioners and the challenges are largely social and organizational, rather than technical (Roepke, 2000).

System development is a viable research methodology that researchers can use to fill the gap between the social and technological aspect of IS research. The rigor of the SD methodology as a research methodology has been questioned and the evaluation criteria issues have been raised by many researchers (Weber, 1987). Nunamaker et al. (1990) proposed five criteria to which SD research must conform (p. 101): (1) the purpose is to study an important phenomenon in areas of information systems through system building, (2) the results make a significant contribution to the domain, (3) the system is testable against all the stated objectives and requirements, (4) the new system can provide better solutions to IS problems than existing systems, and (5) experience and design expertise gained from building the system can be generalized for future use.

Several researchers have suggested ways of alleviating these concerns. Lee (1989) proposed a case study method that "satisfies the standards of the natural science model of scientific research," while Eisenhardt (1989) describes a process for building testable, empirically valid theory using case study research. Moody and Buist (1999, p. 646) advocate

that “Medicine, engineering and architecture should act as role models for IS, as disciplines, which are academically respectable, as well as being highly relevant to practice. Why shouldn’t IS use theory from more pure disciplines and apply it to solve practical problems in the same way that medicine applies results from chemistry and biology to save lives?”

As Benbasat and Zmud (2003) surmise, the IS discipline involves much more than the study of the IT artifact. IS scholars and practitioners strive to increase their collective understanding of (1) how IT artifacts are conceived, constructed and implemented; (2) how IT artifacts are used, supported and evolved, and (3) how IT artifacts impact (and are impacted by) the context in which they are embedded. Within the IS discipline artifacts are broadly defined as constructs (vocabulary and symbols), models (abstractions and representations), methods (algorithms and practices), and instantiations (implemented and prototype systems) (Hevner et al., 2004), i.e., a confluence of people, organizations and technology (Davis and Olsen, 1985; Lee 1999; and Nunamaker et al., 1991). As March and Smith (1995) contend, examination of the IS artifact enables IS researchers and practitioners to understand and address problems in developing and successfully implementing information systems within organizations.

A framework for more effective solution

This quest for more effective solutions not only includes the evaluation and/or analysis of existing systems, but also the development of new theories and methodologies for information systems design. It is the need for the development of new methodologies that has allowed researchers to study design science research. Nunamaker et al. (1991) classified design science as applied research, or research that applies knowledge to solve practical problems. To March

and Smith (1995), design science attempts to create things that serve human purposes, as opposed to natural and social sciences, which try to understand reality.

Design science consists of three basic activities: designing, building and evaluation. Information systems design science designs, builds, deploys and evaluates constructs, models, methods and instantiations of information systems. Design science seeks to create innovations that define the ideas, practices, technical capabilities, and products through which analysis, design, implementation, management, and use of information systems can be effectively and efficiently accomplished (Denning 1997; Tsichritzis 1998; Hevner 2004). These innovations rely on existing kernel theories that are applied, tested, modified and extended through experience, creativity, intuition and problem solving (Markus et al., 2002; Walls et al., 1992). The relevance of IS research is directly related to its applicability in design (Hevner et al., 2004), or as Benbasat and Zmud (1999) concluded, empirical IS research should be implementable.

Action research is an established social and medical science research method that has garnered importance in the information systems community within the last decade. "Action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework" (Rapoport, 1970). Researchers who employ either methodology are united in their beliefs that complex social systems, especially those involving organizations and information technologies, cannot be simplified, factored or compartmentalized and must be studied as intact entities. Action research is unique in "the way it associates research and practice, so research informs practice and practice informs research synergistically" (Avison et al., 1999). It combines theory and practice, in an iterative process involving researchers and

practitioners acting together on a particular cycle of activities, including problem diagnosis, action intervention, and reflective learning.

System development methodology has been suggested as an ideal domain for the use of action research (Baskerville and Wood-Harper, 1996). In fact, in a study conducted by Lau (1997) in which he reviewed articles that have used action research over a twenty-five year period found that 11 out of the 30 articles were categorized as system development. Additionally, Parker et al. (1994) argue that system development is a form of action research when the researcher is involved in the construction and testing of a method or an information system in real-world setting.

Grounded theory is the ying to action research's yang. Grounded theory is "an inductive, theory discovery methodology that allows the researcher to develop a theoretical account of the general features of a topic while simultaneously grounding the account in empirical observations or data" (Martin and Turner, 1986). A grounded theory is one that is derived from the study of a phenomenon and is verified through data collection and analysis. Grounded theory's objective is the discovery of a theoretically comprehensive explanation about the phenomenon using techniques and analytical procedures that enable investigators to develop a theory that is significant, generalizable, reproducible and rigorous. Using the methodology, one does not begin with a theory and then prove it. Rather, a theory emerges from the observations and generated data. The emergent theory can be empirically tested to develop forecasts or predictions from general principles (Strauss and Corbin, 1990). Therefore, we can describe the association between data collection, analysis and theory as reciprocal.

Like action research, grounded theory is an iterative methodology, requiring a steady movement between concept and data to control the conceptual model and scope of the emerging

theory. Action research is concerned with increasing the stock of knowledge within the information systems community. In action research, the researcher seeks to validate a theory with practitioners in real situations, utilizing feedback from the experience to modify the theory before repeating the process. Each cycle augments the theory. Both methodologies complement each other in achieving the dual goal of contributing to both theory and practice.

Grounded theory produces accurate and useful results that encourage an understanding of the phenomena in "the generation of theories of process, sequence and change pertaining to organizations, positions and social interactions" (Glaser and Strauss, 1967). By emphasizing collaboration between researchers and practitioners, action research would seem to represent an ideal research method for information systems, especially because of its ability to address complex real-life problems. Action research's ability to make academic research relevant and grounded theory's ability to develop context-based, process-oriented description and explanation can yield dynamic theories of IS in organizations, rather than objective, static descriptions expressed in terms of causality (Orlikowski, 1993). The synthesized framework established is but a foundation on which the pedagogy of the grounded theory/action research axis in systems development can be refined, debated, and become instrumental in explaining theoretical gaps between theory, research and practice through the establishment of a unifying framework for system development.

The Research Question

According to Alter (2003), many of the topics that IS scholars study today, are distant from the needs of practitioners, yet, such studies are important to the members of the IS practice community and the IS community as a whole. Alter (2003) presents an alternate vision for the IS discipline which he calls the "system in organization" vision. This alternative vision recognizes that the IS discipline started with IT applications, but it also reflects the way the discipline has changed and evolved over time and now encompasses a larger, richer set of concerns precipitated by the dynamic environment in which organizations are operating, an environment characterized by new and poorly understood problems, many stakeholders, etc., a situation that is imposing profound changes on the organizations - their forms, their relationship with their stakeholders and, the deployment and utilization of information technology (Mohrman et al., 2006).

If the goal of IS research is the study of the effective design, delivery and usage of information systems in organizations (Keen 1980) then the role of design as a process (the IS development) and design as product (the developed IS) becomes paramount for practitioners and researchers to produce more effective information systems (Goldkuhl 2004). Walls et al. (1992) defined an information system design theory "to be a prescriptive theory which integrates normative and descriptive theories into design paths intended to produce more effective information systems" (p. 36). Walls et al. (1992) then used the theory elements to develop a design theory for the vigilant Executive IS. This approach was adopted by Markus et al. (2002) and Jones et al. (2003) to integrate explanatory kernel theories into design theories.

Earl (1993) has demonstrated that technology- and methodology-driven approaches to information systems have produced relatively small competitive advantages. In contrast, the most successful approaches are the "soft" organizational approaches that emphasize organizational learning (Checkland et al., 1990; Paul 1994). After all, organizations are more than information; they are characterized by many domains: information, culture, people, processes, learning, decision making, organizational structure, strategy and power (Morabito et al., 1999). Successful organizations are driven by a consistent set of principles and constructs – organizational pieces, their interconnections and their behavior – the organizational architecture.

Currently, there is a dearth of IS design research that will support the governance efforts of these organizations to achieve more effective utilization of available resources. For this study we are asking the following questions: Can we develop an approach/framework for IS design research that incorporates and leverages an organization's technology, organizational and human capital in designing and delivering more effective information systems? Can we employ the tenets of design science, grounded theory and system development methodology to design and construct more effective information systems that best supports organizational goals and provide knowledge support to the design theories that emerge? Can employment of this framework for IS design research enable governmental organizations' IT departments to increase their organizational knowledge by fostering and promoting innovative services to satisfy the needs of their governmental constituents?

This proposed work will consists of three major phases: (1) present a new IS design research framework, the multi-methodological DAGS framework – (D)esign science, (A)ction Research, (G)rounded theory and (S)ystem development -- to the information systems community that synthesize and utilize new research methods and paradigms that will help us

improve not only IS design theories, but also the contribution of IS research to business practice; (2) apply the framework to two actual projects demonstrating instantiations of the framework and its inherent concepts ; (3) formally evaluate the systems developed and the IS research design methodology using appropriate information systems development measures.

CHAPTER TWO: THE MULTI-METHODOLOGICAL APPROACH

In a discipline with a plurality of research paradigms – positivist, interpretivist and critical - the quest for the research method that is most appropriate for IS research has been an ongoing odyssey. Given that IS is influenced by a plentitude of disciples and IS itself affects a variety of organizational entities, a collaborative approach combining several methodologies in whole or in part, and possibly from different paradigms (Mingers and Brocklesby, 1997) should make a more effective contribution in deciphering, understanding and communicating the rich organizational domain in which it is imbedded.

For the sake of clarity it is important that the definitions of the terminology employed in this paper be communicated to the reader. According to Wikipedia, the free encyclopedia**,** *Research* is often described as "an active, diligent, and systematic process of inquiry aimed at discovering, interpreting and revising facts. This intellectual investigation produces a greater understanding of events, behaviors, or theories, and makes practical applications through laws and theories. The term *research* is also used to describe a collection of information about a particular subject." The basic activities employed in the inquiry are *research methods* or *techniques* and represent a generally well-defined sequence of operations that if carried out proficiently yield predictable results (Checkland 1981, Iivari et al. 1998, Mingers 2001).

Often there is confusion between the terms, "*method*" and "*methodology*." Mingers (2001, p 241) defined *method* as "a generally well-defined sequence of operations that if carried out proficiently yield predictable results." Iivari et al. (1998, p. 165) characterize *method* as "a well defined sequence of elementary operations which permit the achievement of certain outcomes if executed correctly." Mingers (2001) distinguished between the two by describing

methodology as: (1) the study of methods; (2) the actual research methods used in a certain piece of research; and (3) generalizations of #2, that is, a structured set of guidelines or activities to assist in generating valid and reliable research results using combinations of methods. According to Hirschheim et al. (1995, p.25) *methodology* is "an organized collection of concepts, methods, beliefs, values and normative principles supported by material resource." For Iivari et al. (1998, p. 165) *methodology* is "a set of goal-oriented procedures that guide the work and various parties (stakeholders) involved in the building of IS application supported by a set of preferred techniques, tools and activities."

The term *paradigm* is somewhat controversial since its definition is context dependent. Within the context of science it was utilized by Kuhn (1970) to describe the historical development of natural sciences – especially physics and astronomy, while within the social science, management or IS communities it is described as "a construct that specifies a general set of philosophical assumptions covering ontology, epistemology, ethics (axiology) and methodology (Mingers 2001, p 242)." The key implication being that in the social sciences, paradigm captures the basic assumptions of coexistent theories, whereas in natural sciences, it captures the basic assumptions of historically successive theories. With the proliferation of information systems development methodologies, researchers such as Hirschheim et al. (1989) and Iivari et al. (1991, 1998) were able to identify and categorize a single set of dominant philosophical assumptions about information systems development which they labeled *approaches*. Iivari et al. (1998, p. 166) defined *approach* as: "a set of goals, guiding principles for the information system development processes that drives interpretations and actions in system development."

Ontology is concerned with the structure and properties of "what is assumed to exist," i.e., the basic building blocks that make up the phenomena or objects to be investigated. According to Iivari et al. (1998) the ontology of IS research is concerned with information and data, information systems, human beings in their different roles of IS development and use, technology, and human organizations and society at large. There are two classical views associated with ontology and the nature of reality – realism and idealism. From an IS perspective, realism views data as descriptive objective facts; information systems as consisting of technological structures; humans as subjects of causality; and organizations as relatively stable structures. Idealism views data as socially constructed meaning signifying intentions; information systems as technical systems with social implications; humans as subjects with social and human choices; and organizations as socially constructed interactive systems (Iivari et al., 1998).

Epistemological assumptions are concerned with the nature of knowledge and the proper methods of inquiry, i.e., the procedures or means by which we can obtain scientific knowledge about IS and the limits imposed by such inquiry. According to Iivari et al. (1998) there are two distinct opposing views associated with epistemology knowledge acquisition – positivism and anti-positivism (interpretivism). Positivism seeks to explain and predict what happens in the social world by explicating the causal relationships between its element, whereas, anti-positivism/interpretivism posit that the socially constructed world can only be understood from the individual's point of view since the individual is directly involved. Accordingly, "positivism views scientific knowledge to consist of regularities, causal laws, and explanations, whereas anti-positivism emphasizes human interpretation and understanding as constituents of scientific knowledge (Iivari et al., 1998, p. 174)."

Axiology is derived from two Greek words and consists of two roots, "axios" (worth or value) and "logos" (logic or theory) and implies the theory of value or "ethics of research" and refers to assumptions about the responsibility of the researcher for the consequences of his/her research approach and results (Iivari et al., 1998). Axiology generates new knowledge about the everyday world and creates a frame of reference which provides a new way of looking at ourselves and our environment.

IS is often described as the child of operations research and management science, the science of rational action. However as researcher and practitioners have discovered, "real world organizations were not easily and tidily fitted into mathematical models; they have social and political dimensions (Mingers, 2004, p. 165)." The purported use of "objective" data did not truly incorporate the social and political dimensions into the mathematical models that sought to maximize profits or minimize costs. Checkland was among the first among others to recognize that for IS to succeed, it needed to incorporate and synthesize a "hard" and "soft" approach to organization analysis. A schism developed between those who saw themselves as basically hard, positivists, and those who saw themselves as soft, i.e., interpretivists, in academics (Mingers, 2004).

> *"We need to remind ourselves that we have no access to what the world is, to ontology, only to descriptions of the world, … that is to say, to epistemology, ... Thus, systems thinking is only an epistemology, a particular way of describing the world. It does not tell us what the world is. Hence, strictly speaking, we should never say of something in the world: 'It is a system,' only: 'It may be described as a system.' … The important feature of paradigm II (soft systems) as compared with paradigm I (hard systems) is that it transfers systemicity from the world to the process of enquiry into the world (Checkland 1983, p. 671)."*

Since then a third approach has emerged and is gaining currency, critical system thinking. Based on the work of German sociologist Jurgen Habermas, the main tenets of critical systems thinking is described by Mingers (2004, p. 167) as "a critique of both positivism and

interpretivism demonstrating that whilst both had a degree of validity in particular circumstances neither had a sole claim to the truth and so other approaches were necessary." It was the dawn of IS philosophical plurality.

The term multi-methodology, or mixed methods research is a research approach which attempts to synthesize a diversity of methods in an effort to provide a more effective contribution in dealing with the "richness" of the real world. In broad terms, the methods that are mixed in this type of research are quantitative and qualitative approaches. If the goal of IS is to uncover the "truth" then it is desirable to go beyond using a single methodology to combining several methodologies, in whole or in part, and possibly from different paradigms (Mingers and Brocklesby, 1997). According to Mingers and Brocklesby (1997) the essence of multi-methodology is the ability to utilize more than one methodology or parts thereof, possibly from different paradigms with a single intervention. According to the authors, (Mingers and Brocklesby, 1997, p 492) "*the term intervention covers a variety of situations from the classic consultancy case of external agents entering an unknown situation and leaving at the completion of the project; through multiple projects with the same organization over time; to someone using methodology in their own workplace*."

Paradigms, Approaches and Philosophical Plurality

According to Hirschheim and Klein (1989) system developers engaged in system building, approach their task with a number of explicit and implicit assumptions about the nature of human organizations, the nature of the design task, and what is expected of them primarily from the project sponsor. It is these propositions that guide the information system development

(ISD) process and has an effect on the artifact created. Their research demonstrated that the outcome of the process is predicated on the assumptions adopted at the onset and the development approach adopted.

While system development has maintained its strong orthodox approach to system materialization, recent developed alternatives based on different sets of assumptions as per the developer's attitudes about reality and how he/she obtains knowledge about reality, has resulted in a better understanding of the different underlying philosophies that lead to different alternatives in terms of design, features, implementation strategies, user satisfaction and system usage, i.e., assumptions shaped by the paradigm to which the developer subscribes.

Hirschheim and Klein (1989) identified four paradigms associated with information system development based on the paradigm with which system developers acquire knowledge needed to design the systems (epistemological assumptions), and those related to their views of the social and technical world (ontological assumptions) to produce a two-dimensional model with a subjectivist-objectivist dimension and an order-conflict dimension. These paradigms are derived from the work of Burrell and Morgan (1979) in the context of organizational and social studies research and are relevant in the ISD domain since ISD is a social activity. The paradigms identified by Hirschheim and Klein (1989) are described below with accompanying narrative describing the developer's assumptions:

> The Functionalist paradigm seeks to explain how individual elements of the social system interact to form an integrated whole, i.e., providing explanations of the status quo, social order, integration, consensus and need satisfaction. The epistemology is that of positivism – the developer gains knowledge about the organization by searching for measurable cause-effect relationships. The ontology is that of realism - an empirical organizational reality that is independent of its perceiver or observer.

The Social Relativist paradigm seeks to explain from an individual perspective how the individual, a social actor, within the social system attaches meaning to activities within the socially constructed institution. The epistemology is that of anti-positivism – the developer gains knowledge about the organization through sense making. The ontology is that of nominalism – organizational reality is socially constructed; a product of the human mind.

The Radical Structuralist paradigm seeks to transcend the limitations placed on existing social and organizational arrangements by focusing primarily on the structure and analysis of power relationships. The epistemology is that of positivism - the developer gains knowledge about the organization through a materialist view of history and society. The ontology is that of realism – there is an existing belief in a preexisting empirical reality.

The Neohumanism paradigm seeks radical change by stressing the role that different social and organizational forces play in understanding change. The epistemology is both positivism and anti-positivism – the developer gains knowledge about the organization through technical control, mutual understanding and emancipation. The ontology is both realism and nominalism/social constructivism – existing empirical reality is augmented with a socially constructed reality.

Uses of these paradigms are largely implicit and are characterized by classes of behavior that follow from the assumptions associated with each. According to Hirschheim and Klein (1989) the paradigms are archetypes - highly simplified but powerful conceptualizations of an ideal type. In practice, information systems development approaches are influenced by more than one paradigm, although the influence of one is always dominant.

An information system development approach (ISDA) is a class of methodologies which share the same fundamental concepts and principles associated with information systems development. The choice of five contrasting approaches by Iivari et al. (1998) was based on the paradigmatic assumptions of Hirschheim and Klein (1989) illustrated paradigms. While the

illustrated approaches do not explicitly express the underlying philosophical/paradigmatic assumptions they embrace, Iivari et al. (1998) sought to identify the key features of each approach, categorize each feature using the paradigms of Hirschheim and Klein (1989), and classify the approach in terms of its dominant paradigm. The approaches identified by Iivari et al. (1998) are:

1. The *Interactionist Approach* focuses on the institutional arrangements associated with IS development and use in organizations. The premise behind the approach is based on the idea that an information system is a social object with social meaning serving different interests. The goal of this approach is to illuminate the social issues involved in organizational changes due to implementation of, or changes to, an information system.
2. The *Speech Act-based Approach* attempts to understand and model the rich meanings inherent in organizational communication. This approach views an information system as a communication system, and as such is interested primarily with those speech acts concerning changes to the existing social structure.
3. The *Soft System Method Approach* attempts to provide a learning methodology which supports debate on desirable and feasible organizational change. The root of this approach is Checkland's soft system method which focuses on problem formulation by helping the users to identify the "relevant" systems from the perceptions of differing stakeholders.
4. The *Trade Unionist Approach* focuses on the ways and means of developing effective worker participation in order to support democracy and the quality of work associated with organizational life through "cooperative design."
5. The *Professional Work Practice Approach* focuses on ways to increase the professionalism of information systems designers. Conceptually, the approach strives to examine the relationship between information systems development methods and practice, and how enhancing such practices and methods can lead to greater efficiency and effectiveness when developing information systems.

Since paradigms differ and linkages may be difficult or even impossible, Midgley (1990) proposed, *methodological partitioning,* a phrase he coined to describe the process of selecting and blending methodologies (Midgley, 1990), i.e., whether they come from the same or different paradigms; or whether or not they are used within the same intervention; or whether whole methodologies or parts are taken out and combined. A review of the literature uncovers three prescribed means:

1. *Methodology Enhancement* is based on enhancing a methodology with techniques from another paradigm. For example, Jackson and Keys (1984) advocated a System of Systems Methodology (SOSM) which is based on the idea that methodologies from different paradigms make particular assumptions about the contexts within which they will be utilized, that is; only one methodology will be used in the particular intervention (Mingers and Brocklesby, 1997).
2. *Methodology Combination* is based on combining different whole methodologies for usage within the same intervention. For example, Flood and Jackson's (1991) Total System Intervention (TSI) in which different whole methodologies may be used within the same intervention to provide different viewpoints (Mingers and Brocklesby, 1997).
3. *Pluralist Combination* is based on splitting or partitioning methodologies into components and these components are combined together to construct an ad hoc multi-methodology suitable for a particular problematic situation (Mingers and Brocklesby, 1997).

In addressing the desirability of multi-paradigm multi-methodology, Mingers et al., (Mingers and Brocklesby 1997, Mingers 2001) reasoned that:

a. Narrow views of the world are often misleading since real world problems are invariably complex and multi-dimensional and since paradigms tend to focus attention on different aspects of the situation, multi-methodology allows the

researcher to deal more effectively with the real world by furnishing a more holistic perspective.

b. There are different levels of social research and different methodologies which may have particular strengths with respect to one of these levels. Since intervention is a process and not a discrete event, combining methodologies will yield a better understanding, produce a clearer picture, and generate more acceptable explanations (of the various phases) and ultimately better results.

Adoption of a particular paradigm provides the researcher with a singular and limited view of the problem situation. Habermas (1984) postulates that we exist in a multi-dimensional world with three distinct dimensions – material, social and personal - and since organizational activities involves all three dimensions, organizational research should accept a plurality of theories and approaches within an integrative framework.

Yet while the multi-methodological approach promises much, Mingers and Brocklesby (1997) and Mingers (2001) have identified some hazards associated with the approach. Some of these problems include:

- Many paradigms are at odds with each other. This can pose a problem. However, once the understanding of the difference or dichotomy is present, it can be an advantage to see many sides, and possible solutions may present themselves.
- Cultural issues affect our view of the world and our ability to analyze it. Our backgrounds tend to dictate and bias our views. Knowledge of the new paradigm is not enough to overcome these biases; it must be learned through practice and experience.
- People have cognitive abilities that predispose them to particular paradigms. The logical thinker can more easily understand and use quantitative methodologies. It is easier to move from quantitative to qualitative, and not the reverse.

Multi-methodology is desirable and feasible because it gives a more complete picture, and while multi-paradigmatic, multi-methodology is more demanding, it is a more effective tool for the job at hand if our goal is to investigate a phenomena thoroughly.

The Multi-methodological Approach to IS Research

According to Nunamaker et al. (1991, p 252), "a research methodology consists of the combination of the process, methods and tools that are used in conducting research in a research domain." To illustrate his approach, Nunamaker proposed a framework for research to explain the relationship between research domains and research methodologies (See figure 2.1). According to Nunamaker et al., (1991, p. 91) "*The body of knowledge includes both research domains and research methodologies. A research process involves both understanding the research domains, asking meaningful research questions, and applying valid research methodologies to address these questions. Results from a good research project contribute to the body of knowledge by expanding knowledge in a given domain*."

Inherent in Nunamaker's framework is the awareness that the scope of a research domain is a determinant in the range of methodologies adopted and the range of methodologies employed will be of the form: concept – development – impact; similar to the life cycle employed by much information systems research. Consequently, systems development in an IS environment can be seen not only as a legitimate approach to IS research, but also as a critical contributor among the methodologies available. Since concepts alone do not ensure a system's viability, systems must be developed in order to test and measure the underlying concepts. "This view of research methodology permits system development to be a perfectly acceptable piece of

evidence (artifact) in support of a "proof," where proof is taken to be any convincing argument in support of a worthwhile hypothesis. System development could be thought of as a "proof-by-demonstration" (Nunamaker et al., 1991, p. 91). Systems development is therefore a key element of IS research.

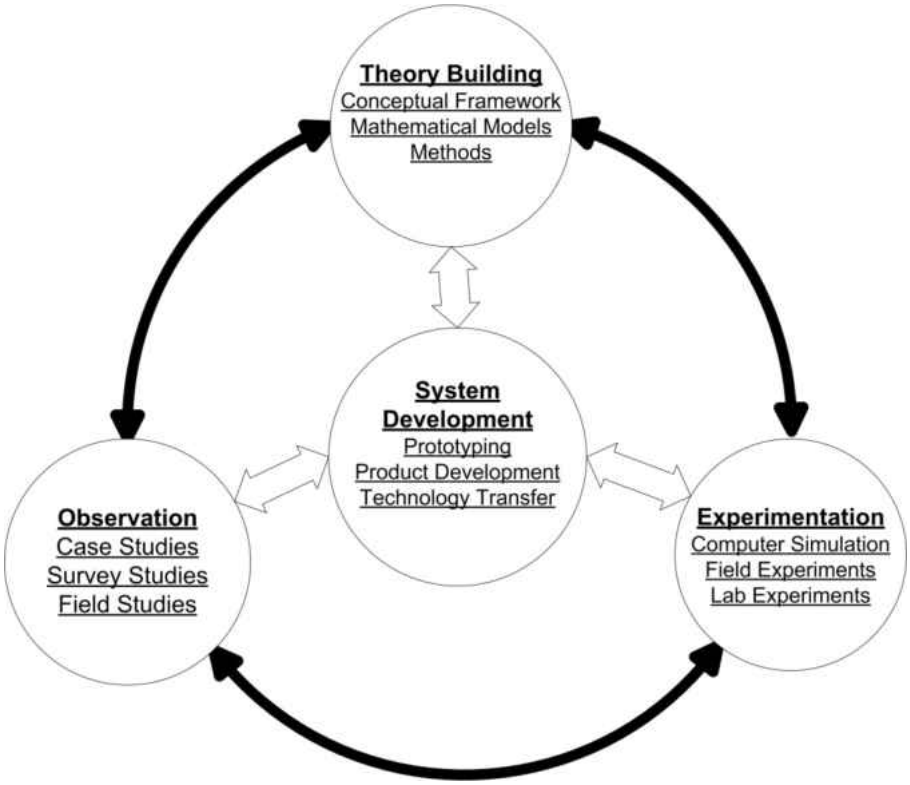

Figure 2.1 - Nunamaker's (1991) Multi-methodological Approach to IS Research

Nunamaker's approach to IS research consists of four research phases: *theory building, experimentation, observation* and *system development*.

1. ***Theory Building*** involves the development of new ideas and concepts, construction of conceptual frameworks, new methods or models. Theories are normally concerned with generic system behaviors and the subject of rigorous analysis. Theories may be utilized

to develop hypotheses, direct the design of experiments and form the basis for conducting systematic observations.

2. ***Experimentation*** includes the selection of research strategies and is concerned with the validation of the underlying theories or with issues of acceptance and technology transfer. The results produced may be used to refine theories and improve systems.
3. ***Observation*** includes utilizing research methodologies that are unobtrusive in collecting basic data. The process may assist researchers in formulating specific hypotheses to be tested or help focus later investigations.
4. ***System Development*** consists of five stages: concept design, constructing the architecture of the system, prototyping, product development, and technology transfer. The system development process permits a realistic evaluation of the included information technologies and their potential for acceptance. The transfer of technology represents the ultimate success of those theories, concepts and systems that complete the process.

System development is the hub of research which interacts with other research methodologies to form an integrated and dynamic program. According to Nunamaker et al. (1991) no research methodology should be considered as the preeminent research paradigm because no one methodology is sufficient by itself to provide the complete understanding of a complex research domain as a multi-methodological approach.

CHAPTER THREE: THE DAGS FRAMEWORK

Business research should be relevant to practice (Benbasat and Zmud, 1999). It should be the goal of every academic researcher to produce high-impact research that not only expands the discipline's knowledge but also finds acceptance among industry practitioners. The purpose of this section is to present a framework (see figure 3.1) that integrates design science, system development, action research and grounded theory methodologies in leveraging information technology to achieve business effectiveness through relevancy.

For the information systems community our primary role is to enhance business management practices and organizational effectiveness through the use of systems and technology. Information systems scholars delve into issues that relate to the use of information systems in organizations, and search for ways to enhance the use of information technology. Researchers should ensure that their investigative efforts are relevant by studying and solving technological issues faced by business practitioners.

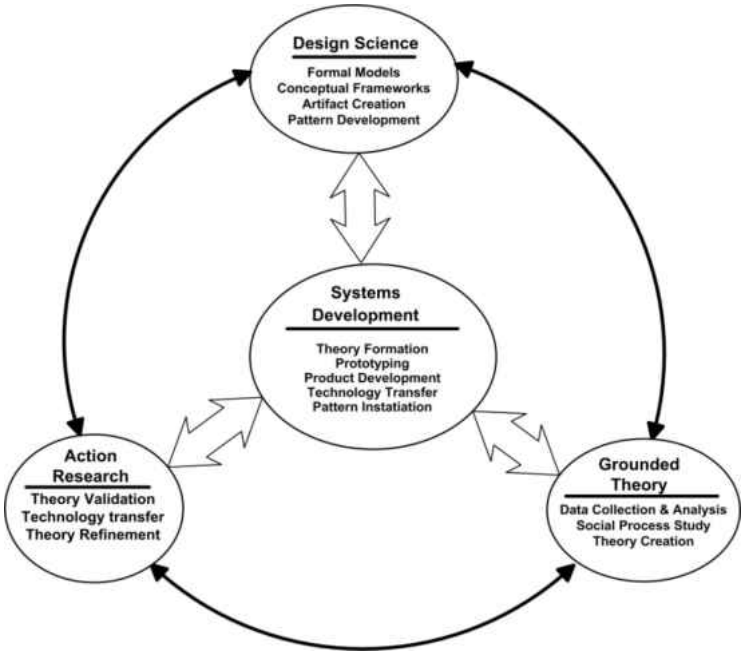

Figure 3.1: The DAGS Framework

Design Science ("D")

Design science is described by famed architect, R. Buckminister Fuller (1992) as:

> *"The function of what I call design science is to solve problems by introducing into the environment new artifacts, the availability of which will induce their spontaneous employment by humans and thus, coincidentally, cause humans to abandon their previous problem-producing behaviors and devices." – R. Buckminister Fuller (1992).*

This quest for more effective solutions not only includes the evaluation and/or analysis of existing systems, but also the development of new theories and methodologies for information systems design. It is the need for new development methodologies that has persuaded researchers to study design science research.

Nunamaker et al. (1991) classified design science as applied research, or research that applies knowledge to solve practical problems. To March and Smith (1995), design science attempts to create things that serve human purposes, as opposed to natural and social sciences, which try to understand reality. Hevner et al. (2004) describe design science as a problem

solving paradigm, that seeks to create innovations that define the ideas, practices, technical capabilities, and product through which the analysis, design, implementation, management and use of information systems can be effectively and efficiently accomplished (Denning 1997, Tsichritizis 1998, Hevner et al. 2004). While the importance of, and the need for, design in IS research is well recognized, designing useful artifacts is a complex process dependent on innovations in problem domains where existing theories are insufficient incubators of creative ideas.

As a discipline, design science is a technology-oriented undertaking which creates and evaluates IT artifacts intended to solve identified organizational problems. Since the domain of IS research is the confluence of people, organizations, and technology, the artifacts produced are represented in a structured form that may vary from software, formal logic, and rigorous mathematics to informal natural language descriptions (Hevner et al., 2004). March and Smith (1994) characterized design science products or outputs as being of four types:

1. ***Constructs***: Concepts form the vocabulary of a domain. They constitute a conceptualization used to describe problems within the domain and to specify their solutions.
2. ***Models***: A model is a set of propositions or statements expressing relationships among constructs. In design activities, models represent a situation as problem and solution statements.
3. ***Methods***: A method is a set of steps (algorithm) used to perform a task. Methods are based on a set of underlying constructs (language) and a representation (model) of the solution space.
4. ***Instantiations***: An implementation is the realization of an artifact in its environment, an instantiation that operationalizes constructs, models and methods.

Design Science, like software engineering, consists of three basic activities: designing, building and evaluation. Information systems design science builds and evaluates constructs, models, methods and instantiations of information systems. It also theorizes about these artifacts and attempts to justify these theories. Building and evaluating information technology artifacts have design science intent, whereas theorizing and justifying have natural and social science intent. While building a system does not constitute research, Nunamaker, et al. (1991) argue that the synthesis and expression of new technologies and new concepts in a tangible product can act as both the fulfillment of the contributing basic research and as an impetus to continuing research.

The role of design science in information systems research is not without controversy. The arguments against design science are centered on the approach's theoretical contribution. What constitutes a theoretical contribution in information systems research? Whetten (1989) argued that research contributions could be categorized as either: a contribution *to* theory, or a contribution *of* theory. The esteemed former editor of the *Academy of Management Review* characterized a contribution to theory as "taking an existing theory and adding some insight to the theory to make it marginally more complete. A contribution of theory, on the other hand, does more that just alter existing thought; the researcher modifies or expands existing theory in important ways (Whetten, 1989)." "A contribution of theory must explain the *what, how* and *why* of the phenomena. It must define the "*who, where* and *when"* of the theory. Describing the what, how and why of a phenomenon are the keys to creating a contribution. *Who*, *when* and *where* are necessary because they define the boundaries of the theory (Ball, 2001)." Whetten (1989) proposed six issues that need to be addressed by every proposed contribution of theory. These issues are "*what's new, so what, why so, well done, done well* and *why now*. (Whetten, 1989)"

Clearly design science can pass the strict criteria for making a contribution of theory, and hence it qualifies as an appropriate method in conducting information systems research.

Given its relevancy, why has design science not garnered more adherents? One of the primary reasons is that most information systems researchers do not build artifacts is the absence of needed skills. Most information systems researchers are skilled in evaluating, theorizing and justifying existing artifacts, not creating them (Au, 2001). It would be ideal if information systems researchers built business artifacts that could be implemented, evaluated and improved. This could help to cement a partnership between theory and practice, practitioners and theorist.

According to Hevner et al. (2004) information systems and the organizations they support are complex, artificial and purposefully designed. According to Walls et al. (1992) design is both a process, i.e., a set of activities, and a product, an artifact. Viewed from this perspective, the design process is a series of expert activities that produces an innovative product, i.e., the designed artifact. This complimentary iterative process is indispensable, i.e., the evaluation of the artifact provides both feedback and greater awareness about the problem which in turn contributes to improvement in both the quality of the product and the design process. March and Smith (1995) argued that "there are four basic activities involved in research: (1) building artifacts; (2) evaluating artifacts; (3) building theory and (4) verifying theory." Each activity constitutes a research contribution. "All four of these elements must be present to some degree; in design science research before the results of a project becomes a significant contribution" (Ball, 2001). The authors, March and Smith (1995) also identified four artifacts associated with design science research, namely: constructs, models, methods, and instantiations. According to Hevner et al. (2004), *constructs* provide the language in which problems and solutions are defined and communicated. *Models* use constructs to represent the design problem and its

solution space, i.e., they aid problem and solution understanding and represent the connection between problem and solution components. *Methods* define processes, i.e., guidance on how to solve problems, while *instantiations* demonstrate that the constructs, models or methods are feasible.

Hevner et al. (2004) proposed seven guidelines for use in design science information systems research. The steps they identified are:

1. ***Design as an Artifact***: The result of design science research in IS is by definition a purposeful IT artifact created to address an important organizational problem. The artifact must be described effectively, enabling its implementation and application in an appropriate domain. The authors' definition of an artifact includes the constructs, models, methods or an instantiation.
2. ***Problem Relevance***: The acquisition of knowledge and comprehension that enable the development and implementation of a technology-based solution to heretofore unsolved and important business problems utilizing a combination of technology-based, organization-based and/or people-based artifacts.
3. ***Design Evaluation***: The utility, quality and efficacy of a design artifact must be rigorously demonstrated via well executed evaluation methods. Because of the inherent iterative nature of design, this phase/step provides essential feedback to the process.
4. ***Research Contributions***: Effective design science research must provide clear contributions in the areas of the design artifact, design construction knowledge and/or design evaluation knowledge, i.e., methodologies.
5. ***Research Rigor***: Design science research requires the application of rigorous methods in both the construction and evaluation of the designed artifact. Rigor is derived from the effective use of the knowledge base – theoretical foundations and research methodologies.
6. ***Design as a Search Process***: Design is essentially a search process to discover an effective solution to a problem, and this (search) process should be viewed as utilizing all available means to reach the desired goals while satisfying the existing environmental laws.

7. ***Communication of Research***: Design science research must be presented both to technology-oriented as well as management-oriented audiences which will enable practitioners to take advantage of the benefit offered by the artifact and researchers to build a cumulative knowledge base for further extension and evaluation.

According to the Hevner et al. (2004), the abovementioned guidelines are catalytic aids in conducting effective design science research. Given the artificial nature of organizations and the information systems that support them, the role of design science is significant in ensuring the effectiveness of IS research.

Another limitation associated with the design science approach is the availability of resources for building artifacts. The technologies used to build artifacts are perishable. The extent to which the contribution that is developed is grounded in the technology used to build the artifact, the weaker it will be. Instead it must be grounded in the problem that the artifacts was designed to solve and in explaining why the approach used to build the artifact solves the problem more effectively than another approach (Ball, 2001). Hevner et al. (2004) argue that design science research must be both proactive and reactive with respect to technology and recommended a research cycle where design science research is aligned with real-world experience.

The lesson for information systems researchers is simple. If we become fixated on or distracted by the "push" to achieve legitimacy as a "science" and respect from peers in other academic disciplines and lose sight of information systems' real objective – the effective use of technology in the design, implementation and use of information systems in practice, we will fail to recognize the contribution of knowledge that has been produced by information systems

researchers who subscribe to this concept of "diversity." According to Robey (1996) the following are examples of the knowledge generated by information systems research:

- The configuration of useful business applications of information technology, including operating systems, networks, architectures, interfaces, data storage and retrieval
- The factors motivating the adoption and use of information technology by individuals, groups, organizations, and industries
- The process of technology use and adaptation, wherein the consequences of IS use are realized
- The organizational consequences of information technology, particularly the effects on the structural forms
- Awareness of information technology's role in supporting group processes
- Knowledge about the development of IS applications, including technical issues and development methodologies, the social process of IS development and the connection between development tools and social processes.

As an applied discipline, the research conducted in information systems arena should be relevant to the needs and practices of the business community. There should be a bi-directional flow of information between research and practice, researcher and practitioners. Design Science is indispensable today because it facilitates and utilizes this bi-directional information flow in applying technology to satisfy the organizational needs and demands of the marketplace, forcing the enterprise, especially the information systems professionals, to utilize new methods and modes of operation in order to remain competitive while concurrently playing a significant role in resolving the fundamental dilemmas that have plagued IS research: rigor, relevance, discipline boundaries, behavior, and technology (Lee 2000).

Action Research ("A")

Qualitative approaches to Information Systems research are finally gaining acceptance as a valid research methodology. A particular strength of the approach is its value in explaining what happens in organizations during the adoption of technology. Since IS is a highly applied field, and action research methods are highly clinical in nature, it is not surprising that action research is the "touchstone of most good organizational development practice" and "remains the primary methodology for the practice of organizational development" (Van Eynde et al., 1990). Action research is one popular and accepted methodology that produces exceedingly relevant research findings primarily in "the way it associates research and practice, so research informs practice and practice informs research synergistically" (Avison et al., 1999). Such relevance is an important measure of the significance of IS research (Keen, 1991).

Although action research combines theory and practice, the method has not been popular with American researchers. The number of articles published in the major journals has been sparse although the methodology has made substantial knowledge contributions to the IS research community. As IS matures, researchers are discovering that they need to become more aware of the social and psychological aspects of introducing technology into the work place. The present empirical-based research efforts in understanding and explaining the relationship between technological, social and psychological relationship has yielded inconclusive results. "Action research is a method that could be described as a paragon of the post-positivist research methods. It is empirical, yet interpretive. It is experimental, yet multivariate. It is observational, yet interventionist" (Baskerville and Wood-Harper, 1996).

Developed in the earlier fifties by Kurt Lewin (1947a, b) and researchers at the Tavistock Clinic (e.g. Trist and Bamforth, 1951), action research was conceived as an approach in

studying social psychology within the framework of field theory, i.e., how a theory on social change could be facilitated. Since then several classification schemes have been proposed to categorize Action Research's various forms and originations, (Baskerville and Wood-Harper 1998, Avison et al. 1999, Baskerville 1999) and over a dozen different manifestations have been identified, each characterized by a different models, structures and goals (Davison et al., 2004). Linked closely to systems theory from its inception, action researchers recognized that human activities are systematic of the social systems in which they coexist. Hence the methodology can be described as an "interventionists approach to the acquisition of scientific knowledge that has sound foundation in the post-positivist tradition" (Baskerville et al., 1996). As Blum (1955) explained, "Action research is a simple two stage process. First, the diagnostic stage involves a collaborative analysis of the social situation by the researcher and the subjects of the research. Hypotheses are formulated concerning the nature of the research domain. Second, the therapeutic stage involves collaborative change experiments. In this stage changes are introduced and the effects are studied." However, the method lack the structure(s) needed for scientific rigor.

Susman and Evered (1978) detailed a five phase cyclical process (See figure 3.2). The approach requires the establishment of a client-system research environment, i.e., researchers and practitioners acting together on a particular cycle of activities. An integral feature of the research environment is the collaborative nature of the relationship between researchers and practitioners. Together they provide "the subject system knowledge and insight necessary to understand the anomalies being studied" (Baskerville et al., 1996).

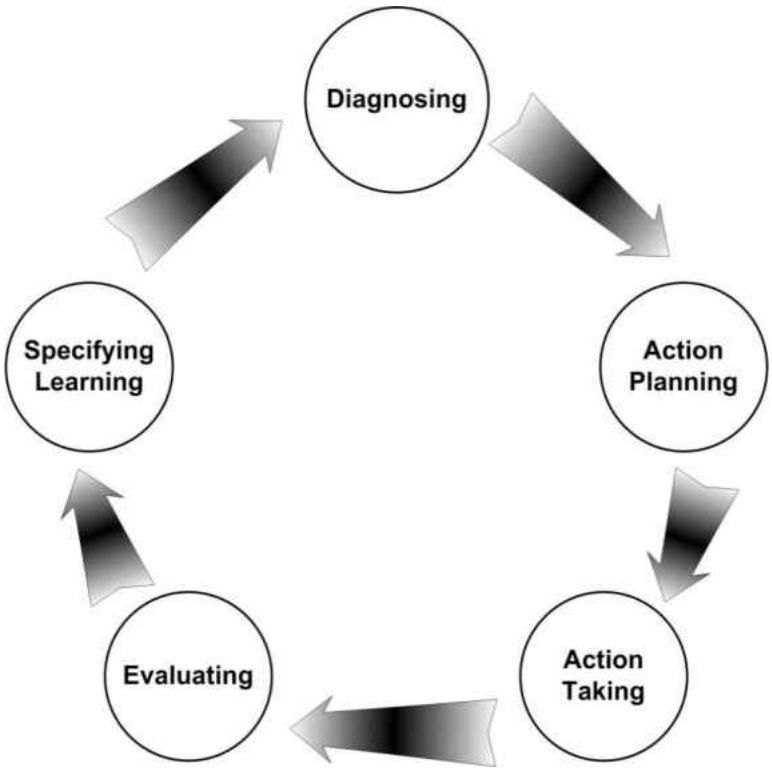

Figure 3.2: The Action Research Model (Susman and Evered, 1978)

The five identifiable phases articulated by Susman and Evered (1978) are: diagnosing; action planning; action taking; evaluating; and specifying learning.

1. The diagnosing (DI) phase involves the identification of the primary problems that are the underlying causes of the organization's desire for change. This diagnosis will develop certain theoretical assumptions about the nature of the organization and its problem domain.
2. The action planning (AP) phase involves the specification of organizational actions that should relieve or improve these primary problems. This joint effort between researchers and practitioners is guided by the theoretical framework established in the previous phase and should yield the target for change and the approach to change.

3. The action taking (AT) phase involves the actual implementation of the planned action. Researchers and practitioners collaborate in the active intervention into the client's organization, causing certain changes to be made.
4. The evaluating phase (EV) involves both researchers and practitioners appraising the results of their actions. Both parties are charged with determining whether the theoretical effects of the action were realized, and whether these effects relieved the problems. If the change is successful, the evaluation process must resolve whether the undertaken action was the sole cause of success or if some other unexplained organizational action was the sole cause of success. If the change is unsuccessful, both parties have to establish a new framework for the next iteration of the action research cycle.
5. The specifying learning (SL) phase is an ongoing process. The knowledge gained from the prior four phases is used to either restructure the organization, if the change was successful; provide foundations for diagnosing in preparation for further research, if the change was unsuccessful; or provide important knowledge to the community regardless of success or failure of the research effort.

The iterative nature of the method implies that the research cycle can continue whether the hypothesized action proved successful or not to develop further knowledge about the phenomena and the validity of relevant theoretical assumptions (Baskerville et al., 1996). In action research, the researcher seeks to validate a theory with practitioners in real situations, utilizing the feedback from the experience to modify the theory before repeating the process since each iteration of the process augments the theory. As Hult and Lennung (1980) remarked, "action research simultaneously assists in practical problem-solving and expands scientific knowledge, as well as enhancing the competencies of the respective actors, being performed collaboratively in an immediate situation using data feed back in a cyclical process aiming at an increased understanding of a given social situation."

Action research therefore attempts to link theory and practice, thinking and doing, achieving both practical and research objectives (Susman, 1983). By emphasizing collaboration between researchers and practitioners, action research would seem to represent an ideal research method for information systems especially because of its ability to address complex real-life problems. However, this is not the case as there are several factors mitigating against its acceptance. First there is the categorization problem. There is no singular universal approach; instead the process has been sub-categorized into four types (Avison et al., 1999):

- Action research focusing on change and reflection
- Action science trying to resolve conflicts between espoused and applied theories
- Participatory action research emphasizing participant collaboration
- Action learning for programmed instruction and experiential learning.

Accord to Avison (1999, p. 96), "Although there are examples of action research articles, there is still a lack of detailed guidelines for novice researchers and practitioners to understand and engage in action research studies in terms of design, process, presentation, and criteria for evaluation." Baskerville and Wood-Harper (1996) identified additional problems associated with action research. Among the problems they identified were:

- Researcher's partiality has led to rejection of the action research method by a number of researchers. Yet, this problem is not peculiar to the action research method. It is rooted in the philosophical supremacy of the researcher
- Some of the action research offered to the scientific community lacks rigor making it difficult for the research to be properly assessed. Here, rigor relates to fitting the research methods to the problem in order to produce valid scientific explanations, and the use of multiple methods to produce valid research
- Action research is sometimes branded as "consulting masquerading as research"

- Action research is context-bound and not context free. Therefore it is difficult to determine the cause of a particular effect that could be due to the environment, researcher or methodology.

The problems highlighted are the usual problems associated with social science research and action research shares these problems with the other qualitative methods. Rapoport (1970) identified three dilemmas associated with the action research methodology which he labeled: *ethics, goals* and *initiatives*. However, these problems were known to all qualitative researchers regardless of the method they employed. The problems identified by Avison, Baskerville and Wood-Harper can be collapsed into three general categories, or as Kock (2003) described them, "the threats of action research." – *Uncontrollability, contingency* and *subjectivity* threats. Orlikowski and Baroudi (1991) identified similar threats which they associated with research methods that do not conform to the positivist research traditions, those being:

1. *Uncontrollability threat* – though the action research researcher attempts to change the environment being studied, he or she does not have full control over that environment. The essence of the uncontrollability threat is that while the environment being studied will often change in ways that have been predicted by the researcher, sometimes change will be unexpected, forcing the researcher to revisit his or her methods, theoretical assumptions or research topic before a single iteration of the action research cycle is complete (Kock, 2003).
2. *Contingency threat* – as an agent of change, the researcher often has access to a large body of data which is usually "broad and shallow" rather than "deep and narrow." Data with the former characteristic are often difficult to analyze since it is not easy to generalize research findings from data whose context makes it difficult to separate out different components that refer to particular effects or constructs. In experimental research, the data tends to be "deep and narrow" thus the effect of one particular variable or another can be easily isolated through experimental controls. This is not possible with action research. If an action research project employs control groups, it is no longer

action research since the researcher may not be able to distinguish between contingent causes (i.e., related specifically to the organization that is studied) and general causes. Isolating causes from one another is virtually impossible since they are interconnected and the action researcher lacks the controls to separate or test them.

3. *Subjectivity threat* – the involvement of researchers with the client organization may foster the introduction of personal biases into the research findings. While personal involvement on the part of the researcher has the potential to bias results, in action research it is impossible for a researcher to both be in a detached position and at the same time exert positive intervention on the environment and subjects being studied. The essence of the subjectivity threat hinges on the fact that, in action research, the personal involvement of the researcher is likely to cause subjective interpretation of the data which will ultimately lead to faulty conclusions (Kock, 2003).

Implicit in the identification of these threats is the need to develop solutions to address and minimize their negative effects on action research. Kock (2003) seeks to address and eliminate the identified threats with the introduction of three principles or methodological "antidotes"- *unit of analysis*, *grounded theory* and *multiple iterations*.

1. *The Units of Analysis* antidote – is based on the use of the unit of analysis method, which prescribes that research data collection and analysis should be centered on units of analysis identified prior to the beginning of the research study. The more instances of a unit of analysis that are studied in different contexts and the higher the external validity of findings relating patterns, the more likely it is that statistical analysis techniques can be used to ascertain whether an observed trend is or not due to chance. This antidote negates the effect of the contingency threat as the method seeks to increase the external validity of research findings that refers to observable patterns in different instances of one or more units of analysis. This antidote also neutralizes the negative effects of all three action research threats identified (Kock, 2003).
2. *The Grounded Theory* antidote is based on the use of Glaser and Strauss's grounded theory (GT) methodology. The essence of the GT is a three-step coding process,

conducted in an iterative fashion and aimed at increasing the reliability of the analysis of large bodies of unstructured research data. The coding process attempts to foster objective data analysis by ensuring that regardless of the coder or their level of involvement in the process, they will produce the same final data analysis results. GT is used for the summarization of findings into causal models linking independent, moderating, intervening and dependent variables derived from the study. This antidote counteracts the negative effects of the subjectivity threat, as it provides the starting point for the removal of subjectivity of analysis of large bodies of data (Kock, 2003).

3. *The Multiple Iteration* antidote is based on conducting multiple iterations of Susman and Evered's action research cycle (See figure 3.2). By conducting multiple iterations of the AR cycle, the researcher collects cumulative research data about specific units of analysis in different contexts and strengthens the research findings by building on evidence gathered from previous iterations in the cycle. The practice of multiple iterations expands the research scope by augmenting the generality of the results through the identification of invariable patterns. This antidote neutralizes the negative effects associated with the contingency and uncontrollability threats conferring more legitimacy on the results obtained (Kock, 2003).

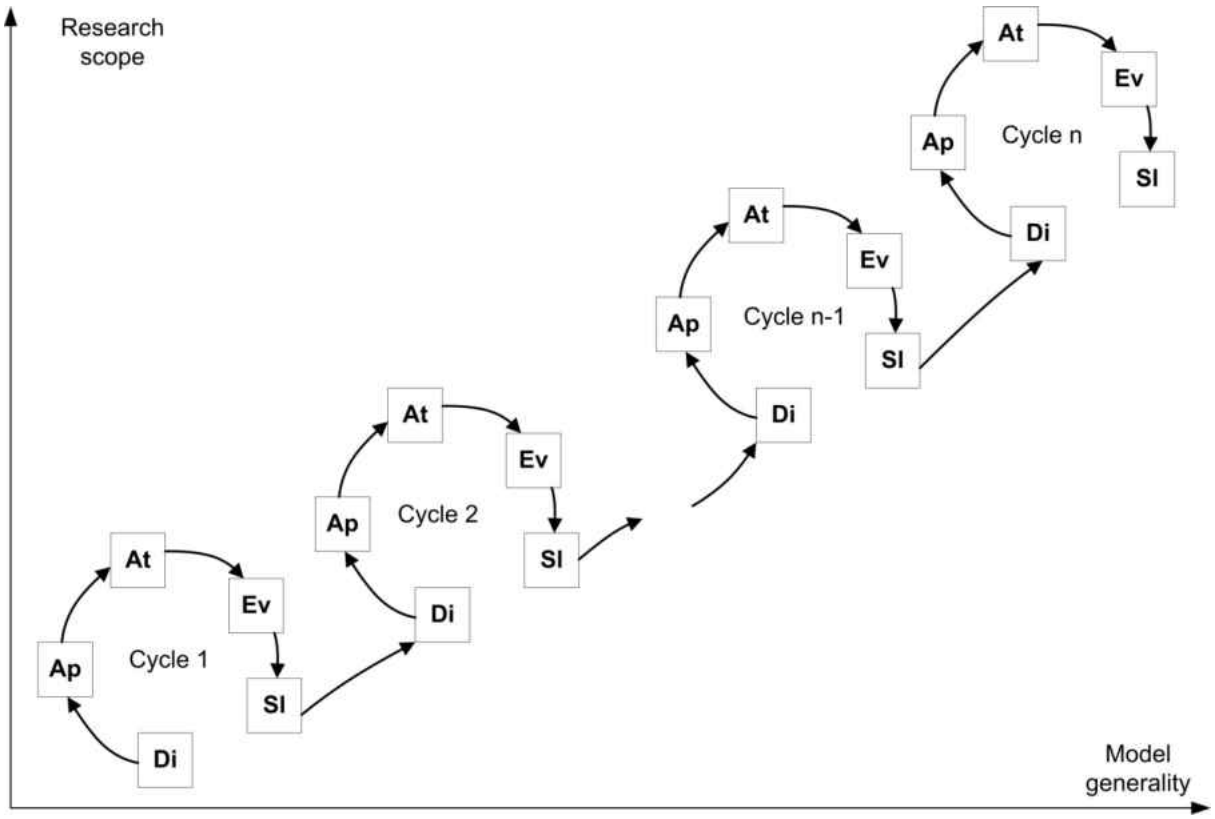

Figure 3.2: The Iterative Action Research Model (Kock, 2003)

Discussion of threats and antidotes are part of the examination of the AR methodology that can potentially lead to more highly desirable outcomes as these "threats" seemed to be more associated with action research and are often viewed as drawbacks to the delivery of more rigorous research projects.

To overcome action research's perceived weaknesses, it is important that action researchers undergo enhanced training in the approach so they better prepared to negotiate these dilemmas. Information System Action Research if conducted "rigorously" has the potential of always yielding acceptable results. One of the reasons for the emergence of AR and its consequent use in the information system field is the recognition that a social system can be

more deeply understood if the researcher is part of the socio-technical system being studied, which can be achieved through applying positive intervention on the system (Kock et al., 1997). Action research, in contrast to positivist research approaches, tries to bridge the gap between scholars and practitioners while scholars are typically preoccupied with philosophy and general theories, practitioners are more concerned with problem-solving and bottom-line techniques (Kock et al., 1997).

To alleviate some of these problems, Lau (1999) proposed an IS action research framework that provides a descriptive view on features of IS action research studies by defining the criteria by which these studies are conducted and assessed. This unifying framework is comprised of four dimensions:

1. The *Conceptual Foundation* dimension includes the research aim, the theoretical assumptions, perspective/tradition and stream of action research used. The research aim and theoretical assumptions provide the intellectual framework, while the perspective/tradition serves to clarify the researcher's philosophical stance. Finally, the stream of action research distinguishes the intent of the study.
2. The *Study Design* dimension describes the methodological details of the study. The design details include the background of the study, the intended change, research site, participants, data source, duration, degree of openness, access/exit and presentation.
3. The *Research Process* dimension refers to the sequence of steps by which action research is conducted. These steps are what make action research distinct from other methods. Generally, the steps should include one or more iterations of problem diagnosis, action interventions and reflective learning.
4. The *Role Expectations* dimension addresses the capacity and expectations of the researcher and those taking part in the study. This is one aspect of action research that is necessary to clarify how the respective individuals and organizations are involved, i.e., the respective roles of the researcher and participants, the level of participant

competency before and after the study, and ethical issues for the organization and its participants (Lau, 1999).

With its ability to make academic research relevant, the framework established is but a foundation "on which the pedagogy of action research in systems development can be refined and debated, perhaps helping establish a unifying framework in system development" (Avison, 1999).

Davidson et al. (2004) took a different approach in addressing the rigor-relevance problems associated with AR, by developing a set of interdependent principles and associated criteria that researchers, reviewers and practitioners can use to ensure and assess the quality of canonical AR (CAR). The term "canonical" is used to formalize the association with the iterative, rigorous and collaborative process-oriented model developed by Susman and Evered (1978) which has gained "canonical" status in the research community. Rigor according to Benbasat and Zmud (1999, p5), is "the correct use of methods and analyses appropriate to the tasks at hand." Relevance also depends on context, i.e., to whom or what a study is relevant and as such "will focus on concerns of practice [and] provide real value to IS professionals" Benbasat and Zmud (1999, p. 5). Thus at least two factors, the nature of the selected topic and the implications of the results, can be used to assess the relevance of a (research) study" Davidson et al. (2004, p. 67).

CAR aims to address organizational problems while at the same time contributing to scholarly knowledge. To achieve these potentially conflicting aims Davison et al. (2004) proposed the following five principles more as a guide to good practice rather than a checklist:

1. ***The Principle of the Researcher-Client Agreement (RCA)***: In order for the RCA to be effective, it is necessary that the client understands how CAR works and the benefits to and drawbacks for the organization. Achieving this understanding may require a process of knowledge transfer between researcher and client, mutual guarantees for behavior in the context of the project; provide a solid basis for building trust among the various stakeholders while contributing to the internal validity of the research.
2. ***The Principle of the Cyclical Process Model (CPM)***: The activities of the researcher will be informed by and designed to follow a CPM. Progressing through the CPM in a sequential fashion will help ensure that a CAR research project is conducted with systematic rigor.
3. ***The Principle of Theory***: A CAR project may begin without a clearly articulated theoretical framework, i.e., theory-free action learning. However if a "grounded theory" does not emerge during the diagnostic stage, then explicit theorizing is necessary as part of the planning stage. Theory can illuminate particular facets of the focal situation, suggest specific action that may be effective, and provide the basis for outlining the scope of data collection and analysis.
4. ***The Principle of Change through Action***: The essence of CAR is to take actions in order to change the current or prevailing situation and its unsatisfactory conditions while demonstrating the indivisibility of action and change with intervention seeking to produce change. Lack of change implies there were no meaningful problems, the intervention failed to address the existing problem(s), or that the existing situation could not be altered due to obstacles neglected during the RCA phase.
5. ***The Principle of Learning through Reflection***: The researcher involved in CAR project as multiple responsibilities to clients, and to the research community. Clients will focus on practical outcomes while the research community will be interested in the discovery of new knowledge, i.e., practical progress and the advancement of knowledge through reflection and learning.

The growing use of AR in IS research makes it important that the quality of such studies are beyond reproach as producing research that is rigorous and relevant is both desirable and

practical and certainly not mutually exclusive. The spirit of the principles and criteria is that they facilitate the clear and systematic presentation of ideas and findings, at the same time helping researchers to justify their choice of action, their contributions to knowledge and their conclusions (Davison et al., 2004).

The contingency threat arises because of the huge amount of data that is usually at the disposal of the researcher. Contrary to experiments, action research often has access to a very large amount of general data, instead of a small amount of specialized data. Because of this, the researcher may not be able to distinguish between contingent causes (i.e., related specifically to the organization that is studied) and general causes. Isolating causes from one another is virtually impossible since they are interconnected and the action researcher lacks control to separate or test them.

Grounded Theory ("G")

Qualitative studies and research are often judged by quantatively-oriented readers and/or evaluators using quantitative canons which qualitative researchers regard as inappropriate for evaluating qualitative research (Corbin and Strauss, 1990). This is not to imply or even suggest that qualitative researchers do not believe in the canons of "good science" – significance, theory observation, compatibility, generalizability, consistency, reproducibility precision and verification – only that there needs to be some "redefinition" in order to fit the realities of qualitative research and the complexities of social phenomena.

Since its introduction in 1967, Grounded Theory (GT) has not changed in form. However, the specificity of its procedures has been elaborated as the method as evolved due to practice. As envisioned by its creators, Glazer and Strauss, the grounded theory procedures were

designed to cultivate an integrated set of concepts that offer a thorough theoretical explanation of the social phenomena under study (Corbin and Strauss, 1990). The term "Grounded Theory" implies that theory must be developed from a systematic analysis of empirical data; therefore, a grounded theory is one that is derived from the study of a phenomenon and is verified through data collection and analysis, i.e., theory that is developed inductively from a body of data that should explain as well as describe. According to Martin and Turner (1986, p. 141), "Grounded theory is an inductive, theory discovery methodology that allows the researcher to develop a theoretical account of the general features of a topic while simultaneously grounding the account in empirical observations or data."

Conceptually, grounded theory derives its theoretical foundations from two important principles derived from the Pragmatism and Symbolic Interactionism orientations. The first is concerned with change. Because the social phenomenon under study is continually changing in response to evolving conditions, "an important component of the method is to build change, through process, into the method" (Corbin and Strauss, 1990, p. 5). The second principle involves determinism and it is rejected. The independence of the actors interacting with the social phenomena is paramount, as "they are able to make choices according to their perceptions, which are often accurate, about the options they encounter" (Corbin and Strauss, 1990, p. 5).

For the qualitative researcher, grounded theory provides assistance in revealing relevant conditions, and how actors respond to changes and the consequences associated with their actions. As in other qualitative approaches, the data for grounded theory can be culled from a variety of sources. The primary data collection procedures - interviews and observations – is often augmented with data obtained from a variety of secondary sources – newspapers, letters,

books and other organizational communiqués – anything that may shed light on the phenomena under study.

Grounded theory's objective is the discovery of a theoretically comprehensive explanation about the phenomenon using techniques and analytical procedures that enable investigators to develop a theory that is significant, generalizable, reproducible and rigorous. Using the prescribed methodology, one does not begin with a theory and then prove it. Rather, a theory emerges from the observations and generated data. The emergent theory can be empirically tested to develop forecasts or predictions from general principles (Corbin and Strauss, 1990).

The Elements

The three basic elements of grounded theory are concepts, categories and propositions. *Concepts* are the basic unit of analysis since it is from conceptualization of data that theories are developed (Pandit, 1996). According to Corbin and Strauss (1990, p. 7), "Theories can't be built with actual incidents or activities as observed or reported; that is, from 'raw data.' The incidents, events, happenings are taken as, or analyzed as, potential indicators of phenomena, which are thereby given conceptual labels." By comparing incidents and naming like phenomena with the same term, the theorist can accumulate the basic units for theory." *Categories* are more abstract than the concepts they represent. According to Corbin and Strauss (1990, p. 7), "Categories are higher in level and more abstract than the concepts they represent and are generated through the same analytic process of making comparisons to highlight similarities and differences that is used to produce lower level concepts. Categories are the "cornerstones" of developing theory. They provide the means by which the theory can be integrated. The third element is propositions.

Propositions are indicators of the generalized relationship between a category and its concepts and between discrete categories (Pandit, 1996). Originally termed "hypothesis" by Glaser and Strauss (1967) it is felt that the term "propositions" is more apropos since propositions involve conceptual relationships whereas hypothesis require measured relationships (Whetten, 1989). Subsequently, we can describe the association between data collection, analysis and theory as reciprocal, recursive and iterative.

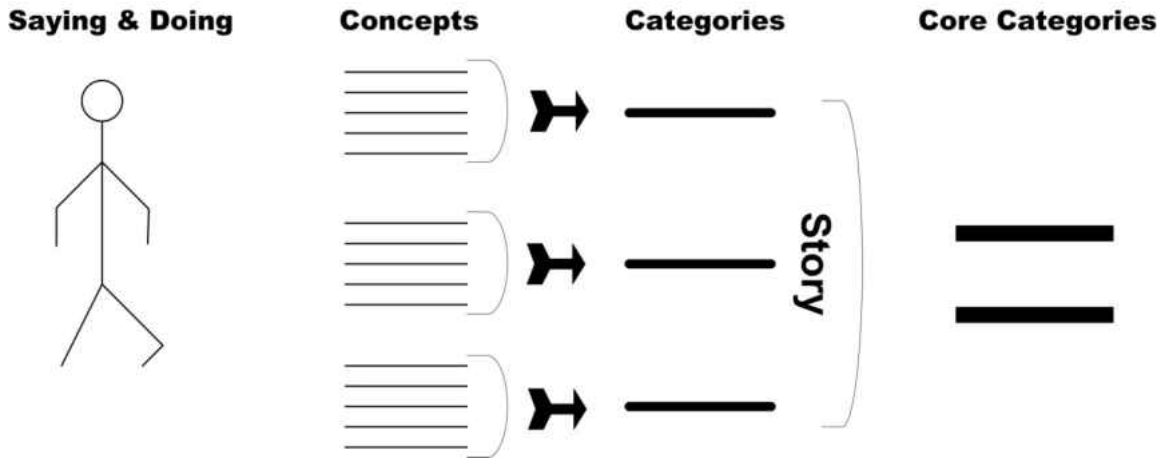

Figure 3.4: The Grounded Theory Research Model (Glazer and Strauss, 1967)

According to Eaves (2001) the major assumptions subsumed in the grounded theory methodology can be summarized as follows:

- Inquiry is structured by discovery of social and social psychological processes
- Data collection and analysis phases of research proceed simultaneously
- Both the processes and products of research are shaped from the data rather than from preconceived logically deduced theoretical frameworks

- Analytic processes prompt discovery and theory development rather than verification of pre-existing theories
- Theoretical sampling refines, elaborates, and exhausts conceptual categories
- Grounded theory methodology is not only aimed at studying processes, but also assumes that making theoretical sense of social life itself is a process
- The systematic application of grounded theory analytical techniques leads progressively to more abstract analytic levels.

The grounded theory methodology is comprised of flexible strategies that guide qualitative data collection and the methodology's strength lies in its ability to convey: (a) the steps for handling data collection and analysis; (b) a way of correcting errors, omissions and of refining analytic ideas; (c) tools for studying basic social and social psychological processes in their natural settings; and (d) strategies for creating middle-range theories (Charmaz, 2002). Grounded theory methodology prescribes specific events for data collection and analysis, with limited flexibility and latitude so rigor can be maintained throughout the project. The primary purpose of grounded theory is to generate explanatory models of human social processes that are grounded in the data (Eaves, 2001).

Procedure and Canons

These events or as Corbin and Strauss (1990) termed them "procedures and canons" are as follows:

1. *Data Collection and Analysis are Interrelated Processes* - Analysis should begin as soon as the first bit of data is collected. Analysis is necessary from the start since it is used to direct the next interview and observations. The simultaneous nature of both operations ensures that the research process captures all potentially relevant aspects of the topic as soon as they are perceived, guiding the researcher towards a more thorough understanding. This ensures that no matter how enamored a researcher is about a

particular concept, if its relevance to the phenomenon under question is not proven through continued scrutiny, it must be discarded (Corbin and Strauss, 1990).

2. *Concepts are the Basic Units of Analysis* – A theorist works with conceptualizations of data. As Corbin and Strauss (1990, p. 7) explained, "If a respondent says to the researcher, 'Each day I spread my activities over the morning, resting between shaving and bathing,' then the researcher might label this phenomenon as "pacing." As the researcher encounters other incidents, and when after comparison to the first, they appear to resemble the same phenomena, then these, too, can be labeled 'pacing.'" Only by comparing incidents and naming like phenomena with the same term can the theorist accumulate the basic units for theory (Pandit, 1996).
3. *Categories are the Basic Units of Analysis* - Concepts that pertain to the same phenomenon must be grouped to form categories. Categories are the "cornerstone" of a developing theory as they provide the means by which a theory can be integrated (Corbin and Strauss, 1990).
4. *Sampling in Grounded Theory proceeds on Theoretical Grounds* - Sampling in grounded theory proceeds not in terms of concepts, their properties, dimensions and variations. On commencement of a study, the researcher using his knowledge can elect to sample groups of individuals, an organization or a community representative of the prescribed phenomena can be selected for study. For example, if the researcher wants to study programmers' work then he or she would go where programmers work to observe what they do.
5. *Analysis makes use of Constant Comparisons* - As an incident is noted, it should be compared against other for similarities and differences. Making comparisons assist the researcher in guarding against bias and also to achieve greater precision and consistency. The data must also be examined for regularity whether it is or is not apparent. It is only through this comparative examination that patterns and variations can be uncovered.
6. *Patterns and Variations must be Accounted for* – The data must be examined for regularity and for understanding of where that regularity is not apparent. Locating patterns or regularities helps to give order to the data and assist with integration.
7. *Process Must Be Built into the Theory* – In grounded theory, the term "process" has several meanings. Process analysis can mean breaking a phenomenon down into stages,

phases, or steps. The term can also denote purpose action/intervention that is not necessarily progressive but changes to prevailing conditions.

8. *Writing Theoretical Memorandums is an Integral Part of doing Grounded Theory* – Since the researcher cannot readily keep track of all the categories, properties, hypotheses and generative questions that evolve from the analytical process, the use of memos is the procedure designed to accomplish the recording and tracking and its implementation should not be delayed. Writing memos should begin with the first coding session and continue on to the end of the research project.
9. *Hypotheses About Relationships among categories should be Developed and verified as Much as Possible during the Research Process* - As hypotheses about relationships among categories are developed, they should be taken back into the field for verification. Embedded in the verification procedure is the search for negative and qualifying evidence.
10. *A Grounded Theorist Need Not Work Alone* – An important part of research is testing concepts and their relationships with colleagues who have experience in the same substantive area. Opening one's research and analysis to others can help guard against bias.
11. *Broader Structural Conditions Must Be Analyzed, However Microscopic the Research* – The analysis of a setting must not be restricted to the conditions that bear immediately on the phenomenon of interest but should include broader conditions such as economic conditions, cultural values, political trends, social movements and so on.

Although grounded theorists have given priority to data analysis over data collection, the quality of the collected data influences the final analysis. Full, richer data provide a more comprehensive view of the studied topic. A hallmark of grounded theory studies is that data collection and analysis proceed simultaneously with each activity providing a check on the other. This approach shapes future data collection by focusing on material that fits the topic instead of the researcher's preconceived thoughts or ideas.

Building Theory

Grounded theory was developed for the purpose of studying social phenomena using a systematic set of data collection and analysis procedures to develop inductively derived theory from the data (Strauss and Corbin, 1990, 1994). According to Strauss and Corbin (1994), the major distinguishing factor between grounded theory and other qualitative research methods is its emphasis on theory development - substantive or formal. Eaves (2001) asserts that Grounded Theory's primary purpose is, the generation of explanatory models of human social processes. Generation of theory occurs during actual research (Strauss and Corbin, 1994) and is based on comparative analyses, using the constant comparative method, between groups of persons within a particular area of interest (Eaves, 2001). The constant comparison assists the researcher in identifying patterns and relationships between these patterns (Eaves, 2001). According to Morse and Field (1995) the theory generation process is "hierarchical and recursive because researchers must systematically categorize data and limit theorizing until patterns in the data emerge from the categorizing operation. This method requires data collecting, open categorizing, writing memorandums, determining a core category, recycling earlier steps in terms of core category, sorting memorandums, and writing up the theory" (p. 157).

Grounded theory methods are emergent both in type and nature of data and analysis throughout the research process. Prior to the adaptation of grounded theory, researchers often discovered that they had gathered extensive but "thin" data. However, with the use of the grounded theory approach, researchers were able to obtain more complete or "fat" data for analysis. Because grounded theory methods aim to further the theoretical power of the analysis, these methods tailor data gathering to the researcher's emerging analysis. Thus adopting these methods makes data collection more efficient and streamlines the research process (Charmaz,

2002). Forming theory is like completing a puzzle; each piece is but a small snapshot of the total picture. The purpose of grounded theory's strategies is to support the development of middle-range theories. By definition, middle-range theories are theories that are moderately abstract, inclusive, organized within a limited scope, have a limited number of variables, testable in a direct manner and have a strong relationship with research and practice.

Although grounded theory's creators called for conducting qualitative research and developing theory, they were less clear on details about methodology. The original approach as developed by Glaser and Strauss (1967) has evolved into two dominant streams identifiable by, and based on the work of grounded theorist Charmaz (1983) and Strauss and Corbin (1990). As originally advocated by Glaser and Strauss, grounded theory builds on discovered data, avoids preconceiving interpretation of them through extant theories or categories, relies on comparative methods, and aims towards theory development. Thus, the grounded theorist compares data with data, data with concept, concept with concept, and theoretical category with theoretical category. Charmaz's approach retains the tenets and embodies the ideals of the original approach but from a constructivist orientation by placing emphasis on the studied phenomenon rather than on the methods of studying it and adopting the grounded theory strategies as useful tools, not as rigid prescriptions, viewing the resulting theoretical analyses as interpretive renderings of a reality by advocating that each stage of the grounded theory analysis moves the work toward theoretical formulations. The techniques involved in the strategies employed namely, coding, memo-making, and theoretical sampling (Charmaz, 2002).

Coding and *Categorizing* is the first phase of the theory construction process. According to Charmaz (2002, p. 6398) "theory coding includes the following characteristics: (a) a focus on action and process; (b) a practice of line by line initial coding; (c) a simultaneous involvement in

coding and further data collection; (d) an emphasis on analytic development rather than description." With its two stages, initial/open and focus, coding represents the initial phase of the analytic method and is simply the process of categorizing and sorting data. Codes serve as devices to label, separate, compile, and organize data (Charmaz, 1994).

The second phase of the theory construction process is *Memo-Writing*. This phase is the pivotal intermediary stage between coding data and drafting the theoretical analysis. According to Charmaz (2002) through memo-writing, grounded theorists fill out their code and identify gaps in them. They define the code, delineate and analyze its properties, specify conditions under which it exists and changes, demonstrate its relationship to other codes, and weigh its significance for processes discovered in the field.

The third phase of the theory construction process is *Theoretical Sampling* which is sampling to develop or refine emerging theoretical categories, not to describe populations chosen before the research begins. According to Charmaz (2002) "theoretical sampling occurs after the grounded theorist has defined and analyzed core theoretical categories through focused coding and memo-writing but needs more data to develop, refine and check the properties, boundaries, causes, and consequences of these theoretical categories. Thus, theoretical sampling builds precision, density, and complexity into the emerging theoretical statements and keeps them grounded in data." This approach has significantly influenced the development of qualitative research in the social sciences, nursing and education professions (See figure 3.5).

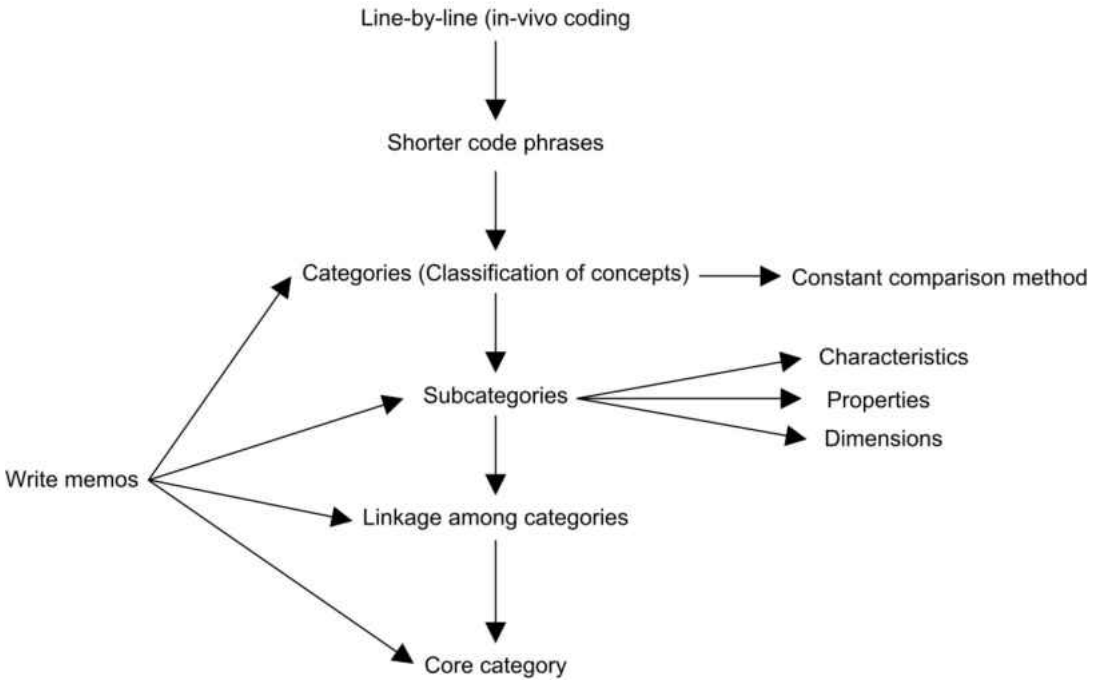

Figure 3.5: Charmaz (1983) multi-step coding and analysis technique

Strauss and Corbin took grounded theory in somewhat different directions (See figure 3.6). They explicated a complicated technique filled with smaller steps and introduced several new techniques, stress description, included verification as part of grounded theory and prescribed adherence to a set of technical procedures (Charmaz 2002, Eaves 2001). Corbin and Strauss, (1990) identified three basic types of coding: open, axial and selective:

1. *Open Coding*. Open coding is the interpretive process by which data are broken down analytically. According to Corbin and Strauss (1990) its purpose is to give the analyst new insight by breaking through standard ways of thinking about or interpreting phenomena reflected in the data. Charmaz (1994) describes open coding is an analytic device for examining the data line by line, the objective being to identify the processes in the data. According to Corbin and Strauss (1990) "events, actions or interactions are compared with others for similarities and differences. They are also given conceptual

labels. In these way conceptually similar events, actions or interactions are group together to form categories and subcategories." Open coding and its utilization of questioning and constant comparison enables researchers to "break through subjectivity and bias" (Corbin and Strauss, 1990).

2. *Axial Coding*. In axial coding, categories are related to their sub-categories, and the relationship tested against data. This type of coding is referred to as "Focused" coding by Glaser (1978), and its purpose "is to build and clarify a category by examining all the data it covers and variations from it." Irrespective of the name, axial or focused, this type of coding describes the process by which a limited set of codes that were developed in the initial phase are applied to a large amount of data. The coded data is compared with other data and assigned to clusters or categories according to obvious fit. The resultant categories are simply coded data clustered together. The use of constant comparative analysis is a central feature of the grounded theorist analytic approach.

3. *Selective Coding*. Selective coding is the process by which all categories are unified around a "core" category, and categories that need further explication are filled-in with descriptive detail. This core category represents the central phenomenon of the study. The other categories will always stand in relationship to the core category as conditions, action, interactions strategies or consequences.

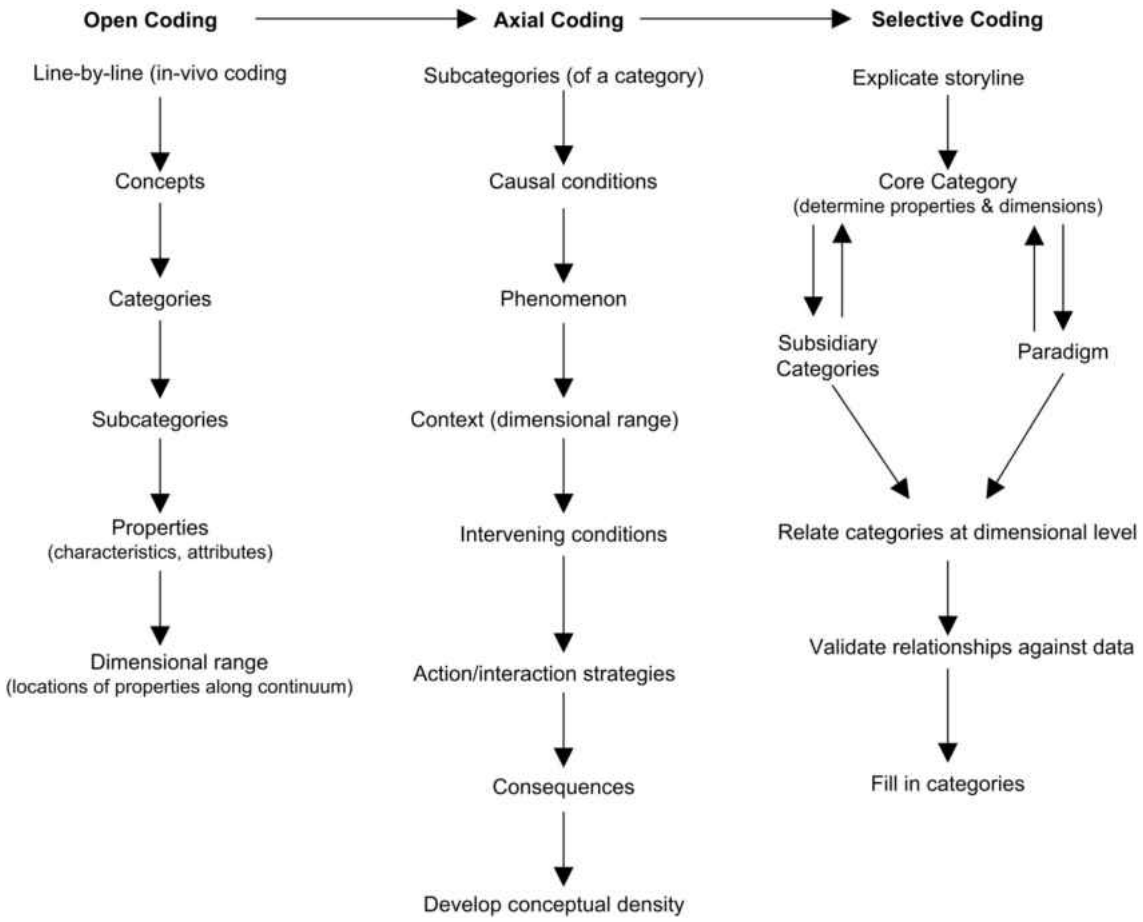

Figure 3.6: Strauss and Corbin's (1990) multi-step coding and analysis technique

According to Pandit (1996), a more detailed reading of Corbin and Strauss' "canons and procedures" reveals the presence of five analytic phases namely: research design, data collection, data ordering, data analysis and literature comparison. While not necessarily sequential, adherence to the methodological steps embedded within these phases is a process for building theory using grounding theory (See figure 3.7). Below is a brief description of each phase:

1. ***Research Design*** involves the overall configuration of the research effort and seeks to answer such questions as: what kind of evidence is gathered from where and how this evidence is interpreted and utilized to define the basis research question(s). According to Pandit (1996, p. 4), "these should be defined narrowly enough so that the research is focused and broad enough to allow for flexibility and serendipity." According to Strauss

and Corbin, (1990, p. 53), "a good source of research questions is the technical literature on the general problem area." Completion of the initial step, *technical literature review*, is followed by the second, *theoretical sampling,* which involves the collection of data on various categories, for the development of properties and propositions (Pandit, 1996).

2. ***Data Collection*** involves the use of multiple data sources that relates to the same phenomenon. Different kinds of data gives the researcher different views from which to understand a category and to develop its properties (Glaser and Strauss, 1967). The use of multiple data source enhances construct validity and reliability.
3. ***Data Ordering*** is primarily concerned with research data that is ordered chronologically, allowing the researcher to untangle the causal events and relationships over time.
4. ***Data Analysis*** is central to the generation of theory using the grounded theory research approach. Data analysis for each case involves generating concepts through the process of coding, i.e., the decomposition, conceptualization and recomposition of data in new ways to uncover underlying relationships and emergent theories (Corbin and Strauss, 1990).
5. ***Literature Comparison*** is the final step and involves comparisons between the emergent theory and the extant literature to determine what is different and why. According to Pandit (1996) tying the emergent theory to existing literature enhances external validity and generalizability.

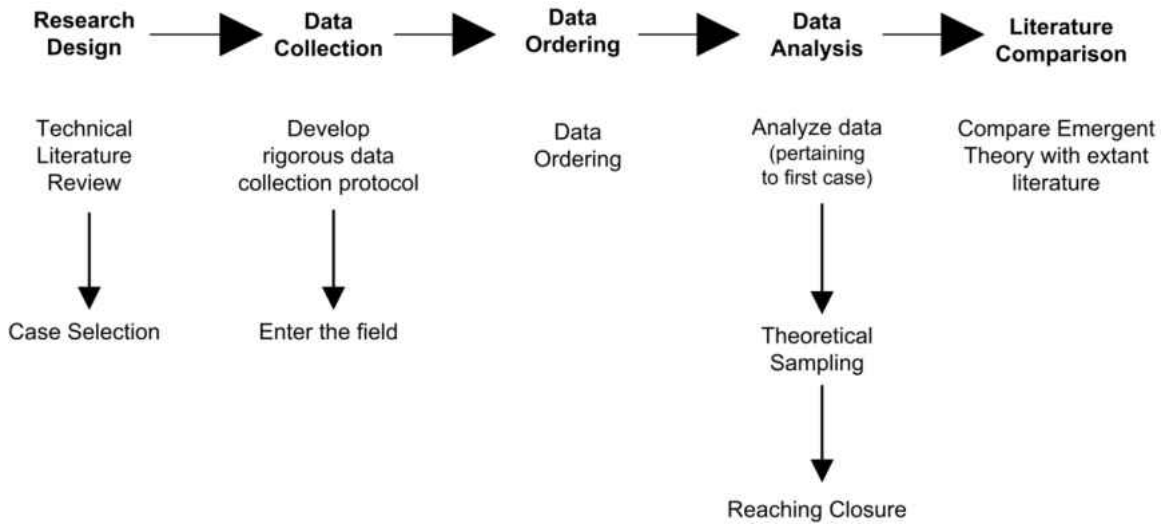

Figure 3.7: Grounded theory using Strauss and Corbin's multi-step process (Eaves 2001)

As a qualitative research approach, grounded theory like any research method has its strength and weaknesses. Its strength lies in its ability to discern theory that is grounded in data methodically gathered and analyzed and that its theoretical structure is generated from the data rather than from previous studies. The primary weaknesses associated with the methodology are: the lack of clarity associated with its jargon, for example, terms such as codes, theoretical codes, categories, theoretical categories, concept, conceptual framework and theoretical sampling. The secondary weaknesses are associated with how the method clarifies its ontological and epistemological assumptions. The grounded theory approaches are becoming increasingly common in the IS research literature and renewed support from those IS scientists and professionals, because the method is extremely useful in developing context-based, process-oriented descriptions and explanations of the phenomenon while producing conceptual analysis of rigorous empirical and qualitative research.

System Development ("S")

IS is a multi-paradigm discipline that explores all aspects of information systems from an individual, group and total organizational perspective. The primary purpose of system development research is to add to the body of knowledge about the creation and evaluation of software design, development and implementation issues from an individual, group and/or total organizational perspective by investigating "all aspects of the software development process, including software formulation, implementation, description, evolution, modeling and evaluation," (Morrison et al., 1995, p. 81) or as Keen (1987, p. 3) succinctly articulated it, "study the effective design, delivery, use and impact of information technology in organizations and society."

Within the IS community a variety of research approaches and methodologies have been employed, however, these approaches can be categorized into four generally accepted research approaches (Morrison and George, 1995):

- *Formulative* research involves development and refinement of theories, models or frameworks that guide research activities and support scientific progress through paradigm shifts.
- *Evaluative* research involves methodologies that employ the scientific method and normally consist of theory or model generation or observation followed by hypothesis generation and testing.
- *Descriptive* research involves the development and description of theories or models to provide the input for developing units of theory, its laws of interaction, system states and model boundaries.
- *Developmental* research involves the generation of knowledge for examining or solving general problems.

While the research approach chosen is often dependent on the domain and the researchers' philosophical approach, the bulk of IS research has employed the evaluative approach when evaluating system development (Morrison and George, 1995).

According to Nunamaker and Chen (1990), systems development, especially the development of software systems, is a research domain as well as a research methodology. A research domain is the subject matter under study in a research project. A research methodology consists of the combination of the process, methods, and tools which are used in conducting research in a research domain. A research process involves understanding of research domains, developing meaningful research questions, and applying valid research methodologies to address these questions. Research methods are means of finding truth in research domains. According to Nunamaker and Chen (1990, p. 632), "Systems development as a research methodology can be

used not only as a means of better understanding a research domain, but can sometimes even change the processes and products in a research domain."

System Development Research Methodology

The systems development methodology is an age-old method and process that humans used to study nature and to create new products. In the software development realm, methods and tools, structured programming, design and analysis have been introduced in practice by the practical experiences learned from developing real systems. While building a system does not necessarily constitute research, Nunamaker et al. (1991), argue that the synthesis and expression of new technologies and new concepts in a tangible product can act as both contribution to both basic and applied research, and as an impetus to continuing development of an IS knowledge base.

Nunamaker et al. (1991, p. 97), asserted that "Methodology is the philosophy of the research process" an assertion that underlines the relationship or parallels between the behavioral and the engineering approaches to research. Whereas the detailed methods and tools employed differs, both approaches embrace the assumptions and values that serve as a basis for research and the standards or criteria the researcher uses for interpreting data and reaching a conclusion. According to Nunamaker et al. (1991), first, the researcher identifies research problems and related research questions; second the researcher develops and evaluates a software prototype for a system-based development method using the steps shown; thirdly, evaluation of results may suggest revision of prototype concepts, requirements, and architecture, design and implementation considerations before evaluation of results is repeated; the evaluation-prototype refinement process may continue through several iterations. Ultimately, the goal is to satisfy the

research question and affirm, confirm or refute existing theory (Morrison et al., 1995). Below is the framework prescribed by Nunamaker et al. (1991) which they labeled the Systems Development Research Methodology (See figure 3.8).Using this methodology, the prototype itself serves as a system specification or as an evolutionary working system.

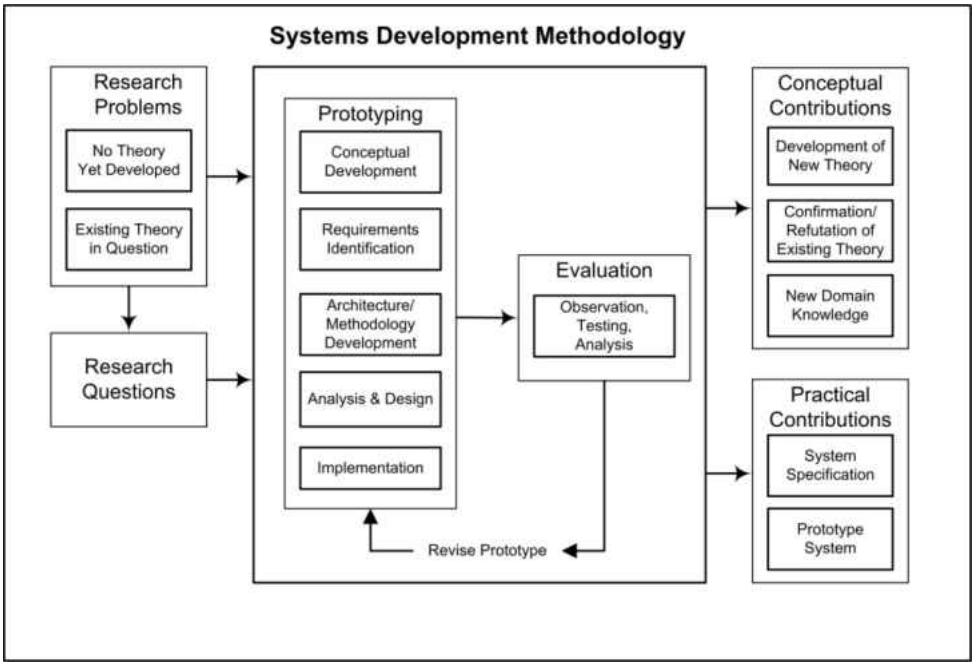

Figure 3.8: Nunamaker et al. (1991) System Development Methodology

The research process is the heart of the research methodology and is often regarded as the application of scientific methods to the complex task of discovery, i.e., providing solutions to problems. Nunamaker et al. (1991) distilled the research processes associated with the social and behavioral sciences down to a five step prescription which he labeled the Systems Development Research Process (See figure 3.9). This iterative framework consists of the following steps: Construct a conceptual framework; Develop a System Architecture; Analyze and Design the System; Build the System; and Experiment, i.e., Observe and Evaluate the system.

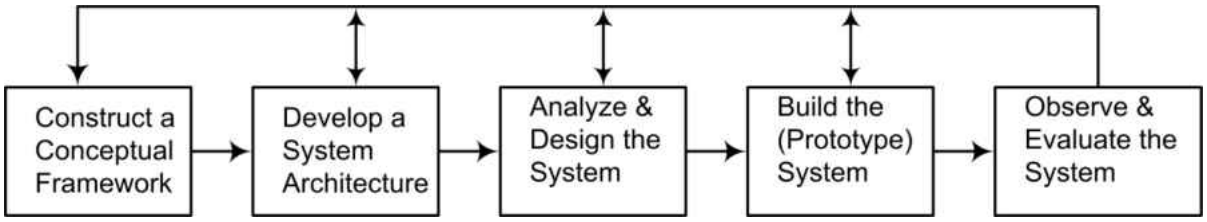

Figure 3.9: Nunamaker et al. (1991) System Development Research Process

The principal steps are discussed in more detail below:

1. ***Construct a conceptual framework*** by selecting a research problem that is new, creative, and important, or if it proposes a new way of doing things, based on the suggested new methods, techniques, or design. The conceptual framework leads to theory building
2. ***Develop system architecture*** by providing a road map for the systems building process by placing the system components into perspective using the functional descriptions and structural relationships between the system components.
3. ***Analyze and Design the System*** - a step which requires a thorough understanding of the studied domain, and how to apply scientific and technical knowledge in creating, synthesizing and evaluating alternative solutions.
4. ***Build the System*** involves the application of software engineering principles in constructing a prototype to demonstrate the feasibility of the design and the usability of the functionalities requested.
5. ***Experiment, Observe and Evaluate*** the built system by testing its performance, usability and impact on individuals, groups, and/or organizations.

To be effective the use of system development as an IS research methodology has to be evaluated in accordance with the approach's ability to satisfy the following criteria: (1) study an

important phenomenon in areas of information systems building, (2) make a significant contribution to the domain, (3) the system is testable against all stated objectives and requirements, (4) the new system can provide a better solution to IS problems than the existing systems, and (5) generalize experience and design expertise gained from building the system (Nunamaker et al., 1991).

Software Engineering Research Methodology (SERM)

Software systems have changed the way we think and the way in which we solve problems. Nunamaker et al. (1991, p. 101) defined software as: "(1) the embodiment of the functions of a system, (2) the captured knowledge of an application area, and (3) the information produced during the system development process." Software engineering then can be viewed as the application of "sound engineering, scientific and mathematical discipline and practice to the design, development, testing and maintenance of software systems" (Vick and Ramamoorthy, 1984). The term "software engineering" was coined in 1968 and now "refers to a collection of management processes, software tooling, and design activities for software development" (Shaw, 1990, p. 15).

According to Shaw (1990, p. 15) use of the word "engineering" to describe the current practices of development takes "considerable liberty with the common usage of the term versus its more customary usage which refers to a disciplined application of scientific knowledge to resolve conflicting constraints and requirements for problems of immediate, practical significance." Definitions of "engineering" abound and they all share some commonalities:

- ***Creating cost-effective solutions*** … Engineering is not just about solving problems; it is about solving problems with economical use of all resources, including money.

- … ***to practical problems*** … Engineering deals with practical problems whose solutions matter to people outside the engineering domain – the customers.
- … ***by applying scientific knowledge*** … Engineering solves problems in a particular way: by applying science, mathematics and design analysis.
- … ***to building things*** … Engineering emphasizes the solutions, which are usually tangible artifacts.
- … ***in the service of mankind***. Engineering not only serve the immediate customer, but it also develops technology and expertise that will support the society.

Shaw (1990, p.16) postulates that "Engineering relies on codifying scientific knowledge about a technological problem domain in a form that is directly useful to practitioners, thereby providing answers for questions that commonly occur in practice."

Eastman (1989) proposed the purpose of software engineering research is to add to the body of knowledge about software, i.e., the creation and evaluation of software development methods, system designs and system implementation. Nunamaker et al. (1991) suggests that the goals of software engineering research should include:

- Developing systems to prove their feasibility
- Measuring system properties
- Improving system performance
- Developing formal models of application domains
- Using specification languages to describe system behaviors
- Improving prior systems
- Reviewing and synthesizing prior research.

Morrison and George (1995, p. 81) suggested that the objectives of software engineering research are to investigate all aspects of the software development process including "software formulation, implementation, description, evolution, modeling and evaluation." Thus, one can safely conclude that software engineering concerns all types of software. Farley (1986) and Morrison and George (1995) suggested a broader approach to software engineering research including:

1. Original contributions to knowledge (*formulative*);
2. Development of outstanding software artifacts (*developmental* if the methodologies are generalizable or *descriptive* if specific innovative software systems are described);
3. Experimental studies (*evaluative*) and;
4. Significant case studies in software engineering similar to those in IS, i.e., *formulative* and *evaluative*.

According to Morrison and George (1995) the identified research approaches: *formulative*, *evaluative*, *descriptive* and *developmental* are both appropriate and comprehensive for the domains encountered in IS research.

According to Nunamaker et al. (1991), the development of (software) systems research has its roots in the research paradigm of engineering schools, which has heavily influenced systems development research methodology. Building on the research of Nunamaker et al. (1991), Gregg, et al. (2001), proposed the Software Engineering Research Methodology (SERM), which is described as an approach that allows the synthesis and expression of new technologies and new concepts in a tangible product that can contribute to basic research and serve as an impetus to continuing research" (Nunamaker, Chen and Purdin, 1991, p. 102). SERM

includes “proposing, formalizing and developing software systems to improve the effectiveness and efficiency of processes at the individual and organizational level,” (Gregg et al. 2001, p. 169) by bridging the gap between human processes and technological capabilities.

IS research has normally adopted either the Positivist or Interpretive approach. However, in our current operating environment, the development and implementation of innovative software is not adequately covered by these paradigms.

To this end, Gregg et al. (2001) proposed the Socio-technologist/Developmentalist approach as a new paradigm that not only incorporates the assumptions made by the positivists and interpretivists but extends them to cover SERM research. According to Mumford (2000), today’s systems design problems are complex and difficult and often outside the designer’s normal experience and it is only with a through understanding of the problem and the organizational and human changes that will result from implementation, and the consequences of failure can we hope to succeed in producing systems that are both innovative and efficient. How we solve system design problems will depend on a large extent on recognition of the socio-technical factors present, specifically the nature of the environment that will contain the new system, the beliefs, values and assumptions of the designer. Effective utilization of the socio-technical approach implies that the designers are aware of and are taking into account the technical, economic, organizational and social issues at every stage of the design process.

The question that arises is whether software engineering can be research? Since research is often described as an approach to promoting knowledge enhancement and/or understanding, Gregg et al. (2001) reasoned that since scientific research is a process of systemic inquiry conducted under the aegis of a theoretical framework, the use of theory as a basis for inquiry

combined with systematic inquiry methods addressing the research question through proof-of-concept can and should be viewed as research.

According to Guba and Lincoln (1994) for an approach to be considered a paradigm it needs to answer three questions. What is the nature of the reality that it addresses (ontology)? What is the nature of knowledge (epistemology)? And what is the best approach to obtaining the desired knowledge and understanding (methodologies)? The Socio-technologist/Developmentalist paradigm allows the *creation* of new systems and transfer of the technology to domains that need them and since it is intertwined with the other two paradigms, it is in fact a "multi-methodological approach" (Nunamaker et al., 1991) to IS research. The Interpretive paradigm *generates* the concepts and propositions needed to create the research context; the positivist paradigm allows dispassionate and objective *confirmation* of the propositions identified and highlighted (Gregg et al., 2001).

According to the authors, the methodology advocated connects the three paradigms. Firstly, in the *generate* phase of the software engineering cycle, developers interpret and construct realities than can be created using a software system; secondly, in the *create* phase, concepts are translated into reality using system development activities; and finally, in the *confirmation* phase scientific evaluation and measurement of the new system along with technology transfer is accomplished.

The SERM framework (See figure 3.10) is based on the three phases of the software engineering methodology: the conceptual, the formal, and the developmental. "Conceptualization or the theoretical grounding of the system requirements is suggested as the focal point of the research effort. The conceptual basis is followed by, either mathematical or logic based

formalisms and/or development of a system as different approaches to establishing the proof of the concept" (Gregg et al., 2001). Both the formal and the developmental approaches are important parts of the methodology; and when combined are more likely to produce a more rigorous research effort (Gregg et al., 2001). Below is a more thorough discussion of the phases.

1. The *Conceptual phase* is the primary activity. Here the theoretical foundation of the research effort is defined. "Concepts help researchers think about and communicate ideas via definitions and propositions" (Gregg et al., 2001, p 174). The success of this phase is dependent on the clarity with which problems are articulated, and the understandability and translatability of the concepts identified. "Once an idea is conceived and validated the software engineering effort can take on either a formal approach or a developmental approach (or both)" (Gregg et al., 2001).
2. The *Formalization phase* is concerned with the application of mathematical or logic based techniques to describe, develop and verify a software system. This phase addresses the needs specified in the previous phase that is, providing a mathematical or logic-based explanation that builds and give shape to ideas. The use of mathematical and/or logical rules reduces the possibility of misconceptions and misunderstandings.
3. The *Development phase* is concerned with prototyping. The development of a prototype allows researchers to study the validity of their solution by studying system performance in a controlled environment. Prototyping is ideal for this phase. It is an iterative process that allows successive developments on initial success. The process of developing a working system can provide researchers with insights into the advantages and disadvantages of the concepts and the chosen design alternatives (Nunamaker et al., 1991).

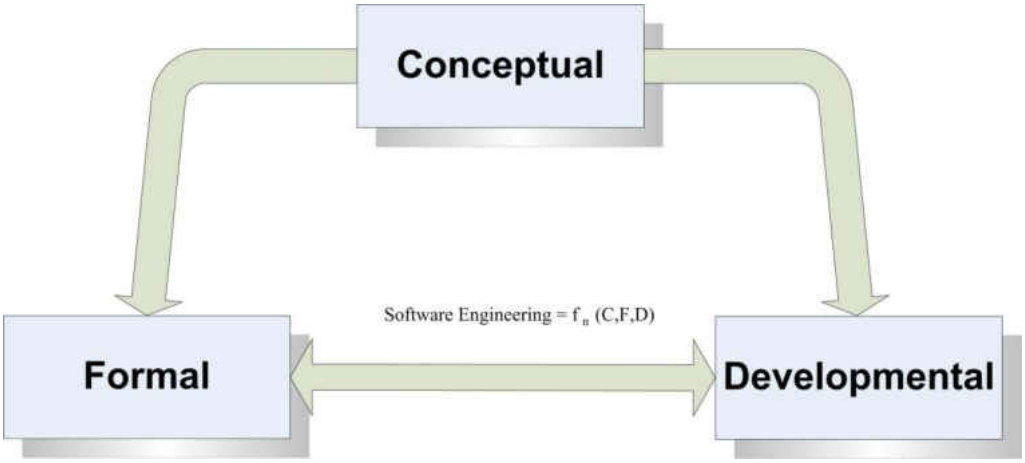

Figure 3.10: The SERM framework model

"Software engineering has always been considered important to IS research. It is at the core of the IS discipline" (Gregg et al., 2001). The systems development research methodology is linked to the research paradigm of engineering schools, which encourages cooperation between theory and practice. It is evident that IS research is still dominated by the positivist approach, (Vessey et al., 2002), however, "the use of the systems development research methodology in conjunction with other research methodologies in various reference disciplines has been very successful and productive," (Nunamaker, et al., 1991, p 103) in producing fruitful research results.

Software Development Practices

Within the last decade the practice of software development has undergone dramatic changes as practitioners have migrated from a purely mechanistic engineering approach to a more people-centric approach to the analysis, design and implementation of information systems. With the pervasiveness of IT in our daily lives, coupled with the demand for faster and more innovative applications with ever-decreasing delivery times, and the increasing competitive and

dynamic environment in which organizations operate such a philosophical shift was inevitable. Chronologically, we can identify three major periods and approaches associated with software development, namely, structured, object-oriented/model-based and agile approaches.

The structured approach is characterized by its separate emphasis on data and process, i.e., the relationship between data entities are modeled and the functional activities necessary to establish and preserve these relationships are decomposed into series of activities formalized by algorithms. The object-oriented approach sought to synthesize data and functional activities into objects which mimic the behaviors of the system being realized. The focus of the approach is on the relationship between the classes or high level abstractions of the real world concepts being modeled. The agile approach seeks to synthesize the knowledge of people (users), process and data into a complex adaptive and responsive work system. The focus of the approach is agility and adaptability in an environment where change is inevitable and constant (Cockburn and Highsmith, 2001).

According to Robey et al. (2001) and Herschheim et al. (1989, 1991) information system development is a social process that involves actors in various interacting social roles and while certain roles have become routinized across the various approaches, the particular mix of actors varies with the development method used. The roles of the developer and user have been the primary focus of much study; however, over time the role of additional stakeholders in process have been incorporated into studies. IS development is assisted by methodologies and methods, which affects the interactions among actors and the social implications of such roles. “By assigning responsibility for different activities and by indicating how roles are to interact, development methodologies may bestow more power to certain roles while diminishing others in importance” (Robey et al., 2001, p. 54).

Since all the major processes involved in an IS development project are a set of social interactions affected by role differentiation, degree of interdependence and communications between the roles, the influence of IS system development on the outcome of development projects is immense given that it imposes technical discipline while concurrently influencing the social interactions from which system knowledge emerges.

The various methodologies in practice can be classified into two established paradigms – traditional life cycle and the iterative-incremental (Robey et al., 2001). The *traditional life cycle paradigm* with its positivist's roots is based on the assumption that proper execution of each step will eliminate flaws/corrections later in the process resulting in reduced overall costs. Conversely, *the iterative-incremental paradigm* with its intrepretivist's roots, seeks to produce a "correct" system through the repetition of cycles and the close interactions of stakeholders in an evolutionary process. Recently, a third development paradigm has emerged. Referred to as the *Component-based Development*, this approach regards systems development as a user-centered activity (Robey et al., 2001) in which the commoditization of system development has transformed the process into one which users can develop and maintain their system with greater autonomy than permitted by the other two paradigms.

The three identified paradigms can be differentiated on the basis of four dimensions: linear-iterative, developer centered – user centered, new development – reuse/reassembly, and structured-unstructured (Robey et al., 2001). The *linear-iterative* dimension distinguishes between the traditional linear development process that enforces sequential interdependence and limits user participation to specific activities within the chain of activities versus the iterative process that favors repetition as the primary manner in which prior work can be refined and corrected through developers and users' interaction. The *developer centered-user centered*

dimension distinguishes between a process which is driven by developers with very little input from users versus the user-centered dimension which promotes better collaboration between users and developers with each contributing their respective expertise to system development effort. The *new development-reusable component* dimension seeks to distinguish between development efforts initiated from "scratch" versus development based on utilizing existing or previously built (software) components. The *structured-unstructured* dimension distinguishes between the formality of the developmental process, i.e., structured development is plan specific and follows a predefined set of steps versus the unstructured or ad hoc approach in which change might be necessitated based on knowledge gleaned during execution of the process.

In a social process like system development, it is important to identify the actors and the interdependencies that exist for the roles they play, especially since these roles are affected by the development paradigm to which the actors subscribe. We are at a cross-road in which the craft-based approach to system development and the two historic paradigmatic approaches to system development have given way to a new reality based on the recognition of the interaction taking place between technical, economical, organizational and social factors when systems are designed and afterward when they are being used. Designing a new system requires knowledge of the nature and extent of the problem and of the means available for solving it (Mumford, 2000). It must never be forgotten that system development is a difficult process that can always be improved.

Critical examination of the old ways can only lead to improvements in the future as new methodologies will emerge to help manage the complexity inherent in today's environment. Information system research progress is achieved primarily by thorough problem examination and the employment of sound development methods to construct systems that solve the identified

problems. Such research could address software related problems currently confronting organizations. An interdisciplinary, multi-dimensional, multi-faceted approach to research involving software development and system development methodologies has proven to be catalytic in producing insight and contributing knowledge through mutually beneficial research and the exploration and synthesis of available technologies.

Integrating the Components

> *"All technical evolution has a fundamental behavior pattern. First there is scientific discovery of a generalized principle, which occurs as a subjective realization by an experimentally probing individual. Next, comes objective employment of that principle in a special case invention. Next the invention is reduced to practice. This gives humanity an increased technical advantage over the physical environment. If successful as a tool of society, the invention is used in bigger, swifter, and everyday ways. For instance, it goes progressively from a little steel steamship to ever-bigger fleets of constantly swifter, higher-powered ocean giants." – R. Buckminister Fuller, Critical Path*

An examination of the contribution from each of the DAGS framework component identified will make plain the contribution in achieving the tenets advocated earlier: rigor and relevance.

Design Science

If we view design science as the design and research about Human Computer Interaction (HCI), whose goals can be described as the "design of novel information, interaction, and communication technology" (Fallman, 2003, p 225). In other words the design science

component of the mode seeks to encourage the design and construction of innovative kinds of information and interaction technology and theory (See figure 3.11).

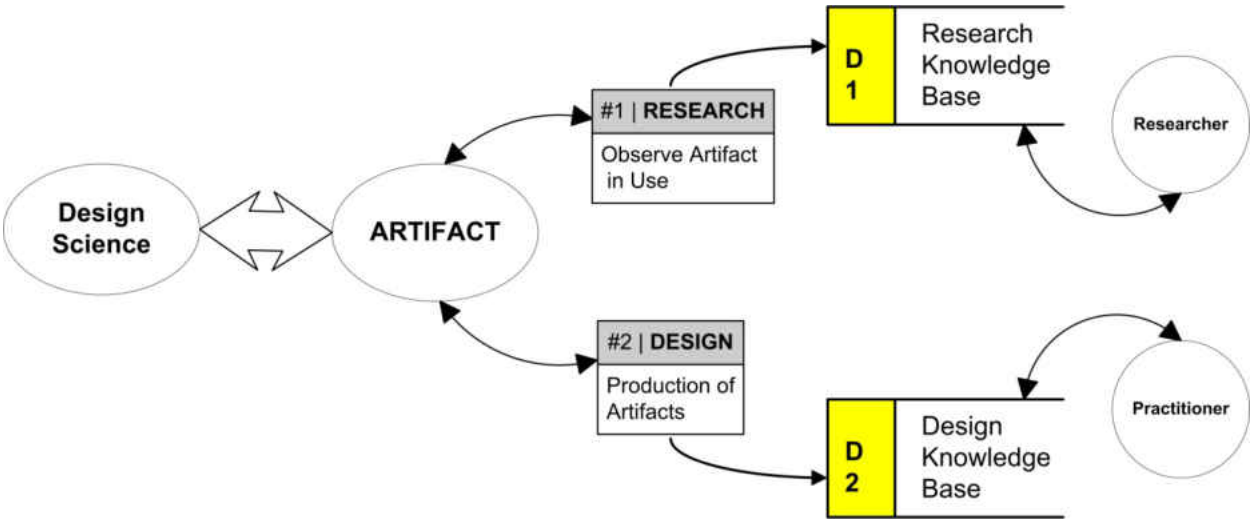

Figure 3.11: Design Science within the DAGS framework

With the continuing embedding of ubiquitous computing in our daily environment, the IS community needs to foster relevancy by involving practitioners, researchers, users and designers in the quest for artifacts and approaches which will enhance HCI. Yes, there is definitely a design-oriented bias as far as "design science" is concerned; however, we propose that only through research can the philosophical, theoretical and methodological foundations within the field can be strengthened. To accomplish this we need to make a distinction between the conduct of Design-oriented Research and Research-oriented Design. According to Fallman (2003), design is a matter of making. It is a research attitude that involves the researchers in creating and giving form to something not previously there. Thus, "design-oriented" is about being proactive in one's research, a commitment to technology, and technological development that goes beyond the "critique." According to Fallman (2003), the research prototype plays a very important role

in this process. Once implemented, the research prototype is typically used as a researchers' proof-of-concept (Nunamaker, 1997) as well as exposed to users to conduct evaluations which in-itself require substantial efforts in terms of experimental design, rigor and control to the testing of the designed artifact.

In advocating the design science approach as an integral part of our model we want to propose that the IS community acknowledges the distinction between the conduct of *Design-oriented research* and *Research-oriented design*. The former has as its goal, truth and knowledge - knowledge which would have not existed if the artifact was not constructed and tested - the knowledge comes from studying the artifact in use or from the process of the bringing the artifact into fruition. In contrast, the latter best illustrates the relationship between researchers, practitioners and IS design and relationship that is sure to yield relevancy. Action research and grounded theory are utilized in studying the artifact in use or they are employed in studying the process of bringing the artifact into existence.

Design Patterns

From a software development perspective the notion of patterns is significant, because of the potential for software reuse. Patterns have been in use in the other scientific disciplines, e.g., biology, chemistry, and physics, and IS is just beginning to awaken to its importance. Since patterns build on no specific software paradigm, they are unconstrained in describing the structures of our increasingly complex systems. The adaptation of patterns into the IS discipline will confer several benefits to practitioners and researchers alike (See figure 3.12). A wealth of knowledge, experience, stories, and good proven solutions to recurring problems can be captured

and cataloged using patterns. This knowledge can be shared by researchers and practitioners, e.g., analysts and programmers.

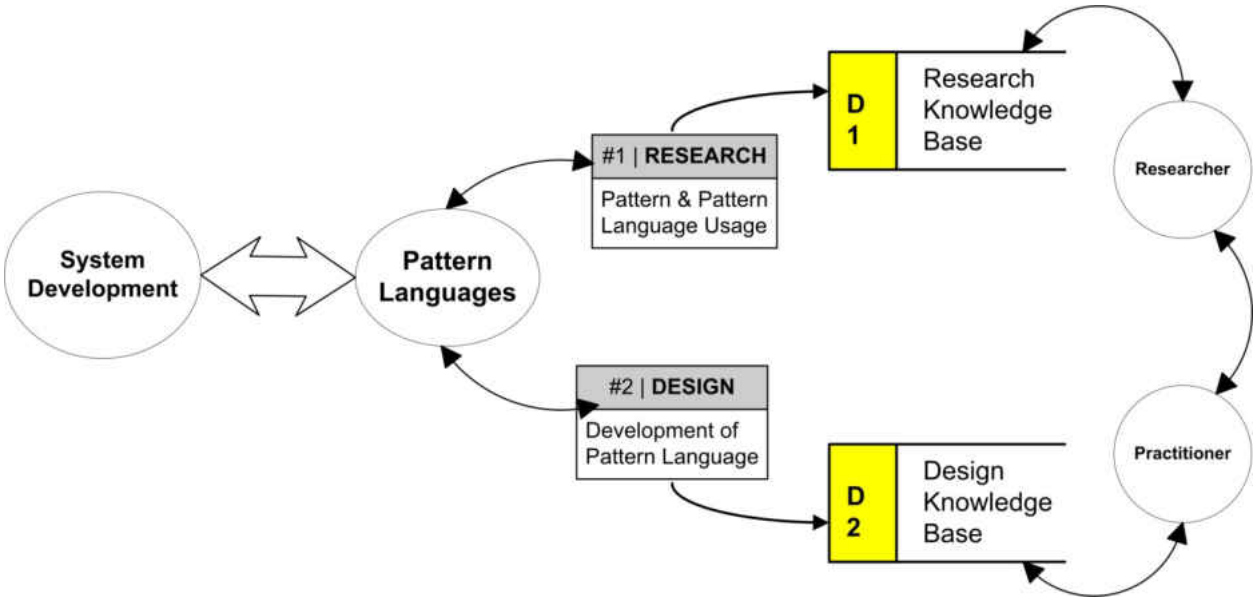

Figure 3.12: Design Patterns within the DAGS framework

The use of patterns can be leveraged to capture information about system-level relationships since they do focus directly on wholeness (Coplien, 1997). The concept of patterns is not only germane to processes but can be applied to organizations – they are helpful in understanding the characteristics of both successful and not-so-successful organizations. They present us with a more holistic view of the organizational architecture. Understanding of the organizational architecture is an acknowledgment of the relationship between technological and humanistic perspective in organizations. Patterns encapsulate an important structure, a central idea, a key technique known to expert practitioners, be it an architectural structure, a process practice, a marketing strategy or an organizational concept, hence, the incorporation of patterns

into organizations promote problem resolution, enabling more efficient and effective IS development and deployment. To quote Alexander (Alexander, 1977, p 378):

> *"These patterns in our minds are, more or less, mental images of the patterns in the world: they are abstract representations of the very morphological rules which define the patterns in the world. However, in one respect they are very different. The patterns in the world merely exist. But in the same pattern in our minds are dynamic. They have force. They are generative. They tell us what to do; they tell us how we shall, or may, generate them; and they shall tell us too, that under certain circumstances we must create them. Each pattern is a rule which describe what you have to do to generate the entity which it defines."*

Action Research/Grounded Theory

Grounded theory is "an inductive, theory discovery methodology that allows the researcher to develop a theoretical account of the general features of a topic while simultaneously grounding the account in empirical observations or data" (Martin and Turner, 1986). A grounded theory is one that is derived from the study of a phenomenon and is verified through data collection and analysis. Grounded theory's objective is the discovery of a theoretically comprehensive explanation about the phenomenon using techniques and analytical procedures that enable investigators to develop a theory that is significant, generalizable, reproducible and rigorous. Using the methodology, one does not begin with a theory and then prove it. Rather, a theory emerges from the observations and generated data. The emergent theory can be empirically tested to develop forecasts or predictions from general principles. (Strauss and Corbin, 1990) Therefore, we can describe the association between data collection, analysis and theory as reciprocal (See figure 3.13).

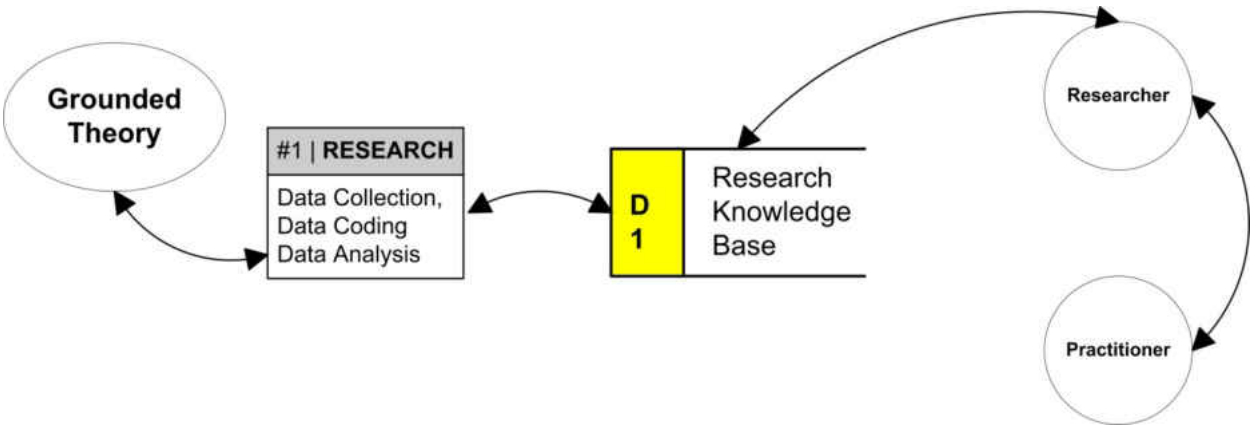

Figure 3.13: Grounded Theory within the DAGS framework

Action research is an established social and medical science research method that has garnered importance in the information systems community within the last decade. "Action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework" (Rapoport, 1970). Researchers who employ either methodology are united in their beliefs that complex social systems, especially those involving organizations and information technologies, cannot be simplified, factored or compartmentalized and must be studied as an intact entities. Action research is unique in "the way it associates research and practice, so research informs practice and practice informs research synergistically" (Avison et al., 1999). It combines theory and practice, in an iterative process involving researchers and practitioners acting together on a particular cycle of activities, including problem diagnosis, action intervention, and reflective learning (See figure 3.14). Grounded theory is the ying to action research's yang.

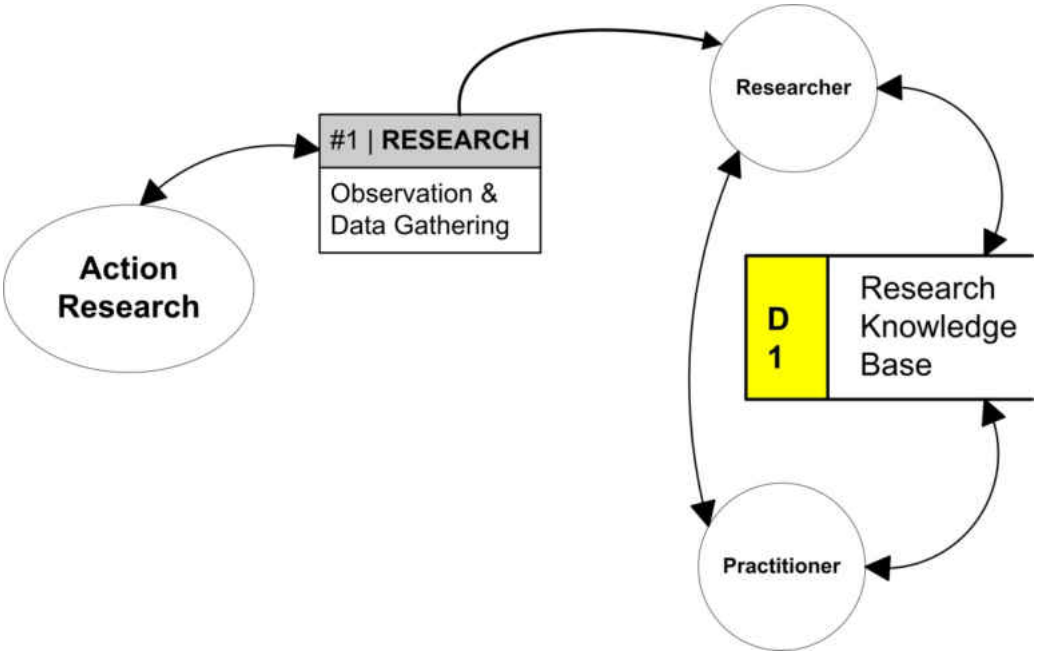

Figure 3.14: Action Research within the DAGS framework

Like action research, grounded theory is an iterative methodology, requiring a steady movement between concept and data to control the conceptual model and scope of the emerging theory. Action research is concerned with increasing the stock of knowledge within the information systems community. In action research, the researcher seeks to validate a theory with practitioners in real situations, utilizing feedback from the experience to modify the theory before repeating the process. Each cycle augments the theory. Both methodologies complement each other in achieving the dual goal of contributing to both theory and practice.

Grounded theory produces accurate and useful results that encourage an understanding of the phenomena in "the generation of theories of process, sequence and change pertaining to organizations, positions and social interactions" (Glaser and Strauss, 1967). By emphasizing collaboration between researchers and practitioners, action research would seem to represent an ideal research method for information systems, especially because of its ability to address

complex real-life problems. With action research's ability to make academic research relevant and grounded theory's ability to develop context-based, process-oriented description and explanation, rather than objective, static description expressed in terms of causality (Orlikowski, 1993), the synthesized framework established is but a foundation on which the pedagogy of the grounded theory/action research axis in systems development can be refined, debated, and become instrumental in explaining theoretical gaps between theory, research and practice through the establishment of a unifying framework for system development.

CHAPTER FOUR: RESEARCH APPROACH

In order to validate the effectiveness of the proposed research framework advocated, I will adopt a multi-methodological approach involving design science, action research, grounded theory, and system development methods. The goal is to validate the DAGS framework by applying the approach in a real-world setting and through diagnosis and examination craft a solution for a problem or a class of problems being encountered in a wide range of enterprises. The solution or artifact obtained will be a Decision Support System (DSS) or Knowledge Management System (KMS) prototype or an architectural solution derived using the framework's prescription. The artifact produced will be evaluated and the feedback generated used not only to refine the artifact but the findings uncovered will be communicated to both the research and practitioner communities. This blueprint for action incorporates the action research, design science, design science, system development and grounded theory research approaches.

Problem Description: The Critical Nature of Requirements Elicitation

Rossi and Tuunanen (2004) argue that the traditional views of requirements engineering-specification process (RE-SP) and methods being employed are not meeting the challenges faced by the Information System Development (ISD) community when dealing with the development of and delivery of value to the user community. Contemporary specification practices have not been able to adequately capture the needs of a single group of users. Most of the current requirements approaches assume that the users are known and requirements are obtained using some predefined, semi-formal approach. From the responses obtained requirements are generally specified. However, complete specification involves more than just finding the right informant

and applying the right technique, especially since users often cannot express all their needs. Researchers have realized that meeting multiple user demands require not only prioritization of requirements, continuous improvements and rapid response but changes in the current approach, i.e., new methods that will be more effective in eliciting the expressed and hidden needs of users.

At an abstract level the RE/SP process consists of transforming an input (user needs) into a desired output. At the beginning of the process, knowledge about the system is hazy – some features are obvious, others are vague (Pohl, 1994). At the start of the process each stakeholder has a personal view/mental model of the system to be built, modified or enhanced. These mental models can be expressed using different formats. However, what is desired is a standardized format that all parties are in agreement with and one which represents the synthesized knowledge from all the different mental models and can become the basis of input for the next stage of the system development cycle.

Requirements Engineering

Requirements Engineering can be best described as a process that leads from vague ideas presented in some textual language and without an agreed upon viewpoint into a desired end state, where there is a common agreement on a set of formalized requirements that serves as an architecture for IS design and implementation (Tuunanen, 2003). Pohl (1994) identified three main goals associated with the requirements process:

- Improving an opaque system comprehension into a complete system specification
- Transforming informal knowledge into formal representation
- Gaining a common agreement on the specification out of the personal views.

Each of these goals can be associated with one of the three dimensions identified by Pohl (1994) namely: specification, representation and agreement.

The *Specification* dimension is concerned with the methods used to gather and organize requirements from stakeholders. According to Pohl (1994, p 247), "specification must be unambiguous, complete, verifiable, consistent, modifiable, traceable and usable during operations and maintenance." Specification can be further categorized into functional and non-functional requirements whereby the former is concerned with what the software must do, while the latter is concerned with performance, design constraints, external interface and quality attributes. In summary, specification is concerned with identifying the varying needs of stakeholders.

The *Representation* dimension is concerned with representing the requirements gathered using some form of diagrammatical notation to express knowledge about the system. Pohl (1994) identified three different categories of representation: Informal representation like natural languages; Semi-formal representation such as SA or ER diagrams; and Formal representation languages with their well defined semantics. It is important that the representation mechanics make understanding easy.

The third dimension, *Agreement*, is concerned with consensus among the stakeholders regarding the specifications. According to Pohl (1994) at the beginning of the requirements process, each stakeholder has his/her own mental model of the system stemming from their interaction with the system. Different views of the same system will have a positive effect on the requirements process since they provide a good basis for requirements elicitation and examination of the differences can be used in validating requirements (Tuunanen, 2003).

Requirements Process

Software development is concerned with the creation of information system that solves user's problems, leverages their opportunities or satisfies their needs (Hickey and Davis, 2004). Classic software development involves execution of a well defined series of phases in which requirements activities are performed at the beginning of the process. Given the constantly changing user needs, requirement activities need to be performed regularly since such activities are essential to understanding users' needs and the success of the software development effort.

According to Hickey and Davis (2004) the requirement process is often described as a series of activities (see figure 4.1) which includes:

- *Elicitation*: learning, uncovering, extracting, surfacing, or discovering needs of customers, users, and other potential stakeholders
- *Analysis*: analyzing the information elicited from stakeholders to generate a list of candidate requirements, with the goals of increasing understanding and searching for incompleteness
- *Triage*: determining which subset of the requirements ascertained by elicitation and analysis is appropriate to be addressed in specific releases of a system
- *Specification*: documenting the desired external behavior of a system
- *Verification*: determining the reasonableness, consistency, completeness, suitability, and lack of defects in a set of requirements.

A review of Requirements process models reveals that although the process is often described as *an ordered set of activities*, in actuality requirement activities are performed iteratively and often in parallel. The common denominator is all include a requirement elicitation activity either as a separate activity or part of another requirement activity.

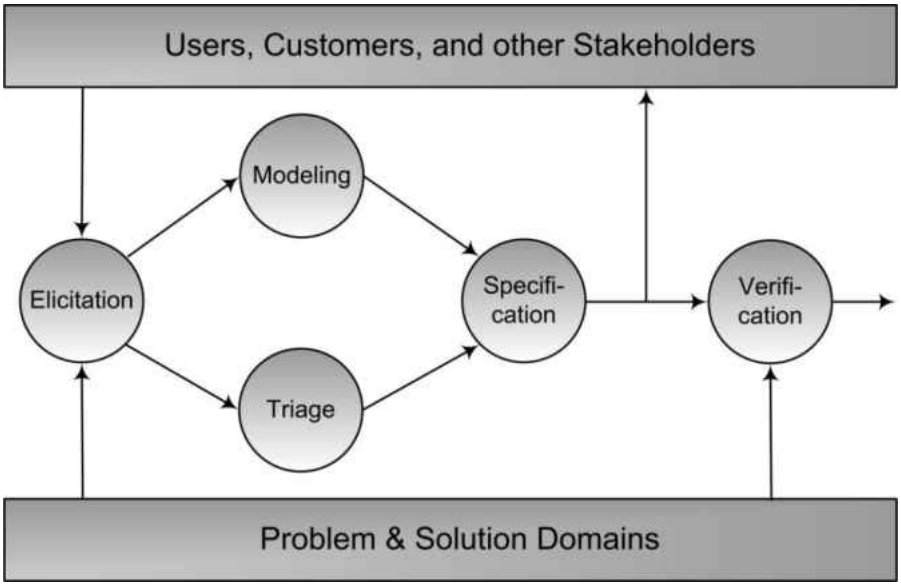

Figure 4.1: Data flow among Requirements activities (Hickey and Davis, 2004)

Requirements Elicitation

Requirements elicitation is recognized as one of the most critical activities associated with software development. Poor elicitation will almost guarantee that a development effort fails. Since software development projects failure is the norm, improvements in the way elicitation is accomplished could have a dramatic effect on success rate of IS development projects (Hickey and Davis, 2004).

Elicitation is all about determining the needs of stakeholders. A literature review reveals that most requirement elicitation models focus on specific methodologies or approaches (Hickey and Davis, 2004). The gamut ranges from detailed models of requirements elicitation activities to communication-based models focused on the cognitive aspect of the user-analyst interaction. These latter models involve interviews, scenario analysis, use-case, soft systems methods,

observation and social analysis, ethnographic analysis, requirements re-use and prototyping (Tuunanen 2003). It is evident that many requirement elicitation methodologies and techniques exist, all with the common goal of assisting the analyst in understanding needs (Hickey and Davis, 2004).

It is important that techniques used to acquire stakeholders' viewpoints during the elicitation process can provide the desired types of information, since the type of requirements information acquired is determined by the technique used. Valusek and Fryback (1985) identified three categories of obstacles to effective communication during the elicitation process. *Within obstacles* are the cognitive and behavioral limitations within the individual as an information processor and problem solver (Byrd et al., 1992). *Among obstacles* are the difficulties arising from different users' conflicting or inconsistent perceptions and requirements - differing views that have to be resolved and synthesized for consensus to be reached (Byrd et al., 1992). *Between obstacles* are the communication difficulties between users and analysts caused by their different background, work objectives and organizational culture - perceptual background and vocabulary barriers to effective communication and mutual understanding (Byrd et al., 1992).

It is evident that effective communications and interaction between the participants are needed to facilitate communication and a shared understanding of system requirements, and thus it is important that the technique(s) employed strive to promote these objectives (Darke and Shanks, 1997).

Acquisition Techniques

From Byrd et al.'s (1992) extensive survey of requirement analysis and knowledge acquisition techniques, and Darke and Shanks' (1997) efforts, fifteen requirements acquisition techniques were identified. These observed techniques were grouped into five categories of elicitation types or methods of acquiring information. The identified types were: *observation*, *unstructured elicitation*, *mapping*, *formal analysis* and *structured elicitation*. The techniques and categories are listed below (see table 4.1):

Table 4.1: Elicitation categories and techniques (Byrd et al., 2004)

Categories	Techniques
Observation	Prototyping
Unstructured Elicitation	Open Interviews, brainstorming, goal-oriented approach
Mapping	Cognitive mapping, variance analysis, rich pictures, data flow diagrams
Formal Analysis	Repertory grids
Structured Elicitation	Scenarios, Structured interviews, Critical Success Factors, Future Analysis, JAD Sessions, Focus groups

According to Byrd et al. (1992), Kim and Courtney (1988) and Darke and Shanks (1997) the requirements acquisition techniques selected should be based on the communication obstacles they help to overcome, and whether they can be applied by users or jointly require analysts who are skilled and experienced in their use. Requirements analysis is the most critical step in the system development process and it is imperative that appropriate and sufficient tactics are adopted to improve the elicitation process. This involves capturing and organizing user

requirements by reaching all potential stakeholders who can effectively contribute to the software development process.

Critical Success Factors

One approach that has been tried with varying degrees of success is Critical Success Factors (CSF). Developed by J. F. Rockart in the late seventies, CSFs have been described as "those few things that must go well to ensure success for the manager and/or the organization and therefore they represent those managerial or enterprise areas that must be given special and continual attention to bring about high performance (Boynton and Zmud, 1986, p. 17)."

The CSF methodology as advocated by Bullen and Rockart (1981) is a procedure that attempts to make explicit those few key areas crucial to managerial or organizational success. Essentially, CSF is an information system tool, a mechanism for defining the informational needs of a chief executive officer. As a procedure CSF is interviewed based, and from this structured dialogue between analyst and executive emerged a set of CSFs and associated performance measures. Rockart (1979) stressed two points: (1) CSFs provide a focal point for directing a computer-based information system development effort; and (2) the CSF method should result in an information system useful to a CEO in that it highlights key areas that require attention. Bullen and Rockart (1981) later broadened the definition of CSFs and proposed that they be used as an MIS planning tool, and as such CSFs could be extended throughout the organization, i.e., a structured dialogue between analyst and system users from a cross-section of the organization, which could be then synthesized into a set of organizational CSFs at the strategic, tactical or even the operational levels.

The CSF method basically allows the creation of a project out of a problem definition by decomposing a well defined goal into a comprehensive list of sub-goals called *factors*. From these factors a list of supporting *activities* is generated and both lists – factors and activities are entered into a matrix and their relationship (activities to factors) validated (Wasmund, 1993). The basic steps of the CSF method are explained and illustrated below (See figure 4.2). The steps are:

1. Define the goal
2. Decompose the goal into a set of factors
3. Define activities
4. Build and validate the CSF matrix
5. Execute the activities

Reiteration of this sequence of steps may be necessary due to changed goals or environment. Goals and CSFs go hand-in-hand. Both are needed to accomplish the organization's mission and neither can be ignored.

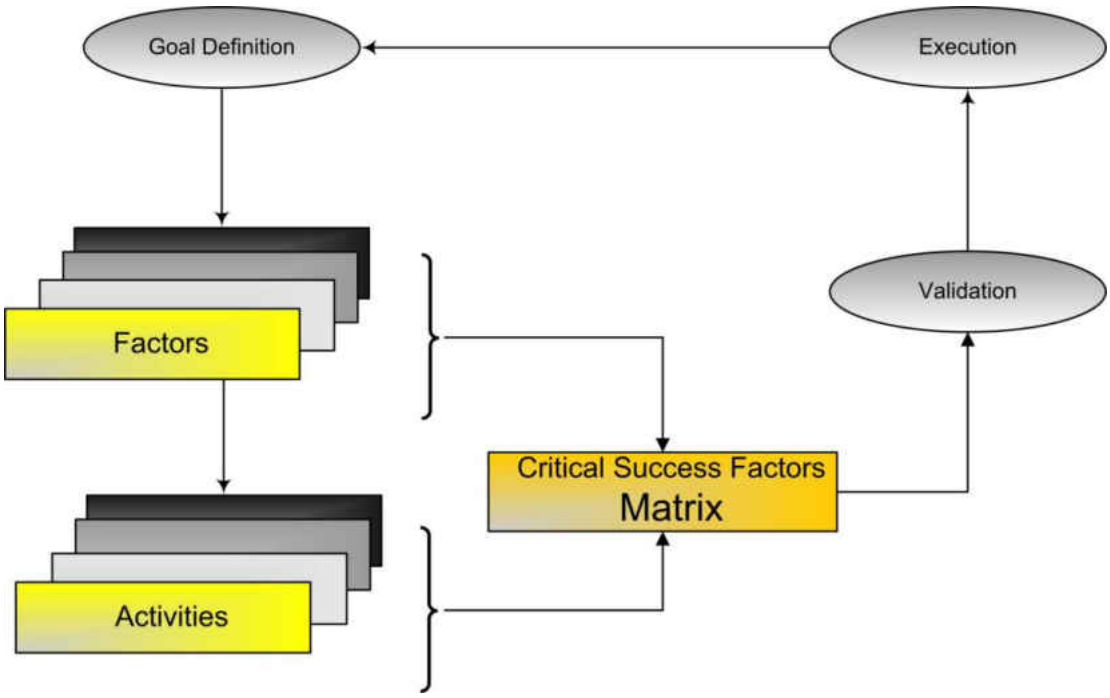

Figure 4.2: Critical Success Factors method illustrated (Wasmund, 1993)

Research conducted by Munro and Wheeler (1980), Boynton and Zmud (1984), and Shank et al. (1985), indicated that the strength of CSFs as a MIS planning tool lies in its ability to: generate user acceptance at the upper levels of management and to facilitate a structured, top-down analysis (of the organization) by initially focusing on a core set of essential issues which are refined allowing an evolving "design" to be continuously examined for validity and completeness. Implicit in this assertion is the capability of CSFs to be used for both MIS planning and requirements analysis.

When applied to the planning process, CSFs need to be viewed from two different perspectives: an information function and information resource perspective. From the information function perspective, CSFs address the traditional technical activities undertaken to deploy an information system product within an organization. From an information resource

perspective, CSF addresses the management of information technologies from an organizational-wide-perspective (King and Zmud, 1982). There are also three levels of planning associated with CSFs as a planning tool: operational, strategic and policy.

- *Strategic planning* attempts to link an organization's strategic interests with information technology, i.e., CSFs form a bridge between the organization's strategic and tactical interests by enhancing the communication between the strategic and tactical levels of the organization
- *Operational planning* involves those activities required to implement specific information systems. CSF helps ensure that critical organizational information needs are explicitly addressed (Boynton and Zmud, 1984)
- *Policy planning* is aimed at establishing an organizational culture that is able to make appropriate use of information products and services and one that recognizes that information technologies provide strategic opportunities.

Planning in both the information function and information resource contexts is a process that is heavily dependent on conceptual thoughts. Since CSFs represent a high-level conceptualization of factors it provides an ideal means of bringing structure and consistency to articulating management's vision (Boynton and Zmud, 1984).

As a requirement analysis tool, CSFs provides a sound methodology, a business-driven one, for understanding the informational needs of managers, and thus CSFs can be very important instrument in the analyst's toolbox. According to Zmud (1998) CSF promotes a top-down structured approach that in the conceptual phase represents an effort to arrive at an information system design that evolves from an overall understanding of an organization's operating environment and the important opportunities and challenges associated with the environment. This conceptual phase is an abstraction, a model, of the major internal or external forces that influences organizational behaviors. However, because concrete thought processes are

required to arrive at detailed specification requirements, the CSF method by itself is not as effective a requirement analysis tool as it is a planning tool.

---- Critical Success Factors -----						
A	**B**	**C**	**D**	**E**	**F**	**Activity**
X	X			X	X	1
X	X	X			X	2
			X			3
X						4
	X		X			5
X			X	X		6
X		X	X	X		7

Table 4.2: Critical Success Factors Matrix (Wasmund, 1993)

Critical Success Factors (CSFs) has been very successful in identifying the strategic needs and the performance requirements on which success of the organization depends (see table 4.2). According to Peffers, Gengler and Tuunanen (2003), the strengths of CSF, a top-down planning approach, can be extended using Personal Construct Theory (PCT) to explicitly model the relationship among system attributes, performance consequences and organizational performance using Critical Success Chain (CSC) methodology.

Figure 4.3: Critical Success Factors causal model (Peffers and Gengler, 2003)

According to these authors, CSFs confer several benefits to the organization among them a portfolio of IS projects, organization-wide user participation in the planning process and rich models of the relationship between IS attributes, CSF and organizational objectives (see figure 4.3) – models which may help developers have a more complete understanding of the user's needs (Peffers, Gengler and Tuunanen, 2004).

Personal Construct Theory

Personal Construct Theory (PCT) was developed by psychologist George Kelly (1955) to better understand how his clients understood the world around them – the relationship between states of the universe, the consequences of those states, and the impact of those consequences on their individual values. These relationships, or personal constructs, result from our individual observations and interpretations of events (Peffers, Gengler and Tuunanen, 2004). Individually, we all possess these multi-dimensional models or constructs, which describe the *attributes* and behavior of objects and events, their resulting *consequences*, and the effect on our *values*. PCT-based data gathering methods seek to elicit information about people's knowledge structure based on their response to a given stimuli (see figure 4.4). Thus, a community's collective

knowledge about how the universe works is an aggregated synthesis of all these individual models.

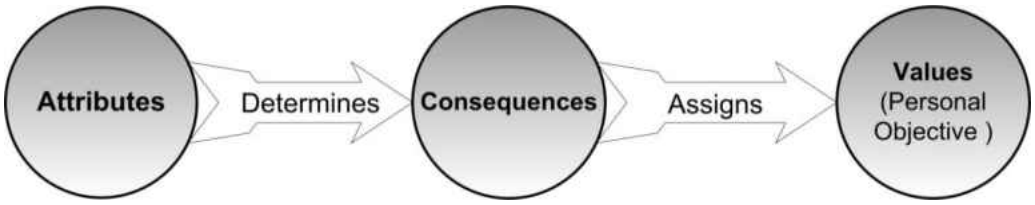

Figure 4.4: Personal Construct Theory generic relationships (Peffers and Gengler, 2003)

From a planning perspective, when mangers use CSFs, they are implicitly using a three-element model of consequence that is similar to PCT (Peffers, Gengler and Tuunanen, 2003). The assumption, "if the firm develops a system with appropriate attributes, the use of this system will result in outcomes that are observable as changed CSF performance, which is, in turn, required to achieve important firm goals." (Peffers, Gengler and Tuunanen, 2003, p. 58)

According to Kim and Courtney (1988), one approach to handling the representation of an individual's personal model is the repertory grid technique (RepGrid) developed by Kelly. IS research and practice can benefit from the RepGrid technique and the cognitive map produced, since it can provide insight into the quality of the understanding between stakeholders and analysts and/or the members of a group. The RepGrid contains three major components: elements, constructs and links, where:

1. *Elements* are the objects of attention within the domain of investigation. They define the entities upon which the administration of the RepGrid is based. For example, to explore

the critical success factors (CSFs) associated with IS projects, the IS researcher can use IS projects as elements in the RepGrid (Tan and Hunter, 2002).

2. *Constructs* represents the research participants' interpretations of the elements. Further understanding of these interpretations may be gained by eliciting contrasts resulting in bipolar labels. For example, in the investigation of IS projects and CSF, participants may come up with bipolar constructs such as "high user involvement - low user involvement" to differentiate the elements (the IS projects). The labels represent the CSFs of IS projects (Tan and Hunter, 2002).

3. *Links* are ways of relating the elements and constructs. The links illustrates how the research participants' interpretations of the similarities and differences between the elements and constructs. For example, a seven point rating scale can be used to get participants to differentiate between the IS projects (elements) along each elicited CSF (construct) (Tan and Hunter, 2002).

Researchers have extended Kelly's original binary rating method to include rating scales (Kim and Courtney, 1988). According to Tan and Hunter (2002) elements represent aspects considered important within a specific domain and can be used to describe people, objects, events or activities. There are two basic ways of selecting elements – researcher supplied or participants supplied, i.e., *supplied* or *elicited* elements.

Use of the RepGrid technique allows for different methods of obtaining constructs. The researcher can provide the constructs or they can be elicited from the participants using the triad method, or they can be elicited using the group construct elicitation approach. Of the three approaches, the group elicitation approach is not only the most economical but it facilitates team building and organizational learning. There are three ways of linking elements to constructs: *dichotomizing, ranking* and *rating.*

The *dichotomizing method* consists of selecting a binary response, a rating scale with only two points. However, as Easterly-Smith (1980) demonstrated, this method can result in a skewed distribution. *Ranking elements method* was originally used as an alternative to dichotomizing and involves placing the elements in an order between the two contrasting poles of a construct. While the "Ranking method" prevents skewed distribution, it may force participants to indicate differences between elements where none really exists. The *Rating method* is the method most often employed using rating scales of five, seven, nine or eleven points. It has been suggested by researchers, Easterly-Smith (1980), Tan and Hunter (2002) and Hunter (1997), that a five or seven point scale is most appropriate for most situations (see table 4.3).

	Elements (Project Managers)							
Constructs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Delegator – Does Work himself	7	2	5	4	2	6	1	9
2. Informs Everyone – Keeps to himself	8	2	3	3	8	6	1	8
3. Good User Support – No User Support	5	2	4	2	4	2	1	9
4. Regular feedback – No feedback	6	1	5	3	5	3	1	9
5. Knows details – Confused	2	1	4	3	5	1	1	9
6. Estimates based on staff – Estimates based on himself	8	3	4	6	4	6	1	9
7. User involvement – lack of user involvement	6	2	5	5	3	3	1	9

Table 4.3: Personal Construct theory RepGrid (Hunter, 1997)

Extending Critical Success Chains

Peffers, Gengler and Tuunanen (2003) coined the phrase "Critical Success Chains (CSC)" to describe the linkage between IS attributes, CSF performance, and organizational goals (see figure 4.5). For example, "*within a rental car firm, a system that allocates cars to locations (IS attributes) affects the availability of cars for customers with reservations (CSF performance). This availability is critical for customer satisfaction and market share (firm goals)* (Peffers, Gengler and Tuunanen, 2003, p. 58)."

Figure 4.5: Critical Success Chain Model (Peffers et al., 2003)

This CSC along with others for the firm could be used to identify and evaluate the attributes of any actual or potential IS system. One could argue that there is a one-to-one relationship between PCT and CSC, where the attributes are limited to IS within an organizational context, and consequences are limited to the consequences of implementing such system, and the values can either be individual or organizational.

A process called "laddering" may also be employed in conjunction with the elicitation technique. Laddering permits the research participant to further elaborate on a particular construct using a series of probing questions in the form of a structured interview. In effect, the researcher is trying to determine the participant's underlying assumptions as it relates to a

particular construct. Hence, laddering is used to model participants value structure related to their preferences by collecting chains of features, reasons and values from the participants (see figure 4.6). The chains are aggregated across participants to produce network models of participants' constructs (see figure 4.7).

Figure 4.6: "Laddered" Critical Success Chain collected (Peffers et al., 2003)

Applying "laddering" techniques to CSC allows the development of aggregate models that can show the reasons why people prefer certain IS features, i.e., it facilitates the "bottom-up" ideas generation process for new product features. When the models are aggregated over a number of participants, they provide the analyst with a wealth of knowledge about a community of users. The central idea behind this multi-methodical approach is that the user knows best, i.e., users know what feature(s) will best satisfy their needs.

The usefulness of the CSC model for IS planning is well documented due to the efforts including those of Bowman, Davis and Wetherbe (1983), Shank, Boynton and Zmud (1985),

Segars and Grover (1999), Peffers, Gengler and Tuunanen (2003), Peffers and Gengler (2003), and Rossi and Tuunanen (2004). Viewing internal and external stakeholders as partners and their personal knowledge of the organization as strategic assets is important since better information is a key determinate of IS planning success.

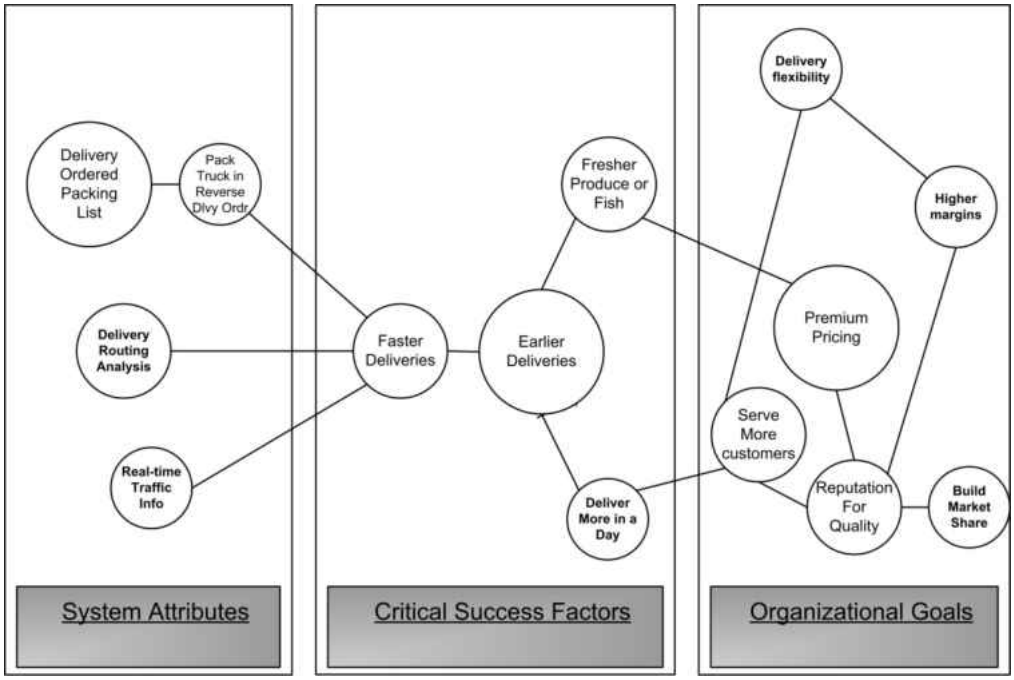

Figure 4.7: Aggregated Critical Success Chain network model (Peffers et al., 2003)

Use of the CSC method results in rich models that are valuable in communicating important relationships within the organization to developers, helping them to have a more comprehensive view of the organization based on the synthesis of top-down planning and bottom-up ideas. According to Peffers, Gengler and Tuunanen (2003) use of CSC may be extended to use in IS project requirements determination since requirements determination is similar to IS planning. Can CSC be adapted for effective use to plan the requirements for information systems?

Proposed System: Collaborative User Requirements Engineering

One of the primary functions of the IS department within any organization is to manage the intensively competitive requests emanating from within their organization. For its internal customers/constituents the IS department provides a variety of services including consulting, application development, systems operations and IT resource maintenance. At the strategic level, an organization needs new systems that will provide added value to existing products, increase effectiveness or reduce costs to its external customers/constituents. And while innovative strategic-level systems are important, their very realization is dependent on attainment of the operational goals which are represented by small practical projects that involve training, user support or incremental system improvements, all of which have the potential of contributing significantly to the achievement of organizational goals.

As the technology advances, there is pressure to develop new tools, techniques and systems to exploit the opportunities presented. How can we identify these opportunities? How can we know which (opportunity) will yield the greatest benefit to the organization? For the IS department the answer lies in understanding both their internal and external constituents: understanding how they carry out their activities, how they make their decisions, and what value they place on certain features. This knowledge is crucial in creating products/systems that reflects their needs, desire, limitations and capabilities (Galvao and Sato, 2004).

How can an organization use knowledge about these opportunities – strategic and non-strategic systems, to achieve organizational goals? Peffers and Gengler (2003) addressed this question by extending CSFs with a concept from marketing research for generating bottom-up ideas for new product features to create the Critical Success Chains method for IS planning. The

objectives for all the organization's units are similar – "provide more value for customers while capturing some of it for the organization (Peffers and Gengler, 2003, p. 84)." Thus the organization's stakeholders across the organization and beyond can be partners with IS in adding value to products.

It is a recognized fact that individuals have unique views about how things work in an organization. These personal views, personal constructs, systematically aggregated, can be a source of invaluable knowledge. PCT can be used to extend CSFs by adopting the "laddering" methodology to model the value users place on system features (Peffers and Gengler, 2003). Aggregated over many users the derived models can be effective for designing systems with high user value.

The approach that is being advocated would involve instantiating Critical Success Factors (Rockart, 1979) extended with Personal Construct Theory (Kelly, 1955) and with Critical Success Chains (Peffers, Gengler and Tuunanen, 2003) and aggregated into Critical Success Network maps (Peffers and Gengler, 2003) to develop a Collaborative User Requirement Engineering/Elicitation System (CURE) which would help system designers better elicit, capture and understand what new services – applications and/or features, will be most valued by users and will yield the greatest value to the affected stakeholder (See figure 4.8).

In other words, we would be extending information system planning information through requirements elicitation to assist in better requirements specification and more effective system development. The resultant collaborative user requirements engineering/elicitation system would gather, store, analyze and visualize these needs to help decision makers and developers leverage the organization's information resources.

The proposed system would be based on Critical Success Factors, i.e., the principles of the method. The Critical Success Factors method allows the creation of a project out of a problem definition by decomposing a well-defined goal into a comprehensive list of sub-goals (factors) and associated activities. CSF provides an easy method to maintain an overview of all the relevant activities that need to be executed in order to solve a problem while ensuring that no essential activities are omitted and redundant activities are eliminated (Wasmund, 1993).

One of the goals of the proposed system is collaboration, i.e., the development of a system that enables diverse stakeholders to effectively work together in identifying, analyzing, selecting, documenting and managing the requirements for information system through development of and operation of said system.

The *elicitation process* involves learning, uncovering, extracting, surfacing, and discovering stakeholders' needs by an analyst. In a collaborative environment we need to add joint discovery between users and analysts as an additional goal of the elicitation process.

Triage is involved with determining which requirements are necessary in a joint process of balancing users' business needs for requirements and developers' needs for clarity and understanding.

Modeling the elicitation process involves the use of Personal Construct Theory (PCT), RepGrids, Critical Success Chains and CSC network graphs to synthesize users' needs and present them in a manner which will ensure effective communication of user and business needs and establish the link between the models, business goals and stakeholders' needs.

Specification involves documenting the desired external behavior of a system. Collaborative approach implies that users are involved in documenting the desired system external behavior.

Verification involves the determination of whether a work product conforms to the described requirements, and/or meets stakeholders' intentions and/or needs.

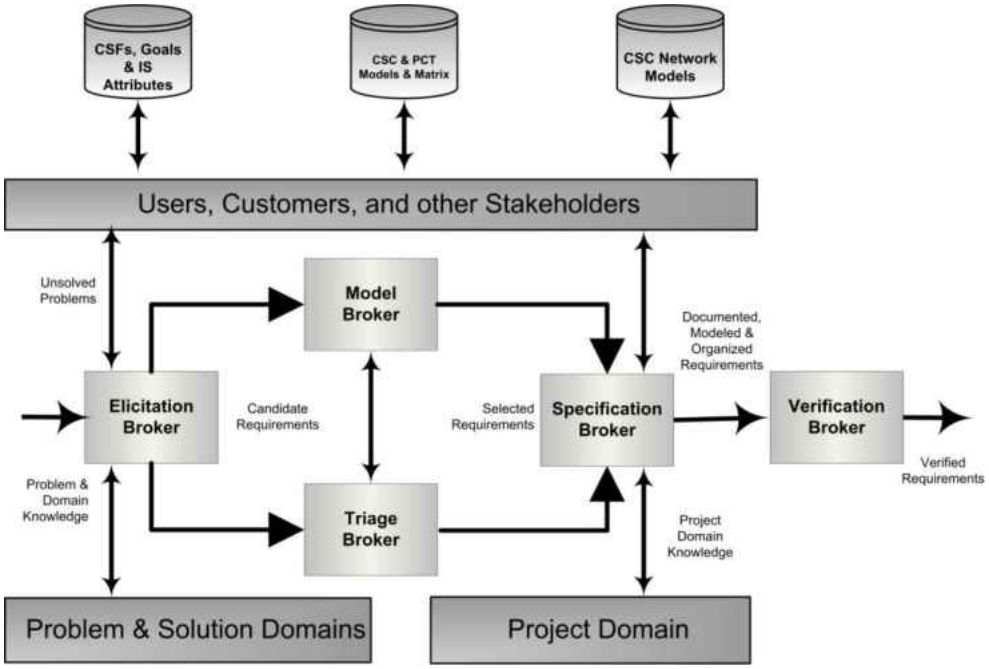

Figure 4.8: CURE system architectural overview

The goal of the proposed system is to introduce a methodological foundation for supporting IT users while providing an appropriate match between users' mental activity and the conceptual model of the system, i.e., the users' desired features. According to Galvao and Sato

(2004), knowledge about the use of a product within its context-of-use can help define the early stages of the design process. Given the increasing computational and communication capabilities of today's information systems, it is important that technology conform to people's perceptions, therefore matching system specifications to users' requirements is critical to successful system implementation. This integration of technology and users is best accomplished through a human-centered approach (See figure 4.9).

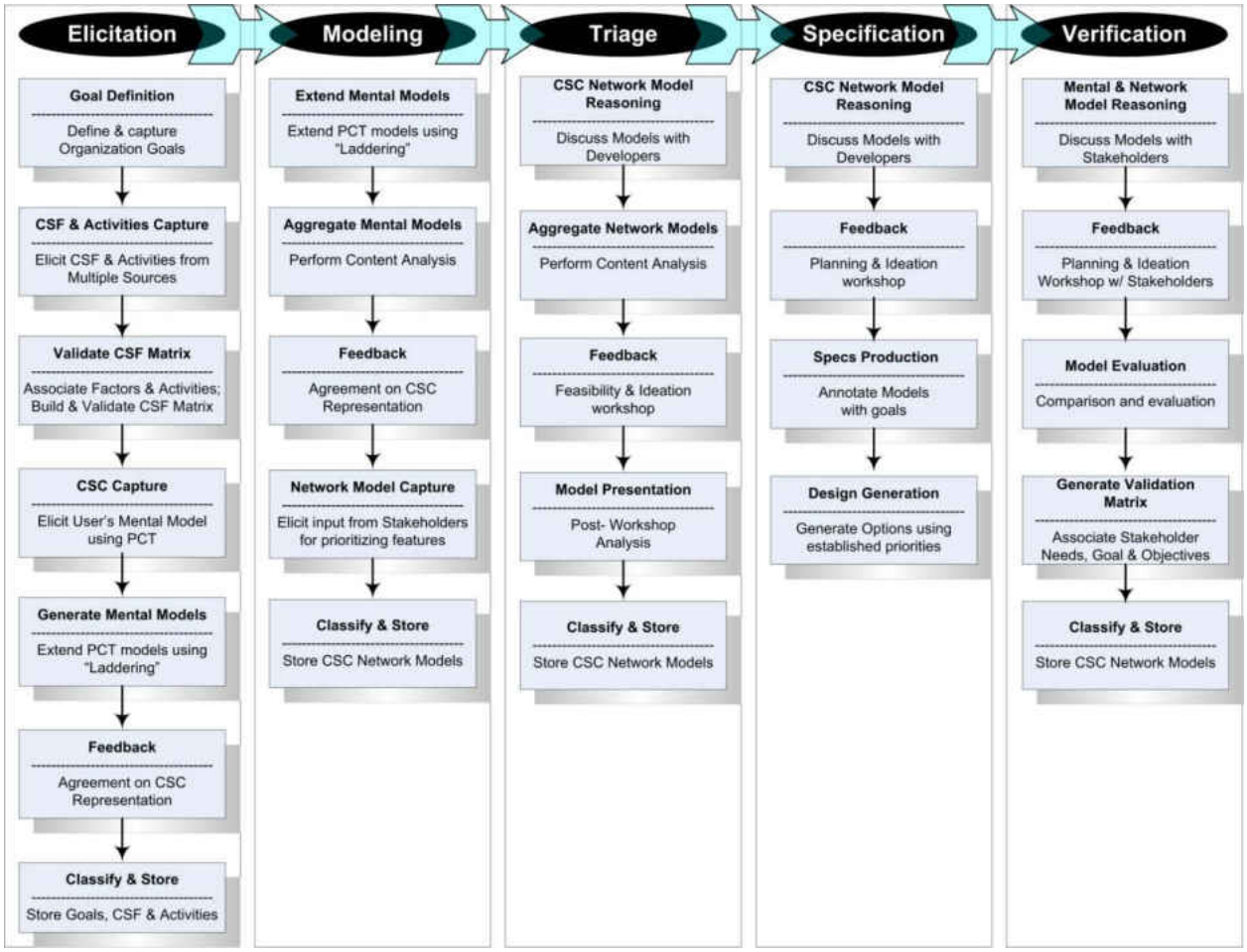

Figure 4.9: CURE system processes

The development of CURE will be based on the Human-Centered System Architecture (HCSA) proposed by Galvao and Sato (2004), a framework which makes use of tools to identify, capture and organize knowledge and experience gained from the system development process by aligning users' requirements with the overall structure, functionality and working principles of the system. Utilizing the framework allows the information collected during the interaction with users, i.e., their mental models, to be transformed into solution-independent specifications (See figure 4.10).

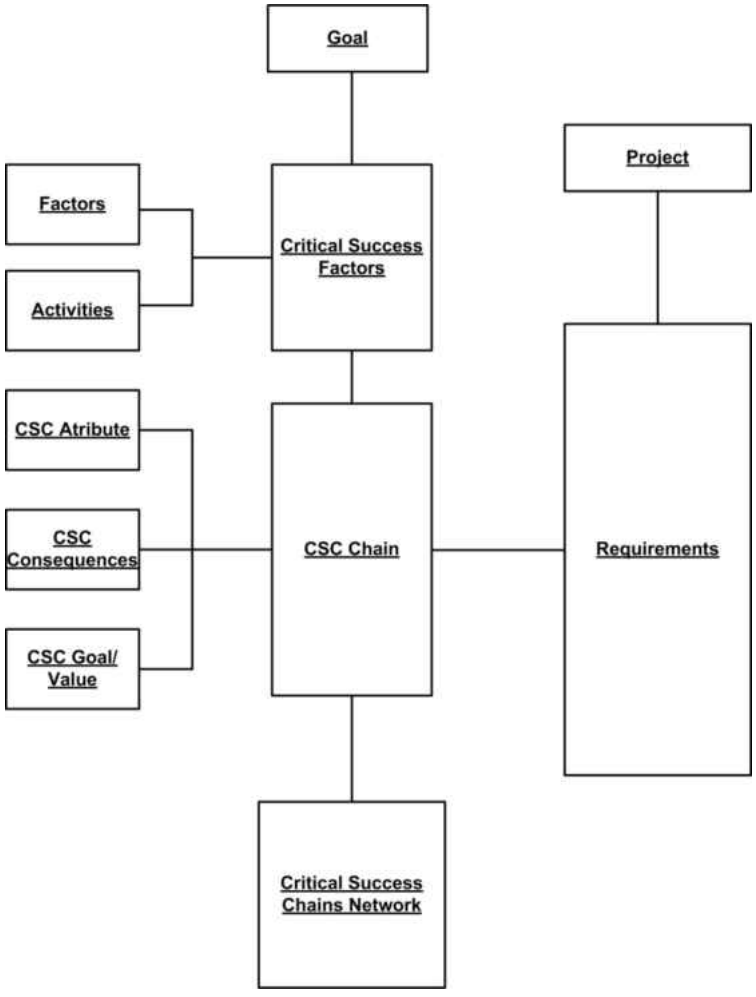

Figure 4.10: CURE meta-model

Site Description

Within the public sector no area is immune to the competing pressures of shrinking revenues, increasing expenses and rising expectations. Local governments find themselves turning to information systems to contain costs and "do more with less." Many governmental organizations manage a diverse portfolio of IS applications, such as packaged, (PeopleSoft, SAP), legacy, proprietary and custom, and web based IS applications. Subsequently we have a combination of systems – MIS, GIS, DSS, EIS and CIS – that are collaboratively engaged in providing an environment to augment organizational decision-making and as such affect all aspects of the organization – people, processes, culture and even the environment within which it operates (Davenport 1998).

However, much of the efforts of such systems are geared towards process automation. According to Koch (2006) stakeholders are expecting IS to deliver value through process innovation. The success of Total Quality Management (TQM) and the Six Sigma movement of the eighties and nineties have imbedded process change in individual functions and business units and the success of such initiatives is driving the demand for process innovation that will spur strategic business transformation (Koch 2006). Within the governmental environment, the impact of the service fulfillment IT model is waning and this demise can be attributed primarily to the need for "agility," i.e., the ability to change IT quickly to fit business needs. Waiting in the wings are several highly touted strategies of which the odds-on favorite being the Service Oriented Architecture (SOA) model. According to Koch (2006), the attraction of SOA lies in its promise to give organizations a portfolio of services that can be mixed quickly and matched

expeditiously to create automated business processes, thereby reducing application development time and costs.

With more and more governmental organizations adopting the federated model and shared services (Koch 2006), the need for an "IT infrastructure based on the work of the business rather than applications and functional silos" (Koch 2006, p 50) has become a necessity especially since infrastructure and back-office applications are primarily utilitarian and competitive advantage can only be realized through innovative customer/constituent facing applications, an approach which emphasizes process and strategy over technology. As Benner et al. (2002) advocate, organizations need to balance process management activities and their desire for innovation. In an environment characterized by disparate and collaborative systems the key to innovation lies in integration. According to Koch (2006) packaged software is a piece of the service, i.e., just another component in a larger organizational process and as such linkage between the different components is essential in delivering value for the enterprise and its external customers.

Like most organizations, the city of Orlando is trying to cope with: an abundance of information stored in a large number of disparate, distributed sources that need to be integrated while satisfying stringent security and management requirements; an ever increasing budget needed to maintain those systems supporting daily business operations; and array of legacy systems which are fast becoming obsolete and preventing the organization from effectively responding to changes in their operating environment; and the demands from management to be more agile in improving processes and service delivery to their external and internal constituents.

In most organizations there is no shortage of ideas for new IS projects, however finding candidate projects with the most potential beneficial impact requires great deliberation about the

available alternatives, a problem that is recognized by researchers in the IS planning arena. According to Segar and Grover (1999), for IS planning to be successful, the process needs to be participative, i.e., incorporating the ideas of many, while maintaining its strategic focus. Achieving these potentially conflicting ideals can be expensive. Extending CSF with PCT can be an economical means of accomplishing these goals.

The current IS planning process employed by the city of Orlando although top-down in orientation does not utilize CSFs. Our proposal is to help the city develop a formal IS planning system which will incorporate CSFs extended with PCT and CSC to support the development of a broad portfolio of IT projects. The use of CSFs in IS planning ensures that projects that support the organization's strategic initiatives are recognized and justified (Peffers, Gengler and Tuunanen, 2003). However, to optimally utilize the use of IT resources, Rockart (1982) recommends the development of a complete CSF model by studying the views of personnel at various level of the organization, especially since these users may represent an untapped reservoir of knowledge that maybe critical to the firm's success. Indeed, an excellent understanding of the organization's objectives, the role of IS in the organization, and the relationship among systems in the organization are essential for successful strategy execution (Jenster, 1987).

Once the IS planning is in place, we will use PCT and CSC to develop the specifications for an application that has been identified in the planning process. Since requirements determination is similar to IS planning but at a lower level of aggregation and with a need for multiple levels of abstraction (Peffers, Gengler and Tuunanen, 2003) we believe the CSC can be adapted effectively to elicit IS application requirements and generate specifications that would be used by the city's application developers to design and implement the identified application.

CHAPTER FIVE: THE DAGS APPROACH – CONCEPTUAL MODEL

Many IT systems fail to realize their objectives because not enough attention has been paid to the business context in which the system functions. One of the primary reasons for this disappointing result is the technical focus of current system development practices approaches which tend to omit business and organizational issues germane to the organization's and the system's success (Flynn and Arce, 1994). Within the RE community there has been several attempts to develop and utilize approaches which are aimed at illuminating business and organizational informational needs - such as goal analysis and business strategy. According to McKeen and Smith (2003), Porter (1987), Galliers (1991) and Bleistein et al (2006), when an organization's information system is in line with, and provides support for its business strategy – strategic alignment – superior business performance is often the result. In this chapter, the DAGS framework is used to develop an integrated web-based requirements elicitation system which is based on Critical Success Factors (CSFs), Jackson's problem diagrams and organizational strategy analysis technique to represent and model an organization's IT requirements.

Context Description

Most research has been focused on the identification of CSFs for executive level managers in specific industries, or heads of specific kinds of departments, principally MIS departments. There has also been some minimal research focused on the diversity of applications of CSFs. One fairly common problem with much of the research is that many of the identified

CSFs have not been stated in the form of an activity. This led to the identification of CSFs that were ambiguous and hard to measure. One early research study that demonstrated this problem was conducted by Boynton and Zmud (1984). This research focused on the use of CSFs and showed that CSF analysis can be used successfully to identify the key concerns of senior MIS management, can be used in developing strategic plans, and can help identify critical implementation issues. CSFs can also be used to help managers achieve high performance and establish guidelines for monitoring a corporation's activities. Boynton and Zmud (1984) also noted that CSF analysis demonstrated certain weaknesses. They found that CSFs were difficult to use unless analysts possess the capability to successfully apply an identification process. A second weakness was the potential introduction of analyst or manager bias, through the interview process. A third was that the requirement analysis methodology and the resulting information model may not accurately represent the deployment environment.

But the researchers concluded that, in spite of these criticisms, the CSF method generates user acceptance among senior management, and works well at the policy, operational, and strategic levels of information systems resource planning. It forms a bridge between corporate strategic interests and information systems (IS) strategic planning. Boynton and Zmud (1984) also found that CSFs can help identify issues that merit close management attention, which is their intended purpose. They further found that CSFs are useful for requirements analysis in building conceptual models of an organization or a manager's role. However, the use of CSFs may not be appropriate where managers are experiencing difficulty conceptualizing the organization or their role in the organization (Dobbins and Donnelly, 1998). Boynton and Zmud's data support the assertions that CSFs generate enthusiasm from senior managers, improve user communications, build managerial support for information technologies, and were

particularly successful in defining organizational information infrastructures. Their data also indicated that lower-level managers may have difficulty formulating meaningful CSFs and specific information measures. This finding underscores the need for specific training in CSF identification and analysis processes and the need to describe these factors in terms of activities.

While CSF strength as a structured design process for eliciting both MIS plans and managerial information needs is the key to its success, Boynton and Zmud (1984) concluded that the weaknesses attributed to CSFs could be overcome through careful application of the method. In another significant study, "Variation of Critical Success Factors over Stages in the Project Life Cycle" (Pinto and Prescott, 1988), the authors hypothesized a set of CSFs, and then conducted a validation study based on empirical evidence. The objective was to identify a set of CSFs for each life cycle phase that was general rather than company- or industry-specific, and to determine the relative importance of the CSFs across life cycle phases. The final set of CSFs were identified and related to the life cycles during which they were important (see Table 5.1).

Table 5.1: Software Development Life Cycle Critical Success Factors (Pinto & Presscott,1988)

Project Phase	Critical Success Factor
Concept	Project Mission Client consultation
Planning	Project Mission Top Management Support Client acceptance
Execution	Project mission Troubleshooting Well-defined schedule or plan Technical tasks Client consultation
Termination	Project mission Technical tasks Client consultation

From the list of identified CSFs the difficulty of not specifying the factor in terms of an activity is clearly demonstrated. This is especially true when a CSF is specified with ambiguous terms such as "technical tasks" or "project mission." This ambiguity makes the factor difficult to measure, and therefore difficult to know whether an activity has been done well. Zahedi (1987) developed an evaluation of reliability of an information system as a measure of the system's success based on CSFs. Zahedi addressed the issue of the difference between behavioral and perceived measures of IS effectiveness resulting from a lack of conceptual foundation to guide the development of proper measurement and the absence of a rigorous program of measurement validation. He concluded that CSFs needed to be defined and their interconnectedness identified. Similar results were obtained by Pinto and Prescott (1988), who investigated CSFs from a reliability viewpoint. In each case the CSFs were not treated as activities that are interrelated.

Leidecker and Bruno (1984), stress the applicability of CSFs for strategic planning and business strategy development, identification of threats and opportunities, and identifying a criterion for strengths and weaknesses assessment. Walsh and Kanter (1988) stress the importance of using the CSF identification process to identify major causes of project failure and then ranking these major causes by relative value, so that such problems can be avoided in future programs. In one of the few comparative studies done, Chung (1987) concluded that if the inquirer wants to know what management is then the *process view* of the organization should be studied. However, he summarized that if we want to know why selected organizations are successful in highly competitive environments then we need to study the three critical success factors of corporate strategies, human resources, and operational systems. Chung (1987) concluded that the truly successful companies deal with these three CSFs differently from the way they are dealt with in other companies.

More recently, the research in this area has continued with the same commercial emphasis as described above, but applied to current business trends. One group studied critical success factors as they apply to establishing strategic alliances (Rai, Borah, and Ramaprasad, 1996). A further study of CSFs in business alliances, this time with a process focus in the oil and gas industry, was reported in the trade press ("Seven Critical Success Factors," 1996). CSF analysis has also been used for community improvement as demonstrated by VanDeusen (1996). The researcher gleaned six factors from 14 community scale future search conferences conducted between 1993 and 1995. The CSFs identified are: leadership, scope, participation, structure, results, and strong conference management. Note once again the ambiguity and the problem when CSFs are not specified in terms of activities. It is very difficult to measure something like structure" or "scope" or even "leadership," especially when something like leadership can be defined and measured in so many different ways.

Business processes for new product development have not escaped the application of CSF analysis. A benchmarking research study of 161 business units conducted by Cooper and Kleinschmidt (1996) identified the CSFs for new product performance at the business unit level. They found that the CSFs fell into major categories. Two key performance dimensions—profitability and impact—were identified. Four key drivers were identified: a high-quality new product process, the new product strategy for the business unit, resource availability, and research and development spending levels. Merely having a formal new product process had no impact. CSF analysis has also been applied directly to people, to measure productivity. Christine Bullen, one of the leaders in the application of CSF analysis, completed a research study of knowledge worker productivity (Bullen, 1995). She found that the context-specific nature of personal productivity demands an understanding of the processes by which knowledge workers

achieve their goals and objectives. Once the nature of personal productivity is understood, measurement becomes a much simpler task and the measures have real meaning.

These studies all show how CSF analysis is applicable to a wide variety of industries and subsets of industries. CSF analysis has also been effectively applied to individual process areas within a corporation, such as strategic planning and information technology implementation, although it is not routinely found as a part of strategic management.

The Critical Success Factors Method

This section describes our approach to developing organizational Critical Success Factors which is based on the work of Bullen and Rockart (1981) and Caralli et al. (2004). Our approach was primarily focused on deriving a set of enterprise CSFs that could be used to align requirements goals, objectives and activities with the strategic intent of the organization. As such the CSFs presented are actually derived from the organization. Document review and interviews provide the raw material for deriving the CSFs and subsequently the organizational IS requirements.

A review of the research literature regarding CSFs from Daniel (1961), Rockart (1979), Bullen and Rockart (1982), etc., focuses on the connection between CSFs, information systems and technology – a relationship that has been validated over time and continues to evolve because of the simple nature of, and the broad applicability of CSFs with regards to functional and non-functional requirements. According to Rockart (1979) one of the most powerful uses of CSFs is to enhance communication among the organization's managers at all levels – allowing managers to have a common focus. Other advantages identified and articulated include:

- Reduction in organizational ambiguity i.e., CSFs reflect the inherent, collective drivers of key managers and are better at articulating the organization's key performance areas;
- CSFs are more dependable than goals as a guiding force for the organization i.e., CSFs are reflective of what managers do to get the organization to achieve its mission in spite of the quality of goals articulated;
- CSFs reflect the current operating environment of the organization i.e., CSFs are more dynamic and reflective of current operating conditions;
- CSFs provide a information planning and requirement perspective for the organization to consider;
- CSFs can provide valuable guidance for course correction i.e., when CSFs are publicized it can align managers perceptions with reality of their operating environment.

Since managers strive to accomplish goals, and realization of organization goals foster attainment of organization mission, it is important that organizations utilize their limited resources to exploit and leverage the organization's information and technical assets to support the organization's mission.

Our interest in the CSF approach evolved from our recurring observation and experience that organizations have difficulty developing and implementing a requirements management or requirements determination approach that maintains a focus on and is in agreement with the organization strategic goals. Regardless of the nature of the organization or the sector in which it operates, its mission can be decomposed into a set of requirements. The gathering, documenting, verifying and managing of requirements can have an adverse effect on an organization ability to satisfy the needs of its stakeholders and accomplish its mission. Research has shown that when requirements are not well managed a project can fail or become more costly.

Collaborative User Requirements Engineering (CURE):

The inherent purpose of system development is the construction and delivery of a system that satisfies user needs. Successful attainment of these needs demand that requirements are systematically defined, managed and tested. From a software engineering perspective, Requirements Engineering (RE) is not only the first activity of the software process, but it like a sentinel in its ability to unearth errors, minimize cost and deliver expected benefits. Many organizations are interested in improving the RE process because of the potential that any advancement will help in the development of successful systems.

According to McKeen and Smith (2003) and Bleistein et al (2004) strategic alignment of IT exists when an organization's goals and activities are in agreement with its supporting information systems. This concept has been advocated and demonstrated by a host of academic researchers including Porter (1987) and Galliers (1991) so it is not surprising that practitioners consistently rank alignment of IT and business strategy as a top priority. Yet despite this overwhelming support, business strategy and strategic alignment are often ignored in research and practice, as only a handful of approaches have attempted to incorporate both factors to validate requirements against the organization's strategy.

Strategy and Strategic Planning

The word strategy comes from the Greek work *stratEgia* and has it roots in warfare means – (1) the science and art of employing the political, economic, psychological, and military forces of a nation or group of nations to afford the maximum support to adopted policies in peace or war; (2) the science and art of military command exercised to meet the enemy in combat under advantageous conditions. Today, strategy is a term of general management applied to any area in which a broad plan is needed to achieve a grand objective and it conveys the idea of critical goals achieved under battle conditions (Andersen, Belardo and Dawes, 1994).

"An organization can be said to have a strategy when the leaders and the organization as a whole have committed themselves to a particular vision of how the organization will operate to create value (Moore, 2000, pp. 183)" Thus the organization's strategy is derived from its vision of the value it will produce. In for-profit organizations, this vision/strategy is expressed in terms of financial targets for the organization as a whole, along with a business plan that describes how a company plans to compete in various product and service markets. (Andrews, 1971) In non-profit and governmental organizations, the vision is described in terms of the organization's mission and the particular activities undertaken in pursuit of its mission. (Moore, 1995)

In the development of a corporate strategy the need is for one which is feasible, value creating and sustainable. To ensure this result, the organization's existing capabilities have to be fitted to the challenges and opportunities of the environment in which it operates (Porter, 1980). However, while the need for an organizational strategy is common across organizations in both the for-profit and government sectors, the form that such strategies take and the analytic tasks in developing them differ in important ways (Bryson, 1995; Oster, 1995).

According to Moore (2001) the difference between organizations operating in the for-profit and the public sectors is highlighted by two key differences – the organization's revenue source and the manner in which the value they deliver is measured. For organizations operating in the public sector the principal source of revenue is taxation. For those in the for-profit sector the defining source of revenue is from the sale of products and/or services to customers. Another difference between these organizations lies in what constitutes and how one measures the value produced by the different organizations. The principal value delivered by for-profit corporations is the financial returns delivered to shareholders and the use value delivered to customers while the principal value delivered by the government sector is the achievement of the politically mandated mission of the organization and the fulfillment of the citizens' aspirations reflected in that mandate (Moore, 2000).

In the for-profit sector, the normative and analytic framework for strategy formulation is based on Porter's (1980) framework, i.e. that the organization's primary purpose is the maximization of shareholders' wealth through customer's satisfaction, financial performance and exploitation of the firm's distinctive competence. In contrast, within the public sector strategy formulation begins with the mission of the organization and is focused on the collaboration necessary to provide services and maintain the attention and support of the organization's various clients and constituencies (Andersen et al, 1994). In other words, the mission of a governmental organization defines the value that the organization intends to produce for its stakeholders and is the metric that is used to assess performance (Moore 2001).

Strategic Alignment

Strategic alignment of IS is said to exist when an organization's goals and activities are in harmony with the information system that support them. According to Galliers (1991) and Porter (1987) effective strategic alignment has been shown to have a positive influence on IS effectiveness and often times lead to above-average performance. Despite this, information system research which explores this relationship is not very prevalent in the IS research literature. However, this type of phenomenon remains of interest to practitioners.

An organization's business strategy can be defined as "the understanding of an industry structure and dynamics, determining the organization's relative position in that industry and taking action either to change the industry structure or the organization's position to improve organizational results (Oliver 2001, p. 7)." Or as Porter postulated t*he rationale for and the means by which business organizations competes with rivals*.

The requirements engineering research literature describes numerous approaches that address various aspects of organizational information systems including Yu and Liu (2001), Loucopoulos (2001) Rolland et al (1998 & 2004). However, these approaches do not include a technique for the explicit representation of business strategy as most are concerned with either the functional and/or operational aspects of the business or organization. Utilizing these approaches makes it difficult to validate system requirements against the intentions of management and the organization's stakeholders.

A review of strategic alignment literature reveals a number of frameworks and/or approaches for evaluating and validating alignment between information systems and business strategy including Luftman et al., (1999), Reich and Benbasat (1996) and Henderson and

Venkatraman (1991) all of which tend to be concerned more with management issues rather than the relationship with system requirements.

Goals and Goal Modeling

Goals have been recognized as an essential component in the requirements engineering process. “Requirements definition must say why a system is needed, based on current or foreseen conditions, which may be internal operations or an external market. It must say what system features will serve and satisfy this context. And it must say how the system is to be constructed (Ross and Schoman, 1977, p. 6).” A goal is an objective that a system under examination should achieve, i.e. goal formulations is concerned with the intended properties to be established; they are optative statements bounded by the subject matter (Jackson, 1995). They may be formulated for high-level strategic concerns through to low-level, technical concerns and cover different types of concerns: functional concerns associated with the services to be provided, and non-functional concerns associated with the quality of service (van Lamsweerde, 2001).

According to van Lamsweerde (2001), goals are important to the requirements process since they help to:

- Achieve requirements completeness, i.e. they provide a precise criterion for sufficient completeness of a requirements specification; the specification is complete with respect to a set of goals if all the goals can be proved to be achievable from the specification and the properties known about the domain.
- Explain requirements to stakeholders, i.e. goals provide the rationale for requirements;
- Provide a natural mechanism for structuring complex requirements, i.e. make them more readable;

- Provide alternatives for consideration in validating choices;
- Provide a mechanism for managing conflicts among multiple view-points;
- Drive the identification of requirements to support them (goals).

Goals are generally modeled by types and attributes and by their links to other goals and to the other elements of the requirements model. As such goals can fall into different categories. *Functional* goals describe the services a system is supposed to deliver, for example, *satisfaction* – functional goals concerned with satisfying agent requests; *information* – functional goals concerned with keeping agents informed. *Non-functional* goals describe expected system qualities, for example accuracy, security, safety, performance, usability, flexibility and interoperability, where *accuracy* – non-functional goals requiring software objects to accurately reflect the state of corresponding objects; *performance* – time and space performance goals; security – confidential, integrity and availability goals (van Lamsweerde, 2001). Another distinction made in the literature is between *soft* goals – goals whose satisfaction cannot be established in a clear-cut sense; and *hard* goals – goals whose satisfaction can be established by verification techniques.

The identification of goals is not an easy process. Sometimes they are explicitly stated by stakeholders but more often they are implicit and emerge through a process of elicitation. According to Zave and Jackson (1997) goals are essentially optative as they make explicit the intended properties needed for successful attainment of objectives. Since goals may be formulated at different levels of abstraction – from high-level strategic concerns down to low-level technical ones, they can be used to validate system requirements against business objectives or goals (van Lamsweerde, 2001).

The influence of goals on requirements engineering is undeniable. Goals provide the rationale, drive the elaboration, and operationalize requirements (Kavakli, 2002). A goal modeling approach to RE is concerned with the use of goals for "eliciting, elaborating, structuring, specifying analyzing negotiating, documenting and modifying requirements. (Lamsweerde, 2001, pp 1)" From a review of the current research literature it is evident that there is no universal definition of the RE process, however, three processes are common to most of the prescribed approaches – elicitation, specification and validation.

According to Kavakli (2002), Elicitation is primarily concerned with: (1) understanding the organization's current operating environment, and (2) describing the needs and constraints for the system under development. Thus, from an elicitation perspective, goal modeling would be utilized to represent the goals of individuals, groups or organizations. From a specification perspective goal modeling is utilized to link the organization's needs and objectives to the system's functional and non-functional components. Specification is concerned with mapping these needs onto a requirements model. Finally, Validation seeks to ensure that the derived specifications are congruent with the original expressed needs while conforming to the organizational and environmental constraints, i.e. goal modeling is used during specification to assess the system's components regarding specification. "Goal modeling furnishes a mechanism for linking requirements in a progression of problem diagrams. (Bleistein et al., 2006, p. 366)"

The requirements engineering literature is rich with various goal modeling approaches (Yu and Lui, 2001; Rolland et al., 1998; Nurcan and Rolland, 2003; Kolp et al., 2003). However none of these approaches incorporate an organization's business strategy. What is needed is a set of steps for analyzing, deconstructing and transforming strategic intent into a requirements model.

Critical Success Factors and Goals

In strategic planning the definition of a goal or an objective is well known, i.e. targets established to achieve the organization's mission that is specific, measurable, achievable, realistic and tangible. Goals and CSFs compliment each other – they are both needed to accomplish the organization's mission and are both concerned with the achievement of a common objective. Thus, organizations that have been successful at achieving their goals are more likely to achieve their CSFs. Consider the following goals for a company:

- Increase sales in our Northeast division by 15% by 2nd quarter, 2008.
- Decrease travel expenses by 10% in the next 30 days.
- Expand product line to include Data warehouse and Business Intelligence (BI) appliances.
- Increase geographic scope by opening at least two retail stores in at least two Caribbean markets by 3rd quarter 2008.

The first goal might be commonly found in many manufacturing companies: to achieve a 15% increase in sales in a divisional unit. To achieve this goal, the company is relying on its ability to perform well in a few key areas. While the goal is simple, it also reflects many fundamental assumptions or existing conditions. Thus, accomplishing this goal implies that:

- The growth of the company is dependent on the organization's capability for increasing sales.
- Sales staff must be empowered and enabled to meet the challenge of attaining an increase of 15%.
- The company must act quickly because it needs to retain and grow its market share in the Northeast as other competitors ramp up.
- The Northeast division is an important area in which sales expansion brings the company a competitive advantage.

These assumptions or conditions embody CSFs that are directly related to the potential success in achieving the goal. For example, consider the following dependencies between the goal, underlying assumptions and conditions, and CSFs (Figure 5.1):

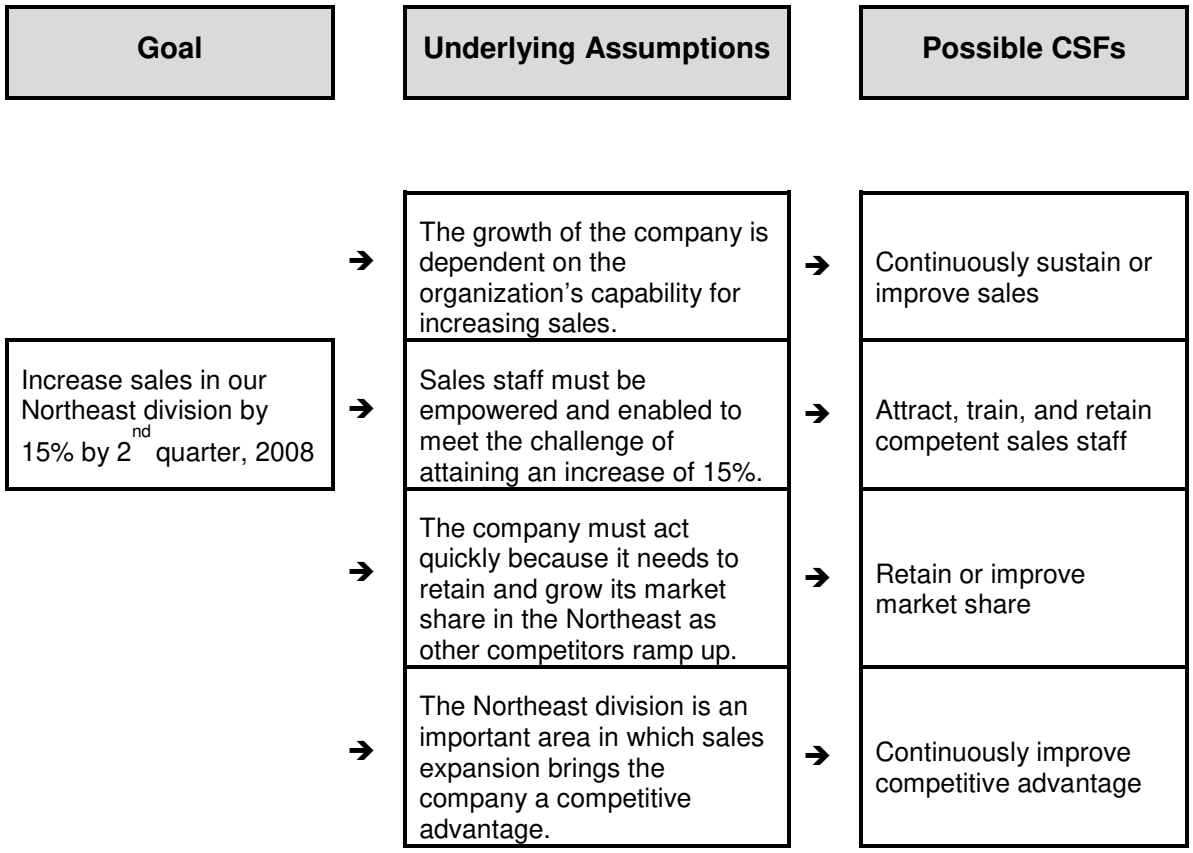

Figure 5.1 – Relationship between Goals and CSFs (Adopted from Caralli et al., 2004)

The importance of the CSFs in helping the company achieve its goals cannot be overstated. In this example, at least one of the CSFs—attract, train, and retain competent sales staff—is vitally important if the company wants to achieve the goal of attaining a 10% increase in sales (Caralli et al., 2004). If the company fails to consistently retain qualified sales staff, the goal is not achievable, putting the company's mission in jeopardy.

As illustrated above, an organizational goal may be related to more than one CSF to be achieved. Conversely, a CSF may influence or affect the achievement of several different goals. This many-to-many relationship between goals and CSFs is indicative of their interdependent nature and the importance of CSFs in helping the organization to realize its mission.

Goal Modeling and Strategy

Previous approaches to using CSFs did little to help information architects or requirements engineers validate system requirements against the more abstract high-level requirements that represent the business strategy the IT system is intended to support. This research effort seek to craft an approach that integrates Critical Success Factors (CSFs), Jackson problem diagram with requirements engineering goal modeling that enables verification and validation of an organization's IT systems requirements in terms of alignment with and support for business strategy in a manner that satisfies the information needs of a diverse group of stakeholders (Bleistein, 2005). In the remainder of the chapter I will describe an approach to addressing this limitation.

According to Hofer and Schendel (1978) CSFs play an important role in strategy formulation in three primary areas specifically: environmental analysis; resource analysis and strategy evaluation. Environmental analysis is an assessment of the social, political, economic and technological climates and their impact on an industry and/or organization. It is used to identify the significant threats and opportunities facing a firm by diagnosing the essential competences, resources and skills needed to be successful in a particular industry. Resource analysis is concerned with an inventory of the organization's strength and weaknesses, i.e. those

variables that have been instrumental to its success. Strategy evaluation involves the comparison of strategic alternatives with specific goals and objectives the firm and it various constituencies.

According to Sondhi (1999) strategy is a way of thinking than can be expressed in term of the organizations' v*isions, mission, objectives, goals, strategies* and *tactics.* Using Sondhi (1999) prescriptions for analyzing and deconstructing business strategy – VMOST (vision, mission, objective, strategic and tactic) analysis, we extract the organizational components from the elicited CSFs.

Table 5.2: VMOST concepts (Sondhi (1999) and Bleistein et al (2006))

VMOST Concepts	Descriptions
Vision	An end-state towards which the organization strives
Mission	The primary activity of the organization that achieves the vision
Goal	An abstract statement of intent whose achievement supports the vision
Strategy	A long-term activity designed to achieve a goal
Objective	A specific and measurable statement of intent whose achievement supports a goal
Tactic	A short-term action designed to achieve and objective

Next the Business Rule Group (BRG) motivation model is employed to generate the rules needed to associate the organizational components into a requirements model, i.e. how the components are related, aligned and supported. According to Bleistein et al (2006, p. 368), "the BRG-Model describes a framework in which organizational '*means*' achieve organizational '*ends*'. *Means* consist of *processes, tasks*, and *activities* and include *mission, strategy*, and *tactic*. *Ends* are states (goals) toward which the means are meant to strive. These include *vision, goal,* and *objective*."

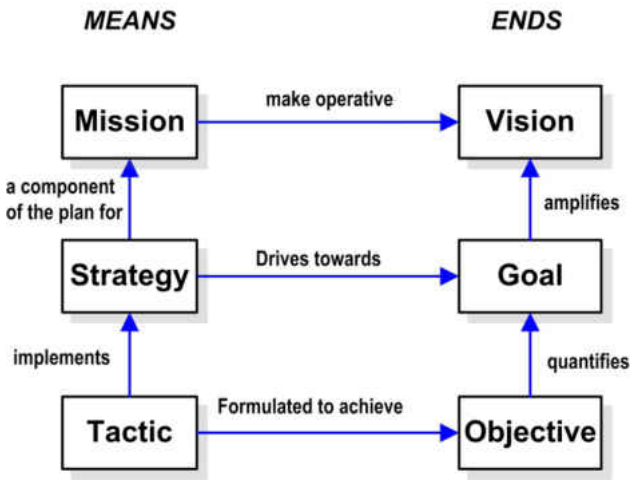

Figure 5.2: BRG-Model (Kolber et al. (2000))

Appropriating notational entities from Yu (1993) i* framework permit better representation of an organization's strategic intent and requirement needs by describing the rules by which each component relates to each. According to Bleistein et al (2006) this operationalized BRG Model provides a mechanism for unifying the business strategy model with the system requirements model. The benefit of unification provide "a traceable rationale for validating system requirements against business strategy within a single framework and notation (Bleistein et al., 2005, p. 1302), and avoid having to map from one model to the next. Semantically, the rules that govern the model's behavior helps to reduce the complexity associated with goal modeling while facilitating a greater degree of consistency between models. For example, *means* contribute to *end; tasks* contribute *to soft goals* and *hard goals;* and *hard goals* contribute to *soft goals. (See figure 5.2)*

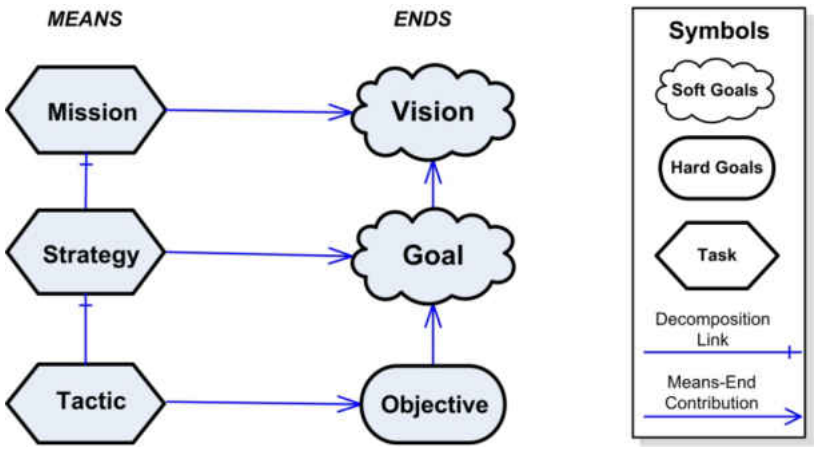

Figure 5.3: BRG-Model Mapped to i* notation [(Kolber et al. (2000), Bleistein et al. (2006))

According to Bleistein et al (2006), an organization's intent can be represented by several goal modeling notation. These include a *concrete goal* – one whose achievement is measurable; an *abstract goal* – one whose achievement is not quantifiable; plus entities to represent tasks and processes – both of which can decomposed into sub-tasks or refined into sub-goals.

In many ways CSFs can be viewed as multi-functional meta-tool and according to Caralli et al (2004, p. 85), "(CSFs) are a target at which many important initiatives of the organization can be aired and compared." The assumption being that for a given goal – hard or soft, there is one or more supporting CSFs associated with that goal - whose purpose is to enable verification and validation of requirements in terms of alignment with and support of business strategy and the goals and processes that support that strategy. Thus, since CSFs captures and expresses the explicit quantifiable and non-quantifiable goals within or across an organization, its use can augment and extend the BRG model by explicitly making evident the relationship between such goals, strategy and CSFs.

Table 5.3: Modeling Entity Definitions (Yu (1993) and Bleistein et al (2006))

Modeling Entities	Definitions
Soft Goals	An abstract goal whose achievement is not quantitatively measurable, e.g. *vision* and *goals.*
Hard Goals	A goal whose achievement is quantitatively measurable, e.g. an *objective.*
Task	A specific activity or process, e.g. *mission, strategy* and *tactic* are activities or encapsulate processes
Decomposition Link	Link indicating task decomposition into sub-tasks
Contribution Link	Link indicating contribution to a goal from a sub-goal

The RE notation and techniques propose may be used singularly but doing so will result in neglecting critical aspects of IT requirement analysis for any organization. Organizational goals describe only objectives and intention but communicate little about the context in which they occur (Bleistein et al., 2006). It is important to verify that goals are in alignment with the context in which they occur, and as such this relationship must be clear. The *i** notation is utilized because it is widely recognized within the research community although we only utilize a subset of its modeling entities. Each of the above mentioned requirements notation need to be integrated and to achieve this we employed several different techniques. Integration of i* goal model with Jackson problem and context diagrams is accomplished by treating goals as the requirements part of a problem diagram. Jackson context diagrams are integrated with CSFs by maintaining equivalence between goals and Critical Success Factors. CSF Activities are cross-referenced with task, soft goal and hard goal entities in the i* (operationalized BRG) model and as such CSFs are connected to the goal model at multiple points of reference.

To validate lower-level requirements against higher-level strategic objectives, we employ a simple mechanism to facilitate top-down refinement and bottom-up traceability. This is accomplished using a goal model, as goals can be refined from high-level strategic concern to low-level technical ones (Lamsweerde, 2001).

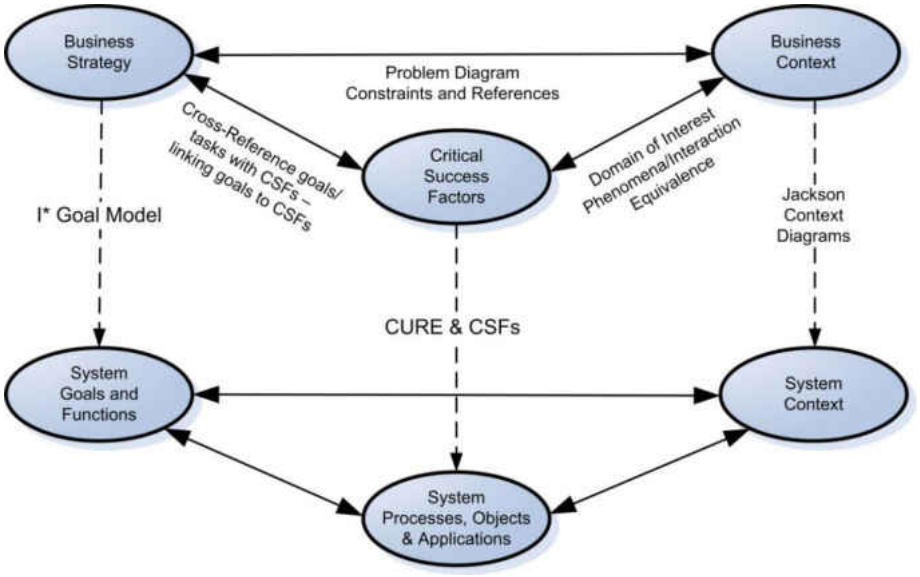

Figure 5.4: CURE framework [Adapted from Bleistein et al. (2006))

The architectural framework which guides the development of CURE is shown in Figure 5.4. The top level organizational model is represented by the three elements – business strategy, CSFs and business context. *Strategy* and *context* are integrated using requirements constrains and references. Context and CSFs are connected using equivalence between the domains of interest and shared phenomena and interaction. Strategy and CSFs are connected via cross-referencing goals and tasks with the CSFs. Strategy can be refined to represent system goals and requirements via the i* goal model (Bleistein et al., 2006).

In summary, since requirements expresses the objectives of an organization's strategy, the use of goal models integrated with Jackson's (2001) problem diagrams and CSF models

serves as a means of truly understanding and verifying the IT requirements of an organization in a comprehensive manner at both the lower level and the upper level, and that the IT requirements are aligned with and provide support for objectives/goals at a higher levels.

CURE: The Software Tool

What is needed is a software tool, CURE, which employs CSFs for IT planning and for determining information system requirements. To be effective CURE should provide support for conducting CSF analysis by providing a mechanism to maintain, retrieve and analyze information relevant to the organization's need and link these to the relevant IT systems (Flynn and Arce, 1997).

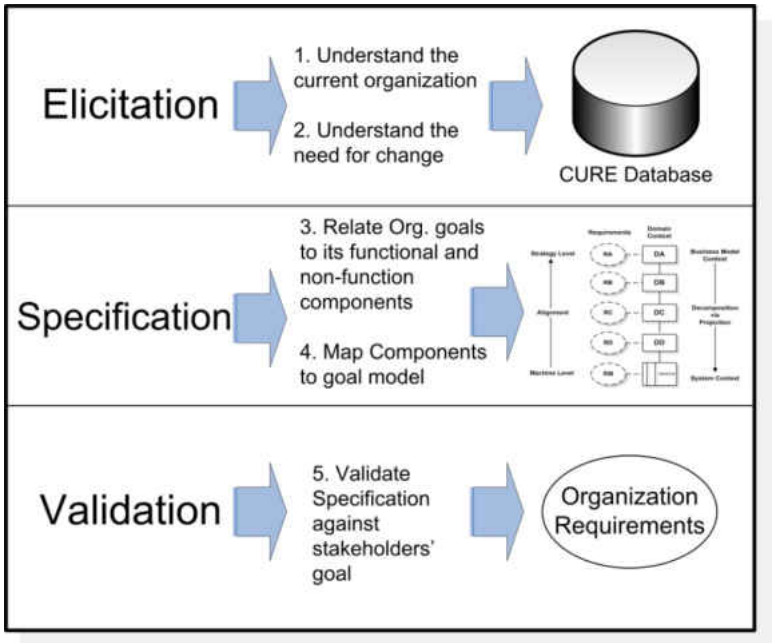

Figure 5.5 – CURE Application Model

Moreover the CURE should provide answers to some of the problems encountered in understanding an organization's requirements determination in a given context: (1) the lack of awareness about the relationship between business objectives, key performance measures and information sources; (2) facilitating the need for both top-down and bottom-up approaches to requirements determination; (3) the need for an objective manner in determining requirements priority; and (4) the need to determine which IT system will support and assist the organization's in satisfying its information needs.

Capturing Requirements

Undertaking an enterprise-wide view of an organization's informational requirements is a task fraught with complexity yet it can be very instructive in highlighting the challenges facing the CIO. The CIO is often tasked with deploying IS resources effective and as result to perform the task satisfactory needs to answer some very important questions:

1. What are the information needs? Why and in what priority?
2. What parts of the organization should be involved in this effort? How can we convince these units to work together?
3. How will I know when the organization unmet needs have been met? How will success be measured?

From out research, it is evident that the answers to these questions lie in an examination of the organization's CSFs. Why? Given the way they are employed in most organizations, CSFs, especially at the executive level are too high-level to act as anything but indicators of business needs (Flynn and Arce, 1997). However, at the operational level CSFs are essentially refinements of the objectives and strategies or mission statements and are often measurable.

Extending the CSF concept to include organizational metadata information sets – applications, objectives/entities, goals, objectives, strategies, tactics, assumptions, measurability and priority determination factors – will make it more likely to produce meta-data informational sets.

CURE is designed to be used by the information or systems analyst participating in IT planning or system development activities, i.e. requirements determination. For CURE we have established the following requirements:

- To provide a database to catalog and maintain information relevant to the analysis of CSFs for IT planning and requirements determination;
- To produce a range of reports documenting the relationship between CSFs, supporting themes, activities and organization goals;
- To provide a mechanism to identify inconsistencies and align components by offering the ability to interrogate and detail the different multi-dimensional relationships captured;
- To provide a mechanism to validate the strategic alignment of organization IT requirements with the organization's business strategy.

CURE is utilized primarily for cataloging and associating activities, supporting themes and CSFs elucidated by the interviews and document review. For example, selecting a specific CSF, the analyst should be able to examine its effect on the executive and operational levels of the organization

CSF Database – Capturing, Cataloging and Managing Requirements

The CURE database consists of a set of organizational variables, a subset of which is important in determining the components of the organization's IT system. The initial database design was intended to assist in cataloging and managing the CSFs; next the design was

extended to include the organization IT-related dependent metadata components – dependent variables *Application*, *Object*, *Business Unit* and *Business Process*. Next, the database was extended to catalog and document the organization's goal model.

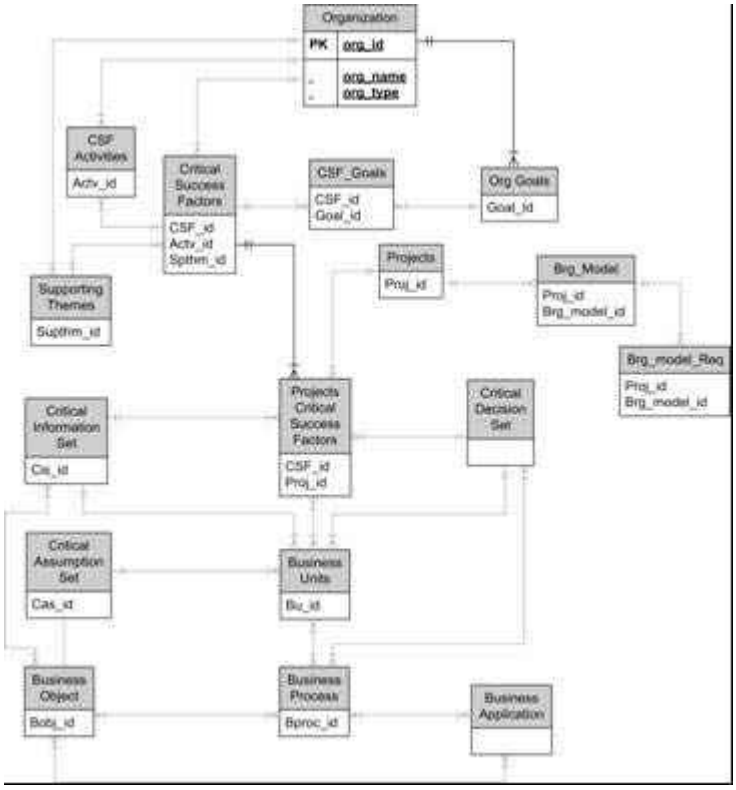

Figure 5.6 – ER Database Diagram

From a planning viewpoint, an important issue that needs to be addressed is priority determination. Inclusion of a dependent variable offers two perspectives – organizational and technical. The organizational perspective is concerned with the priority associated with the various business units and the technical is concerned with the priority associated with applications and/or objects (Flynn and Arce, 1997). The ability to perform priority determination is important to the practice of IT planning and requirements determination. However, for the

purpose of simplicity, we will allow the system analyst/architect in consultation with system's stakeholders to establish an organizational priority determination hierarchy.

From a requirement viewpoint, CURE should facilitate the coupling of and the relating to of enterprise and operational CSFs. Unlike goals which tend to cascade throughout the organization in a tight one-to-one fit, often there is not a one-to-one match between every operational unit CSF and an enterprise CSF, however, there must be some congruence between the units since each layer of the organization has its own focus and operates under different environmental conditions (Caralli et al., 2004).

Within the confines of Requirements Engineering (RE) *Elicitation,* the first step is concerned primarily with knowledge building – an understanding of the organization's current state and an understanding of the need for change. The remaining steps – *Specification* and *Validation* involves: establishing the relationship between the organization's function and non-functional components; and authenticating the organization's stakeholders goals, respectively. These three steps are essentially knowledge states (Kavakli, 2002), represented by different models which aid the understanding and development of organizational requirements at each stage. Combining each into a coherent whole provides a powerful mechanism for effective requirement engineering.

Specifying Requirements (with Problem Frames)

One approach which has been suggested to bridge the gap between requirements engineering, system analysis approaches and frameworks for validating strategic alignment of organizations involves the use of problem diagrams and requirements goal modeling in an

integrated framework (Bleistein et al., 2006). This integrative approach allows for the representation of business strategy (using Jackson's problem diagrams) and analysis of business strategy from a goal seeking perspective.

Jackson's (2001) *problem frames* is a requirements analysis framework that can be used to represent an organization's business strategy. This representation allows analysis of these requirements in terms of support for and alignment with that strategy (Bleistein et al., 2006). Problem frames capture, structure and classify recurring software development problems using a problem diagram framework based on real-world physical entities and their observable interactions and behaviors (Jackson 1995). A problem diagram describes the properties of a software problem in two ways: the way the world presently is, and the secondly the way we would like the world to be (Jackson 2001). The former is described as the *indicative mood* and represents "everything in the problem that is given and will remain unaffected by the software system including physical domains, entities such as: people, organizations, departments and devices and their shared phenomena such as activities, processes, events, states, commands and information. (Bleistein et al., 2006, p. 364)" The later, the *operative mood,* represents "the way we would like everything to be, given construction of the software system and thus represents the requirements including business goals, objectives, processes and all the other business and system requirements (Bleistein et al., 2006, p. 364)."

As a diagrammatic entity, a problem frame consists of two major components – a requirements part and a domain context diagram since a requirement can only be understood in the context in which it occurs. (Jackson 2001) Context diagrams contain real-world physical domain entities and the behavioral phenomena that occur between these physical entities. The

diagrams always contain one domain of special interest, the machine. The requirements describe the effect in the real world that the machine should guarantee. See below (figure 5.7)

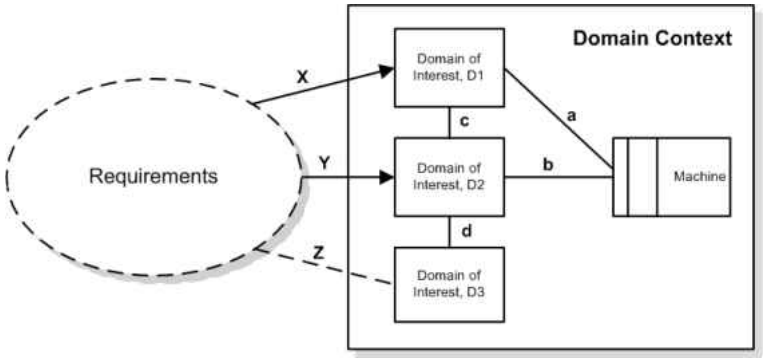

Figure 5.7: Jackson's Problem Diagram

Problem frames diagrams are very helpful in analyzing business strategy. According to Bleistein et al. (2006) the business model is the problem context in which the physical domains of interest represent business models, participants whose actions are described as shared phenomena. *Activities* and *processes* are the ways by which the organization achieves it business objectives. These are the requirements. The IT-enabled organization supporting that strategy is represented by the machine and "the manner in which the machine support requirements of business strategy, effectively describes successful strategic alignment (Bleistein et al., 2006, p. 365)."

Making sense of a problem diagram at the business strategy level is often too abstract to begin designing and building a solution consisting only of hardware, software, networks resources and people. What's needed is refinement, i.e. the concept of a *progression of problems*

(Jackson 2001), see figure 5-2. Essentially, requirements ovals RA, RB, RC, RD, and RM refer to domain context diagrams DA, DB, DC, DD and M respectively. The domain context DA represents the *indicative* properties of the problem context at the level of the business model. Requirement RA represents the *optative* properties of the business strategy. Analysis of DA will lead to its decomposition into DB; and analysis of DA and RA will yield requirement RB that refers only to DB while satisfying RA. Similarly, through analysis of DB will yield a decomposed DC; and analysis of DB and RB will yield requirement RC, and so on (Bleistein et al., 2006). Through this process of domain context decomposition, analysis, problem projection, and refinement, ultimately the requirement refers just to the machine, yielding the system specifications (Jackson, 2001).

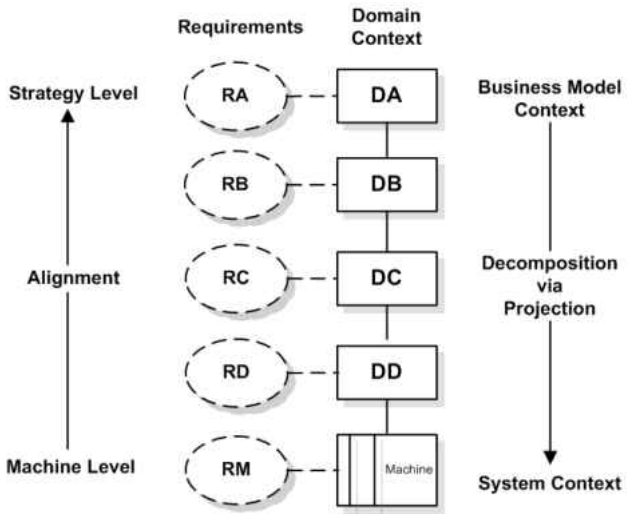

Figure 5.8: Progression of problems (adapted from Jackson (2001, p. 103))

"Problem diagrams provide no explicit, direct linkages between requirements in problem diagrams at different levels of the progressions to describe how requirements at different levels

of abstraction are related (Bleistein et al., 2006, p. 366)." Without this linkage strategic alignment is difficult to validate since the traceability of the optative properties from system requirements to strategic business are absent. Utilizing goal modeling and employing a sequence of activities, we analyze, decompose, and transform the CSFs and their informal expressions of strategic intent into a requirements engineering goal model.

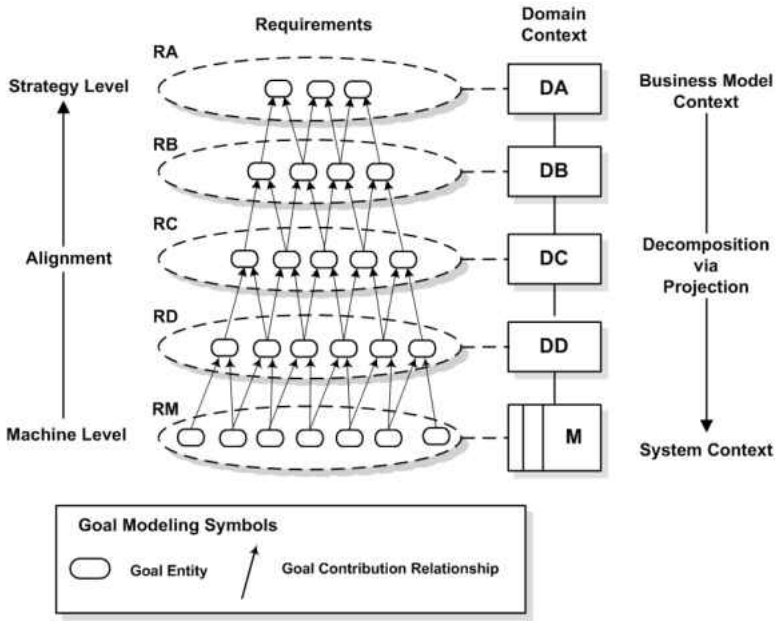

Figure 5.9: Integrating goal model with Progression of problems (Bleistein et al., 2006))

Modeling business strategy with goals is a three step process: VMOST Analysis – analysis and deconstruction of strategic intent into components; BRG-Modeling – relating components of strategic intent according to the rules; and Goal Modeling – assembling components of strategic intent into goal model according to the BRG-Model relationships.

As stated above, Sondhi (1999) VMOST analysis is used to analyzing and deconstructing business strategy into component parts. The analysis consists of interrogating the data using a set

of key questions (See Table 5.4 below). Once the analysis is completed the next step involves construction of the goal model.

Table 5.4: VMOST analysis key questions, adapted from Sondhi (1999)

Key question	Rationale
Vision and mission	
What is the overall, ideal, end-state toward which the organization strives (vision)?	Identification of the vision
What is the primary activity that the organization performs to achieve the end-state (mission)?	Identification of the mission
How are the responses to Questions 1 and 2 (vision and mission, respectively) appropriate and relevant to the environment?	Confirmation of understanding of vision and mission by understanding their rationale in terms of industry and market
Are the responses to Questions 1 and 2 (vision and mission, respectively) explicit or implied? How?	Explanation of how the mission and vision are understood, whether taken from explicit statements of stakeholders, or interpreted via analysis of observed patterns of activities and behavior
Goals and strategies	
What are the basic activities and their rationale by which the organization competes with industry rivals?	Confirmation of understanding of what drives strategic goals and activities by which the goals are achieved
What goals does the organization set to determine if it is competing successfully?	Identification of strategic goals
What activities does the organization perform to achieve the goals in Question 6?	Identification of means by which strategic goals are achieved
How do the goals in question 6 support the response to question 1 (vision)?	Confirmation of understanding the strategic goals by understanding their rationale in terms of supporting the vision
Objectives and tactics	
What are the measurable objectives that indicate achievement of goals identified in Question 6, and what activities does the organization perform to achieve those objectives?	Identification of objectives, the means by which those objectives are achieved, and confirmation of measurability
How do the objectives identified in Question 9 support the goals identified in Question 6?	Confirmation of understanding of tactics and their objectives in terms of the rationale for supporting strategic goals

Assembling the deconstructed components into goal model can be challenging. According to Bleistein et al. (2006B), attempting to model an organization's business strategy, in which soft goals may be the norm rather than the exception, often pose additional challenges for the goal modeler. To alleviate this problem, goal modelers have adopted the BRG-Model rules that place goals into three categories: *hard goal*, *soft goal*, and *task*.

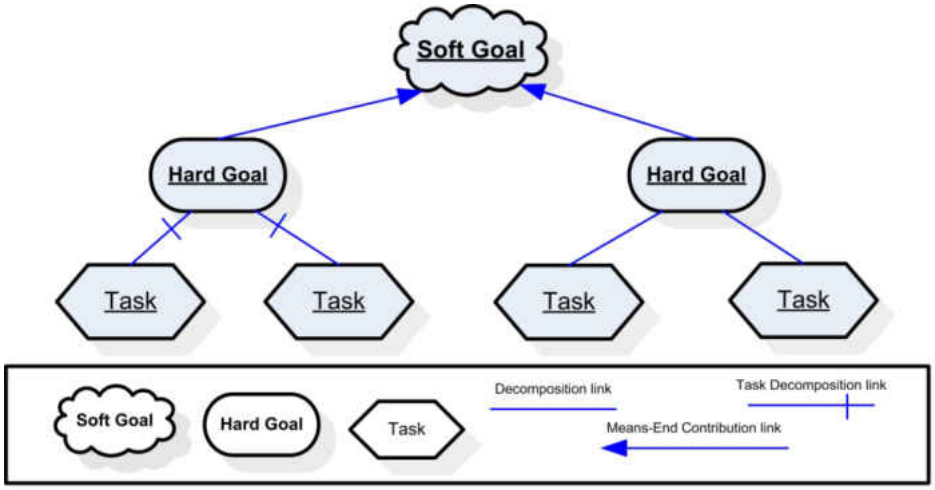

Figure 5.10: Integrating goal model with Progression of problems (Bleistein et al., 2006))

Once business strategy is deconstructed a recognized difficulty is encountered regarding problem scope. According to Bleistein et al (2006) Jackson's context diagrams are helpful in defining the scope of the problem to be modeled by representing "what is useful and necessary to describe the problem being addressed." According to Weill and Vitale (2001), a business model is simply a description of the roles and relationships among the organization's primary stakeholders that identifies the major flow of products, services, information and monetary resources. Based on this definition, Weill and Vitale developed a graphical modeling notation whose activities include the organization of interest – suppliers, vendors, customers and the relationships among these entities. While their notation was specifically designed for to e-

business modeling, the notation is sufficiently generalized enough to apply to any business or organization.

The Weill and Vitale business model framework dovetails with Jackson's problem diagrams, i.e. it provides the basis for the separation of concerns, between model context and the requirements of the business strategy. "Physical domains of interest represent business model participants, i.e. the organization of interest, suppliers, allies, customers, and consumers. The relationships among the participants are indicated as interfaces, whose flows of money, products, and information are described as shared phenomena. The machine domain of interest can be used to represent Weill and Vitale IT-enabled organization of interest. (Bleistein et al., 2006, p. 11)"

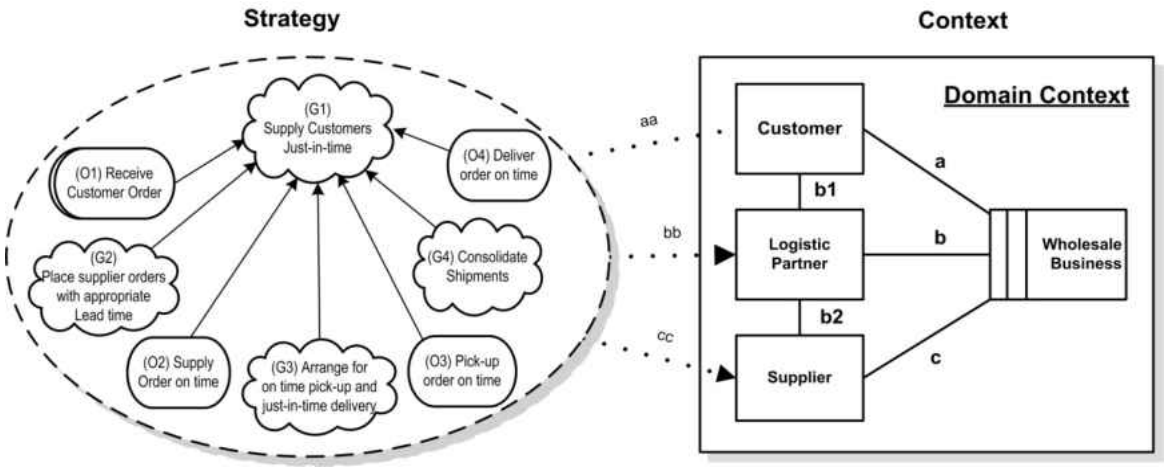

Figure 5.11: Business Strategy and Context as a Problem Diagram (Bleistein et al., 2006))

Bleistein et al., (2006), proposed the following steps when assembling the deconstructed components into a goal model:

1. Identify the business model participants, i.e. who are the *organization of interest, suppliers, allies, customers*, and *consumers* in the model? These are your *domains of interest* and the *machine* in the context diagram;
2. Identify the relationships among the participants, i.e. what the *flows of money, product, service* and *information* and between which participants do these flows occur? The flows represent *shared phenomena*, the relationships *interfaces.*
3. Identify the strategic requirements of the business model and represent these as a goal model, i.e. combine VMOST analysis with goal model construction according to the BRG-Model rules

In refining the requirements from a high-level down to machine level we employ the progression of problems concept. The process begins with a systematic analysis of domain, DA, which (if possible) is decomposed into a more refined context diagram, DB. Then, a meticulous analysis of domain, DA, and Requirement, RA, it is possible to find a requirement RB that refers only to domain, DB, while satisfying RA, and so on. Using this recursive process of domain context decomposition, analysis, problem projection and refinement will ultimately yield the machine requirements specification (Bleistein et al., 2006).

In summary, it is important that the top-level program diagram defines both the scope of business problem to be solved and the critical strategic business objectives that are to be met. If these are absent, it can be difficult to ensure a through understanding of the system's lower-level requirements and strategic alignment will remain elusive (Bleistein et al., 2006).

Validating Requirements Specifications

Attainment of the goals at the strategic/executive level of the organization is critical to the success of the organization. Achievement of these goals is dependent upon the sub-goals and tasks that contribute to them. This is how we can primarily validate strategic alignment of low-level requirements. In modeling strategy, the use of problem diagrams allows us to treat goals as requirements, a representation that permits and facilitate the validation of lower-level requirements against higher-level goals, enabling validation of requirements alignment against objectives of business strategy. Concurrently, requirements can be understood within a specific domain context. According to Bleistein et al. (2006 B, p. 853), "The problem diagram framework thus also enable validation of requirements alignment within organizational context. Bottom-up traceability of requirements in the goal model in conjunction with verifying requirements within the context in which they occur at appropriate levels of refinement are both essential to validating overall strategic alignment of requirements."

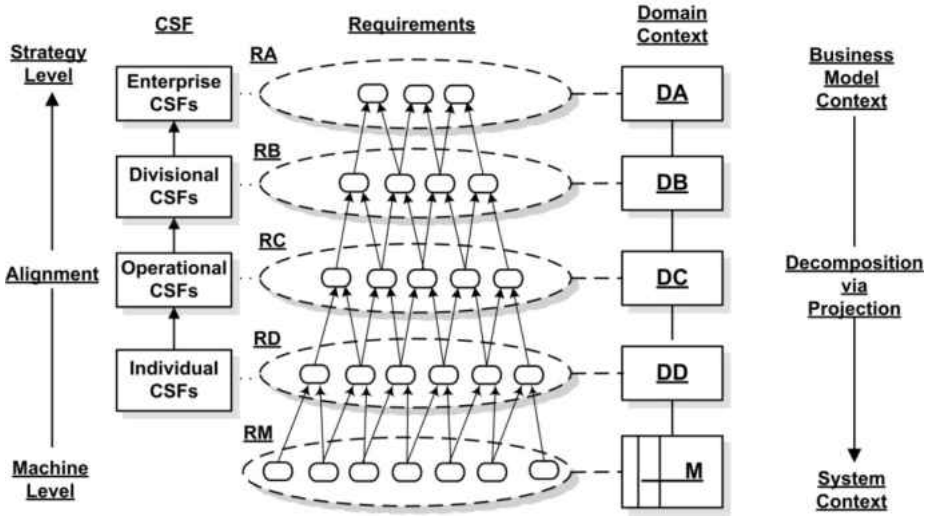

Figure 5.12: Integrating CSF, Goal model and Progression of problems

The traditional practice of adopting a functional view when managing an enterprise has resulted in organizational structures which emphasize or stress maximum performance of individuals or business functions (Kavakli and Loucopoulos, 1999). However, this focus on parochial performance rather than global efficiency is oftentimes disadvantageous to the organization since improvements tend to be piecemeal and separate. In contrast, adoption of a process view of the organization forces us to view the organization not as a collection of separate pieces but as a homogenous collection of related components that form a purposeful system aiming to achieve defined objectives.

CHAPTER SIX: THE DAGS APPROACH - FIELDWORK

In this section, we outline and describe our approach to developing organizational Critical Success Factors (CSF). According to Caralli et al. (2004, p. 45), "The goal of the CSF method is to tap the knowledge and intuition of the organization's managers. Many experienced managers act with a 'sixth sense' that makes them successful. The CSF method attempts to make this 'sixth sense' explicit so the organization can use it as an aid in setting strategic direction and in directing resources to those activities that can make it successful.

The process begins with the document review and interview, phases which provide the basic raw data needed to produce CSFs.

City Of Orlando Document Review

A document review has proven to be a very effective means for obtaining an understanding of the focus and direction of an organization or operational unit (Caralli et al., 2004). Most organizations document their purpose, vision, and values in a mission statement that is communicated to all employees. Furthermore, many organizations have a formal process for documenting short- and long-term strategies, as well as the related goals and objectives for personnel implementing these strategies. This information provides a good basis for examining and determining those activities that are most important to managers.

For the City of Orlando, we used the Annual Budget 2006-2007 and 2007-2008. Their contents included:

- the stated, documented mission and vision of the organization and its operational units;

- the stated goals and objectives for the current year (fiscal or calendar) for all departments and divisions;
- the performance metrics used to evaluate any and all stated goals and objectives.

Additionally, we researched the stated CSFs of county and city governments.

The City of Orlando operates under a Mayor/City Council form of government. The Mayor is a voting member of the 7-person City Council and serves as the city's Chief Executive Officer (CEO). The Mayor and the six Commissioners are elected to four-year terms. The Mayor is elected at-large while the six Commissioners represent individual districts within the city. From an organizational perspective the government of the City of Orlando organization chart (See figure 6.1) displays the relationships between organizational units of the City.

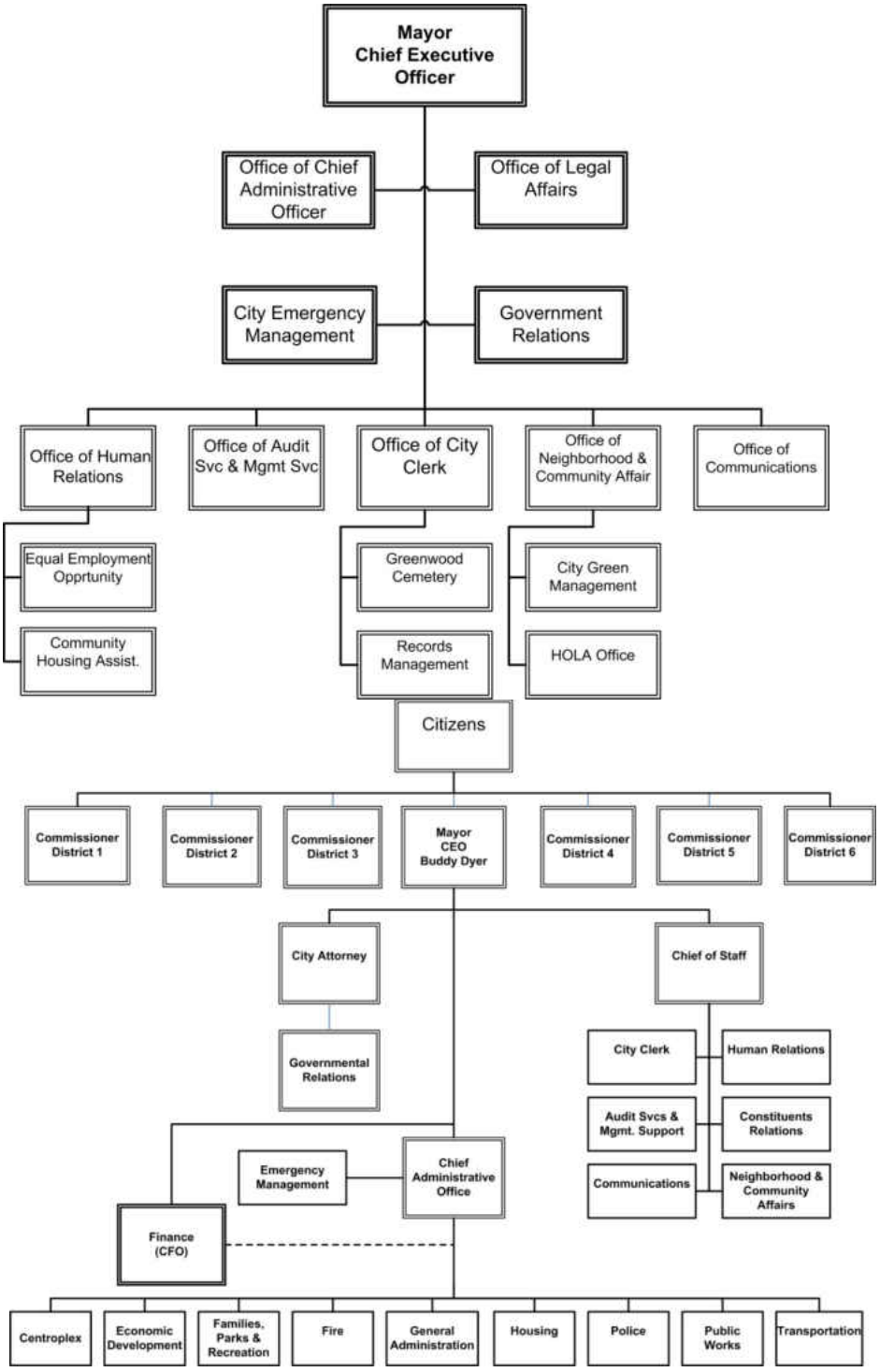

Figure 6.1 – City of Orlando Organizational Chart

Under the mayor-council governance model, the Mayor oversees the administration of the City's operations and implementation of the mayor's and commissioners' policies through a cabinet consisting of the Chief Financial Officer (CFO), the Chief Administrative Officer (CAO) and nine departmental directors. In this organizational structure the CAO and CFO report directly to the Mayor, while the department directors report to the CAO. The Chief of Staff and City Attorney serve as advisors to the cabinet. In addition, there are six staff offices that report to the Chief of Staff. The City provides a full range of municipal services to its citizens, including police and fire protection; comprehensive land-use planning and zoning services; code enforcement and neighborhood improvement; streets and drainage construction and maintenance; traffic engineering services; recreation, parks and cultural activities; refuse collection; and stormwater and wastewater treatment.

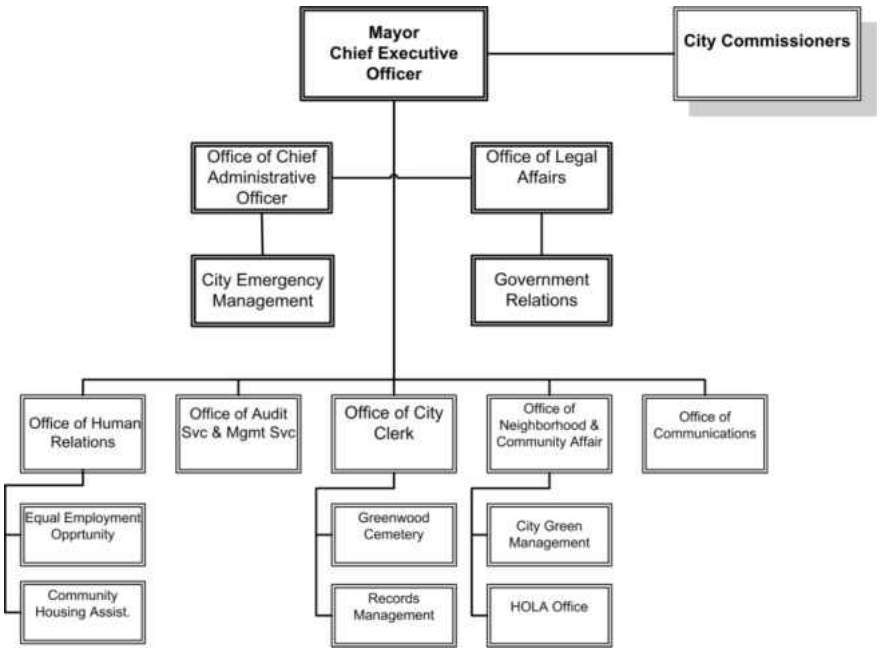

Figure 6.2 – City of Orlando Executive Branch Organizational Chart

For the purposes of gathering the CSFs at a strategic level, i.e. Enterprise CSFs, we examined the documented mission statements and stated goals and objectives for the executive offices associated with the City of Orlando operating departments. Below is a summary of our findings.

The Executive Offices

As CEO, the mayor has an executive staff which provides the mayor and the elected city commissioners with the support services needed to communicate with and serve the citizens of Orlando. The offices within the Mayor's (Executive) office include: Office of Human Relations; Office of the City Clerk; Office of Audit Services and Management Support; Constituent Services; Office of Communications and Office of Neighborhood and Community Affairs. The Executive office's mission statement is: "*Enhance the quality of life in the City by delivering public services in a knowledgeable, responsive and financially responsible manner.*"

The Mayor's Office

As the city's CEO, the mayor is charged with setting the strategic direction of the city and overseeing the daily administration of city operations and implementation of city policy through a cabinet which consists of Chief Administrative Officer (CAO), Chief Financial Officer (CFO) and nine department directors.

Table 6.1: Mayor's Office Mission & Activity Statements

Mission Statement	Activity Statements
Serving Orlando with innovation, responsiveness, knowledge, courtesy and professionalism.	• Continuously improve the way the city of Orlando (COA) does business • Remain responsive to the needs of the city's constituents • Serve all constituents with professionalism and courtesy • Utilize technology to service citizens better and more efficiently.

Office of the City Commissioners

These commissioners constitute the legislative body of the city and in conjunction with the mayor, the city commission serves as the governing body of the City; they set policies and rules by which the City is operated, including establishing City goals and target issues. As a group they are responsible for taxation, appropriations, ordinances, and other general functions.

Table 6.2: The City Commissioners Office Mission & Activity Statements

Mission Statement	Activity Statements
Interact with the public and form and direct the policy of City government to achieve goals in the public interest.	• Provide progressive, service-oriented, responsible government

Office of Audit Services and Management Support

The Office of Audit Services and Management Support provides meaningful, independent and objective audit services and management support by examining and evaluating City operations, contractors and related agencies in order to safeguard City assets and promote maximum accountability, efficiency and effectiveness through audits, management studies and other support services.

Table 6.3: Office of Audit Services and Management Support Mission & Activity Statements

Mission Statement	Activity Statements
To provide meaningful, independent and objective audit services and management support by examining and evaluating City operations, contractors and related agencies in order to safeguard City assets and promote maximum accountability, efficiency and effectiveness.	• Continuously develop innovative ways to provide needed services with existing staff and resources • Maximize delivery of audit services to the city's internal clients. • Continuously develop innovative ways to safeguard city assets • Improve the way OASMS delivers value-added service to the city's stakeholders • Create strategic partnerships with other city departments, contractors and related agencies

Office of Human Relations

The Office of Human Relations (OHR) is an agent of the Equal Employment Opportunity Commission (EEOC) and the U. S. Department of Housing and Urban Development (HUD), and is charged with administering federal, as well as local laws that prohibit discrimination in employment, housing and public accommodations. The OHR is comprised of two major units. The Discrimination Unit processes complaints of discrimination via mediation, conciliation or investigation, in an impartial manner, seeking appropriate corrective measures; conducts education and outreach programs for citizens, informing them of their rights and remedies available to them; and, provides technical assistance to business and industry, housing providers and places of public accommodation regarding their compliance with discrimination laws. The Community Relations Unit promotes the attitude of inclusiveness and fairness, of and for all people, regardless of their socio-economic status, thereby presenting a positive image of the City.

Table 6.4: Office of Human Relations Mission & Activity Statements

Mission Statement	Activity Statements
Ensure equality of opportunity by enforcing City and Federal laws that prohibit discrimination in employment, housing and public accommodations; to conduct training and awareness programs for the public on the rights provided them under these laws via community relations activities.	• Create partnerships and relationships with common interest groups • Ensure continued compliance with State & Federal regulations • Develop, train and prepare employees to contribute to Service Delivery • Empower employees to act responsibly in enforcing rules and regulations • Use technology to train and create awareness programs for the public • Continuously improve the way training, evaluation and implementation of EEOC directives are conducted

Office of Neighborhood & Community Affairs

The Office of Neighborhood and Community Affairs (NCA) informs, engages and connects with all sectors of the public in an effort to raise awareness, acquire resources and gain support of City priorities, programs, services and needs through partnerships and outstanding customer service. NCA assists community, arts/cultural and neighborhood groups, and individuals in using City services and other community resources to enhance the quality of life in Orlando. NCA encompasses four primary programs that are focused on delivering exceptional customer service and accomplishing the listed outcomes and objectives. These programs are: Community Outreach, Arts/Cultural and Community Affairs, Hispanic Office of Local Assistance (H.O.L.A.), and the Volunteer Program.

Table 6.5: Office of Neighborhood & Community Affairs Mission & Activity Statements

Mission Statement	Activity Statements
To inform, engage and connect with all sectors of the public in an effort to raise awareness, acquire and provide resources and gain support of City priorities, programs, services and needs through partnerships and outstanding customer service.	• Create partnerships and relationships with community interest groups • Remain responsive and accountable to citizens • Attract and retain high-quality volunteers for the volunteer programs • Continuously Focus on community needs • Use technology to facilitate contact and communication with community groups about the city resources and services available • Use technology to attain service delivery through e-government initiatives. • Continuously train and prepare employees to use technology more effectively.

Office of Communications

The Office of Communication's mission is to effectively communicate, increase understanding and promote participation in City services, programs and events. The City's Strategic Plan is organized into seven Strategic Focus Areas (SFA's); currently the Office of Communications is supporting three of the SFAs and will be supporting the other four this upcoming fiscal year, 2008 - 2009. Organized by teams, the Office of Communications provides support to the Office of the Mayor, Office of City Commissioners, and remaining City Departments and Offices.

Table 6.6: Office of Communications Mission & Activity Statements

Mission Statement	Activity Statements
To effectively communicate, increase understanding and promote participation in City services, programs and events.	• Continuously improve the way the city communicates with its constituents • Maximize and optimize content delivery to all interested parties. • Continuously improve the feedback process associated with the city's constituents • Remain responsive to constituents • Develop train and prepare employees to utilize technology for their jobs

Office of City Clerk

The City Clerk's Office is responsible for preparing City Council Agendas and Minutes, available both internally and on the Internet. The Office maintains and updates City Policy and Procedures, as well as any changes to the City Code. The City Clerk manages City elections in cooperation with the Supervisor of Elections, serves as liaison to the Office of City Commissioners regarding administrative functions, and coordinates the Citizen Advisory Board appointment process with the Mayor's Office. Finally, the Office provides resource information to the public regarding City and County services.

Table 6.7: Office of City Clerk Mission & Activity Statements

Mission Statement	Activity Statements
To provide a centralized resource at City Hall to allow the City government process to work efficiently, effectively and economically for citizens, elected officials and City staff.	• Provide progressive, service-oriented, responsible government • Create partnerships and strategic relationships with citizens, elected officials and city staff. • Accelerate infrastructure development to develop and sustain a "paperless" environment • Continuously promote information sharing and teamwork between city staff

City's Attorney's Office

The City Attorney's Office is divided into four sections: Planning & Zoning/Economic Development; Public Works/Environmental Services; Criminal Justice; and Labor/Employment/Civil. The Office is staffed by a City Attorney, one Deputy City Attorney, four Chief Assistant City Attorneys, eleven full-time and four part-time Assistant City Attorneys who provide timely, efficient and cost-effective in-house legal services and representation to the government of the City of Orlando.

Table 6.8: The City Attorney's Office Mission & Activity Statements

Mission Statement	Activity Statements
To provide timely, efficient and cost-effective in-house legal services and representation to the government of the City of Orlando.	• Continuously improve the way Orlando provide legal services • Provide cost-effective legal services and representation to city staff • Hire, train and retain competent legal personnel. • Develop a system to assist the legal personnel in providing cost-effective legal service

Office of Chief Administrative Officer

The General Administration Department effectively manages the provision of administrative services within City government to allow other departments to focus on their core businesses. The Department consists of five divisions or programs: Fleet Management, Facilities Management, Human Resources, Purchasing & Materials Management, and Technology Management.

Table 6.9: Office of Chief Administrative Officer Mission & Activity Statements

Mission Statement	Activity Statements
To effectively manage the provision of administrative and internal services within the City government to allow other departments to focus on their core businesses.	• Continuously improve the way Orlando does business • Seek to understand the long term goals and objectives for the City's internal customers • Continuously encourage and improve communications and interlinking between internal customers • Define and prioritize long term goals and objectives • Utilize technology more efficiently and pervasively.

Given the city's hierarchical organizational structure, the departments within the Mayor's executive offices are primarily charged with establishing, achieving and communicating the city's strategic policy and direction. The above-mentioned departments and their respective heads are a good source for the organization's enterprise CSFs. Given Orlando's size these CSFs would represent a comprehensive and consistent guide that can be used across the organization to align operational and individual activities with the city's strategic direction. The scope of these units' mission requires a good understanding of the environment, the industry and the

organization. Utilizing the document review process and information readily available in the public domain, i.e. sourced industry information from local government industry associations, news articles, trade associations, prospectuses of various city and county governments, we intend to generate a set of Enterprise CSFs for the city.

Operational Departments

Outside of the mayor's executive offices are nine departments that fall under the Mayor's auspices. The nine departments are: *Orlando Venues (formerly Centroplex); Economic Development; Families, Parks & Recreation; Fire; General Administration; Housing; Police; Public Works* and *Transportation*. It is through these departments that the city delivers its wide-array of constituent services. The mission and activities associated with these departments are very important since attainment of their core mission impacts how the city meets or satisfies the objectives established at the executive/strategic level, i.e. how well the city discharges its obligations to its primary stakeholders – constituents; staff and elected officials. (See Appendix 1)

General Administration

The General Administration (GA) department is one of the city's nine operational departments and is comprised of five divisions – Human Resources, Fleet, Facilities, Technology, Purchasing and Materials Management. The GA department effectively manages the provision of administrative services to the city's internal customers, allowing the other eight departments to focus on their core businesses. The organizational structure is shown below.

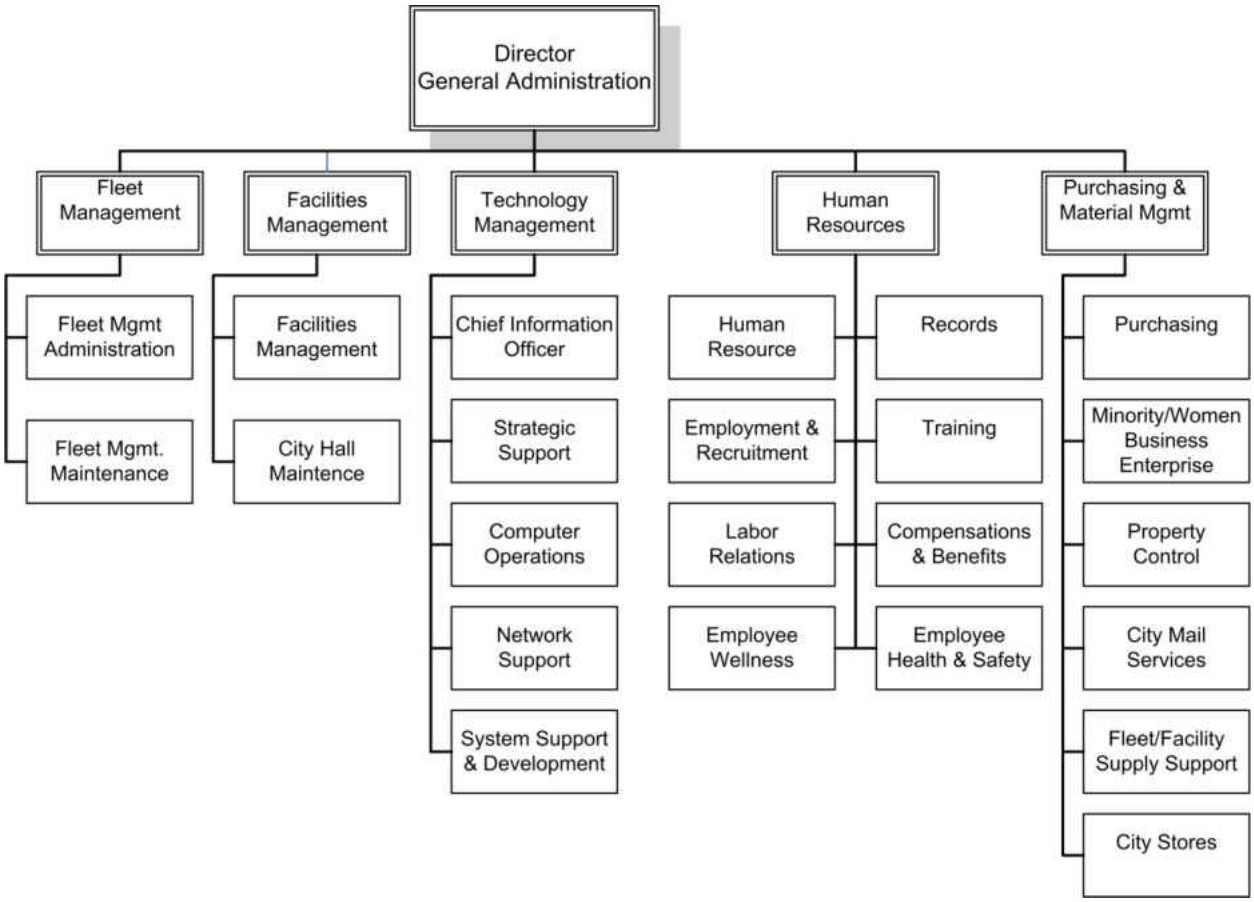

Figure 6.3: General Administration Organization

The department is the service provider for the City internal customers in five key areas: technology, human resources, facilities, transportation, and goods and services procurement.

General Administration Department

The General Administration Department (GAD) manages the provision of administrative services within the City government to allow other departments to focus on their core businesses. Within the department are five divisions: Fleet Management, Facilities Management, Human Resources, Purchasing & Materials Management, and Technology Management.

Table 6.10: The General Administration Department Mission & Activity Statements

Mission Statement	Activity Statements
To effectively manage the provision of administrative and internal services within the city government to allow other departments to focus on their core business.	• Conduct strategic planning • Move away from decisions based purely on financial constraints • Manage proactively instead of reactively • Define and prioritize long-term goals and objectives • Maintain interfaces and communication between departmental and operational areas • Promote information sharing and teamwork • Promote a shared vision of the city's mission, goals and vision.

The Purchasing & Materials Management Division

The Purchasing & Materials Management Division acquires needed goods or services using the most cost effective means and ensures that the City meets its goals for contract awards to certified minority and women owned businesses. The division also provides additional ancillary services including: citywide mail service, property control of City fixed assets, operation of City Stores and facilities and vehicle parts supply services.

Table 6.11: The Purchasing & Materials Management Division Mission & Activity Statements

Mission Statement	Activity Statements
To provide and maintain economical systems for timely acquisition of goods and services at their lowest possible cost, consistent with quality needs of the requesting users, accounting for all capital property owned by the City and disposing of all capital property when it becomes surplus to the City's needs.	• Focus on internal customer needs • Implement technology to service internal customers better and more efficiently • Provide service-oriented and proactive programs • Be responsive to growth and its impact on service delivery • Maximize service delivery • Maintain awareness of regulatory climate • Comply in an effective and efficient manner • Monitor compliance activities

Technology Management Division

The Technology Management Division provides computer, telecommunications and Geographic Information support services to all City departments and offices. Technology Management provides these services with an innovative and proactive approach, ensuring that the City networks, computer applications and equipment for enterprise operations are available to any authorized users at any time.

Table 6.12: Technology Management Division Mission & Activity Statements

Mission Statement	Activity Statements
To provide quality and innovative technological support to other City departments allowing them to concentrate on their core business functions.	• Align information technology with city's strategic planning activities • Migrate from legacy systems • Expand service delivery through E-government • Automate people-intensive activities • Seek efficiencies and effectiveness through the deployment of information technology • Manage culture resistance to change • Eliminate stove-pipes and duplication of efforts • Promote information sharing

Human Resources Division

The Human Resources Division designs and manages services that result in the most efficient and effective recruitment, selection, development, retention, support, utilization and management of the City's work force.

Table 6.13: Human Resources Division Mission & Activity Statements

Mission Statement	Activity Statements
Design and manage services that result in the most efficient and effective recruitment, selection, development, retention, support and utilization of the City's work force.	• Attract high-quality employees from the available workforce • Develop, train and prepare employee to contribute to the growth and effectiveness of service delivery • Empower employees to act and take responsibility for their actions

Facilities Management Division

The Facilities Management Division is an internal support function. The primary duties are to maintain and repair City of Orlando owned facilities, parks and special structures. Facilities Management also provides support for City events and oversees Alteration and Improvement projects.

Table 6.14: Facilities Management Division Mission & Activity Statements

Mission Statement	Activity Statements
To provide efficient and cost effective maintenance, repair and renovation services to all City facilities.	• Expend taxpayer revenues efficiently and in accordance with the law • Invest in high-payoff capital improvements • Collect, measure, avoid, control and recover costs • Coordinate planning to maximize the use of city facilities to all qualified groups • Maintain communications between all city departments and operational areas • Confront growth issues and impact on service delivery

Fleet Management Division

The Fleet Management Division maintains and repairs the city's fleet of over 2,250 vehicles to achieve their maximum economical service life and lowest lifetime maintenance costs. The attainment of the division's objectives is achieved through an enhanced preventive maintenance program with fixed scheduling and an aggressive quality assurance evaluation program for assessing vehicle repairs.

Table 6.15: Fleet Management Division Mission & Activity Statements

Mission Statement	Activity Statements
To maintain and repair City of Orlando vehicles and equipment to achieve their maximum economical service life and lowest lifetime maintenance costs with minimum amount of downtime.	• Implement a higher degree of best practices throughout the city • Utilize technology more effectively and pervasively • Review and re-engineer processes pervasively • Streamline decision-making • Conduct strategic planning • Define and prioritize long-term goals and objectives

City of Orlando: the Interviews

According to Caralli et al., (2004) the most important data collection activity is the interview with participants. The interactive nature of the process allows participants the opportunities for elucidating and exposing the barriers and obstacles to accomplishing their mission. In Bullen and Rockart (1981) presented detailed instructions for conducting a CSF interview along with information gathering and analysis techniques for subsequent development of CSFs. Using these instructions and the modifications suggested by Caralli et al (2004) as a guideline, we developed an interview protocol designed to elicit the data necessary for the development of CSFs. Our protocol consisting of three distinct conventions: pre-interview preparation; interview and post-interview follow-up.

In preparing for the interviews we subscribed to the following preparatory activities and techniques:

- Reviewed all documents pertaining to the departments goals and objectives
- Developed a consistent set of questions for the interview (See Appendix A)
- Identified the individual to be interviewed. While there was no order for interviewing participants, in general, we generally interviewed the manager first followed by the subordinates

We also developed interviewing guidelines that were followed in each interview. These include:

- Practiced engaged listening
- Avoided leading the response of participants
- The interviews were just that – interviews, not an audit, assessment or an examination
- Conducted interviews in one-on-one fashion to avoid any problems associated with intimidation and/or "group think"

- All participants were party to a confidential agreement

In conducting the interviews the prescriptions recommended by Bullen and Rockart (1981) were rigorously adhered to:

- State the purpose of the interview
- Clarify the participant's view of the organization or operational unit's mission
- Clarify the participant's view of his or her role in the organization or operational unit
- Discuss the participant's goals and objectives
- Ask a series of open-ended questions to elicit CSF data
- Summarize the interview by playing back the important points
- Ask the participants to prioritize the requirements
- Ask the participants for measures
- Reserve the right to follow-up and get confirmation of interview notes if necessary
- Kept the interviews as short as possible
- All conversations were recorded for transcription to ensure that all the details of the interview could be captured

The actual interview questions used can be found in Appendix A. The actual interviews were conducted over a five week period with each division manager and supervisor interviewed singularly in no particular order besides availability. The confidentially of the interviews allowed frank exchange to take place ensuring the richness of the data and lasted approximately thirty to forty minutes. All interviews were taped with permission of the participants. After the interviews were transcribed the contained factual data was analyzed and categorized. It is accepted knowledge that CSFs gleaned from interviews, i.e. raw data, are more representative than the ones identified by managers.

City Of Orlando: Data Analysis

In the data analysis phase our goal was to analyze and categorize the data from the interview notes and documents that collectively describe the operational goals, objectives and activities performed by managers that supports the existence and/or attainment of the CSFs to be derived. Caralli et al., (2004) utilized the concepts of activity statements and supporting themes which are similar to the Grounded Theory approaches recommended by Corbin and Strauss (1990) and Charmz (1994). Whereas GT involves *Saying and Doing, Concepts, Categories* and *Core Categories*, Applying affinity analysis involves: *Interviews and Document Review*, *Activity Statements, Supporting Themes* and *Critical Success Factors (CSF).*

According to Caralli et al (2004, p. 65), *Activity Statements* are "statements harvested from interview notes and documents that reflect what managers do or believe they and the organization should be doing to ensure success, i.e. they collectively describe the operational goals, objectives, and activities performed by managers throughout the organization or in the operational unit that supports the existence and/or attainment of a CSF. It is important to note that activity statements can reflect something that the organization is already doing, paying attention to, or monitoring (as established in goals, objectives, or operational activities), or reflect something that the organization should be doing (such as barriers and challenges to effectiveness)." In other words, an activity statement is the raw data from the interviews transformed into manageable declarations which can analyzed. *Supporting Themes* describe the fundamental content or intent of a CSF, i.e. the intention and substance of the activity statements as they have been grouped together (Caralli et al., 2004).

The interviews and document analysis yielded a total of 159 activity statements with 39 statements obtained from the documentation. We also conducted document review at the executive level which yielded an additional 42 statements. The activity statements were developed and placed into affinity groups, i.e. similar or related statements. Affinity groupings enable the categorization of data that share common characteristics or qualities so that a common description can be developed on which to base further analysis (Sen and Taylor, 2007). Caralli et al (2004) recommended the following approach or process for performing affinity grouping:

- Mark the origin of each activity statement, i.e. considering the core content what was intended by the interviewee;
- Use only the activity statements when creating affinity groupings, i.e. if an activity statement is difficult to categorize it may need further clarification;
- Work each activity statement individually, i.e. the essence of affinity grouping is to make immediately recognizable connections between similar data elements by using core content, intention or meaning portrayed by the activity statements as the primary decision criteria;
- Stabilize the affinity groups, i.e. once all activity statements have been grouped, each group should be examined to determine if sub-groups are emerging and should be extracted;
- Address any left over activity statements or small groups of statements, i.e. each activity that doesn't fit into a group must be re-examined although a single activity statement maybe so compelling that it eventually defines its own CSF or it may have to be discarded.

Using the mechanism of Affinity Grouping we summarize the core thoughts and concepts embedded in the activities managers feel they need to pay attention to. We also provided an instrument for making decisions about which CSFs are created, why it was developed and how it is important to organization. To illustrate, let us assume the following words represents different activity statements. From a visual introspection specific grouping appears – *Horses, Cats* and *Dogs*; however a refinement would allows categorization of - *Equines, Felines* and *Canines*. The

resultant labeling is lot more meaningful and informative, in much the same way; activity statements can be grouped to form supporting themes.

Table 6.16 – Affinity Grouping – an example

Appaloosa	} **Horses**	▶ **Equines**
Arabian		
Birman		
Criollo		
Zebra		
Bengal Tiger	} **Cats**	▶ **Felines**
Calico		
Persian		
Boxer	} **Dogs**	▶ **Canines**
Greyhound		
Terrier		

The next step in the process is the development of supporting themes. According to Caralli et al, (2004) developing supporting themes can be easy or difficult depending on a particular grouping. With supporting themes, the objective is to decipher the underlying concepts or intentions that categorize the relationship between activity statements in a particular grouping. Indeed, while the process can be somewhat subjective, the objective is to develop a statement that captures the essence of the intent of the activity statement. The concluding step in the process is derivation of Critical Success Factors. This extraction process is accomplished by focusing on the supporting themes. CSFs should be brief and concise descriptions that capture the essential intent of the source activities. In executing this step Caralli et al, (2004) offer the following guidelines:

1. Let the Supporting themes do the work: If the other activities in the CSF process have been performed well the supporting themes will accurately represent the operational

environment of managers. Although most of the CSF process is self-correcting, bias can be introduced and can eventually affect the CSFs that are derived.

2. Aim for the fewest number of CSFs that can accurately and completely characterize the organization or operational unit: The aim of CSFs is to identify those activities that are most important to manager to achieve the organization's mission thus the number of CSFs derived should be minimized.
3. Recognize the difference between the composition of "good" CSFs and "poor" CSFs: A "good" CSF begins with an action verb and clearly and concisely conveys what is important and should be attended to. A "poor" CSF is vague and requires extensive explanation to be conveyed.
4. Determine if additional combining of CSFs needs to be performed: As with the repeated grouping of activity statements and supporting themes, CSFs should be examined to determine if additional combining can be performed.

The derivation of CSF from document review and interviews is only one way of obtaining CSFs and need to be augmented with CSFs from outside sources such as professional organizations, trade journals and academic research publications.

In the modern organization each layer of management has a set of conditions that need monitoring and generally will yield a unique set of CSFs. At the executive level, CSFs not only guide managers at this level but also represents the critical and key areas performance for the organization. In analyzing the city of Orlando we derived CSFs from the mission statements of the various executive departments to better understand the activities, concerns, strategies, and goals of executive-level management. According to Caralli et al, (2004, p. 25) these "enterprise CSFs provide the most effective strategic view of what is important to the organization and to accomplishing the organization's mission."

At the enterprise level of the organization forty-two (42) activities statements were derived from the mission statements expressed for the Mayor's Office and other members of the

city's executive offices. From these activities statements we were able to derive nineteen (19) supporting themes and finally seven (7) CSFs (see table 6.17 below).

Table 6.17 – CSFs and Supporting Themes at the Enterprise level

Critical Success Factors	Supporting Themes
Manage Internal & External Partnership *Source/Type : Temporal* *Dimension: Monitor*	Manage Long term Goals and Objectives Promote Information Sharing and Teamwork Maintain Partnerships and Relationship with Common Interest Groups
Develop and Manage Human Resources *Source/Type: Competitive-Position* *Dimension: Internal*	Develop, train and prepare Employees to deliver quality service Train Employees to utilize technology more effectively Educate and Empower employees to act in achieving the city goals
Improve Service Delivery *Source/Type: Industry* *Dimension: Adapting*	Improve service delivery to all external & internal stakeholders Provide Value-added service to Stakeholders Review, Improve and monitor service processes
Deliver Service-Oriented Government *Source/Type: Industry* *Dimension: Adapting*	Continuously respond to constituents service needs Adopt and utilize technology more effectively Incorporate Best practices in service delivery processes
Deploy Technology Strategically *Source/Type: Competitive-Position* *Dimension: Adapting*	Support all E-Government Initiatives Augment and strengthen technology Infrastructure Incorporate more technology in the Training and Education programs
Manage Community Partnership and Relations *Source/Type: Temporal* *Dimension: Internal*	Manage partnership with community groups align technology with needs of community groups Improve communication with community Groups
Manage Financial Resources *Source: Industry* *Dimension: Monitoring*	Utilize tax revenues efficiently Safeguard City Assets

A CSF's source underscores its importance as a prognosticator of the organization's health. For example, every organization inherits a set of operating conditions and challenges that characteristic of the industry in which it operates. These "Industry" CSFs must be achieved by the organization to maintain or increase their competitive position, achieve their goals, and accomplish their missions. Failure to realize these CSFs will make the organization uncompetitive. CSFs are further classified by their dimension. According to Rockart (1981), a CSF dimension provides an understanding of a manager's world view. The source and dimension

of a CSF provides additional information for understanding the importance of a CSF and it contribution to the accomplishment of the organization's mission.

Like other members of the management team, executive-level managers are guided by their own set of unique CSFs. However, because of their role in the organization, the CSFs associated with executive-level managers typically represent the organization's truly critical and key area of performance, i.e. "provide the most effective strategic view of what is important to the organizations and what's needed to accomplish the organization's mission. (Caralli et al., 2004, p25)"

In organizational literature, an operational unit can be a department, a division, sub-division or any other grouping of activities that share a common function, purpose or mission. In spite of how it is defined, each operational unit may have it own set of CSFs which will reflect the concerns and strategic directions of the unit's manager(s) as well as the strategic direction of the organization. Enterprise and operational unit CSFs must fit together and relate to each other, i.e. they must be congruent, unlike goals which are tightly coupled.

At the operational level of the organization we focused on the activities of the General Administration Department (GAD). GAD manages the provision of administrative and internal services within the organization – they are the service providers to the other departments. Thirty nine (39) activity statements were derived from the mission statement expressed for GAD and the individual divisions that make-up the department. One hundred and twenty (120) activity statements were derived from the interviews conducted with the departmental managers for a grand total of one hundred and fifty-nine (159) statements. From these activity statements, thirty-nine (39) supporting themes were the used to represent the underlying concepts expressed in the activity statements, which were finally rolled-up into nine CSFs. See Table 6.21 below

Table 6.18 – CSFs at the Operational level

Critical Success Factors	Supporting Themes
1. *Manage Financial Resources and Management Support* *Source: Industry* *Dimension: Internal*	• Educate Employees about the Budgeting Process • Develop Capital Renewal/Replacement Policy • Manage Budget Resource Allocation process • Utilize Financial Resources Effectively • Maximize Returns on Financial Resources • Attract and manage visible and consistent financial and resources support
2. *Maximize Internal Interlinking & Collaboration* *Source: Industry* *Dimension: Adapting*	• Establish and enhance intra- and inter-department communication • Manage Inter-Departmental Planning • Establish and Manage strategic relations with key internal and external customers
3. *Develop and Manage Human Resources* *Source: Competitive-Position* *Dimension: Internal*	• Develop, train and prepare employees to serve internal customers • Empower employee with more autonomy • Establish and Manage employee training with department goals & mission • Recruit, attract and retain highly qualified employees • Incorporate more applied technology training into educational offering
4. *Improve Operational Efficiency* *Source: Industry* *Dimension: Monitoring*	• Adopt and incorporate industry best practices • Modernize existing application systems • Review and re-engineering operating procedures and processes • Report, Monitor and Refine performance • Prioritize Projects and Programs Using Consistent Measure
5. *Perform Strategic Planning* *Source: Temporal* *Dimension: Adapting*	• Conduct Intra- and Inter-Departmental Strategic Planning • Develop City Wide Facilities Use Plan • Conduct Intra- and Inter-departmental Contingency Planning • Educate all stakeholders on City's Vision, Mission and Goals
6. *Deliver High Value Customer Products & Services* *Source: Industry* *Dimension: Adapting*	• Develop and Maintain Customer Focus Service • Develop Intra- and Inter-department Information Services • Identify New and Value-added Products and Services • Continuously Evaluate Service & Product delivery performance
7. *Manage Compliance* *Source: Environmental* *Dimension: Monitoring*	• Monitor Compliance Activities • Develop and Prepare Employee to Comply in an Effective manner • Evaluate and Adopt Certification Standards that add value • Maintain Compliance Awareness with ongoing education
8. *Manage Operational Suppliers and Vendor Partnership* *Source: Temporal* *Dimension: Internal*	• Collaborate with partners to improve delivery of goods & services • Develop and maintain a more effective inventory system • Maintain effective stakeholders' relationships to promote goals & Objectives
9. *Manage and Deploy Technology Strategically* *Source: Competitive-Position* *Dimension: Adapting*	• Manage the IS/IT Production Environment for effective Service delivery • Manage the IS/IT Development Environment for Effective Service Delivery • Manage Threats and Risks to data, privacy, connectivity and usage • Align IT/IS with City's Strategic Plan • Expand Government Service Delivery through E-Government Initiatives

CSFs exist at all levels of the organization and as demonstrated can be obtained from a multiplicity of sources. CSFs at the upper level of the organization are related to those at the lower level, since those at the upper level cannot be realized without those at the lower level being accomplished. If lower CSFs are significantly different from those at the upper level, one has to consider if there is proper alignment between the lower level management activities and the strategic direction of the organization.

In most organizations goals setting follows a hierarchical pattern with normally a one-to-one relationship between goals at one level of the organization and goals at the preceding or following level. In contrast, CSFs do not mimic this type of organization, since CSFs are often associated with a particular manager or management layer, there may be some CSFs at lower levels in the organization that are important in achieving upper level CSFs and accomplishing the organization's mission but are not explicitly related to or subordinate to a higher level CSF (Caralli et al., 2004).

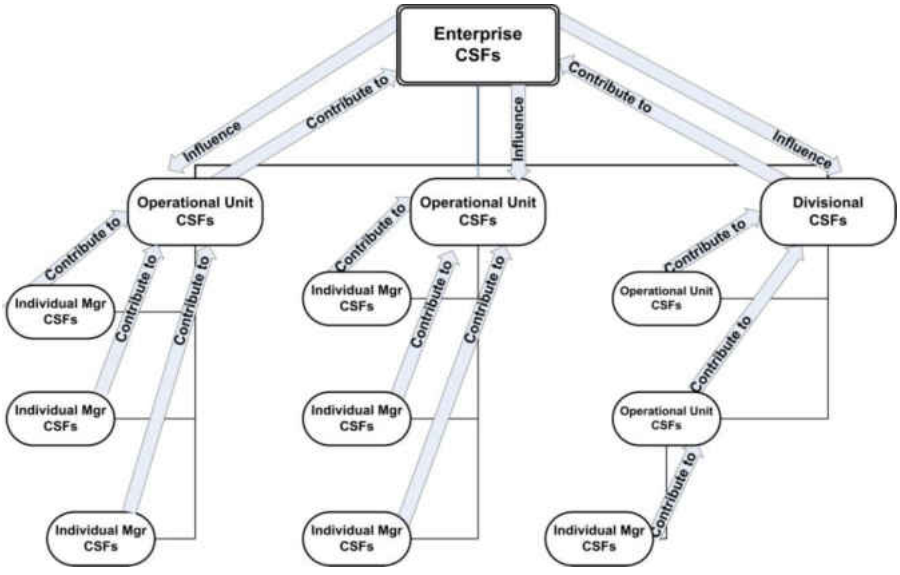

Figure 6.4 – Relationship between Enterprise and Operational Unit CSFs (Caralli et al., 2004)

Affinity Analysis

In many ways CSFs can be viewed as a multi-functional tool and according to Caralli et al (2004, p. 85) they can be used as a target in which "many important initiatives of the organization can be aimed and compared." One popular method used to perform this analysis is Affinity Analysis (AA). The term "affinity" describes the perceived similarity between two objects. Affinity Analysis is an approach to studying the relationship between two objects and the possible effect of one on the other. Thus a comparison between an organization's CSFs and some defined comparison criteria can expose gaps and provide insight into possible problems. Caralli et al (2004) provides the following recommendations on performing affinity analysis using CSFs:

1. Determine comparison criteria, i.e. determine which comparison criteria to gather data on and the objectives for performing the analysis;
2. Develop a comparison matrix, i.e. once the comparison criteria are established populate the matrix;
3. Determine the intersections, i.e. determine the relationships between the CSFs and the comparison criteria;
4. Analyze the relationships, i.e. examine and question the relationship between the CSFs and the chosen criteria.

For example, AA could be performed between CSFs and data elements, organizational processes, information assets, information requirements, operational unit goals and objectives, operational unit CSFs (to determine "fit" or alignment), data entities to business function, business function to application systems, etc.

Table 6.19 – Affinity Analysis – an example

Enterprise Departments	Critical Success Factors						
	Manage Internal & External Partnership	Develop and Manage Human Resources	Improve Service Delivery	Deliver Service-Oriented Government	Deploy Technology Strategically	Manage Community Partnership and Relations	Manage Financial Resources
Office of Technology	x		x	x			x
Office of Communication	x		x		x		
OCOMM		x		x		x	
Office of City Attorney		x	x	x	x		
Office of City Clerk	x			x	x		
Office of Community Affair	x	x	x		x		
Office of Health Initiatives	x	x		x	x	x	

Using CSFs as a development approach that addresses IS planning and requirements determination purports the existence of an assessment mechanism that will evaluate the appropriateness of those requirements in relation to the organization's mission, purpose, goals and objectives. Affinity analysis provides the means for assessing the enterprise and/or operational CSFs and the various departments or operational areas of the organizations that will provide significant support for the achievement of the organization's mission.

When attempting to analyze and understand the business context in which IT systems operate in the public sector there are several problems that need to be addressed (Caralli et al, 2004):

- The lack of awareness of the major relationships between business objectives, key performance measures and information sources

- The need for top-down as well as bottom-up approaches when examining the above relationships
- The links between objectives and aims to sustain the desired outcomes
- Having enumerated established business needs it is not easy to decide upon the information systems that will support and assist attainment of goals and objectives

At its core, CSFs relate to the functions of management - planning, organizing, commanding, coordinating and controlling. Thus, applying CSFs to validate and ensure alignment with the organization's mission will enhance any decision, initiative, effort or process (Caralli et al, 2004). The complexity of undertaking an enterprise-wide view of the organization's requirements needs is reflected in the challenges facing the organization in deploying its scarce IS resources effectively. This gives rise to some important questions, namely: What are the organization's information needs? Why do they have these needs and how are these needs prioritized? What areas of the organization should be involved in this effort? How will we know when the organization's information needs have been met? How will we measure success? An examination of the CSFs can yield some answers to these questions.

According to Caralli et al (2004), the "field of vision" of top management is represented in the CSFs which provide a powerful clarification of what is important to the organization. Failure to achieve the CSFs directly affects the organization's ability to accomplish its mission, thus requirements engineering efforts need to be align with the CSFs.

Affinity Analysis – Fit and Alignment

According to Thayer and Thayer (1997) one of the most important and difficult tasks in the RE process is the analysis and documentation of requirements. A significant task in this process is to determine the scope of the requirement acquisition. The use of CSFs and affinity analysis can be a simple yet effective way in determining the effects of interacting priorities of the organization, i.e. between Enterprise or Operational CSFs and the various departments or operational areas of the organization. To this effect we sought to understand the relationships between the Executive Offices and the CSFs culled from the City's mission statement.

Table 6.20 – Affinity Analysis: Executive Offices and City' Derived CSFs

Enterprise Departments	Critical Success Factors						
	Be Responsive to Needs of City Residents	Develop and Manage Human Resources	Provide Innovative Government Services	Deliver Service with Professionalism & Courtesy	Deploy Technology Strategically	Continuously Improve How City Government Does Business	
MAYOROFF	x	x	X	x		X	
OASMS	x		X	x			
OCAOFFC	x		X		x	X	
OCOMM		x		x			
OCTYATTY							
OCTYCLRK	x	x		x	x		
OHMNRLTNS	x	x	X			X	
ONCAFFRS	x	x		x			

From the above the matrix we can infer the following (an "**X**" in an intersection indicates that the department is contributing to the attainment of the CSF; the absence of an "**X**" indicates that the department is not contributing nor has no apparent connection to achieving the CSF):

- The work of the Office of Communication (OCOMM) and the Office of City Attorney (OCTYATTY) has no apparent connection to achieving the "Be Responsive to Needs of City Residents" CSF.
- The work of the Office of Communication (OCOMM), the Office of City Clerk (OCTYCLRK) and Office of Neighborhood & Community Affairs (ONCAFFRS) has no apparent connection to achieving the "Improve Service Delivery"
- The work of the Office of Communication (OCOMM), the Office of City Attorney (OCTYATTY), the Office of Human Relation (OHMNRLTNS) and the Office of Office of Neighborhood & Community Affairs (ONCAFFRS) are a primary factor in achieving the "Develop and Manage Human Resources" CSF

Next we sought to examine the relationship between the CSFs for the executive branch of the organization and the various departments at that level of the organization.

Table 6.21 – Affinity Analysis: Executive Offices and Executive CSFs

Enterprise Departments	Critical Success Factors						
	Manage Internal & External Partnership	Develop and Manage Human Resources	Improve Service Delivery	Deliver Service-Oriented Government	Deploy Technology Strategically	Manage Community Partnership and Relations	Manage Financial Resources
OASMS	X		X	X			X
OCAOFFC	X		X		X		
OCOMM		X		X		X	
OCTYATTY		X	X	X	X		
OCTYCLRK	X			X	X		
OHMNRLTNS	X	X	X		X		
ONCAFFRS	X	X		X	X	X	

From the above the matrix we can infer the following (an "**X**" in an intersection indicates that the department is contributing to attainment of the CSF; the absence of an "**X**" indicates that the department is not contributing nor has no apparent connection to achieving the CSF). An examination of the:

- The work of the Office of Communication (OCOMM) and the Office of City Attorney (OCTYATTY) has no apparent connection to achieving the "Manage Internal & External Partnerships" CSF.
- The work of the Office of Audit and Management Service (OASMS), Office of Chief Administrator (OCAOFFC) and the Office of City Clerk (OCTYCLRK) has no apparent connection to achieving the "Develop and Manage Human Resources" CSF

- The work of the Office of Communication (OCOMM), the Office of City Clerk (OCTYCLRK) and Office of Neighborhood & Community Affairs (ONCAFFRS) has no apparent connection to achieving the "Improve Service Delivery"

The General Administrative Department and five divisions - Fleet Management, Facilities Management, Human Resources, Purchasing & Materials Management, and Technology Management. Next we performed Affinity Analysis on Executive CSF and the Operational CSFs to see how they match up. The results are presented below.

Table 6.22 – Affinity Analysis: Operational Offices and Executive CSFs

	Critical Success Factors						
	Manage Internal & External Partnership	Develop and Manage Human Resources	Improve Service Delivery	Deliver Service-Oriented Government	Deploy Technology Strategically	Manage Community Partnership and Relations	Manage Financial Resources
Operational Depts							
FACMGMT	X	X	X	X	X		X
FLTMGMT	X	X	X	X	X		X
HMNRES	X	X	X	X	X		X
PMMGMT	X	X	X	X	X		X
TECHMGMT	X	X	X	X	X		X

CSFs reflect the goals of the organization and managers seek to achieve goals. In the case of requirements elicitation, CSFs can be a very powerful means for shaping and guiding the

managers' responses. "Their knowledge of the enterprise or operational unit CSFs can enable participants to identify areas of concern to them. (Caralli, 2004, p. 40)" Their information needs can be identified relative to these goals – the information assets and process that support these goals and the organization's mission. The drivers for requirements engineering should be the same as the business drivers used by the organization to accomplish its mission. The determination of requirements – functional and nonfunctional, should be the way for organizations to enhance their operations and achieve their goals.

Goal Modeling

The RE notation and techniques used here may be used in isolation, but used together illuminates all the critical aspects of the organization. Organizational goals describe only objectives and intention but not the context in which they occur. The first task in this process is VMOST analysis for the city of Orlando. Utilizing the questions that appeared in Table 6.4 below are the results.

Question 1: *What is the overall, ideal, end-state toward which the organization strives (vision)?* The mayor described his vision to "*To be dynamic service-driven organization built on community values and needs, continuously improving the way city government does business"*

Question 2: *What is the primary activity that the organization performs to achieve the end-state (mission)?* To help realize the vision he articulated in question #1, the mayor has declaring that the city's mission is "Serving Orlando with innovation, responsiveness, knowledge, courtesy and professionalism."

Question 3: *How are the responses to Questions 1 and 2 (vision and mission, respectively) appropriate and relevant to the environment?* As a local government entity operating under somewhat adverse conditions, the city's strategy focuses heavily on a value proposition to its primary stakeholders.

Question 4: *Are the responses to Questions 1 and 2 (vision and mission, respectively) explicit or implied?* The mayor articulated his vision and the city mission explicitly in the city's yearly budget document and on the city's web site.

Question 5: *What are the basic activities and their rationale by which the organization competes with industry rivals?* Strategic planning in the public sector focuses primarily on the community and not on the organization, thus it is critical to the success of the city and the mayor to deliver needed services to the various city constituencies in the most cost-effective manner, satisfies mandates while promoting economic development and providing a safe environment. Inherent in these goals is the use of IT to help achieve the various articulated e-government initiatives and facilitate communication between the city's various stakeholders.

Question 6: *What goals does the organization set to determine if it is competing successfully?* In the government sector the goals set are motivated by several factors including – compliance with mandates, maintaining and improving constituent engagement, improved service, and reduced costs. Service to the community is improved through continuous and faster service times. The city of Orlando goals, both short- and long-term, are part of the city's yearly budgeting process.

Question 7: *What activities does the organization perform to achieve the goals in Question 6?* There are several activities that need to be completed depending on the requirements prioritized. For example, the city must enable constituents to have easy access to all the services provided when they want them according to changing needs. This could be accomplished by providing a single point of contact approach to electronic service delivery. The city could educate and communicate with constituents regarding the benefits of their "green program."

Question 8: *How do the goals in question 6 support the response to question 1 (vision)?* The city's goals represent the value proposition to its constituents - vendors, suppliers, partners, staff and other local government entities as they are proposals to solve difficulties confronting the city as they strive to solve some of problems that will make the city more service-oriented and constituents-focused.

Question 9: *What are the measurable objectives that indicate achievement of goals identified in Question 6, and what activities does the organization perform to achieve those objectives?* For most of the departmental goals established, the city has defined a set of performance measures which will be used to evaluate outcomes using the following criteria: efficiency, effectiveness, and service measures.

Question 10: *How do the objectives identified in Question 9 support the goals identified in Question 6?* What can be measured can be improved. The measures provide a mechanism for measuring changing stakeholders' needs.

Building the Model

According to Bleistein et al. (2006), attempting to model an organization's business strategy in which soft goals are the norm can very cumbersome process and suggested that the key to modeling successfully is to represent what is useful and necessary to describe the problem being addressed. We also incorporate Weill and Vitale (2001) graphical modeling notation. Weill and Vitale business model framework provides the basis for separation of concerns, between business model and the business strategy requirements. The business model participants – organization of interest, suppliers, allies, customers, and consumers – are the physical domains; while the flow of money, product, and information – shared phenomena, are the interfaces. For the sake of this exercise we are only using the following modeling entities: soft goals, hard goals and task to represent strategy.

Bleistein et al. (2006) recommends the following steps in constructing the Jackson/Weill and Vitale integrated model problem diagrams:

1. **Identify the business model participants**. Who are the organization of interest, suppliers, allies, customers, and consumers in the model? These are the domain of interest and the machine in the context diagram
2. **Identify the relationships among the participants**. What are the flows of money, product/service, and information and between which participants do these flows occur? Flows are the shared phenomena; and the relationships between participants correspond to the interfaces between the domains of interest.
3. **Identify the strategic requirements of the business model and represent these as a goal model**. Combine the results of the VMOST analysis with goal model construction according to BRG-Model rules.

Utilizing the result from the VMOST analysis we assemble the goal model by identifying and labeling means and ends entities. All the optative properties of the system – organization goals, objectives, activities, business processes are considered requirements, i.e. the behavioral properties the system is intended to ensure (Bleistein et al., 2006).

Requirements set RA and domain DA

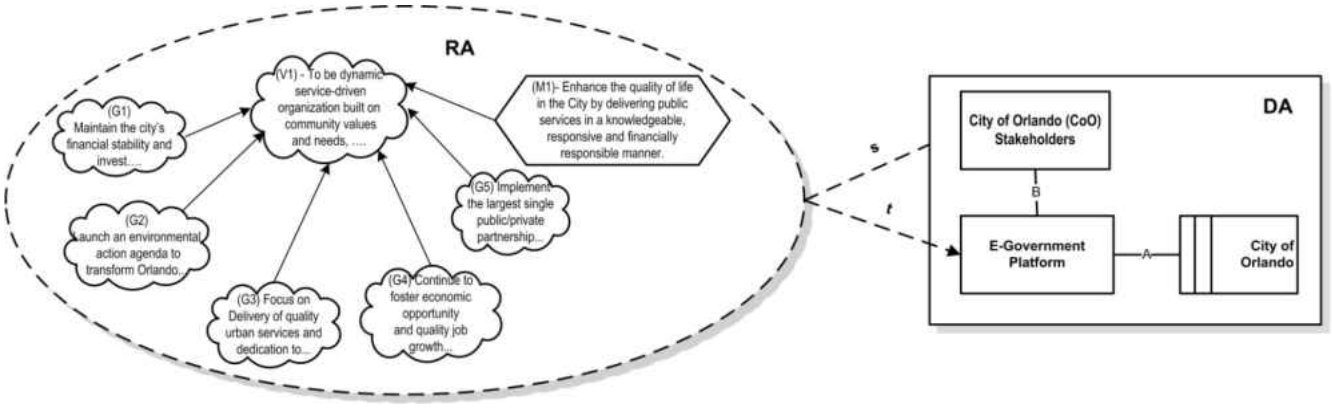

Figure 6.5: City of Orlando Progression of Problems, (part1)

The business model and strategy is the top-level requirement problem for the city of Orlando, described by RA and DA in figure 6.5. Domain, DA contains the domains of interest. The city's IS system, which we treat as the machine domain and the city's primary stakeholders – customers, constituents, employees, suppliers and vendors. These domains are critical in describing the city's vision and mission, and, represent the city value proposition to its stakeholders. At interface *A*, the city's IS is responsible for providing data to support the city's E-Government platform. At interface *B*, the E-Government platform is responsible for providing the stakeholders with one-stop access to the services provided by the city.

The City of Orlando's vision is to (V1) - To be a dynamic service-driven organization built on community values and needs, continuously improving the way city government does business. Its mission (M1) - Enhance the quality of life in the City by delivering public services in a knowledgeable, responsive and financially responsible manner makes the vision operative. The core goals as expressed by the city's vision, V1, are: G1 - Maintain the City's financial

stability and invest additional resources for neighborhood safety while faced with state-mandated budget cuts; G2 - Focus on the delivery of quality urban services and dedication to accessible, accountable and transparent government; G3 - Continue to foster economic opportunity and quality job growth throughout the City and in the downtown urban core; G4 - Implement the largest single public/private partnership in Central Florida's history by overseeing construction of a new performing art center, event center and renovated Citrus Bowl; G5 - Launch an environmental action agenda to transform Orlando into a leading "Florida Green City." It is important that the stakeholders' domain is understood since it is critical to getting the city's requirements right.

Requirements set RB and domain DB

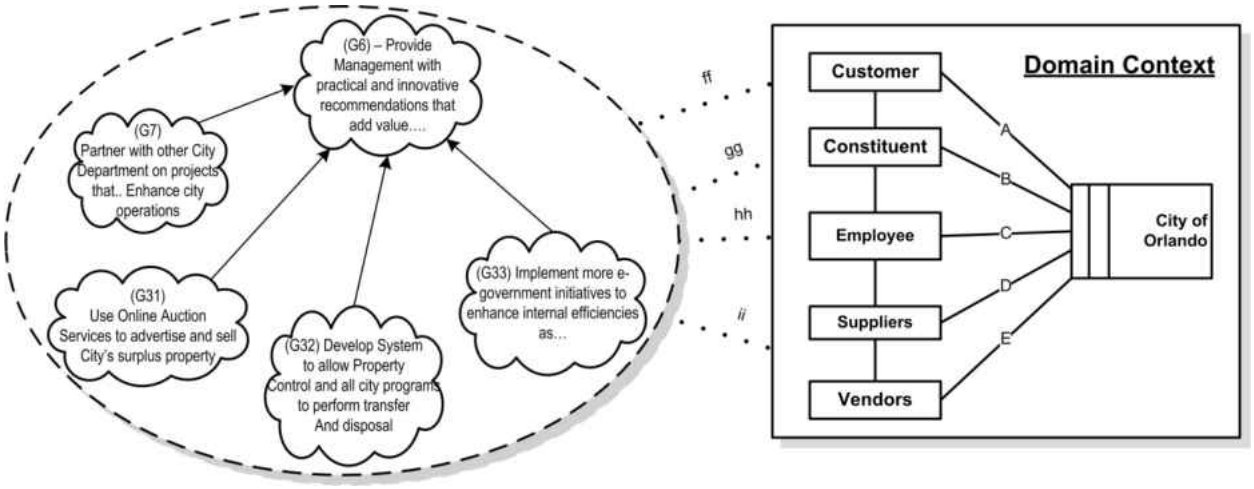

Figure 6.6: City of Orlando Progression of Problems, (part2)

The business model and strategy described by RA and DA are projected to RB and DB in figure 6.6. Here, the Context diagram DB shows six domains with the City of Orlando system again being treated as the machine domain, the others; customer, constituent, employee, supplier

and vendor represent the city's various stakeholders. The City of Orlando system is responsible for providing each with a variety of e-government services. RB describes a number of the city's goals which can be directly transformed into specific requirements and strategies and represent e-government services that will satisfy the various stakeholders.

Requirements set RC and domain DC

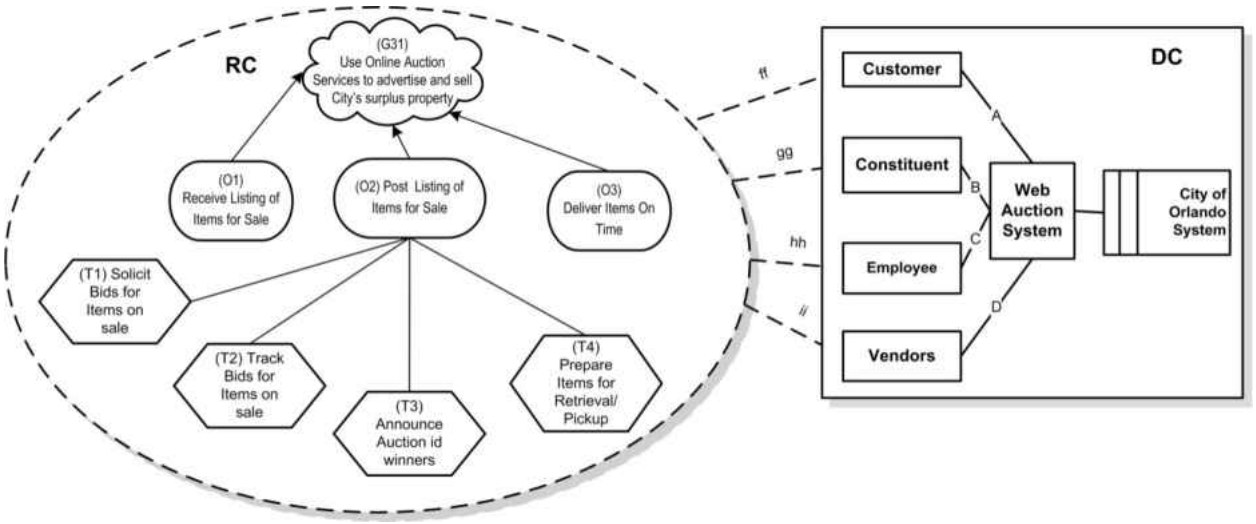

Figure 6.7: City of Orlando Progression of Problems, (part3)

DC in figure 6.7 shows six domains of interest: the City of Orlando system, the machine domain, the auction web system, customer, constituent, employee and vendors. The web auction system allows the users (customer, constituent, employee and vendor) to have access to the city property being auctioned. The web system interfaces with the city's system to provide the stakeholders with information on the items being offered for sale and submitted bids and purchased data are recorded on the City of Orlando system. In RC, goal G31 – *Use online Auction service to advertise and sell city's surplus property* supports G6 in RB, Objective (O1) – *Receive listing of items for sale;* (O2) – *Post listing of items for sale*; and (O3) – *Deliver Items on Time* supports goal (G31).

Requirements set RD and domain DD

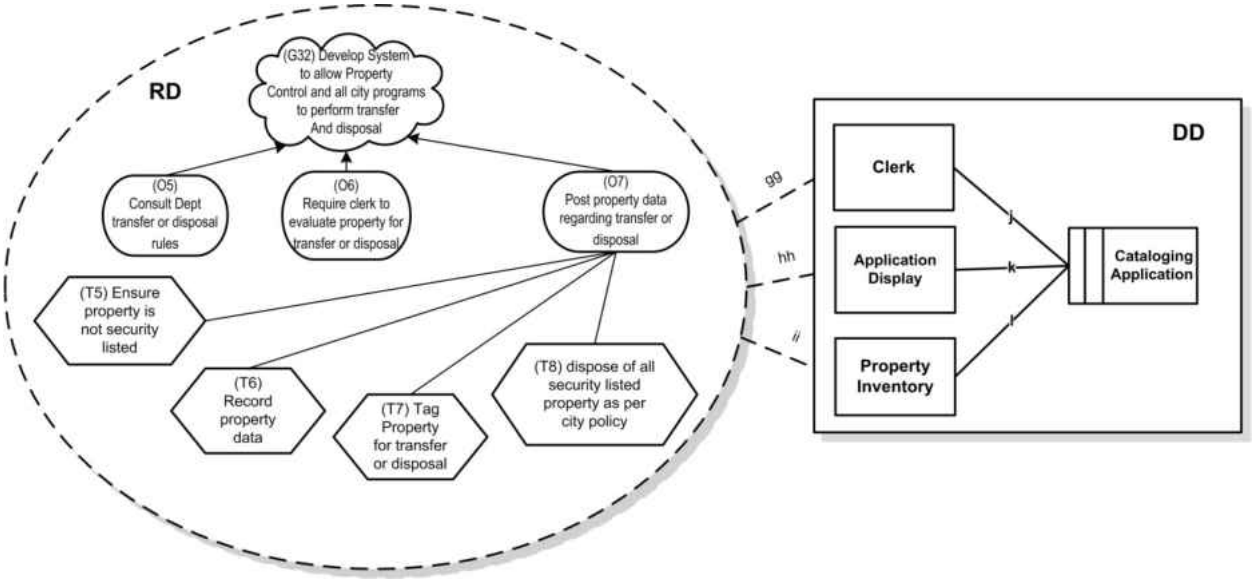

Figure 6.8: City of Orlando Progression of Problems, (part4)

Domain DD contains four domain of interest: the cataloging application treated as the machine here; the Property inventory that needs to moved and tagged as surplus to needs, i.e. dispose of thru auction or transfer to another program or department within the city; the clerk and the application display. RD describes a number of objectives and tactics. Tactic (T5) – e*nsure property is not security listed*; (T6) – *Record Property data*; (T7) – *Tag property for transfer or disposal*; and (T8) *dispose of all security listed property as per city policy* all support (O7) – Post property data (to the cataloging system); while (O5), (O6) and (O7) all support (G32).

As show above, we have refined requirements down to a relatively low level of detail with our aim being to illustrate a link between system requirements and the organization's strategic objectives.

The Integration approach used achieves verification of requirements in an integrated CSF and BRG-Model, while keeping the model simple. The critical feature of this integration

approach is the use of a table to capture the relationships between goals, CSFs and requirements. For each goal there might be one or more CSF associated with that goal. Explicit identification of relationships between goals, CSFs and requirements allows us to verify each goal with its correspondent CSFs and each goal with the corresponding requirement and context domain. The primary benefit of this approach is that it makes what is an already complicated diagram simple.

According to Bleistein et al. (2006) the integration of goal modeling with Jackson's problem diagram bestows several advantages. Firstly, each goal entity refers to a specific shared set, i.e. shared phenomena between domains of interest within a referred domain context. This arrangement enables contextual verification of requirements – the goal model provides the mechanism by enabling explicit connections to be expressed in terms of super-goals and sub-goals. This arrangement helps ensure that requirements are consistent with the business and system context, and that requirements achieve the organization objectives. The integration of goal model, CSFs and problem diagrams improves the requirements manageability of complex systems.

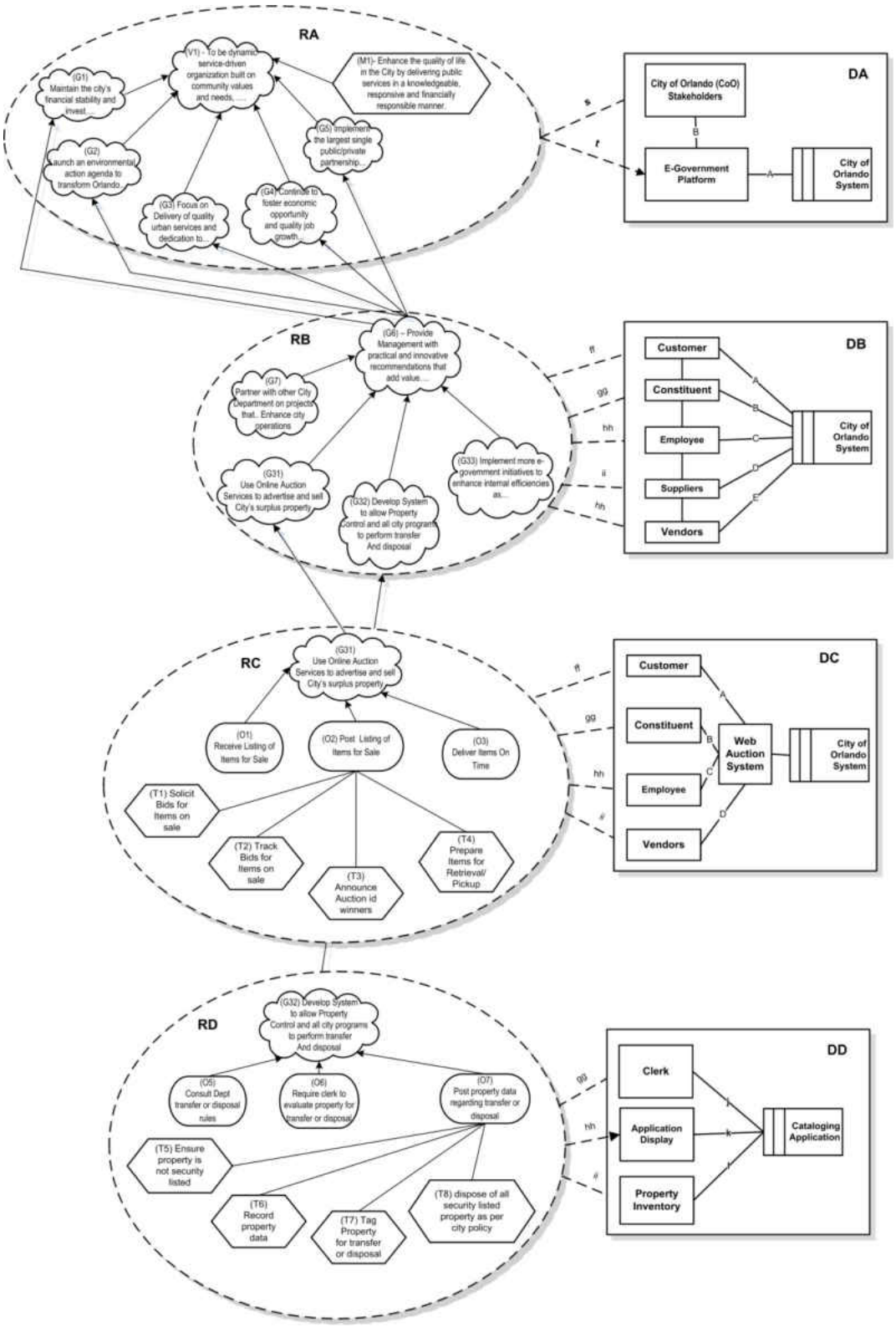

Figure 6.9: Integrated City of Orlando Progression of Problems

Discussion and Evaluation

The integration of goal modeling with problem diagrams is advantageous primarily because each goal entity refers to a specific phenomenon between domains of interest. It is this shared phenomena that foster the verification of requirements in the context within which they occur. The goal model provides a mechanism for verifying alignment as it enables explicit connections to requirements that are consistent with the organization and system context, while the goal model helps to ensure that the requirements achieve their intended organization objectives Bleistein et al. (2006). Concurrently, integration of goal model and problem diagrams supports the manageability of requirements in very large systems. The progression of problem diagrams from the strategy to the system level supports the partitioning of requirements, where each partition is part of a larger goal model.

This process of modeling business organizational strategy with goals is not a straightforward process. Often times it was necessary to repeat the process steps several times before the model could conveniently represent the city's strategy and system requirements. According the Bleistein et al. (2006) there are several weaknesses associated with the approach we utilized. Firstly, requirements are deemed to be in or out of alignment according to a snapshot in time yet an organization requirements change depending on their operating environment which is dynamic. Secondly, the use of VMOST analysis and BRG-model cannot be applied in all cases. For many organizations strategic planning is not something that is done and the members of the organization lack the knowledge to perform VMOST and BRG modeling.

This process of analyzing organization strategy within the context of system requirements can be somewhat qualitative and subjective in the sense that there is no guarantee that the result

model is absolute and correct or that an independent analysis could not produce a different but equally valid model. The benefit of requirements gathering is really embedded in the process of capturing these requirements, i.e. the relationship between the analyst and the stakeholders and the unfolding understanding about the organization itself.

CHAPTER SEVEN: SUMMARY, CONTRIBUTION AND SUGGESTIONS FOR FUTURE RESEARCH

In this dissertation, we utilized a multi-methodological approach incorporating (D)esign science, (A)ction Research, (G)rounded theory and (S)ystem development to synthesize and utilize new research methods, paradigms and perspectives in an effort to improve IS design theories while making substantive contribution to IS business practice. This integrated set of holistic principles and guidelines, the DAGS framework, is utilized to design and construct a collaborative user requirements elicitation system as a foundation tool to assist in designing more effective information systems. The guiding premise behind our approach is the use of a multi-methodological approach to validate the DAGS framework by applying the approach in a real-world setting and through diagnosis and examination, craft a solution for a problem or a class of problems encountered in a wide range of enterprises. The principal theme of this multi-methodological approach is the formulation of a synthesized design that combines the use of Critical Success Factors, goal modeling and problem diagrams to provide a governmental agency with the mechanism for achieving strategic alignment between its business strategy, its IT strategy and the requirements of its stakeholders. The principal focus of research efforts is the public sector - especially local city and county municipalities, whose current operating environment demand that Information and Communication Technology (ICT) play a more overt role in the organization and functioning of government and its ability to deliver services.

In this chapter, I will present a summary of my findings, reflect on the research work and attempt to draw lessons learned, discuss the limitations and contributions of this research effort and finally suggest recommendations for future research.

Summary of Findings

The findings of this study presented in this dissertation can be summarized as follows:

1. It is feasible to implement the CURE methodology and CASE tool proposed in this dissertation. This is evidenced by my discussion with city of Orlando's CIO and his staff regarding possible adaption and use of the system. All steps of the approach were carried out as described with the exception of generating a BRG-goal model on screen.
2. The use of CSF-based approach to requirements elicitation has the ability to enhance communication among an organization's managers, providing them with a common focus on the same goals. During my interviews with the General Administration bureau chief, it was evident that the CSFs obtained reflected an independent articulation of the organization's key performance areas.
3. CSFs can be used in generating both functional and non-functional requirements, for example Enterprise security, contingency planning, staff-reductions and disaster preparedness.
4. Use of the CSF method affords the managers and their subordinates the ability to identify the links between the mission of their department and achievement of the city's overall mission.
5. The process of modeling business organizational strategy with goals is not a straightforward process. Often times it is necessary to repeat the process steps several times before obtaining the model that could conveniently represent the city's strategy and system requirements.

6. The use of VMOST analysis and BRG-model is not applicable in all cases. The needs to be a more specialized version for the governmental sector.

The CURE approach is still in its infancy, however and as the above findings attest there room for improvements both from the perspective of applicability and usability.

Lessons Learned

Below are some of the lessons learnt and reflections on the development and implementation of CURE approach

Success is contingent on the Organization

Successful adaption and use of the CURE approach in any organization is dependent on the availability of a corporate sponsor, someone who has power and ability to direct resources towards the effort. Use of the CSF method can have a transformative effect on an organization but it requires adherence to some basic guidelines regarding the type of organization, the type of CSFs being developed and finally, the purpose for performing the activity. In our case, we conducted the CSF activity to better understand Orlando's business drivers so that we could help the general administrative management develop information needs, strategies, plans and activities from the requirements elicitation process we undertook. Being an outsider did not have any measurable impact on our ability to interface with middle management but we would have benefited more from having another sponsor at the upper levels of the organization. We have discussed with the city the idea of incorporating CSFs into their strategic planning process.

E-Government Initiative Success is contingent on the Organization

Like most governmental entities, the city of Orlando has embraced E-Government, i.e. "use of the most innovative information and communication technology, particularly the web-based internet applications, to provide citizens and businesses with more convenient access to government information and services and to provide greater opportunities to participate in democratic institutions and processes. (Fang, 2002, p.1)" The E-Government concept is an evolutionary one with four distinct phases:

1. Catalog;
2. Transactions;
3. Vertical-integration;
4. Horizontal integration.

The CURE approach can be most helpful to governmental entities like the city of Orlando which have progressed through the first two phases and is currently operating in the third phase getting ready to transition into the fourth phase.

Goal Modeling Approach

A review of contemporary Requirements Engineering (RE) methodologies indicates that the modeling of an organization's goals is central to the RE process. According to Kavakli (2002) goals provide the rationale and drive the elaboration of requirements. It is important to implement goals in the same way that programs implement design specifications. Yet most of the modeling approaches have not incorporated context, strategy and/or processes, an element that would make them more attractive to actually solving business problems. The modeling

phase is the most tedious step in the CURE approach primarily because most modelers are not familiar with the modeling of strategy. This process needs to become less tedious, an objective that can be achieved through training and education.

Software Development and Governmental Agencies

Within the government sector, the process of transforming user needs into desired output has been outsourced. Most of the software employed in the government sector are Commercial Off The Shelf (COTS) products and by all indication the developers of such products are still adhering to contemporary specification practices that have not adequately captured the needs of the city's multiple stakeholders. The CURE approach is intended to provide a holistic approach to requirements acquisition that will help the city's purchase of COTS that assist in satisfying the needs of their diverse stakeholders.

Research Contributions

This dissertation offers several theoretical and practical contributions to IS research.

1. Critical Success Factors can form a bridge between corporate strategic interest and an organization's strategic goals by providing management with a conceptual model of an organization role at the enterprise level or a manager's role at the operational level.
2. The CURE approach helps information architects or requirement engineers validate system against the more abstract high-level requirements that represent the business strategy each information system is intended to support.
3. This research effort seek to craft a framework/approach that integrates Critical Success Factors (CSFs), Jackson problem diagram with requirements engineering

goal modeling that enables verification and validation of an organization's IT systems requirements in terms of alignment with, and support for business strategy in a manner that satisfies the information needs of a diverse group of stakeholders (Bleistein, 2005).

4. This research effort adds knowledge to the field of action research and further demonstrates the validity of information system development as a means of creating useful practical knowledge. Beyond any doubt this effort fulfill Avison's observation, that Action Research is unique in "the way it associates research and practice, so research informs practice and practice informs research synergistically."
5. Jackson's problem diagrams offer a number of advantages when modeling requirements for business strategy. Here, interfaces, constraints, and the separation of requirements from shared phenomena provide a mechanism for adjudicating consistency, completeness and correctness of business requirements by allowing the analyst to catch inconsistencies.
6. This research effort resulted in the development of a web-based prototype collaborative user requirements elicitation system, CURE, for the Information Technology Management group in the city's General Administration division. The CIO has been very receptive to the system and we are currently looking at way we can improve its functionality.

Limitations and Suggestions for Future Research

There are several limitations associated with this research effort, below is a discussion of each.

One of the pillars of the DAGS framework is "Action Research," which was utilized in this study as a means of associating research and practice. Baskerville and Wood-Harper (1996), suggested that system development is an ideal domain for the use of action research. To minimize the introduction of biases into the research process from the start of the project the interview process was standardized and all interviews conducted according to the established protocols for the study plan. All interviews were recorded and transcribed. During the review process if any clarification was needed, a follow-up meeting was arranged and together we recapped the interview before seeking clarification. Although we incorporated Lau's (1999) prescriptions into the research protocol, we were not able to completely eliminate the twin threats of - *Uncontrollability* and *Subjectivity.* In the case of the former, prevailing economic conditions and the need for the city to make budget cuts limited my ability to meet with the executive teams. In the case of the later, the use of another developer might have made clear events or activities that I was blind to. This is an inherent limitation associated with action research that is encountered when there is only one researcher.

External validity is another weakness associated with this study. Because we collected data from one entity, the results produced should be generalized, carefully. In the future, data gathered from several governmental agencies would make with data more robust and would make generalization of results more applicable.

The CURE approach needs some work to be able to more convincingly demonstrate its transferability. While we have done a thorough job of describing the research context and the assumptions central to the research study, development of a more standard and precise methodology that could be used by practitioners and other researchers alike would make the concepts and techniques employed by the CURE approach more satisfying of this quality – transferability.

Because it has been employed for such a long time, one recommendation proposed by Caralli et al. (2004) would make the CSF method more robust is the formation of a CSF team to conduct the CSF activity exercise within an organization. The composition of such a team is dependent on the organization's culture and the availability of qualified personnel to staff such a team. One approach that is being considered at the city of Orlando is the establishment of a cross-functional team that understands the value of CSF activity and is willing and able to perform it. Coupled with this issue is the question of frequency. How often should the CSF analysis be performed? This is a goal that is being studied for possible implementation.

Future research efforts would involve development of a more robust modeling notation for use in modeling CSF besides the standard hierarchical graph or the operationalized BSG model mapped to *i** notation. To achieve greater acceptance of, and use of CSFs in practice, a notation which can impart greater visual acuity is essential. Augmentation of the CURE approach with process modeling would provide another viewpoint helpful in validating the strategic intent of the organization against its IT strategy. With more organizations trending towards adaption and deployment of the service-oriented architecture model and the commitment of local governments to the E-Government initiatives, such an extension could have a positive

impact on the quest for vertical and horizontal integration. Finally, we would like to extend the capabilities of CURE to produce both functional and nonfunctional requirements.

Conclusion

Many IT systems fail to realize their objectives because current system development practices tend to omit business and organizational issues germane to the organization's and the system's success (Flynn and Arce, 1994), and deficient requirements have been identified as the most significant factor in software development failure. In his study of organizations, Capers Jones (1996) discovered that requirements engineering is deficient in more than seventy-five percent of all enterprise software projects. The Standish Group Chaos report (1998) arrived at a similar conclusion – "26 percent (%) of all MIS projects and less than 24 percent (%) of large company projects are completed on time and within budget with all requirements fulfilled. In excess of 46 percent (%) of projects were over budget, late, and with fewer features and functions than originally specified." In other words, getting requirements right maybe the single most important and difficult part of software development.

With the continual introduction of new information technologies into many different areas of society there needs to be new research methods - methodologies and theories that will unearth new knowledge about Information Systems and their effects on decision makers. The need for collaboration with our colleagues within the academic and business communities is essential to fulfilling the promise of relevance in information systems research. What's needed is a change in the current IS research models. The DAGS framework is a multi-methodological

approach to IS research which offers a prescription in fulfilling the promise of relevance in IS research. Using this framework IS researchers can contribute to both theory and practice. Thus achieving relevance in IS research without compromising rigor.

Academics and practitioners have to become part of the same community so that the information gained from research becomes readily available to the practitioner. Conversely, when the research results are incorporated into practice, the practitioner needs to provide the researcher with feedback for evaluation and further study where appropriate.

According to McKeen and Smith (2003), Porter (1987), Galliers (1991) and Bleistein et al (2006), when an organization's information system is in line with and provides support for its business strategy – strategic alignment – superior business performance is often the result. CURE represents a multi-methodological collaborative approach aimed at illuminating an organization's information requirements in contrast to the needs of its diverse stakeholders in support of strategic alignment. Thus to be effective the requirements engineering process should employ methods and techniques which can capture and determine the needs of all its customers and users.

As an applied discipline, the adoption of the DAGS framework's multi-methodological approach to IS system development by more IS researchers will allow the discipline to make more significant contributions to the practice of information systems development and foster adoption of its methods and techniques in business practices.

This research project is concerned with employing the DAGS framework for IS design to assist the IT department of a local governmental organization in developing a system – process, procedure and artifact - to assist in designing and constructing more effective information systems that incorporate the needs of its various constituent-stakeholders in support of

organizational goals while fostering and promoting innovative services to satisfy the varied needs of these constituents.

The intent of this dissertation was to utilize the DAGS research framework in developing a system to capture, catalog and relate both the strategic objectives of the organization and the associated activities, strategy, goals and CSFs by which those objectives are achieved within the context of a conceptual model based on the rules, methods and adapted tools necessary to achieve strategic alignment.

APPENDIX A: INTERVIEW QUESTIONS

Interview Question	Intent	CSF Source	CSF Type
What are the critical success factors in your job right now?	The intent of this question is to directly elicit CSFs from the participant. However, meaningful responses are highly dependent on the participant's understanding of the CSF concept and the consistency of the participant's definition to those conducting the CSF activity.	This question can identify CSFs from all sources—industry, peer, temporal, etc.—depending on the perspective of the participant.	This question can identify both enterprise and operational unit CSFs, depending on the manager's perspective and the scope of the CSF activity.
In what one, two, or three areas would failure to perform well hurt you the most?	This question helps to draw out CSFs from a different perspective—by getting participants to think about possible failures that would interfere with or interrupt their ability to achieve their goals and mission. Answers to this question generally reflect CSFs for the manager.	Industry, peer, environmental, and temporal CSFs are more likely sources than management-function CSFs.	At the organizational level, this question can bring about a distinct set of enterprise CSFs that the entire organization should be mindful of, particularly if they are repeated by different participants across various interviews.
In what area would you hate to see something go wrong?	The implication of this question is that the participant will identify areas where poor performance might interfere with achieving goals and accomplishing the mission. This question gets to the impact of failure and where the impact would be most felt and destructive. If the impact is on achieving goals or mission, it may signify a CSF.	Industry, peer, environmental, and temporal CSFs are more likely than management-function CSFs.	Depending on the manager's level, this question might be very useful for identifying operational unit CSFs.

Interview Question	Intent	CSF Source	CSF Type
Assume you are placed in a dark room with no access to the out-side world, except for daily food and water. What would you most want to know about the organization when you came out three months later?	The purpose of this question is to identify what is most important to the manager. By providing a scenario where the manager "must take their eyes off of the road," a manager can reflect abstractly on their role and articulate what parts of their information dashboard they most need to pay attention to.	This question might identify industry and peer CSFs because of the focus on attempting to get reacquainted with the organization's industry and competitive position	This question is beneficial for identifying enterprise CSFs.
What is your personal mission and role in the organization?	This question helps to set context for the remainder of the participant's responses. For example, if senior managers have different views of what they are there to accomplish, it provides insight into the things that they consider to be most critical. Often, a particular manager has a CSF that appears to be out of line with the rest of management and management's goals. Responses to this question can help to identify such CSFs during analysis so that a determination can be made as to whether they are something the entire organization or operational unit should be concerned about.	May be useful for identifying industry, peer, or environmental CSFs, depending on the level of the participant being interviewed. Management-function CSFs may also be identified if the participant focuses on the unique role they play in the organization or operational unit.	Either enterprise or operational unit CSFs can be identified by this question.

Interview Question	Intent	CSF Source	CSF Type
What are your most critical goals and objectives?	This question is very important if there are no documents to review before the interview. In addition, this question is highly recommended if the organization does not have a formal goal setting and performance management process. Responses to this question often characterize what an individual manager believes is his or her role, which may be completely out of line with what is expected or necessary to help the organization or operational unit accomplish its mission.	Highly useful for identifying temporal CSFs if managers have short-term goals related to operating conditions, seasonality, etc. Could bring about industry CSFs depending on the management level of the participant. Management-function CSFs are also possible, particularly if the manager holds a common role (such as Manager, Accounts Payable).	Depending on the management level of the participant, both enterprise and operational unit CSFs are possible.
What are your three greatest business problems or obstacles?	This question is essential for identifying CSFs that the individual manager, organization, or operational unit may not be aware of explicitly. By considering opportunities or accomplishments that are impeded because of obstacles, this question can identify not only those CSFs that are in the manager's scope of view but those he or she may not have thought about.	Many temporal CSFs can be de-rived from this question, but industry, peer, and environmental are possible as well. Management-function CSFs might be identified if the manager feels that the position he or she holds is a barrier to effectively meeting his or her goals and objectives in the organization.	Depending on the management level of the participant, both enterprise and operational unit CSFs are possible.

APPENDIX B: INTERVIEWS

Interview Transcript

Interview No: 01
Interview Date: <N/A>
Organization: City of Orlando
Department: <N/A>
Personnel: <N/A>

Questions:

(1) What are the critical success factors in your job right now?

Respondent A:

"As division manager the CSF associated with my job is to oversee the operational maintenance and repairs of city owned property, that is, buildings, equipment and special structures."

- ✓ Oversee the maintenance of city buildings, facilities and special structures in a timely manner
- ✓ Oversee the repair of city buildings, facilities and special structures in a timely manner

(2) In what one, two, or three areas would failure to perform well hurt you the most?

Respondent A:

"Meeting client expectation regarding the time required to answer and resolve a service call within a given time period given the budgetary constraints under which we operate and the limited resources at our disposal it might take longer that allocated/budgeted time. I would like to set the expectation based on some priority. For example, if I say we will be there in five days then the client should be assured that we will be there (on site) within five days unless something with a higher priority arises. However, priorities are not determined by some objective metric/measure but by political pull."

- ✓ Failure to meet client's expectations due to service request response time?
- ✓ Attain efficiencies through the effective and efficient use of resources
- ✓ Establish procedures to prevent political pull from to prevent project priorities from being adhered to

(3) In what area would you hate to see something go wrong?

Respondent A:

"The ability to meet customer expectations and we don't have a mechanism to identify or to fix it. For example, the police say they need more officers and they have more statistically per capita than ninety (90) percent of the country. So if they need more they tend to get more. I can do the numbers (budgeting) but this is what is needed to improve this backlog (of requests). I need x-amount of people to get through it. Look at new positions. Other organizations have had growth and we have experienced growth but we have only had one position in the last three years and

our efficiency has increased but we are not being rewarded effectively. We are doing a heck of a job but we can't keep up (the workload) without some increase in resources. There is suppose to be four new fire stations plus 110,000 sq ft of new Rec. Centers and Parks and we have not gained one salaried position. Mater of fact we do have vacancies. We can only squeeze so much efficiency out of the system."

(4) Assume you are placed in a dark room with no access to the out-side world, except for daily food and water. What would you most want to know about the organization when you came out three months later?

Respondent A:
"Has the organization stayed on task without my leadership or guidance within this period? Are things in place so that the organization can be self-sustaining then we would have matured enough as an organization to be self-sustaining."

(5) What is your personal mission and role in the organization?

Respondent A:
"To try and explain the functioning of the facilities management division to the funding people is one of the biggest difficulties I have. The Budgeting (dept) just looks at the bottom line. What I am saying is that if you don't replace your roof on schedule you are going to have a liability and there are several ways that liability can be viewed. For example, injury to occupants or (the division) could become a victim of inflation - three years ago roofing material cost was calculated at $6 per sq ft. This year it is approximately $12 per sq ft. That is a liability because it wasn't funded. The bottom line is that I need to be able to explain this conceptually to the budgeting folks."

(6) What are your most critical goals and objectives?

Respondent A:
"To maintain and repair City buildings, facilities and special structures in a timely manner.

(7) What are your three greatest business problems or obstacles?

Respondent A:
"CMMS – Need to coach professional staff. Migrate from the current computerized maintenance management system (CMMS) to a Total Infrastructure and Facilities Management program (TIFM) which will provide the opportunity to (1) improve the tracking of facilities asset costs and (2) update City programs with the status of their requested services; and (3) Job scheduling application."

(8) How would you measure the critical success factors/activities you have identified above?

Respondent A:
Facility Condition index; "Expense" versus "Benefits"

Interview No: 02
Interview Date: <N/A>
Organization: City of Orlando
Department: <N/A>
Personnel: <N/A>

Description: <N/A>

Questions:
(1) What are the critical success factors in your job right now?

Respondent B:
"…, there are really four primaries activities as I thought about these questions. The first is the Capital renewal and replacement of facilities components and Systems; Development of a master plan for the city facilities; Development of an energy saving programs for city's facilities and acquire LEED-EB certification for the City Hall. (*The U.S. Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) for Existing Buildings (EB) establishes a framework that maximizes operational efficiency while minimizing environmental impacts of buildings. The USGBC LEED-EB program confers certification upon buildings that garner a predetermined amount of credits based on specific performance measures and pre-requisites. Of particular note, cleaning and maintenance activities can contribute a significant portion of the total points needed to obtain LEED-EB certification at a relatively low cost.*) The city is moving towards some strategic initiative to improve how we are from a global perspective. So, earning that plaque and mounting it is one of those goals that we have out there."

- ✓ Capital Renewal/Replacement of facility components & systems
- ✓ Develop master plan for city's facilities
- ✓ Develop Energy saving programs for city facilities
- ✓ Acquire LLED-EB certification for City Hall

(2) In what one, two, or three areas would failure to perform well hurt you the most?

Respondent B:
"There are two areas that concern me. One is the failure to acquire certification of City Hall despite all efforts that has been put forth. (2) Budget is always a concern. All of us sitting here all have different budget experience. In the facilities world breakdown maintenance has always cost more that preventative maintenance. I will admit that in my previous employment I have always had more budgeted preventative maintenance dollars per square foot basis than I have here. The existing department has done a heck of a job to keep up with what we have done here but I am concerned that budgetary issues may prevent us from continuing at the level we have."

- ✓ Failure to acquire certification for Orlando's city hall in the face of all efforts extended towards green initiatives
- ✓ Secure adequate funding for repairs and maintenance budget
- ✓ Negative impact of breakdown on the facilities occupants.

.

(3) In what area would you hate to see something go wrong?

Respondent B:
"The area(s) in which I would hate to see anything go wrong is in the Resources allocation needed to meet our mission is kept the same or reduced. Historically, I have worked in much wealthy governmental environment where we have had more dollars/sq foot to achieve mission goal than I have seen here. I have only been with the city for a year but I am continually amazed has to how well the existing systems are being maintained with the limited dollars available. Secondly, we as a city government has made a decision to go forward with a "Green" initiative including certification of city hall to show we are dedicated to what we are saving but it is going cost money. This green initiative will require funds to get them into place and it is going to cost some political clout to make sure these goals are achieved. The politicians that lead our city will have to get behind these projects for the net results to be achieved."

However we in governmental organizations need to show the ROI and when those cost savings come into play. We have to accomplish what we set out to accomplished. "

- ✓ Reduction in resources budgeted for maintenance and repairs
- ✓ Failure to adapt and implement a "green" initiative
- ✓ Establish strategic relation with the city leaders

(4) Assume you are placed in a dark room with no access to the out-side world, except for daily food and water. What would you most want to know about the organization when you came out three months later?

Respondent B:
"The financial viability of the city and the status of those tasks and projects that were assigned to me three months prior, i.e. where they stood now. Many of the projects I have been assigned are long term in nature. "

- ✓ The current financial viability of the city
- ✓ The status of the ongoing projects

(5) What is your personal mission and role in the organization?

Respondent B:
"Maximize efficient operational readiness of occupied facilities first and extending the lifecycle of all assets owned by the city."

- ✓ Maximize the operational readiness of occupied facilities
- ✓ Extend the lifecycle of all capital assets

(6) What are your most critical goals and objectives?

Respondent B:

"To improve communication within the division and upward throughout the chain of command. Better organization of the engineering section of FM and improve the flow of information sharing. Improve the quality of shared information; Develop metrics and use them.

- ✓ Improve intra-division communication and the quality of information shared
- ✓ Reorganizing the engineering department to facilitate quicker response
- ✓ Develop metric to be used evaluating performance

(7) What are your three greatest business problems or obstacles?

Respondent B:

"Insufficient finances to meet mission goals. Communication barriers caused by personality conflicts internally and "old way was best way" mentality still held by many."

- ✓ Insufficient funding to meet division's mission and goals
- ✓ Educate employee on city's mission, goals and objectives and division goals
- ✓ Lack of education and knowledge about new techniques and methods

(8) How would you measure the critical success factors/activities you have identified above?

Respondent B:

Estimated Cost/Priorities Proposed versus Management approved & provided; Improve efficiency and redirect CYA E-mail traffic; Visual and audio results in varied meetings

- ✓ Estimated Cost/Priorities versus Management approved
- ✓ Improve efficiency

Interview Transcript

Interview No: 03
Interview Date: <N/A>
Organization: City of Orlando
Department: <N/A>
Personnel: <N/A>

Description:
<N/A>

Questions:
(1) What are the critical success factors in your job right now?

Respondent C:
"From a fiscal perspective my job involves securing funding for unforeseen projects, accurate billing and timely billing and remaining on task with operational budget. Funding for our department comes from non-revenue funding.

- ✓ Securing funding for unforeseen projects
- ✓ Accurate & timely billing for all project work
- ✓ Remaining on task with operational budget re: costs, revenue and non-revenue items

(2) In what one, two, or three areas would failure to perform well hurt you the most?
Respondent C:
"Firstly, not having the ability to identify and differentiate between On-demand services and Alterations (which might be a larger job and require additional funding, i.e. capital improvement. Time management, i.e. work should be planned for more timely completion. Maintaining Preventative Maintenance Schedule to prevent frequent breakdown by incorporating all city owned structures/properties into the preventative schedule."

- ✓ Develop the ability to identify and differentiate between on-demand services and alternations
- ✓ Develop a Time management system for the facilities management
- ✓ Develop and manage Preventative Maintenance schedule for city facilities

(3) In what area would you hate to see something go wrong?

Respondent C:
"Not having resources to perform needed facilities repairs and maintenance"

(4) Assume you are placed in a dark room with no access to the out-side world, except for daily food and water. What would you most want to know about the organization when you came out three months later?

Respondent C:
"Whether or not the organization is still thriving, i.e. what improvements have being made?"

- ✓ Secure sufficient financial resources to fulfill division's mission
- ✓ Perform intra-department contingency planning

(5) What is your personal mission and role in the organization?

Respondent C:
"To perform the daily operations associated with Facilities management in an efficient and effective manner. Maintaining and sharing accurate information related to the Work Management System and recommending improvements for the good of the organization. Update work requests and ensures that billing is as accurate as possible."

- ✓ Improve the efficiency and effectiveness of daily operations in an efficient and effective manner
- ✓ Maintain and share accurate work-related information
- ✓ Review current operating procedures regarding work requests and billing

(6) What are your most critical goals and objectives?

Respondent C:
"To fully understand the city's budgeting process on an individual level; Influence division's internal customers to plan special projects for budgeting purposes."

- ✓ Educate employees on the city budgeting process and its effect on the division's missions and goals
- ✓ Determine the needs of the division's internal customers
- ✓ Develop city wide facility use plan

(7) What are your three greatest business problems or obstacles?

Respondent C:
"It is centered around communication, lack of workplace cooperation. Help parties utilizing the Work Management System the importance of maintaining the system's integrity."

- ✓ Improve Intra-division communication
- ✓ Educate employees on how technology can improve their performance
- ✓ Promote the value of data integrity and quality practices on employee performance

(8) How would you measure the critical success factors/activities you have identified above?

Respondent C:

- ✓ Estimated Cost/Priorities versus Management approved
- ✓ Improve efficiency

Interview Transcript

Interview No: 04
Interview Date: <N/A>
Organization: City of Orlando
Department: <N/A>
Personnel: <N/A>

Description:
<N/A>

Questions:
(1) What are the critical success factors in your job right now?

Respondent D:
"As division manager the CSF associated with my job are: Maintenance of Equipment – all the equipment the city owns, heavy and light trucks, off road equipment from a lawn mower to a weed eater. We repair it. We repair everything to keep it operational. We are responsible for ordering new and replacement equipment. We have to dispose of all surplus equipment unless totaled. We (investigate and) handle accidents (dealing with motorized assets) and we repair vehicle. Budget management since we are an internal service funded division, we have to bill all the departments for the services we perform. Personnel management – our staff is clerical, mechanics and supervisory personnel. We are primarily into equipment management, like Hertz, we purchase the equipment and lease it to the departments' users. We have policies and procedures on how to maintain that equipment throughout its lifecycle. At the end of the lifecycle we would replace it with another vehicle or piece of equipment. If you do not use the equipment with due diligence, we will remove (take) it from you. For example, the lifecycle for a piece of equipment used by the police depends on the nature of the car – marked, undercover, motor cycle or detective vehicle. How it is used determines its lifecycle. All city departments have to adhere to the rules and regulations that govern equipment usage, i.e. city rules and regulations, Federal, IRS policies and procedures, etc."

- ✓ Maintenance of Equipment
- ✓ Repair of Equipment
- ✓ Order New and replacement equipment
- ✓ Disposing of surplus equipment
- ✓ Motorized assets Accident handling
- ✓ Budget Management
- ✓ Personnel Management
- ✓ Vehicle & Equipment Management
- ✓ Policy Compliance
- ✓ Inter-departmental communication

(2) In what one, two, or three areas would failure to perform well hurt you the most?
Respondent D:
"(1) Maintenance of the equipment. If we can't maintain the equipment, it doesn't get repaired. If we can't perform preventative maintenance we can't keep it on the road or if we can't repair a part the citizens do not get the services they paid for.
(2) If the lifecycle is broken by the budgeting constraints that will delay the ordering of equipment subjecting the units to longer durations of breakdown and repairs Parts are not readily available for older equipment a combination which impacts the department and ultimately the services that it provides to the various city departments and the citizens as a whole.
(3) Budget management. If I can't manage the budget then they don't need me here. If I can't the budget then we cannot do the maintenance and repair of the equipment. It is a domino effect."

- ✓ Maintenance of (Service/City-owned) Equipment
- ✓ Repair of (Service/City-owned) Equipment
- ✓ Order new & replacement (Service/City-owned) equipment
- ✓ Budget Management

(3) In what area would you hate to see something go wrong?

Respondent D:
"The area in which we would hate see something go wrong is maintenance and repairs, our bread and butter. It impacts the departments – they cannot deliver their services and it affects us – we are revenue generator – the mechanics' labor is billed backed to the departments – the source of my funds. If we can't get any revenue from the departments it sinks our ship. Another area involves the ordering and receiving of new and replacement parts. Without that turnover we don't generate revenues. I get more revenue repairing equipment but it is a double edged sword – the older the fleet the more breakdowns, the longer the vehicle remain in the shop and the more mechanics I will need to keep them on the road. One has to manage the program effectively to get revenue, balance your book and keep the equipment on the road to satisfy the public. It's all intertwined."

- ✓ Maintenance of City-owned Equipment
- ✓ Repair of City-owned Equipment
- ✓ Ordering and receiving new & replacement parts and equipment
- ✓ Vehicle & Equipment Management

(4) Assume you are placed in a dark room with no access to the out-side world, except for daily food and water. What would you most want to know about the organization when you came out three months later?

Respondent D:
"I would want to know what equipment we have got that is not available and why it is not? Where we able to maintain our business, i.e. productivity level, and if not why? Where did we fail so we can fix it so we don't have a (experience) another failure. Because we are essential to the departments – our only function is to the departments and we can't service them effectively then they can't do their job and the elected officials, commissioners and mayor and other fail,

because the constituents can not get their trash picked up, no police or fire services. If we had no failures then we know our plan worked that we set in place. So if this becomes a disaster we can relocate and continue providing our services from a different location."

- ✓ Status of Personnel
- ✓ Changes to operational procedures
- ✓ Changes to the Budget

(5) What is your personal mission and role in the organization?

Respondent D:
"My role is the glue that hold it together in that I am personally involved in everything that goes on – I'm with the mechanics working on the equipment and I am aware of the failures we have had and the success we have enjoyed and that we can build on either to stop those practices that are not working or to continue those that works for us. That way it helps my mechanics because I can order the right equipment; it helps the department because we are recovering equipment and a lot of that is through meeting with these departments to determine what their needs are. If you know what their needs are then you can order the right equipment to get the job done. I also make sure that I have the key people in the right place to ensure that the job gets done."

- ✓ To provide managerial support to the organization by promoting the best/safe equipment and vehicles available for all departments in the city.

(6) What are your most critical goals and objectives?

Respondent D:
"Essentially it is to organize the best support, the safest equipment and vehicles for the departments. By that I mean the departments' usage of the equipment and did it meet their needs and satisfied (fulfilled) the job at hand, e.g. Did the garbage truck make 1200 daily stops that is required to service that route. I measure our efforts the department's ability to do the job??; time in the shop and parts failure rate. A lot of time OPD will like to add additional things to their vehicles that impacts the engine, say their alternators, the critical need is to determine the type of equipment will best satisfy their current and future needs effectively. Let say they have they currently have 120 amps alternator the question is should we get 160 amps or greater to satisfy future needs we have to judge things accordingly. I am continually meeting with departments to make sure that if they have problem or changing needs we can address the problems or these needs accordingly."

- ✓ Availability of equipment to departments
- ✓ Providing new and replacement equipment to city departments
- ✓ Budget compliance

(7) What are your three greatest business problems or obstacles?

Respondent D:
"New Technology. Technology is changing every model year on every piece of equipment as mandated by federal and/or state laws. The spread of technology necessitates that we need the latest software, the latest technology to plug into these engine so that we can accurately detect or diagnosis the problem or cause and that changes yearly. So training and technology are two of my biggest problems in that I have got to keep my guys trained and up to date with the newest technology. I need to be aware of the new technology and I have to have the new equipment that take advantage of the technology but that takes money. And being an internal service funded operation we are not given those funds from the outside. The way the budgeting process works for us is that once we calculate Historical cost plus new equipment plus raises we are asked to reduce the total by 5 – 10 % by the budget office. To achieve that across the board where do we reduce cost? I can't reduce my mechanics or personnel so what gets hit? Training and travel is always eliminated.

We are not like a private entity that I can collect overhead, with say $5 in profit or for reinvestment. Our account has to balance, i.e. Revenue = Expenses, that is out budget and that what we have to spend. Right now I have a great need for alignment machine so I can save money from outsourcing but I don't have $25 – 30K so we have scrimp through the year to possible afford the machine. I have just now purchased the 2006 version of the diagnosis software needed for our diagnosis equipment. Currently, we will acquire the 2007 version in 2008. We are always a year behind.

Our software is so proprietary to the equipment we use. For example on the Garbage trucks we have a Mack chassis with Heil body, that's two different manufacturers. So we need specialized training on the different equipment and the changes that occur every year. To circumvent the restriction placed on training we will order new equipment with the training included in the purchase price of the vehicle – it's a freebie that vendors will provide. When the equipment is delivered the local reps (local vendors) train our mechanics for 8, 12, or 16 hours on how to use the all the new technology and software integrated into the new equipment. We also receive training from NAPA, CarQuest, local vendors who offer specialized training for a particular type of equipment with specific due to the budgetary constraints

- ✓ New Technology
- ✓ Training of personnel
- ✓ Money for upgrades and new equipment for the mechanical shop

(8) How would you measure the critical success factors/activities you have identified above?

Respondent D:
Facility Condition index; "Expense" versus "Benefits"

- ✓ By repair task and codes
- ✓ Time Management

- ✓ Performance indicators
- ✓ Compliance
- ✓ Outsourcing index, i.e. percentage

Interview Transcript

Interview No: 05
Interview Date: <N/A>
Organization: City of Orlando
Department: <N/A>
Personnel: <N/A>

Description:
<N/A>

Questions:
(1) What are the critical success factors in your job right now?

Respondent E:
"As division manager I oversea six programs: Mailing Services, Property Control, M/WBE program, Parts Fleet Supply and Contract Management. Our goal is provide material supply and service to the city departments. The CSF associated with my job are: Customer Satisfaction; Timely processing of buyers requisitions; Achieving goals of the M/WBE programs; Inventory availability and accountability; and Efficient delivery of services. "

- ✓ Customer satisfaction
- ✓ Timely processing of requisitions
- ✓ Achieving goals of M/WBE Program
- ✓ Inventory Availability and Accountability
- ✓ Efficient delivery of services

(2) In what one, two, or three areas would failure to perform well hurt you the most?

Respondent E:
"From my perspective I offer the following: Lack of sufficient inventory to support operations. We operate a city stores warehouse and a vehicle parts warehouse and it is critical that they have adequate inventory to support all city operations. Failure to award and renew contracts in a timely manner would be another critical failure. We have over 700 operational, maintenance and commodity contracts for various services and supplies. If they didn't get renewed or awarded in a timely manner the city's operations would suffer. The staff wouldn't have the wherewithal to do their jobs. Thirdly maintain accurate records of capital assets. We are responsible for over $200 million of capital equipment throughout the city. From vehicles to any item costing more than $1,000 and have useful life of more than 1 year. We maintain records of all the city's capital assets. Next would be the untimely delivery of mail. We are responsible for the mail services the mail services for the city – incoming and outgoing, internal delivery, postal services coordination and delivery, FedEx, UPS and so on. Failure to deliver main in a timely manner would create havoc throughout the city. It would be hard to conduct business. Last but not least inadequate

response to an emergency or disaster support operation such as hurricane or mass casualty event. ”

- ✓ Lack of sufficient inventory to support operations
- ✓ Failure to award and renew contracts in a timely manner
- ✓ Failure to maintain accurate records of capital assets
- ✓ Untimely delivery of mail
- ✓ Inadequate response to emergency/disaster support operations

(3) In what area would you hate to see something go wrong?

Respondent E:
“I would hate to see something go wrong in any of the six programs, i.e. purchasing, M/WBE, property control, fleet/facilities supplies, mail services and/or city stores. Anything that would disrupt the timely supply of goods and services. Anything that would disrupt the flow, the timely flow, of supplies and services to the end users.”

- ✓ Purchasing
- ✓ M/WBE Program
- ✓ Property Control
- ✓ Fleet/Facilities Supply
- ✓ Mail Services
- ✓ City Stores

(4) Assume you are placed in a dark room with no access to the out-side world, except for daily food and water. What would you most want to know about the organization when you came out three months later?

Respondent E:
“Did my supervisors provide supplies and services to the city departments in a timely manner? Was accountability and inventory control maintained? Were procedures followed? Were there any incidents of a significant nature impacted our reputation or performance.”

- ✓ Communicate a more shared vision of the City’s mission, goals and vision
- ✓ Encourage employees to act in the interest of the internal customers
- ✓ Empower employees to be more proactive and take responsibility for their actions

(5) What is your personal mission and role in the organization?

Respondent E:
“My job is to supervise the programs under me to make sure the policies and procedures are followed and that adequate support is given to the end user.”

- ✓ To oversee the timely acquisition of good and services
- ✓ Provide effective inventory control of supplies and capital assets
- ✓ Provide Cost effective postal/mail delivery services

- ✓ Ensure equal contracting opportunities for the M/WBE firms

(6) What are your most critical goals and objectives?

Respondent E:
"The timely supply of materials, equipment and fuel to all city departments in a timely manner increasing customer satisfaction in all areas; Expanding services to meet new demands; Implementation of the ERP system; Training; and timely support of the new planned community venues – the new arena, performing arts center and the remodeled Citrus bowl. Success completion of several new projects in healthcare, guard and protective services, and occupational medical services."

- ✓ Implementation of new ERP system
- ✓ Successful completion of RFP projects, i.e. Healthcare, Guard (Protective) services, City Hall operations and maintenance; Ushering & ticket taking for Centroplex facilities and Occupational medical services
- ✓ Timely support of three community venue

(7) What are your three greatest business problems or obstacles?

Respondent E:
"Lack of cooperation on the incentive contracts; the limited resources available for training and professional development; the difficulty of managing multiple high-visibility projects with limited staff; and retaining qualified personnel within the current salary structure."

- ✓ Resources
- ✓ Training & Professional Development
- ✓ Managing multiple high visibility projects with limited staff

(8) How would you measure the critical success factors/activities you have identified above?

Respondent E:
- ✓ Facility Condition index; "Expense" versus "Benefits"

(See Performance Management Program Handout.)

Interview Transcript

Interview No: 06
Interview Date: <N/A>
Organization: City of Orlando
Department: <N/A>
Personnel: <N/A>

Description:
<N/A>

Questions:
(1) What are the critical success factors in your job right now?

Respondent F:
"Clear visible and consistent support from upper management as mine is a very political charges activity so support is necessary. Ability to prioritize projects and programs where often we are given many tasks that all seems to be the number one priority to the extent where we get clear directions on how to prioritize projects and programs that relate to my section. Getting or receiving timely support from the technology management department because of the size of my department. The old adage of doing more with less really means a lot for me since technology is very important and technology is in the neighborhood for me."

- ✓ Clear visible and consistent support from upper management
- ✓ Ability to prioritize projects and programs (using consistent measurement)
- ✓ Receiving timely support from Technology Management Department

(2) In what one, two, or three areas would failure to perform well hurt you the most?

Respondent F:
"The first is the political arena. If we didn't get minority participation I would definitely feel it there. Secondly, is the support of the community? The community is looking for my advocacy to include them in the procurement process. Thirdly, is my professional reputation, I have a lot of years invested in this."

- ✓ Continued program support in the Political Arena
- ✓ Continued program support and advocacy in the minority Community
- ✓ Professional reputation

(3) In what area would you hate to see something go wrong?

Respondent F:
"Speaking from an M/WBE perspective what the areas are direct attack on the legal underpinning of the program. Secondly, a drastic budget cut, any budget cut from the funding provided for the program could lead to staff dismissal. A ten percent cut in the M/WBE budget would lead to a twenty-five percent cut in our staff."

- ✓ An attack on the Legal underpinnings of the M/WBE Program
- ✓ Drastic Budget Cuts in the funding for the M/WBE program
- ✓ The adverse effect of budget cuts on the program staffing requirements, i.e. Staff Cuts

(4) Assume you are placed in a dark room with no access to the out-side world, except for daily food and water. What would you most want to know about the organization when you came out three months later?

Respondent F:
"I am from the old school of management. One (a manager) should be evaluated on how well one delegates to see how one runs an organization. One should be able to walk away theoretically for three months and be assured that your people can maintain the status quo."

- ✓ Manage with a more proactive approach

(5) What is your personal mission and role in the organization?

Respondent F:
"That is easy; to be the best MBE official the city has ever seen, i.e. to maximize the participation level of minorities and women contracts with the city. To the extent we grow the capacity for professional services offered by M/WBE firms as prime contractors. There was a time we didn't have any, we do now as result of the programs and incentives we have put in place to gain that. I look at the city's success in involving minorities in the procurement process, some $280 million – as not too bad. "

- ✓ To be the best MBE official the city has ever seen!!

(6) What are your most critical goals and objectives?

Respondent F:
"It comes right out of the ordinance that governs my department, i.e. achieving a 24 percent M/WBE participation in contracting opportunities. That is the floor, the minimum we want to achieve. Anything over and above is a plus. The timely certification of companies doing business with the city – there is a process that companies go through to determine whether they are women or minority owned and controlled. Lastly, but not least is support of the community

development projects, i.e. crafting and writing and development of a local economic plan to support it and the implementation there after."

- ✓ Achieving 24 percent (%) M/WBE participation
- ✓ Certifying Companies
- ✓ Supporting Community venue project

(7) What are your three greatest business problems or obstacles?

Respondent F:
"My response would not be unique to any department in government that is covering multi-projects with limited resources. We have so many balls in the air; it's a challenge to keep them all up without dropping one or two. Being dependent on others for critical support whether that comes in the form of data from end users department or timely notification of what projects are hitting the street or enforcing the M/WBE ordinance. There are a number of things which might limit/impact my participation. "

- ✓ Covering multiple projects with limited staff and resources
- ✓ Dependent on others for critical support

(8) How would you measure the critical success factors/activities you have identified above?

Respondent F:
"As division manager the CSF associated with my job is to oversee the operational maintenance and repairs of city owned property, that is, buildings, equipment and special structures."

- ✓ Percentage increase in M/WBE participation
- ✓ Timely receipt of data and info from Departments
- ✓ Deployment of new software and hardware in time for project

Interview Transcript

Interview No: 07
Interview Date: <N/A>
Organization: City of Orlando
Department: <N/A>
Personnel: <N/A>

Description:
<N/A>

Questions:
(1) What are the critical success factors in your job right now?

Respondent G:
"Ensure the technical requirements for any products or service that a user department needs are met through timely delivery of specifications and technical help."

- ✓ Satisfy User's technical requirements needs
- ✓ Provide superb specification and technical help

(2) In what one, two, or three areas would failure to perform well hurt you the most?

Respondent G:
"Within an engineering context, failure to adequately address the technical issues could result in the city acquiring inadequate purchases of goods and services or faulty purchases could increase the cost of goods and services if the technical issues are adequately addressed or could interrupt the timely delivery of city services."

- ✓ Address quality issues related to the purchasing process

(3) In what area would you hate to see something go wrong?

Respondent G:
"I would hate to see something go wrong in any of the six programs, i.e. purchasing, M/WBE, property control, fleet/facilities supplies, mail services and/or city stores. Anything that would disrupt the timely supply of goods and services. Anything that would disrupt the flow, the timely flow, of supplies and services to the end users. "

- ✓ Purchasing
- ✓ M/WBE Program
- ✓ Property Control
- ✓ Fleet/Facilities Supply
- ✓ Mail Services
- ✓ City Stores

- ✓ Minimize disruptions to the city's supply chain

Respondent G:
"Speaking from an M/WBE perspective what the areas are direct attack on the legal underpinning of the program. Secondly, a drastic budget cut, any budget cut from the funding provided for the program could lead to staff dismissal. A ten percent cut in the M/WBE budget would lead to a twenty-five percent cut in our staff."

- ✓ An attack on the Legal underpinnings of the M/WBE Program
- ✓ Drastic Budget Cuts in the funding for the M/WBE program
- ✓ The adverse effect of budget cuts on the program staffing requirements, i.e. Staff Cuts

(4) Assume you are placed in a dark room with no access to the out-side world, except for daily food and water. What would you most want to know about the organization when you came out three months later?

Respondent G:
"Within our environment, our organization can be subjected to drastic changes say the proposed property taxes initiative and we need to be prepared for such eventualities."

- ✓ Develop departmental contingency plans

(5) What is your personal mission and role in the organization?

Respondent G:
"To provide the best help to the Purchasing and Material department in matters requiring technical expertise."

(6) What are your most critical goals and objectives?

Respondent G:
"Timely delivery of all the technical requirements to user departments utilizing the best technical research that can be provided to purchasing to maximizing the return the city receives."

- ✓ Maximize city's return of all purchases

(7) What are your three greatest business problems or obstacles?

Respondent G:
"A lot of user departments do not approach or are not aware of the technical expertise (service) that we provide in purchasing and could save a lot of headaches if they did. Their research could be improved and they could help the city get more bang for its bucks. Early contact with purchasing will prevent the last minute press to get the specs out for purchases. User departments do not approach purchasing before they make a decision so we (purchasing) can be of help in

their decision making process. They have brand preferences that they favor, however, if they do not follow the purchasing guidelines then they expose the city to possible litigation by outside vendors. ”

- ✓ Increase users’ awareness about our services

(8) How would you measure the critical success factors/activities you have identified above?

Interview Transcript

Interview No: 08
Interview Date: <N/A>
Organization: City of Orlando
Department: <N/A>
Personnel: <N/A>

Description:
<N/A>

Questions:
(1) What are the critical success factors in your job right now?
Respondent H:
"Technology Management (TM) supports the needs of the City of Orlando; one of our greatest area is the Public Safety sector where system availability on critical application within the city is a Critical Success Factor (CSF) as far as I am concerned. Especially for public safety whose needs is on a 7/24 basis it is important that our systems and applications are available and accessible by them and all users, e.g. Police officers, inspectors, fireman and just about every aspect. Our service may not be as critical in some other areas that operator or a GS (general service) basis because of the nature of the work they do. I would say a payroll clerk and a police officer both need the system to be available but is more critical for the police officer in most cases from saving lives or preventing fires, etc. System availability would be the one of the first CSF I would identify.

Another would be Response time. It is very important that our systems be available but be very response, in other words with sub-seconds response time. Response time is one of those crucial areas. Another area that would be a Critical Success Factor would be the ability to trouble shoot and resolve problems both with these application or hardware side of the house. Machines being they are and we have to get them up and working. Applications being written by human break and we have to quickly fix them. In a sense its responsiveness, availability and our expertise and ability to trouble shoot are very important and critical.

We do have a help desk and our help desk personnel should be able to provide good solid and accurate information to our end-users, that's another CSF as to how responsive and the quality of assistance our help desk can provide.

In terms of the CSF that makes this division successful – because of the diverse areas we support the ability to service our customers (in a timely manner). We do have a unit of business analyst who provide a more soft approach to customer service, they provide support, they provide advice and in doing so get to understand the (internal) customer business. This relationship although long term in focus will allow us to respond faster and better to client needs. Why? It may take a year to see that the advice they gave to say the finance department regarding an application which would make them more productive, actually does. This type of relationship does contribute to our success but it cannot be measured using the standard criteria. It is more an effectiveness measure that is harder to quantify.

- ✓ Ensure the availability of mission critical application systems 24/7
- ✓ Ensure that the System response time is satisfactory to all users
- ✓ Service all customers in timely manner
- ✓ Establish strategic relationships with all internal customers

(2) In what one, two, or three areas would failure to perform well hurt you the most?
Respondent H:
"The inability to have our system accessible because they are down, let's look at the example of the police officer on the street pulling over someone, say a motorists for a speeding violation and not being able to check their license information and having that person standing on the side of the road for minutes on end because they can't get to (access) the system or the system is too slow in responding to citizens even though they are getting a ticket wouldn't be happy since (1) they are getting a ticket; (2) it is taken them forever in getting a ticket and that's a clear reflection on the back-end shop, not being able to make that system accessible and you can extrapolate that example to just about anyone doing business with the city of Orlando. If I have an outage and people just can't get the service they expect that's technology related, that would hurt us in many ways. From an economic perspectives or point-of-view, if there is income to be derived from us issuing tickets or citation then one could lose out on that income or revenue stream. The cop has an option of waiting for 15 minutes until the system is available or just letting the individual off with a warning when he should be getting a ticket. Or say a mother wanting to register her kid for an event in the park, or a customer walking in downstairs (city hall) to our planning or permit group wanting to apply for a permit or a license and our systems are down. That is has a direct impact. From a revenue point-of-view and an impression point-of-view it seems as if the city is not being responsive to our citizenry.

Another would be tied up in the first, i.e. responsiveness. Everybody wants their service and they want it now and for us to take forever would reflect poorly on the city.

The inability to provide technology to some of the areas that need it the most, e.g. Parks and recreation or Streets, they not having the technology necessary would impact the end-users and technology area re: our inability to provide services. It ties back to my CSF for system outage or system availability, i.e. inability to respond fast enough or lack of resources necessary for the individual to do the job or provide a service for the city. "

- ✓ Inability to respond to service requests in a timely manner
- ✓ Inability to provide value-added technology service to internal customers
- ✓ Inability to keep the system available 24/7

(3) In what area would you hate to see something go wrong?

Respondent H:
"We do provide development services for end users. I do have a section of my staff that does application development and I can tell you that if the logic imbedded in our application is wrong the consequences could be real dire, for example, calculating taxes would be an example of

something going wrong. The problem is yes we can do a recall and do a refund but the embarrassment that the city cannot adequate compute its taxes would be more than enough to cause us a lot of grief.
It is imperative that we are very precise and very accurate in the way we code our applications and the logic embedded in the applications. Let's assume our applications are correct but our networks are not up because of viruses or hacking it is a reflection on our inability to adequately support the city. Something goes wrong it could impact every aspect of doing business with the city. So it could be network availability, applications that are incorrect, it could be inconsequential as it may seen on a small scale our personnel not being able to deliver the service in adequate manner. It could be a rude employee who makes someone mad and it becomes a negative for the department. There are so many different things that could go wrong that could make us look real bad. "

- ✓ Gathering Inadequate or incomplete requirements
- ✓ Ensure that network is well maintained and secured and provides connectivity
- ✓ Identify and capture all business processes
- ✓ Employee should provide service in a professional manner

(4) Assume you are placed in a dark room with no access to the out-side world, except for daily food and water. What would you most want to know about the organization when you came out three months later?

Respondent H:
"The thing that I would like to know most about is if the communication's infrastructure was intact and people were able to communicate – department to department; department to citizens; end users to citizens. Again the technology department is responsible for the communication, whether it's data or voice. It's everything from my network to the voice communication and although we do depend on external providers for these services but I would love to know that they keep their end of the bargain and that the communication services that they should provide is provided as far as communication is concern. To a certain extent we do depend on the contractors. Sprint/Embraq for voice, Time-Warner for some data, Bell South/AT&T for some of our data services so it is important that those services are available so our city workers can communicate both externally and internally."

- ✓ Is the communication infra-structure still intact?
- ✓ Were the strategic relationship established still intact?
- ✓ Did the service level provided by our outside vendors change
- ✓

(5) What is your personal mission and role in the organization?

Respondent H:
"Part of my primary goal is to provide leadership and a vision to my staff, my peers and my management on the role that technology can play in the city of Orlando. It is me being able to see

a technical solution and being able to apply to business process or business objective or goal and make sure that the two, the technology and the business goal are in sync with each other and perform or achieve a certain desired result.

Secondly to acquire the necessary resources to support the city functions. It is up to me to make the case for the necessary computers, applications or contractual services whether it is communication or software. Whatever it takes to make the city's business operate in an adequate manner.

A third goal is to foster a good working environment to motivate and compensate my workers so that they can be as productive as they can be. I need to challenge them and when they are producing to be able to recognize and to compensate them."

- ✓ Provide leadership and vision to my staff, peers and management on technology's role in the city
- ✓ Secure the resources needed to support city functions
- ✓ Create an environment which motivate and compensate workers to produce

(6) What are your most critical goals and objectives?

Respondent H:

"My most critical goals and objectives are primarily to meet my customers' expectations by that I mean there are certain perceptions and demands that my end users will have of my division and I should be able to meet those expectations. For example, when they (users) come in the morning they flip a switch and expect their machines to power-up and give them access to the applications and tools that they need to perform their business should be available so that they can do their work.

Management to Management perspective I should be able to enter into strategic relationships with my peers. In other words, if I have another division manager and it is his objective or goal to achieve a business goal or need then I should be able to sit down and strategize as to how technology will help to achieve that goal, i.e. the business strategic relationship with my peer as critical goal and objective. I should be able to do that kind of planning and organization with my fellow managers to achieve.

Another critical goal would be the use and management of IT resources effectively and efficiently. In other words there is an optimal point using any product or tool that I should be able to get to with the different application or systems that we have. If I give you a tool and I don't train you or provide you with the expertise on how to use (it) then I don't think you can optimize that utility of that tool set so I will work in partnership with the user to make sure that they get the most from the tools they have to use.

We need to be fiscally responsible. I do buy servers for the city that I put into use every budget year but there is point where I should be able to say I have gotten the maximum service, now I need to retire it, to upgrade so I need to monitor the resources that is entrusted to me and make sure the city gets the most from the tools that I manage. I am not upgrading my servers because

there is a new technology out there but because I cannot get any more utility or return on my investment. Capacity planning – an approach to maximize equipment useful life."

- ✓ Meet or exceed internal customer expectations
- ✓ Enter into more strategic relationships with my peers (managerial level)
- ✓ Use and manage IT resources effectively and efficiently
- ✓ Utilize city financial resources effectively

(7) What are your three greatest business problems or obstacles?

Respondent H:

"Currently, I would say lack of funding and resources. It is always a challenge to keep abreast of what's out there – the new and improved for example In the year 2000 we acquired PCs for the entire city somewhere in the region of 3000 pieces. We know the useful life of a PC is in any organization is 3-5 years. We are in 2007 and we are just at the point where we are beginning to change out this technology (PCs). 2005 ideally should have been the year we replaced the old PCs with new ones. We have been making the best of this older technology. Our world around us have been changing very rapidly and because we don't have enough money to do this on a timely basis so we find ourselves using older technologies and sometimes not being as productive as we could be. Yes, we do get by, and yes we are able to do business but we have identified many occasion whereby if we had better machines and software on the desktop we would be able to accomplish more. This is an area where lack of resource is a problem.

Attracting and retaining technically competent staff. One of the things we know is that in the technology area changes in languages, platforms, training is one of those key areas where you have to keep up or you get left behind. So we hire staff in but we don't keep them current and so when new and far more challenging stuff comes out they are not aware because they haven't been trained and as result they sometimes leave and are left hanging. In other words a factor driving turnover is lack of training. We do take advantage of all the free courses being offered and we sometime beat-up on our vendors to see if they can provide us with additional training through some collaborative arrangement with IBM and Microsoft regarding training. We do get creative.

Lack of clarity on the overall business goals and objectives that we support. I don't want to pick on anyone but I have a city department that wants technology but not quite sure what they want to do with it. In other words technology seems to be the solution but they have not expanded on what the business problem is. I am the one who help them with the technology they need to tell me what is the business challenge or business goal is. Sometimes they are not quite sure what they want to achieve but they know that technology is out there to solve it. Without a plan from some of these business units it is tough to come up with a technical solution when they are not sure what's their business process, obstacle or challenge is."

- ✓ Securing adequate funding and resources needed to
- ✓ Attracting and retaining technical competent staff
- ✓ Lack of clarity on business goals and objectives the TM supports

(8) How would you measure the critical success factors/activities you have identified above?

Respondent H:
"We do track system up time. For example our measured up-time is 99.98 for all our network and applications as reported on a quarterly basis. We do have a requirement for response time which is based on the system purpose, for example public safety-oriented systems have a lower threshold versus daily business systems.

- ✓ Use industry and departmental-derived metrics

Interview Transcript

Interview No: 09
Interview Date: <N/A>
Organization: City of Orlando
Department: <N/A>
Personnel: <N/A>

Description:
<N/A>

Questions:
(1) What are the critical success factors in your job right now?

Respondent I:
"At a macro- or micro-level? Essentially at Human Resource (HR) my job is to provide support to the operating departments in achieving their objectives, their goals and their mission by providing qualified applicants, a fair pay structure, fair benefit package which is essential for recruitment and retention. All those things are at the macro level. At the micro-level it is filling jobs quickly with qualified applicants so that they can get out quickly to fix potholes, pick up garbage or the do the planning activities or program computers or firefighters, police officers, that is get qualified applicants in the door to be hired and kept here as long as we can as well as provide a safe working environment.

- ✓ Attract high level qualified employees (HR)
- ✓ Provide an attractive benefit package (HR)
- ✓ Hire, train and develop employees to be self-sufficient (HR)
- ✓ Provide a safe working environment (HR)

(2) In what one, two, or three areas would failure to perform well hurt you the most?
Respondent I:
"Not filling jobs with qualified applicants in a timely manner, the inability or not being able to retain the employees through pay or benefits, whatever and not providing the training as part of the retention effort and safe working environment.

It is a mix bag between Human Resources and the operating departments. I have a program called Education Reimbursement which is $1400 - $1600 per year reimbursement for college courses from accredited schools. Now the departments – each operating department, police, fire, planning, Technology management, etc., they determine which training say at the conference level or 40 hours or 80 hours would be beneficial to that person and they fund that. I offer general training to the city for improving such skills as keyboarding, and other basic computer skills we offer at no charge to the employees. We have a whole training catalog for classes like business development, professional writing, and those are things which are important factors in a person's career. The operating divisions are responsible for specific training, while the HR is

responsible for general training while if they wish to get a degree they could work through on of the programs offered by the HR Department."

- ✓ Train and Educate workers continuously
- ✓ Establish a training program with an emphasis on technology
- ✓ Promote the training catalog and associated resources

(3) In what area would you hate to see something go wrong?

Respondent I:
"I would hate to see an employee hurt, injured, disabled or killed at work in a situation that is preventable through training or health safety or wellness. We have safety inspectors. We have people at Waste water plant driving garbage trucks I would hate to see that.

One of the things I do at HR is try to make sure the city is best positioned to defend any charges brought against us. You are talking about excessive costs for discrimination – race, sex, age, national origins – those title VII protected activities. One of the unique things about Government versus Private sector we are transparent under the state of Florida public records law the citizens have a right to look at my personnel file, any employee's personnel file, the hiring practices the promotional practices. Anyone can come in and say 'let me see who was hired and let me see how they stack up against me, my application. You don't have that in private industry. I work in a glass house which means I have to do things right up front. So I have to put processes in place that ensure we are non-discriminatory so someone gets promoted based on merit based on their qualifications, someone gets hired because they are the best qualified person for the job and for no other reason. So, I don't want to fail in that area, because I will end up in court. Every organization does but I want to prevail in court and say we didn't do anything wrong, this is how the system works.

I would hate to be not able to fill jobs such as those for departments that would be critically impacted because they could not fulfill their mission because they are waiting on me."

- ✓ Minimize employee on the job injuries and disability accidents
- ✓ Continuously improve the hiring and promotional practices
- ✓ Ensure that transparency remains in the hiring process

(4) Assume you are placed in a dark room with no access to the out-side world, except for daily food and water. What would you most want to know about the organization when you came out three months later?

Respondent I:
"If I came back after a three months sabbatical and some of this based on time, I would like to know what our budget looks like now and for the future. That makes the biggest difference, if we are operating at the tactical or strategic level. Since 2003 I have been operating at the tactical level not the strategic level. I am operating at the tactical level because of limited funding – that's more so than any other time because our budget was cut and is fixing to be cut again which

means, can I just meet my mission, my basic mission goal with the resources I have (tactical). I am in no way thinking strategic. Since 2003 I am struggling to meet the day-to-day operational need, that's why the budget is important to me.

The second thing I want to know is if things have run smoothly overall and if not where the glitches handled effectively and efficiently and that would be in employment or classification of pay, union negotiations. There going to be glitches. For example, let's look at labor relations. We have ten (10) union contracts and seven (7) bargaining units. Matter of fact, 90% of my work force is unionized so what happened? Such that were any problems handled in house through bargaining procedures or were they sent to arbitration.

That's a measure that always cause time, effort and resources and you don't know what kind of decision your going to get, it's third party and binding. On pay, where there any major pressure that we could get resolved. There are certain things let say longevity bonuses at this time of the year when or in October when every union gets their increases. They are on different contracts than the other employees. It is a very complicated procedure."

- ✓ Secure adequate financial resources
- ✓ Establish better relationship with employee's unions
- ✓ Develop a long-term strategic planning system

(5) What is your personal mission and role in the organization?

Respondent I:
"My goal and mission is to facilitate the operating departments' mission At one time we had a little mission for General Administrative Department (GAD), i.e. 'Serving those who serve.' I am here to facilitate the guy filling in the potholes and picking up the trash, the firefighter, the police officers and their managers. I am here to make their job as easy as I can operating within the parameters of the policy that the city of Orlando has, that are in place to prevent discrimination and to ensure that all employees are treated fairly. Generally people see HR as a hindrance as opposed to a help because HR is making me do this HR is making me do that.

I would like to review what we make our operating department do and make sure it is important, it's critical. Is it there just because it is a rule, or does it have a purpose, a higher purpose, to protect the city? I am here to help more of them through our policies. I want them to call me looking for help, call me before they take that disciplinary action because we have established that working relationship where you know you come to me and ask me these questions ahead of time and I will help you get to where you want to be legally and fairly. Don't call me and tell me, 'I have just fired this employee and they have filed a lawsuit.' Don't bring me in to clean up the mess. Bring me in to do it right. That's my personal mission."

- ✓ Facilitate the operating departments' mission
- ✓ Evaluate all operating rules for effectiveness
- ✓ Establish strategic relationship with all departments regarding problem resolutions

(6) What are your most critical goals and objectives?

Respondent I:
"It goes back to those things that we talk about recruitment and retention employment. In Human Resources it is somewhat of a unique position in that sometimes you represent management to the employee and sometimes you represent the employees to management and say this isn't fair, let's do this. You can write policies till you are blue in the face and you will never cover every incident or instances that will come up with employees. We are a diverse workforce we have different needs, different problems, different issues so how do you manage that work force consistently and fairly and you do both. Probably in the private sector you are representing management – here we have to represent all."

- ✓ Advocate for better employee/management relationship
- ✓ Attaining Budget compliance given our diverse needs

(7) What are your three greatest business problems or obstacles?

Respondent I:
"I don't know if I have three. My greatest is funding and everything stems from that. I'm in a tactical mode not a strategic mode because I don't have money. I am having to move people around with cross training to meet operational needs in my divisions. In 2003 I lost twenty-five percent of my work force and now we have the state doing whatever they are going to do that will result in more funding cuts and I was already operating at the bare minimum since 2003.

I am not aware of where I am going to get another budget cut. I t impacted service in 2003 and it will have greater impact now. I won't be able to fill jobs as quickly as I can. I am going to suffer in the training area. Everyone knows that if you can save positions you cut training which is counter productive but I still have to perform. Whatever happens happens. I am already operating at bare minimum.

One of the reasons I came to the city of Orlando was that it was progressive. They put money into Human Resources programs. My first boss, Dr. Ruth Joyce Barnes was a phenomenal lady and she'd let you go out and try the new stuff but since then with the budget cuts…

One more problem is convincing your employee that they are here to serve and facilitate. We have certain rules but you need to look beyond these rules and see what they are there to accomplish and not just enforce the rules. We run into situations where the rules don't fit. If that is not going to work then what will work to accomplish where we need to get. I don't bend many rules but sometimes I look at a rule and it is evident that the situation does not fit the rule. It was never designed to work that way, never designed for that situation.

I need to get people to think. Not just say this is my job. My job in HR is anything they need me to do. People resent when you have to move them around."

- ✓ Secure adequate funding & resource to accomplish departmental mission
- ✓ Educate employee to serve and facilitate stakeholders' needs
- ✓ Educate employees on the need for flexibility and ownership

(8) How would you measure the critical success factors/activities you have identified above?

Respondent I:

One has to be cautious with metric/measurements. Sometime one becomes too caught-up in measuring what you do. If you are measuring the activities and not the outcomes and sometimes that is hard to do.

If it is pure metrics I am interested in then how long it would take me to fill a job. How many qualified applicants were in the pool? What did it cost me to get those applicants since I have a limited advertising budget. Am I am using that (budget) effectively?

- ✓ How long does it take to fill a job?
- ✓ The number of qualified applicants who applied
- ✓ The cost of securing each employee

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