Chapter 1

Introduction and Scope of Research

The post-industrial era is characterized by increasing knowledge, by tension arising from individuals' need for stability and organizations' need for change, by the complex relationships between organizations and individuals and the responsibilities of one to another, and by the increasing global competitiveness (Drucker, 1992). This new environment, of accelerating change, globalization and the reliance of organizations on individual knowledge as its primary resource for economic success brought about abundant theories, models, and studies dealing with all aspects of improving organizational effectiveness. Two main streams of thought differentiate most of these theories; the performance-oriented school of thought that is driven by the quest to improve the quantitative outputs of the organization, and the humanitarian school of thought that advocates human relation and compassion as the way to encourage employees' voluntary compliance and performance (Trice and Beyer, 1984). Though different in attitude, both these schools attempt to improve the organizational bottom line.

The emergence of the quality philosophy, which emphasized customer satisfaction as the primary long-term objective of organizations above and beyond the shareholder value maximization objective (Grant et al. 1994), can definitely be viewed as a paradigm shift in management thinking with respect to two problematic aspects. First, the new time frame for this objective, which emphasized long-term horizons, was strange to the prevailing way of management thinking, and created a conflict between the actual culture in organizations and the practice of Total Quality Management (TQM). There was no theory to facilitate the change to this new way of thinking. The acceptance and the adoption of TQM's theory were facilitated by the systems approach (Deming, 1986; 1994), but the practices of TQM continue to use tools that emphasize cause-and-effect relationship. Second, the quality philosophy based its practices on the behavioral approaches to performance improvement, recognizing the employee as a customer and emphasizing teamwork and participation as vehicles for job satisfaction, motivation, and organizational performance ignored the wholeness of the individual when considering the

implementation programs (Pruijt, 2000). In most instances, these two problematic aspects led to the continued failure of TQM.

The aim of this research is to give an answer to these two problematic aspects by building a wholistic framework that will focus simultaneously on promoting organizational and employees' outcomes, assuming that a balance between these two outcomes is in the best interest for both the organization and its employees in the long-run (Beer, 1980; Sutermeister, 1976; Rosen, 1992; Karasek and Theorell, 1990). This framework will build on the theory of systems thinking and will use the system dynamics approach. System dynamics modeling is based on creating a learning environment (Senge, 1990) that encourages cultural change and provides a mechanism to derive a new theory. My premise is that this framework will encourage a more holistic quality culture, which will be conducive to a healthier environment, which will promote both; employees' and organization's health. The system dynamics approach will enable the understanding of the dynamic relationship among the various variables in the organization and create an environment for growth and development, which is the basis for learning and for being capable to adapt to change as required by our present organizational realities.

1.1 Background

1.1.1 Organizational Effectiveness and Quality Initiatives

Organizational effectiveness was always an important and a central concern for research in various disciplines such as management, engineering and organizational psychology. Each researcher attempted to link certain independent variables to the dependent variable of organizational effectiveness, viewing the relationship between them as a causal relationship with a certain direction between them, usually from the independent variable (i.e., employee's performance, job satisfaction, work efficiency) to organizational effectiveness (Sutermeister, 1976). As approaches to the sources of effectiveness varied, so were the interpretation for the term of effectiveness and the related terms of productivity, efficiency, or performance. Each discipline (i.e., management, engineering, organizational psychology) viewed these terms from a different perspective. Most of the researchers focused on independent components of the

organization, rather than on the interactions between factors and processes, which are usually the sources of problems in social systems (Beer and Spector, 1993).

This divergence in approaches had also characterized the attitude toward quality programs in the beginning of the seventies. The engineering approach dealt more with the rational aspects of quality concepts (i.e., SPC, quality circles, process improvement), while the behavioral sciences and management looked more to the human relation issues and management concerns (i.e., employee involvement, leadership), as if all these aspects had nothing in common and had no relationship to one another.

In the beginning of the nineties, researchers devoted much effort to the demonstration of the linkage between quality improvement programs to organizational effectiveness (Mann and Kehoe, 1994; Flynn et al., 1995; Powell, 1995), which was followed by research trying to explain the causes of the many failures of these programs (Becker, 1993; Roth, 1994; White and Wolf, 1995; Cole, 1998). Interesting was the fact that in most cases, no matter what was the discipline's background, most of these researches had pointed toward the soft issues concerning the implementation of quality programs (i.e., organizational culture, leadership, employee relation, HRM (human resource management) practices) as the main source for failures (Ackoff, 1993; Roth, 1994; Kolesar, 1995; Savolaonan, 2000; Fok et al., 2000; Wilkinson, 1992; Kaufman, 1992).

This common trend points to the two main problems that were the result of the gap between the practical application of the quality programs and their theoretical and conceptual background. On one side, a systems approach for the implementation of quality programs was advocated, which were supposed to focus on long-term objectives of the organization, and balancing the optimization of the parts in favor of optimizing the whole. However on the other hand, the tools provided to implement the program are based on a linear thinking paradigm, looking for cause and effect relationships, which are close in time and space. This gap created a discrepancy between practice and theory, leading to ambiguity, and to failure. The notion of culture as the source for failure, which happened to occupy much of the literature (Westbrook, 1993; Westbrook and Utley, 1995; Klein, et al., 1995; Chang and Wiebe, 1996; Gore, 1999; Dellana and Hauser,

1999; Abraham, et al., 1999; Detert, et al., 2000), points to the fact that the interface between the human factor and the quality program is not adequately managed.

Many aspects of the role of the individual in the quality revolution and the fit of the individual with respect to strategic quality management in current organizations with their specific structure and culture was neglected, leading to the inability for quality programs to reach long-term sustainability. While it was logically obvious that better quality should lead to better organizational performance, the actual results, as perceived by the current prevailing quality management paradigm, indicated that this direct relationship may not occur in many settings. Only recently was this paradox potentially explainable through the use of a different paradigm. By using a systems thinking approach and utilizing the system dynamics modeling tools, researchers were able to explore the consequences of the complex relationships between the various variables in the system that led to the counterintuitive behavior of the system, and to the unexpected side effects of the quality improvement initiatives (Sterman et al., 1997; Keating et al., 1999; Repenning, 2000; Repenning et al., 2001; Oliva and Sterman, 2001; Oliva et al., 1998; Purnendu, et al., 1998). This new line of research proved that a systems theory with adequate systems-oriented tools was required to support a systems approach to quality in order to address the consistency between theory and application.

1.1.2 Organizational Effectiveness and Employee Health

Throughout history, organizations' attitude toward employee health has seen the same shifts as other important management issues. After almost totally neglecting employee health in the industrial revolution era, people came to realize the limitation of human work, especially with the beginning of the scientific management approach. Management interest in workforce health was grounded on its relation to organization performance. Only those aspects of employee health that were relevant to his/her work were considered valuable to organizations (i.e., environmental hazards, safety).

In the beginning of the seventies, organizations moved to a more proactive approach to employee health, and started programs that reinforced life style changes. Programs like EAP (Employee Assistance Programs), wellness programs, health promotion programs spread to many organizations, especially as organizations realized

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the fast growing pace of heath benefit costs (Pritchard and Potter, 1990; Lynch, 1995; Leutzinger, et al., 2000; Anderson, et al., 2000; Ha Jee, et al., 2001; Goetzel, 2001; Tucker and Clegg, 2002). The main concept underlying these programs was that the individual with his/her chosen lifestyle was the direct cause for his/her health condition and organizations need to help these individuals to change their unhealthy lifestyles

Two problems emerged from this approach; Linear thinking ignored the influence organizations had on employee's health through their practices and their structure, thus targeting the symptoms of unhealthy employees rather than the root causes. This thinking resulted in low success in changing lifestyle practices for the better and did not lead to sustained improvement in health status of employees. The second problem stemmed from the way employees perceived these kinds of organizational efforts. Employees saw these efforts as another attempt of the organization to exploit their work and not as a true concern for their well-being. Because of this, many felt reluctant to participate in these programs. While these programs continue to flourish, other researchers pointed out to the linkage between environmental factors and employee's health especially the effect that stress has on employees' health (Murphy, 1984; Karasek and Therorell, 1990; Kahn and Byosiere, 1992; Jones, et al., 1995; Sauter and Murphy, 1995; Ho, 1997; Van der Klink, et al., 2001).

In this research, organizational practices, structure and behavior are recognized as important considerations when considering stress in the workforce and that the enormous costs for employee health as a result from stress are not explicitly articulated. More theories have emerged to manage stress and to create environments that are less stressful, again with the primary focus on organizational effectiveness. This view of employee's health as a source of organizational effectiveness and not as a value by its own right is still a manifestation of a performance-oriented approach, which ignores the delicate relationship between the employee and the organization and ignores the wholeness of the human being.

Only recently there is an emerging new approach that views employee health as an essential outcome, which an employee deserves and organizations must consider for organizations to achieve sustainable health (Rosen, 1992; Browne, 2000; Browne, 2002). This new approach understands the relationship between the individual health and the

organization's health. This line of thinking is still in its infancy, and my premise is that the use of systems thinking with systems dynamic tools will be most helpful in their quest to optimize both, employee and organizational outcomes.

1.1.3 The Relationship between Quality Culture, Employee Health and Organizational Effectiveness

The relationship between quality, health and effectiveness was not studied and not explored in the literature directly. But the more recent studies about stress in organizations point out management practices that were found to reduce stress. It is astonishing to realize that most of these practices are those that are advocated by quality programs and are very fundamental in a quality culture like employee participation, learning, distribution of control, etc. In reviewing the literature it seems that a certain culture, certain values and certain practices converge when dealing with organizational effectiveness, quality culture and employee's health. It seems that finding the relationships between these independent variables (i.e., culture, values, and management practices) and the dependent variables (i.e., quality culture, employee's health and organizational effectiveness) and among all these variables themselves will have a great value for organizational knowledge and development. It is obvious that the present way of thinking is not adequate to deal with such a complex dynamic organizational system; and, therefore, the systems thinking approach is proposed for dealing with these phenomena. The systems thinking paradigm can be represented by the system dynamics modeling approach, which is suitable for managerial applications. This is the journey this study attempts to embark on.

1.1.4 System Dynamics Modeling

The difficulty with explicitly incorporating causal relationships can be thought as contributing to the ineffective approaches in management. The emphasis of the traditional paradigms focuses on fragmented structures within an organization, where events are considered to be static, and where different organizational activities have little or no influence on each other. This framework does not allow the explicit consideration of feedback loops. The behavior over time of critical variables does not acknowledge the

existence of mental models of the key stakeholders who influence the overall behavior of the system and does not have effective approaches to deal with complex adoptive organizations. In short, the traditional paradigms can be viewed as providing an obstacle when trying to understand organizations in such a way that theories and organizational policies will help create an environment that is adaptable to changes, flexible to new realities, and capable to continuously grow in a turbulent world.

My contention in this research is that system dynamics can be responsive to these challenges and provide the adequate paradigm that can enhance our ability to effectively deal with the present reality of organizations. The system dynamics modeling process considers the history of the system behavior and explores the root causes for its dynamic behavior and attempts to evaluate different policies and their consequences on the behavior of the system. This policy evaluation is conducted without implementing these policies and waiting for their future results.

The lack of research regarding the exploration of those management practices that are significant in enhancing organizational performance by understanding the relationship among organizational effectiveness, quality culture and employee's health prompted me to articulate the following problem statement, the purpose of this research and its necessity.

1.2 Problem Statement

The problem is to find out which practices and management decisions can concurrently positively influence organizational effectiveness, quality culture and employee health given that these three dimensions of organizational performance collectively determine an organization's long-term sustainability.

1.3 Research Purpose

The purpose of this research is to investigate the interactions between organizational effectiveness, quality culture, and employee health, using a dynamic simulation approach (system dynamics), in order to gain a better insight of their relationships, which will lead to interventions that potentially can result in employee

stress reduction and organizational improvement. Following this research it is anticipated that key questions and hypotheses will be revisited and new ones will be addressed (Sections 1.5 and 1.6). Potentially the foundation of a new theory of organizational performance (effectiveness) that is linked to employee health and quality culture might be formulated.

1.4   Need for This Research

The use of system dynamics on modeling the relationships between the three constructs of organizational effectiveness, quality culture, and employee health will add to the interdisciplinary field of management systems engineering as the interrelationships of these three constructs and their dynamic behavior are yet to be explored. Through this research, the general conceptualization of organizational systems will be enhanced, since these three constructs affect some of the complex organizational characteristics (for example, trade-off between long-term and short-term goals, the consequences of actions that are far in time and space, the conflicts between objective/measurable outcomes and subjective outcomes, etc.). This research will add to the incremental development of the study of the design of effective social and organizational systems, where the products and the services are created in a quality fashion, and individuals experience an environment that is conducive to their well-being.

1.5   Research Questions

This research attempts to examine the dynamic interactions between quality culture, employee health system, and organizational effectiveness, so management can gain insights as to the dynamic organizational behavior and make effective decisions with respect to enhancing organizational values and management practices that improve both, organizational effectiveness and employee's health. The fundamental research question can be formulated as:

How can quality culture influence employees' health and in turn be influenced by the culture in an organization? How does the interaction between quality culture and

employees' health influence organizational effectiveness and how is this interaction affected in turn by organizational effectiveness?

A system view of organizations holds that "effectiveness resides not in any one independent component of the organization, but rather at the interface between many factors" (Beer and Spector, 1993, p. 643). This research aims to explore the interaction between two important constructs in the organization and their interaction with the dimension of organizational effectiveness. The following related sub-questions are targeted:

1.5.1 Sub-Question # 1:

In what ways do quality culture and employees' health interact and mutually influence each other?

1.5.2 Sub-Question # 2:

How does the interaction between the quality system and employees' health interact and mutually influence organizational effectiveness?

1.6   Research Dynamic Hypotheses

The research questions are formulated so that they express specific dynamic interactions. Therefore, the hypotheses of this research should also account for the dynamic behavior of the system, based on the underlying feedbacks and interactions between the different system components. This kind of hypothesis is called a dynamic hypothesis. A dynamic hypothesis is a potential explanation of how the system structure causes the observed dynamic behavior as a result of the interactions between several factors in the system over time (Oliva, 1996).

In the real world, the dynamic hypothesis is developed by the modeler who elicits the views of the decision-makers involved in the system about the way the system behaves. In this dissertation, several dynamic hypotheses have been developed for testing by using the diverse body of knowledge reviewed in the Chapter 2.

The following dynamic hypotheses are related to the research question. From the literature review, a list of practices and policies with their relationship to quality culture, employee health and organizational effectiveness was extracted. From this list I chose those items that are relevant to both quality culture and employee health. The underlying assumption is that the activities that promote quality culture and employee health are those that will generate a reinforcing feedback loop between these two constructs. It is also assumed that anything that contributes to either quality culture or employee health, also contributes to organizational effectiveness, thus it would be safe to conclude that anything that contributes to both is definitely increasing organizational effectiveness.

1.6.1 Dynamic Hypothesis # 1 (Double Loop Learning)

To become effective in an organization, the manager or worker needs to be involved in a learning process that influences his/her mental models so that she/ he can move to new ways of thinking which subsequently can lead to a greater acceptance of change and growth. Assuming that there is a desire for this kind of learning and openness, this may result in a gap between the current mental model one has and the new mental models one engages in. This gap may lead to decisions about the actions that one needs to take in order to experience life; and, in turn, this leads to more gained experience. More learning provides more tools and motivation to make one aware of the existing gap and hopefully to accept the new mental models (based on Forrester (1993) and Senge (1995)).

1.6.2 Dynamic Hypothesis # 2 (Stress/Control)

The more experience gained, through the development of one's skills and knowledge, the more control one has on his/her life. The greater the fit between the sense of control and the desire for control, the less stress is introduced in one's life and this fit subsequently encourages a person to look for more experience and more learning opportunities (based on Karasek et al., 1990; Rosen, 1992 and Sapolsky, 1994).

1.6.3 Dynamic Hypothesis #3 (Job Satisfaction/Health)

The more experience, skills and knowledge gained, the more job satisfaction one feels, as long as the perception of the level of collaboration, the level of decision latitude, and the level of participation and the involvement are close to the levels one desires. The closer the level of job satisfaction is to the desired level of job satisfaction, the more one feels pleased. Subsequently this pleasure influences positively one's state of health. If an employee experiences a higher level of health status, he/she tends to be less absent and more productive at work, which provides her/him with a greater opportunity to take more actions and develop more skills and knowledge (based on Karasek et al., 1990; Oliva et al., 1998; Berger et al., 2001; Riedel et al., 2001; Ho, 1997).

1.6.4 Dynamic Hypothesis # 4 (Stress Recovery)

The perceived lack of knowledge and skills, and therefore lack of control causes stress to build up. If this build-up is accompanied with low decision latitude, then stress accumulates even more. When stress builds up, a person experiences a distancing from his desired comfort zone. If he feels stressed, the greater the chances he will get sick providing him/her with an escape route to lower his/her stress (based on Karasek et al., 1990 and Capra, 1983).

1.6.5 Dynamic Hypothesis # 5 (Absenteeism/Stress)

Illness obviously is a frequent cause for absenteeism, subsequently causing the person to be less productive and less able to be involved in a learning process, (acquiring fewer skills and less knowledge), which in turn causes even more stress to build up and eventually more illness (based on Karasek et al., 1990; Berger et al., 2001; Riedel et al., 2001; Sapolsky, 1994; Capra, 1983).

1.6.6 Dynamic Hypothesis # 6 (Motivation)

The greater the job satisfaction one experiences, the more motivation she/he has to work. When motivation is high, the commitment level is also high, which positively influences job performance. This will hold true as long as the level of communication needs is commensurate with the reward received and as long as time horizons considerations are adequate with those required for completing the job. If the actual (as

opposed to desired) level of job performance is high, the level of the quality of the job is high, resulting in a higher level of both employee and organizational effectiveness. When organizational effectiveness rises, so does the level of employee motivation, which is a positive influence on an employee's health (based on Keating et al., 1999; Karasek et al., 1990; Purnendu et al., 1998; Jaffe, 1995; Browne, 2002; Beer, 1980; Rosen, 1992).

1.6.7 Dynamic Hypothesis # 7 (Collaboration Trap)

The larger the gap between the current mental model one possesses and the new mental models one engages in ('openness gap'), the greater the need for collaboration, which increases the perceived gap of the level of collaboration, and also the gap between old and new mental models (based on Forrester, 1993; Gryna,2001 and Detert et al., 2000).

1.6.8 Dynamic Hypothesis # 8 (Health/Quality)

The level of quality culture increases with more managerial practices like collaboration, provision of decision latitude, participation and involvement, and with more communication and long-term plans. The level of quality culture decreases when there is less openness in the organization. As quality culture increases, organizational effectiveness increases, which subsequently influences employee motivation. An increase in employee motivation also causes an increase in employee's health status which lowers the absenteeism rate and improves the learning ability of the worker thus decreasing the openness gap and increasing the level of quality culture (based on Detert et al., 2000; Jaffe, 1995; Browne, 2002; Beer, 1980; Rosen, 1992; Sudit, 1996; Mann, et al., 1994; Ho, 1997).

Based on these dynamic hypotheses, I built a conceptual model that demonstrates the linkage among the variables and processes that are included in the dynamic hypotheses.

1.7 Conceptual Model

Individual level
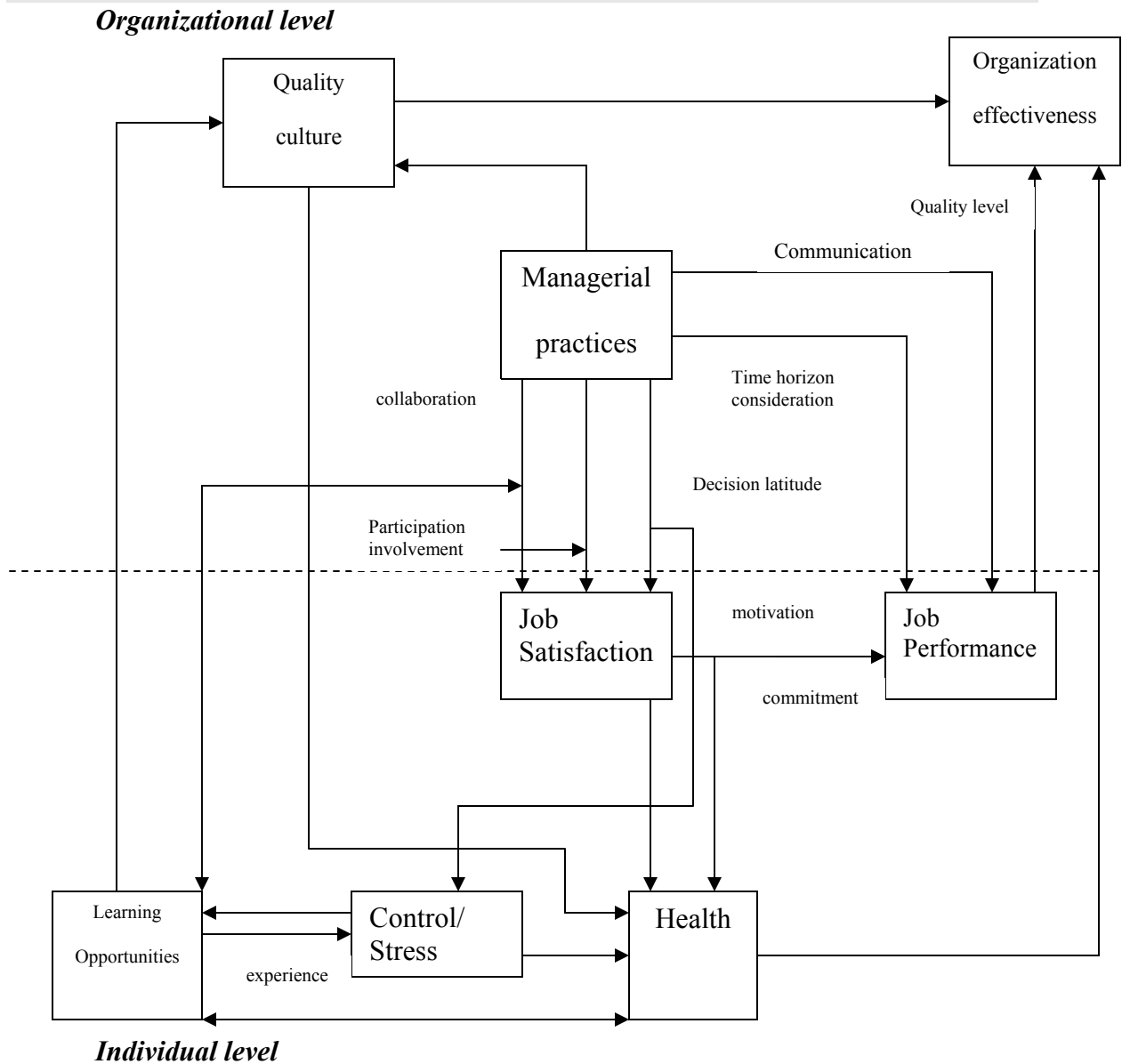
Figure 1-1: **Conceptual model**

This conceptual model summarizes the dynamic hypotheses based on literature. The boxes represent the variables and the arrows represent the interactions and processes that lead from one variable to another.

1.8　Premises, Assumptions, and Delimitations

The main premise in this research is that organizations are social systems and as such their concerns about the individual outcomes is part of their main considerations. Another premise is about trust. This research assumes that a certain amount of trust exists between management and the workforce from which any intervention can begin.

Some additional assumptions made in this research include:

- A systems thinking culture can be considered as a type of quality culture.
- A quality culture is a good enough to guarantee quality programs.
- Health is a required for everyone to enjoy his/her outcomes of work; and, therefore, is a common and important desire for everybody.
- People enjoy learning if given the opportunities and the adequate conditions to learn.
- A system dynamics modeling process can deal with the complexity of the system researched in this study.
- Organizational values, culture, and practices are interrelated and interconnected to each other and will reinforce each other.
- The construct of job performance considers the quality of products or services; therefore, one does not have to separate the level of quality when considering the level of job performance. In other words, if the employee's job performance is considered to be at high level, he/she performed a quality job.

There are delimitations for this research as well. Organizational effectiveness can be affected by organizational values such as profitability and by organizational practices such as training. I will deal only with organizational practices. Also, there are many practices that can promote organizational effectiveness. I will refer only to those that promote both, employee health and quality culture, which will affect organizational effectiveness. No other organizational outcomes will be considered. At the individual level, only health is considered; but job satisfaction and growth as mediators to achieving health will be considered as outcomes of the model.

1.9   The Definition of Terms

The following are the terms and concepts used throughout this research. They will appear in the glossary as well. (Appendix R)

1.9.1 Social system

A system in which the social fabric is the most substantial component of the system; and, without it, the system loses its existence. A social system converts inputs from the environment into outputs that are useable by the environment.

1.9.2 Organizational effectiveness

The degree to which the actual outcome of an organization meets the expected outcomes set by the organization. The degree organizational performance indicators such as customer satisfaction, profitability, market share or growth, are positive (high).

1.9.3 Organizational efficiency

The extent of fit between the internal components of the social system. The more congruity exists between these components the more the organization will function smoothly, with relatively little dissatisfaction on the part of organizational members. Higher efficiency occurs when there is relatively little interpersonal or intergroup conflict among various constituencies, such as supervisors and subordinates or union and management.

1.9.4 Culture

The commonly held beliefs, values, and feelings about how the organization is and should be operating. Culture represents the organization's cumulative learning, which is reinforced through organizational policies and processes.

1.9.5 Organizational Health

The state in which people and practices are combined and coordinated to produce exceptional performance. Such an organization is likely to maintain organizational efficiency and effectiveness in the long term.

1.9.6 Construct

An abstract entity combined or arranged by the relationship between its parts and elements, which are mainly views, beliefs and feelings.

1.9.7 Quality

Meeting or exceeding customers (internal and external) expectation

Chapter 2

Literature Review

2.1　General introduction

The purpose of this research is to build a system dynamic framework for organizational effectiveness. There are many ways and methods to achieve this goal. Organizational effectiveness is one of the important measures for the organization's performance. This research will try to focus on employees' health and on quality culture as two important components in achieving organizational effectiveness. Different approaches for improving effectiveness usually stem from different assumptions, different attitudes, and different life experience, all of which make up different conclusions. It is therefore important to reveal the assumptions underlying any approach in order to better understand its roots and the theory behind it. The first basic assumption in this research is that organizations are systems. They are complex social systems and need to be approached as social systems. This assumption will serve us in the ability to make the conceptual connection between health, quality and effectiveness, and to use the same cognitive structure in approaching them. The social systems paradigm will serve as the framework for this research. The distinction that organizations are social systems implies different weights and emphasis for different components in the system. In this literature review, I will first review the notion of organizations as social systems which are the general framework for my discussion. Then the review will be divided into two parts. The first part will deal with the issue of quality and quality culture, and the second part will deal with the issue of employees' health in the organization. Each of these sections will have a separate introduction, in which I will outline the proceeding discussion. The literature related to the application of system dynamics is woven into the literature reviewed within these sections. First I will review the notion of organizations as social systems as discussed by Beer (1980).

2.1.1 Social systems

Beer uses systems theory to explain the dynamic interrelationships of the parts of a larger whole as it interacts with its environment, and he lists several organizational characteristics that result from applying systems theory to organizations: that organizations are composed of parts that interact with one another, they interact with an external environment from which they obtain energy/matter as input and to which they export a product or service as output. Organizations are a network of people, structure, and processes that transform raw material into products or services. They have feedback mechanisms that allow the adjustment between components. Organizations will deteriorate if the converting process will stop and no reinvestment will occur, meaning that a constant flow of energy needs to be maintained.

Beer (1980) emphasizes that organizations are actually social systems. By that he determines that the social fabric is the most substantial component of the system and, without it, the system loses its potential existence. "For social systems, the most important maintenance source is human effort and motivation. Thus the motivation of people in the organization becomes just as important a source of energy as financial and other energy/matter resources" (p. 18).

The model Beer (1980) proposes of organizations as social systems, emphasizes the relationships between the major organizational components which have to fit or be congruent in order for an organization to be effective. These are: environment, organizational outcomes, human outputs, organizational behavior and process, organizational structures, people, culture, and dominant coalition. A model where people are the main component begins and ends with the human input and human output as the framework of the model. Everything else in the system is in charge of the processes that accomplish this conversion. According to Beer, people bring certain qualities with them when they enter an organization, and after a while with the organization they end with attitudes and psychological states that were affected through the organization's structures (reward systems, policies, control and evaluation systems, etc.). This means that structure shapes organizational behavior and process. Structure and processes together mediate the relationship between people's needs, expectations, and capacities when they enter the organization, and the attitudes and capacities they developed as a result of living and

working in the organization. The two other components in Beer's list, (organizational culture and dominant coalition), are formed by the components I just described, but also influence and shape them. Beer defines *culture* as "the commonly held beliefs about how the organization is and should be operating" (p. 18) and *dominant coalition* is defined as "a small number of key decision makers [who] impact…organizational components through their position of power" (p.18). What we observe in his model are the feedback loops between the components; the influences between the components are bi-directional, they go from cause to effect and from effect to cause. Organizational outcomes, which are usually described by certain measures of organizational performance (profits, quality of life, etc.), are a function of all the components of the social system, as it operates in its social and technological environment. Beer acknowledges that in a social system any part can interact with any other part and the feedback loops between the components of the model have no restrictions and all of them are interdependent. The main difference between viewing an organization as a social system and not just as a system is the consideration of the centrality of several of the components. While in any other system, the tangible assets are considered the center of the system, in a social system even with the most superior technology, or superior financial resources, deterioration of the organization will not be avoided, if employee's well-being is low. "Sooner or later… inability to attract, keep, motivate, and influence talented people will lead to reduced effectiveness of the social system in transforming human energy into profit. This in turn will lead to reduced financial and technological resources" (p. 20).

Beer believes that for organizations to become effective, their managers need to internalize this social systems perspective so that they can appreciate the circularity of the relationships among key organizational dimensions. A social systems perspective also facilitates systematic interventions when they are carried out since the relationships among the various components are identified and acknowledged. This model also forces managers to consider the specific outcomes of any change initiative and make sure that they are aligned with the desired organizational outcomes.

Viewing organizations as social systems may also change the traditional attitude with regard to the organization's performance outcomes. Traditionally, organizations are concerned with economic measures such as profit, return on investment, and rate of

growth. Beer stresses that in a social system, these outcomes, while being important, are not the only ones to consider. They also need to fulfill the needs of its members, their expectations, and their quality of work life in relation to the environment, so that will be able to continue attract, keep, motivate, and influence employees. Quality of work life may be measured by such outcomes as turnover, absenteeism, and the organizational ability to attract good people. Beer points out the likelihood for having conflicts among these different criteria of performance, and recognizes that tradeoffs are inevitable. The main problems in making decisions about tradeoffs among these two sets of criteria are resulting from their inherent different characteristics. One set of outcomes (economic measures) is relatively objective and precise; while the other set (quality of work life) is basically subjective and difficult to measure precisely. These two sets are also very distinct in the time lag between the decision made about achieving or compromising one of the sets and the decision's impact on the organization performance outcomes. Costs originated from absenteeism or turnovers are far in time from the decisions which probably led to their occurrence, and are difficult to be linked directly to them. These differences many times encourage managers to favor economic measures over quality of work life measures. According to Beer, research shows that employee attitudes and psychological states, such as satisfaction, commitment and motivation are good predictors of trends of profits several years ahead, "the way an organization is managed affects employee attitudes and competence and these can help predict the *ultimate capacity* of the organization to perform in its environment" (p. 24). Beer agrees that different types of organizations will usually employ different types of people, with different needs and expectations, which will determine the kind and amount of satisfaction the organization must provide to attract, keep, and motivate them.

Beer also argues that people's behavior, organizational processes and the interactions between them are the means by which potential energy and motivation are converted into results. The more these components and relations are congruent with organizational purposes, the more effective the organization will be in achieving its performance goals. Thus, Beer concludes, "the job of managing an organization is the job of managing and guiding behavior" (p. 25). But since managers are so busy with other problems, they miss the ability to look into the processes themselves. He points to

research that supports the fact that when "process is consciously examined and managed by organizational members, they perceive improvement in the quality of decisions, coordination and effectiveness, clarity of goals and strategy, involvement and motivation and satisfaction, among other processes and outcomes" (p. 25) This finding will later be referred to as the quality culture that affects organizational effectiveness. Beer lists several important organizational processes that have a major effect on organizational performance. Among them are leadership and supervision, communication, intergroup relations, conflict management, decision-making processes, problem solving, planning and goal setting, group and meeting processes, interpersonal relations, evaluation and control processes, and more. All these processes need time and money to be developed into effective processes, a fact that implies that a systems perspective will be most useful in deciding how to rank order these processes and the investment in them, when environmental and tasks considerations will be taken into account on one hand and employee needs and desires on the other. Beer emphasizes that the most important thing is the capacity of management and workers to examine how they are working together so that inappropriate processes can be detected, corrected and improved, using the knowledge people accumulated through their experience on the task.

Structure is another important component in the social system. According to Beer structure influences organizational behavior and since behavior must be consistent with the organization's environment, then the structure, which is appropriate for a certain organization must be consistent with its particular environment. Thus structure and environment must fit in order for an organization to be successful.

Organizations try their best to recruit and select people so that their desired goals can be achieved. The problem with the low rate of success of these processes is that individual potential can be unleashed only with certain organization design and processes. This means that the more management style, job structure and work design fit the needs, expectations, and abilities of the individuals, more of their potential competence will be realized. The more complex the task and the tighter the market of job applicants, the more important is for the organization to elicit the full human potential.

In regard to the individual's differences, Beer points out that individuals differ in abilities and skills and that these differences limit their capacity to respond to various

situations. He categorizes the human's abilities into three major categories: physical abilities, mental abilities, and interpersonal abilities, and recognizes that each job requires a different mix of these three dimensions together with experience and education. In this case, when dealing with the human capacity to accomplish a job, Beer unfortunately abandons his systems perspective, and does not discuss the interrelationships between all these components and how they interact with each other. This does not come as a surprise since this is the pervasive trend in the literature, meaning that humans' abilities are being approached as summations of abilities rather than systems of interconnected abilities through certain feed back loops.

Besides the abilities one possesses, he needs to be motivated to apply them to the work he is doing. Beer argues, "Unless a person has needs he will not behave" (p. 30). He uses Maslow's theory of needs as the framework for his approach, but he believes that a person is likely to experience all needs simultaneously and not hierarchically as Maslow have theorized; even though he acknowledges that there is a kind of hierarchical link between them. This means that when lower level needs are satisfied, higher level needs will increase in strength, and he also pointed out that only lower level needs are likely to become less important as they are satisfied, while higher order needs are likely to stay high or increase as they are satisfied. Therefore he argues that only the higher order needs are actually the continuous source of energy for a social system. This implies that money can serve only as a temporarily motivator, while completing a meaningful task may trigger even a higher need for achievement.

Beer also recognizes that people have certain expectations from their efforts in the organization, which they developed by their own. These plans are often not conscious, but are based on signals organizations send that indicate what is reasonable to expect. Beer refers to these expectations as "part of the individual's psychological contract with the organization" (p. 31). Violation of this perceived contract by the organization may result in dissatisfaction and frustration on the employee's side, which may lead to undesirable behaviors.

Concluding the issue of people as the most important component of social systems, Beer stresses that people are adaptive and will adjust their needs and expectations to environmental requirements if changes occur or are anticipated. This

characteristic of people opens opportunities for organizations to invest in people in order for them to grow and develop to be able to fit to new realities.

The next component of social systems discussed by Beer is organization culture. Culture according to Beer is determined by all of the components of the organizations such as structures, people, processes and environments, but they are more than just their sum. Culture according to Beer is the shared beliefs, values, and feelings "which form an informal set of ground rules about what is expected and what will be rewarded (formally or socially)" (p. 33). Culture represents the organization's cumulative learning, which is reinforced through organizational policies and processes. Beer distinguishes between the formal culture, which consists of idealized statements about what beliefs should be, and the informal culture, which consists of actual beliefs and behavior. Culture is transmitted to new members through a process of socialization, this means that individuals change and modify their behavior as a consequence of membership in an organization. This is actually a learning process, which takes place in a social context. Beer noticed that culture has a profound effect on behavior and therefore any change management wants to implement will require from management the identification of the organizational culture. Since changes require an explicit effort of reeducating people in order for them to be able to adopt new values and norms, it is important to understand the organizational social learning systems. Cultural change is not an easy task because explicit efforts may be perceived as threatening to managers. Beer also acknowledges that sometimes culture espouse implicitly in unethical or destructive behaviors such as conformity, dishonesty, distortion of communication, and other behaviors that have negative effects on organizational effectiveness and quality of work life. Beer concludes that it is not sufficient to consider only structures, processes, behaviors, and environment when viewing organizations, "complete understanding of an organization cannot occur without the holistic perspective that the concept of culture provides" (p. 36).

The last component of the social system discussed by Beer is the dominant coalition, "the group of key decision makers whose influence on the system is greatest" (p. 36). He believes that this group of people is predisposed to their own experience, skills, cognitive orientation, personality and values, so that they perceive certain aspects of their environment and not others. This means that they design, make decisions, and

promote those practices that are consistent with who they are as individuals. This idea is strongly supported by Schneider (1987).

Schneider (1987) proposes a new perspective concerning the relationship between organizational structure, environment and people's behavior. Instead of viewing the behavior as the outcome of structure and environment as is traditionally perceived, he shows that the opposite is the true cause and effect relationship. This means that structure and environment are the outcomes of people behavior. This is called the ASA (attraction-selection-attrition) framework. His perspective rests on the idea that people are not randomly assigned to settings. He argues that it is the people who are attracted to, are selected by and remain in a setting that determined the setting.

According to Schneider organizations are systems driven by goals. These goals emerge initially from the kind of person or persons who establishes the organization, and it is the behaviors of these people in pursuit of organizational goals that determine the processes and structures that evolve in organizations. A particular setting attracts certain people, and causes other to leave, producing a restriction in range in the kind of individuals that compose the organization. "Over time, persons attracted to, selected by, staying with, and behaving in organizations cause them [organizations] to be what they are" (p. 445). Schneider cautions that this phenomenon may produce a very non-diverse workforce that might not be able to adapt to environmental changes. Schneider also opposes Beer's conclusion about people adaptability. This framework suggests that people are rather less changeable and less adaptable than it is believed. According to Schneider, culture is also a product of the people who constitute the organization and share the same views about how things occur and what needs to be done.

Concerning the dominant coalition, Beer concludes that one cannot understand a social system without knowing who the dominant coalition is, what their background and experience has been, and what their personality and values are. Any attempt to help organizations to adapt to changes must include helping the dominant coalition understand how their own predispositions and behaviors have shaped the social system in the way it functioned.

Beer ends his model of organizations as social systems by providing three measures to assess the level of functionality of the system over a long period of time.

These measures include: efficiency, effectiveness and organizational health. The interesting point in choosing these criteria rather than traditional measures such as profitability, or satisfaction, is that these measures consider the long-term abilities of the organization in a systems perspective, while the traditional measures are concerned with short-term outcomes. These measures are important because they assess the extent to which the organization has adapted to internal and external changes, and the extent to which it has the capacity to adapt and cope with future internal and external changes.

According to Beer, efficiency is "the extent of fit between the internal components of the social system. The more congruity exists between these components the more the organization will function smoothly, with relatively little dissatisfaction on the part of organization members" (p. 39). This implies that in efficient organizations not much is needed in order to keep people happy and satisfied, and quality of work life such as turnover, grievances, or absenteeism are rare.

Effectiveness is defined as "the extent of fit between the organization's environment and all the internal components of the social system. The more congruity that exists between the internal social system components and the environment, the more the organization is likely to exchange favorably with its environment" (p. 39). This means that in such organizations performance indicators like customers' satisfaction, profitability and even employee satisfaction from task accomplishment are likely to be high.

Organizational health is defined by Beer as "the capacity of an organization to engage in ongoing self-examination aimed at identifying incongruities between social systems components and developing plans for needed change in strategy (environment), structure, process, people, culture, and the dominant coalition. Such an organization is likely to maintain organizational efficiency and effectiveness in the long term" (p.40). This is actually a dynamic approach on what could be considered a stable organization. Even though it sounds paradoxical, a more stable organization is the one that can more easily identify needs for change, and can act upon without causing damage to its current position, and continue to move forward. In other words, a healthy organization is the one that is flexible by choice, and can adapt to environmental changes consciously.

On the other hand, Forrester (1993) expresses some concerns in regard to the prevailing acceptance of the notion of social systems. First, he acknowledges that while other kind of systems; engineering, physical or chemical systems are usually carefully designed, social systems like; political, economical, or managerial systems, which are a lot more complex, are designed mainly by intuition. Many changes in social systems take place using only personal impressions, or through committee meetings, with no dynamic analysis, which usually would help prevent unexpected consequences. In all other kinds of systems, designing is a carefully studied, analyzed and scientifically controlled and tested. Forrester complains that many redesigns of companies are tested only experimentally on the organization as a whole without dynamic modeling of the long-term effects and with no pilot experiments, which may bring about disastrous outcomes. One of Forrester's explanations for this attitude toward social systems has to deal with the reluctance of humans to accept the idea that social systems are fundamentally the same as physical or engineering systems, with the main difference in their degree of complexity. This attitude stems from the unwillingness to admit that the relationships between the systems parts have a strong influence over individual behavior. The conceptual problem Forrester identified is about the difficulty for humans to perceive themselves as not being in full control on their own behavior, and that they are actually being responsive to their surroundings. This idea is contrary to people's most "cherished illusion that people freely make their individual decisions" (p. 7). Forrester argues that social forces within the systems are in fact controlling systems outcomes. What Forrester tries to point out is that people cannot realize how the structure of the system influences their behavior, and are unable to conceptualize system's dynamic. This limitation, according to Forrester, is the result of the unidirectional paradigm we are all immersed in. The world of social systems as well as other systems is comprised of circular environments where current actions affect conditions, and the changed conditions become the basis for future actions. There is no beginning or ending to this process. This implies that everything is interconnected and intertwined.

Forrester (1971) identified three counterintuitive behaviors of systems that are worthy to acknowledge when dealing with social systems: First, social systems are almost not changeable from interventions that are intended to initiate change. His

explanation for this is concerned with the fact that human intuition accumulated its experience in simple systems where cause and effect are close in time and in space, but in complex dynamic systems, true causes may lie far back in time and arise from an entirely different part of the system from when and where the symptoms occur. People will tend to look for a cause close in time and space to the effect, and will usually identify a symptom of the system, which often is a by-product of the feedback loop dynamics, as the cause, thus overlooking the real cause, and acting in a wrong direction.

Second, social systems have only a few sensitive influence points through which the behavior of the system can be changed. These points are usually not expected and therefore cannot be observed, but even when they are identified, because of the limited intuition and judgment abilities of humans, the actions taken by them will most probably be in the wrong direction.

Third, in social systems there is always a conflict between the short-term and long-term consequences of policy changes. While the short-term consequences are visible, compelling and attract immediate attention, the long-term consequences are difficult to foresee, do not provide the required immediate answer, and many times worsen the present situation. This phenomenon drives policies to favor more short-term solutions, which "can eventually burden a system with long-run depressants so severe that even heroic short-run measures no longer suffice" (p. 63). Forrester (1971) points out that many problems of today are the result of accumulated short-run measures taken in prior times.

Some other important characteristics of social systems as described by Forrester (1993) include the fact that most difficulties are internally caused but usually the system's actors are reluctant to blame outside forces. Also, actions that people take believing they will solve the problem are often the cause of the problem being experienced.

As discussed earlier, several constructs are important for an organization's effectiveness. These constructs are of two kinds: those that characterize the internal processes, the structure of the system, and the economic outcomes, and those that characterize human quality of work life. In the next sections I will review two of these constructs, which I will later link to organization's effectiveness. One of them is quality

culture, which usually has to deal with the characteristics of the internal processes, the structure, and the outcomes of the organization, and the second is employee's health as an important determinant of quality of work life. I will first explain these terms, followed by reviewing literature about their importance in enhancing organization's effectiveness, and closing by reviewing the literature concerning the importance of approaching them using a systems approach.

2.2 Quality, and Quality Culture

2.2.1 Introduction

Since one of the purposes of this study is to link quality culture to organizational effectiveness in a systems approach framework. I will review the literature concerning quality and quality culture in the following manner: First, I will review the literature that shows the link between quality and organizational effectiveness in general. I will than review the literature that reveals the causes for failures in applying change initiatives, showing that the lack of a systems approach and no recognition for the dynamic behavior of the system, were the fundamental reasons for these failures. My next step is to explain through the literature review what a quality culture is, in order to have a common understanding about this construct. I will then explain why I prefer to deal with quality culture rather than with a certain quality program, and review the literature that argues about quality culture being the prerequisite for implementing new quality initiatives. I will than explain the systems thinking concepts in order to articulate the characteristics of the quality culture that is necessary for supporting a systems approach in organization. I will conclude with explaining the usefulness of system dynamics modeling in transferring systems thinking in to the thinking processes and practice in organizations. I will start with defining the terms 'quality' and 'culture'. These are very elusive terms and different people may describe them differently and may attribute to them different meanings.

Garvin (1988) provides five definitions for quality, each of them stemming from a different perspective. Many other authors differ in the quality arena the user-based perspective definition saying "Quality means external and internal customer satisfaction. Product features and freedom from deficiencies are the main determinants of satisfaction" (Juran and Gryna, 1993, p. 5; Gryna, 2001, p. 6), or "Quality is meeting or exceeding

customer expectations" (Evans and Lindsay, p.15, 2002). Since customers are considered both external and internal, these definitions encompass the whole life cycle of a product or a service and are more suitable for a systems approach framework. Some authors challenge these definitions of quality and their holistic perspective has been questioned (Ackoff, 1993; Wood, 1997), but for the purpose of this study, these definitions will suffice, if the notion of 'the customer' in our mind is more broadly conceived (consumer, stakeholder, etc.).

In respect to the term 'culture', I will refer to its interpretations only as they are relevant to 'organization culture'. The most prevailing view of culture is that culture consists of the beliefs, values, and underlying assumptions supporting behavioral patterns and artifacts (Ott, 1989; Schien, 1986). Detert et al. (2000) argue that although there is no single, widely agreed upon definition of culture, there is some consensus that "organizational culture is holistic, historically determined, and socially constructed, and it involves beliefs and behavior, exists at a variety of levels, and manifests itself in a wide range of features of organizational life" (p. 851). Thus, quality culture can be viewed as "A pattern of human habits, beliefs, and behavior concerning quality" (Juran and Gryna, p. 158, 1993; Gryna, 2001, p. 216).

2.2.2 Quality and Effectiveness

Since the era when quality turned to be a major concern in organizations' life, much of the literature has been devoted to the study of the relationships between quality and other important measures of success in organizations like productivity (Fisher, 1990, 1992;Abraham, Crowford, and Fisher, 1999; Hotard, 1888; Mefford, 1989; Ittner, 1994), profitability (Singhal and Hendricks, 1999; Ittner and Larcker, 1996; Tatikonda and Tatikonda, 1996), market value (Hendricks and Singhal, 1996, 2001), competitive advantage (Flynn, Schroeder, and Sakakibara, 1995; Powell, 1995), organizational performance (Treziovski and Samson, 1999; Anderson and Sohal, 1999; Samson and Terziovski, 1999; Dow, Samson, and Ford, 1999; Phillips, Chang and Buzzell, 1983; Hendricks and Singhal, 1996; Easton and Jarrell, 1998; Mann and Kehoe, 1994; Maani and Sluti, 1990), and others. This could be explained by the previous prevailing mind-set that quality by itself is not the end, but a means to something else. Only later

organizations discovered that certain characteristics of quality like zero-defects may also be part of effectiveness goals (Sudit, 1996). While all the measures mentioned above are also in some respect indicators for effectiveness, not much has been written on the nature of the relationship between quality and effectiveness. In the following literature review I will review a theoretical framework that explains quantitatively the relationship between quality and effectiveness. This will be followed by reviewing two field studies that examine the relationship between quality initiatives and effectiveness in a broad sample of companies. Most of the studies in this area are mainly researching TQM programs as the most widely used, and also the more comprehensive initiative than others. The contribution of each of these articles for our purpose will be discussed in the review of each of them.

Sudit (1996) attempts to explore the quantitative relationship between three factors: effectiveness, quality and efficiency. Sudit views quality as the sum of measurable attributes of a product or a service (i.e., reliability, durability), and effectiveness as the "degree to which production and delivery of products and services achieve end-objectives (e.g., profitability, fairness, community service, social responsibility) of the organization" (p.1). According to Sudit, efficiency and quality drive effectiveness, meaning that the more effort is put in quality and achieving efficiency, the higher the levels of effectiveness attained.

The traditional approach is concerning the relationship between quality and effectiveness according to Sudit, is of trade-offs. This means that the more of the one, the less of the other, at least in a certain range which represent the minimally acceptance levels, specified by management, of quality and effectiveness or the characteristics that represent them. Sudit explains that at the source of the traditional view of the relationships between effectiveness and quality is the relationship between costs and quality. The total cost of quality is the sum of the quality failure costs and the quality appraisal and prevention costs. To a certain degree, the more you invest in appraisal and prevention, the less you incur in failure costs, because your investments (costs) are less than the costs savings. The result is a decrease in the function of total cost of quality. Above this degree, the more you invest in appraisal and prevention, the more the total costs of quality will increase. This means that the minimal cost of quality does not occur

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at the maximum level of quality but below it. According to Sudit, this is the result of the conventional cost accounting system. He stresses that in order to drive quality further, costs of quality have to be identified separately from other costs, and analyzed in relation to quality goals.

Sudit explains the new approach to the relationship between quality and effectiveness as represented by the TQM approach. According to Sudit, TQM holds that a total commitment to quality by all organizational levels will turn the relationship between quality and profitability complementary. This new relationship implies that higher quality will constantly drive the organization to higher profitability, thus the optimal level of quality is also the highest level for profitability. This is accomplished according to Sudit by higher levels of employees' motivation and commitment, leading to continuous improvements, re-engineering and innovations. Sudit also mentions that the focus is being shifted away from short-term effects to cut costs to longer-term efforts to improve effectiveness. Sudit points out that the complementary relationships between quality and effectiveness are consistent with Deming's views concerning the inadequacies of traditional cost and performance measures. Sudit also turns our attention to the fact that these two approaches to quality and costs may not be mutually exclusive. When operating at lower levels of quality, the cost-quality trade-offs are likely to apply, but when operating in higher levels of quality as it is expected in a TQM approach, than the relationship between quality and costs turn to be correlated. It is important to realize that Sudit in his discussion had simplified the construct of effectiveness to be represented by the measure of profitability, which may in many cases represent different things than effectiveness (Campbell, 1990).

Mann and Kehoe (1994) evaluated the effects of quality improvement activities on business performance. The authors developed a Business Performance Classification System to assist in the investigation and analysis of quality activity effects of business performance. The aim of this system was to measure business performance accurately at each organizational level reflecting the breakdown of the organization's vision, mission, strategies and goals. This approach indicates that Mann and Kehoe used the term *business performance* the way Sudit used the term *effectiveness*. This is not completely consistent with Beer's (1980) definition of effectiveness. His definition is supposed to be more

holistically-oriented and to include measures about the fit to the environment too. Since we don't have an operational definition of Beer's approach, it is difficult to speculate exactly how effectiveness should be measured. For our discussion, Mann and Kehoe's research is useful in studying about the linkage between quality activities and the organizational effectiveness or business performance in an operational manner

As mention, Mann and Kehoe investigated the linkage between several quality activities and performance measures. Their field study included 83 companies, each of which used more than five listed quality activities. This research is a useful example for the linkage between quality activities and performance measures, not only because of the large number of companies that participated in this study, but also because a wide variety of quality activities were included, such as: quality awareness program, delegated teams, voluntary teams, internal audits, supplier improvement activities, statistical process control, quality costs, ISO 9000, Taguchi methods and TQM.

Mann and Kehoe categorized business performance into strategic business performance measures (SBP), which should address the major corporate goals, and operational business performance measures (OBP), which address the daily or weekly objectives throughout the organization by all levels. In formulating the OBP measures, they considered the inputs, the transformations and the outputs to ensure all elements of the organization were addressed. According to Mann and Kehoe, this classification system ensured that both higher level and lower level effects were investigated and effects across all functions of the organization were included for analysis. The analysis results concerning the linkage to the strategic business performance measures show that the two quality activities (ISO 9000 and TQM), which are implemented across all functions of the organization, scored highest, while Taguchi, the most specific of the quality activities, scored the lowest. This result indicates the importance of systemic activities in relation to effectiveness.

Some other important insights the authors gained from their structured interviews were the realization that several TQM companies experienced a decrease in effectiveness in the time when the study was done. The reason for this was found to be the fact that these companies actually implemented TQM when they already faced a decrease in market share or sales turnover, and it would take them longer to reverse such trends. This

insight is important for the discussion later concerning a systems approach to quality initiatives.

Another important finding with regard to TQM was that all 21 TQM companies interviewed believed TQM has had a positive effect on their organization, and would not like to return to the pre-TQM years. This is an indicator for the social acceptance of TQM.

In relation to the operational business performance measures, the results in average indicated a positive effect on OBP. In this case TQM was found to be the most effective, and delegated teams followed immediately after. Taguchi was found less effective than the other activities. The authors could also compare between different quality activities and their effect on certain OBP. For instance, SPC (statistical process control) was found less effective at improving policy deployment than ISO 9000 but more effective at improving processes.

Besides other findings, Mann and Kehoe found that an impediment to their measures was the fact that most organizations did not measure the effects of quality activities the way they did. Most organizations if they measured at all, their main purpose was to monitor progress at meeting objectives rather than measuring the effectiveness of a quality activity.

Mann and Kehoe have shown in their research that all quality activities that were investigated and particularly TQM, has beneficial effects on business performance. This finding was obtained in spite the difficulty of measuring and assigning specific benefits to particular activities.

Samson and Terziovski (1999) used a sample of 1200 organizations in the manufacturing business to empirically investigate two questions. The first question deals with the level of reliability and validity of the basic elements of TQM (leadership, management of people, customer focus, use of information and analysis, process improvement, and strategic and quality planning) for measuring and predicting organizational performance. The second question looks for those elements of TQM that are best predictors of organizational performance. Their measures of performance include: customer satisfaction, employee morale, productivity, and quality of output and delivery performance.

Samson and Terziovski found that "the TQM elements individually and collectively comprise a reliable and valid instrument for measuring TQM practice and performance" (p. 397), and that "there is a significantly positive relationship between TQM element strength and operational performance" (p. 397).

The relationship between the six practices of TQM and performance were analyzed using regression and their findings provide some interesting insights from a practical perspective as well as from a research perspective. Samson and Terziovski found that three of the factors, leadership, human resources management and customer focus proved to be strongly and positively related to performance, while the other three factors, planning, process management, and information and analysis, very weakly significant or negatively related. These results are interesting because the three strong predictors of performance according to the authors' findings are the three least analytically oriented criteria, the more 'soft' items of the criteria, while the 'hard' elements were not strongly and positively related to performance. Though these results could direct organizations about which practices to prefer concerning quality, the authors do not recommend generalizing their findings as worldwide acceptable findings. They do caution that their study is describing a given sample at a given point in time, whereas quality initiatives are usually intentions for a long period of time and are dynamic in their nature.

Samson and Terziovski conclude that the results of their regression analysis are important for management practices when they have to consider where to concentrate their quality efforts. The authors believe that all six factors contribute to improving performance, but the three 'soft' factors are the distinguisher between high-performance and low-performance firms. The authors claim that their finding are consistent with the findings in the literature, that performance of the organization is related more to the 'soft' factors that quality systems and structural factors.

Samson and Terziovski are aware that there is unexplained variance in their performance construct due to many other factors like technology, scale, business structure and focus, and luck. The authors believe that their study supports the assertion that TQM is a reliable, workable, useful program, and that failures for most cases stem from how the program is implemented. The authors are also aware that there is a time lag

between the implementation of new quality initiatives and the time when performance improvements are observed. They suspect that this last fact also contributed to the unexplained variance found in their performance construct.

This study is the largest study about the effectiveness of quality practices for organizational performance that I have encountered in the literature, and it does highlight the relationship between certain quality practices and performance, and especially is constructive in enhancing our understanding about which practices are more useful than others.

From the above discussion we may conclude that there is a substantial theoretical and practical support for a positive linkage between quality practices and organizational effectiveness. With this recognition in mind it could be considered unanticipated to find so much literature dealing with explanations about why TQM programs fail.

Many researchers tried to figure out the reasons for the lack of success in implementing TQM in the workplace (White and Wolf, 1995; Grant et al., 1994; Page and Curry, 2000; Cole, 1998; Kolesar, 1995; Roth, 1994; Saad and Siha, 2000; Tatikonda and Tatikonda, 1996; Choi and Eboch, 1998). Many of them (Ackoff, 1993; Roth, 1994; Kolesar, 1995; Savolainan, 2000; Fok et al., 2000; Wilkinson, 1992; Kaufman, 1992) have reached the conclusion that by neglecting the 'soft' issues in implementing TQM and focusing mostly on 'hard' issues, organizations contributed to the low rate of success of TQM implementations. A partial list of these 'soft' issues, according to the literature that have not been addressed enough by organizations include employer-employee relationships, employees' perception of TQM, leaders attitude toward quality issues, leaders short-term vision, emphasis on quality products rather than quality interactions, not viewing the employee as one of the main customer and the most important stakeholder of the organization. This body of research supports the findings pointed out by Samson and Terziovski's study mentioned above.

This long list of causes researchers found for unsuccessful TQM implementations, which is far from being exhaustive, brings one to wonder if there could be found a comprehensive explanation for all of these causes, such that will help us to resolve the practical problems mentioned above and improve implementation of quality activities. For such an explanation to exist, one might need a different paradigm. This new

paradigm needs to allow moving from a cause and effect paradigm and linear thinking to a more systems-oriented paradigm where relationships between the components of a system are of prime consideration and system's behavior is acknowledged to be the result of the system's structure and not the other way around. Several authors (Sterman et al., 1997; Keating et al., 1999; Repenning, 2000; Repenning et al., 2001; Oliva and Sterman, 2001; Oliva et al., 1998; Purnendu, et al., 1998) provide such a new approach that offers different insights for understanding the improvement paradox (which consists of a decline at the outset that leads to an increase in the improvement of all outcomes at a later stage). Their system dynamics approach makes it feasible to consolidate the above problems to one big picture, a picture that is the outcome of the behavior of the system. In the next section I will review this literature to gain a new understanding about the dynamic of failing improvement programs.

Sterman, Repenning and Kofman (1997) investigated the case of implementing Total Quality Management at Analog Devices, Inc. The TQM program at Analog was considered a success in all operational measures, but failed to improve financial measures. The authors assume that the cause does not lie in forces that inhibit change, since change was achieved with a certain success, and it also does not lie in external economic events, because other similar companies did improve their financial performance during that period, but it does lie in certain side effects, which were the results of the improvement process itself. Analog was unable to foresee these side effects, causing them to be overlooked and to push the whole system of Total Quality Management to fail.

The authors explain the paradox by the different paces at which improvement initiatives occur in different segments of the company. Problems arose when these paces are not aligned. In the case of Analog, the quick improvement in the manufacturing department, which caused direct costs to fall drastically, initiated a vicious cycle because these achievements were not aligned with the slow and long improvement in other departments like product development and other management functions. Sterman et al. also point to the fact that the cost analysis function in a company needs to be revised when a change process is taking place, in order to mirror the new environment, the change. If such a revision does not occur, and the company continues to work with old

tools in the new system, there is a very little chance to recognize and capture problems that occur.

The authors point out that the first problem has to do with the mental models of the program initiators and Analogs leadership. As in many other quality programs, the persons who are responsible to facilitate the implementation of the program worry that people will not be convinced to take part in the effort and be active, so they tend to launch those projects that are less complex and yield the fastest results, exactly what had happened in Analog's case. The first initiatives were implemented in manufacturing, with the best support and commitment of management, and progress and improvement were very fast. The success attracted more units to the program, but then there were fewer resources for each project, and less support of management, therefore fewer chances to succeed at the same pace as the first ones. Also, the latter were more complex than the first projects.

The fast improvement in manufacturing created excess capacity in manufacturing that could have been utilized for other products if improvement in product development would have caught the pace of manufacturing, but it did not. It did not because of the above reasons, more complexity and later initiation, but also because the people in product development, the engineers, were the most skeptical about the program and therefore were reluctant to help. The extra capacity could not help in capturing additional market share because competitors didn't stand still and also improved their products.

The second problem, according to the authors, is a direct result of the first problem, and has to do with the chain of events that followed the fall in direct costs, and the traditional pricing function at Analog. The authors explain that one of the first results of the improvement initiatives at Analog were the decrease in direct costs. Analog used their unit direct costs as a basis for pricing decision, by marking it up by a standard percentage. This system worked well for them to cover the indirect costs and provide a reasonable return. As long as direct costs were aligned with indirect costs, the traditional markup percentage was sufficient. The moment direct costs fall drastically but indirect costs lagged way behind, this system of markup according to direct costs, was found critically bad for their financial position. Markup percentage did not changed much over the years, so the old pricing system produced shrinking prices according to the new

improved direct costs. This fact affected the competition on prices in the market, ruined Analog's returns even more. With fewer earnings, Analog's investment dropped. Analysts who recognized the rising of the indirect costs fraction had blamed Analog's cost control. With this bad reputation, Analog's stock prices dropped, making the company more vulnerable to takeover. This fact caused more pressure on management to cut costs, which led management to layoff, and as the authors describe: "job security and stability plummet…and commitment to TQM falls" (p. 514).

The authors' main conclusion is that a quality improvement system is a lot more complex than it seems to be considered, and in order for a program to be successful it implies consideration of all systems' elements. In this specific case, their conclusions involve the recognition of the link between the improvement program and all other activities of the firm that have a paramount affect on the side effects of the improvement program, like customers, market competition, and market capacity or the overall health of the market. Creating excess capacity through a quality improvement initiative can be counterproductive if the overall market cannot absorb the excess capacity. If that is the case, layoffs will probably follow, which will eventually lead workers to believe that TQM works against their own good, commitment to the program will plummet until the program will unfortunately die.

The authors acknowledge the fact that it is not coincidental that TQM and other improvement programs confluence with a weak economy and low attrition. That is exactly the conditions that a company seeks to improve itself, and actually is the worse time for an improvement program to succeed easily. Mann and Koheo (1994) also acknowledged this problem (p.37). Beside the above consequences in the firm itself, Sterman et al. indicate that excess capacity will also have harmful side affect on the financial situation in the market. The authors demonstrate that it boosts price competition, which lower the prices, and make financial vulnerability worth, pushing firm to layoffs, thus destroying the ground on which TQM programs rely.

Even though many proponents of TQM will urge to start the program with early results, the authors believe that such an approach works against the chance to succeed. According to the authors, it creates unbalanced start conditions for different sectors in the organization, favoring the easy-to-implement areas; in time, in resources, and in

management support, making it even more difficult to the already complex segments to follow suit. So their ultimate conclusion concerning this issue is that "Improvement programs can fail not in spite, but precisely because of their early success" (p. 519).

The authors also critique TQM that despite its declared concept that a system is to be optimized, not its parts, because it will sub-optimize the system as a whole (Deming, 1994), actually TQM with its perfect tools to rank-order problems, and look for cause and effect relationship, drives the program to "piecemeal policies" (p.519) that eventually, because of its tightly coupled dynamic systems, will "optimize the parts at the expense of the whole and the present at the expense of the future" (p.519).

The authors also acknowledge the fact that TQM works great for manufacturing, but is still immature with its tools for other more complex departments like product development.

Their conclusion about Analog, and for many other TQM programs is that they lacked a framework that should have enable them to understand the implications of their knowledge, actually they implicitly refer to a system dynamic method that has the ability to put all the messy things together (Kim, 1990).

Keating et al. (1999) extends Sterman et al. (1997) research on the paradox between successful improvement programs and their worsening effect on financial performance of the organization. They investigated the internal dynamics of an improvement program and also the interactions of a program with forces outside the intended area of improvement focus. For this study, the authors used detailed field studies from many organizations. They also incorporated extensive interviews and archival data on various metrics of quality, product histories, internal company materials, and financial results. For modeling the system and represent the dynamic relationships between the system's components, they used system dynamics tools.

Keating et al. examined the fundamental improvement trade-offs, and found that the main problem rests in the dynamic trade-off between effort allocated to improvement and efforts that boost throughput. According to the authors, "effort allocated to improvement raises productivity. Boosting process throughput, thereby lowering production pressure and yielding still more time for improvement" (p. 121). This is a reinforcing feedback loop that shows that reinvesting early improvement gains in further

improvement effort creates a positive mechanism that generates even greater gains in quality and productivity. But the authors acknowledge that it takes time for improvement effort to show results. Therefore their first effect is "worst-before-better" (p. 122) pattern. The authors explain that improvement efforts lead to decline in output in the short-run, but if managers insist on improvement and do not succumb to pressure to meet throughput goals, than productivity will rise after a certain delay. If managers are affected by the pressure to meet throughput goals, than they press employees to work harder. Employees will react by cutting back the time devoted to improvement. This will actually increase throughput, but in the long run will also stall productivity and quality growth. This dynamic is strongly supported by Repenning et al. (2001). This trade-off dynamics is also influence by the tendency of managers to harvest initial productivity gains by downsizing or increasing throughput objectives. Expected productivity gains from improvement efforts are assumed in projecting future labor and capital requirements. But reduction in resources ensures that throughput pressure remains high, preventing the workforce from devoting time to improvement, and avoiding anticipated gains to realize. The authors stress that managers must support the improvement efforts by limiting the effect of throughput pressure on effort allocation.

Another source for problems in improvement programs, according to Keating et al. is the reliance of improvement initiatives on managerial push, instead of employees' commitment to the program. The authors explain that since quality improvement rest almost exclusively on the willing of the employee to participate, management drive is less effective than employees' motivation. In most cases the authors observed, that only when the source for motivation and excitement shifts from managerial drive to self-commitment of employees through gaining more confidence in the program value, a self-reinforcing feedback loop is created, which influence the sustainability of the program. This motivation feedback loop may act as a virtuous cycle where improvement reinforce commitment, which reinforce still more effort and improvement, or as a vicious cycle, where poor results lead to less effort, leading to even worse results. The authors list several factors that interact with this feedback loop, and driving it to be either a virtuous cycle or a vicious cycle. This list includes the level of complexity of the process to be improved, since a longer delay between the launching of the program and the observed

results is associated with complex processes, causing employees' motivation to deteriorate. Also, the effectiveness of any improvement effort depends on the scope of the initiative and the adequacy of the chosen improvement methodology. Some programs fit more manufacturing organizations and do not fit service organizations. Also, inadequate support infrastructure or training limits the effectiveness of improvement efforts, and finally, when insufficient job security is present, it may destroy any commitment to improvement if workers believe that productivity gains will lead to layoffs. This last scenario is well described in Sterman et al. (1997).

Another feedback loop identified by the authors is between goals setting, employees' expectation and employees' motivation. According to the authors, employee commitment to improvement increases when workers and managers perceive that improvement efforts have positive results. In order to make any conclusion, they compare the rate of progress they observe to their expectation. Expectations are effected by the goals set by managers. Aggressive goals help the initial push but they erode employees' motivation in the long run. This may affect employee effort, which may cause performance to suffer, confirming people believe that goals were too high, and initiate a vicious cycle.

The authors emphasize that knowing how to set objective that are feasible is very important in preventing the vicious cycle from occurring. For that reason, they recommend using the 'half life' theory. When using this theory, it is possible to estimate the time required for defects to fall by 50 percent. The authors also acknowledge that complexity is a major determinant in the time required to improve. The greater the complexity, the more time is required to learn the problems, the slower the improvement cycle is.

The authors' next observation is about the effect of the first programs that are initiated in an organization, on the later ones. In this respect, the authors repeat the finding of Sterman et al. (1997), meaning that when the first project undertaken in an organization are the easy to implement ones, the harder ones that are left to the next stage, may adversely be affect through loss of employee motivation, that falls due to the comparatively slowing down of the improvement rate.

The authors point out to the sensitive relationship between the required training and support for employees involved in improvement programs and the pace this training is applied. If training is not sufficient or if training is aggressive both will have an adverse impact on the effectiveness of people in the improvement program. The authors recommend the training and support should grow side-by-side with the requirements of the project.

The authors' last observation about internal relationships affecting quality initiatives concerns the level of attention given to a program. The authors claim that when too much attention is given to a successful program, people tend to expand it to all sort of problems for which it is ill suited. This practice shadows the benefits already obtained, and further dilutes worker skills, causing declining of effectiveness, damaging even effective programs.

In relation to external interactions that affect and are affected by improvement programs, Keating et al. point out that many such relationships may have mutual positive effects, but many others can be harmful. The authors' findings in this area are quite the same as those found by Oliva et al., which will be reviewed in detail next, so I will only briefly mention their findings here. The authors found that multiple program lead to greater organization awareness to quality issues. They also generate commitment to improvement that can be transferred from one program to another. Also techniques can be transferred, thus shortening the time required to build competence. But the authors are aware on many other negative effects that can result from multiple programs. One of them is the effect an easy-to-implement program may have on a more complex program concerning the time required to obtain results, causing pressure on the more complex program to speed, thus damaging its ability to succeed. Like Sterman et al., these authors also reveal that improvement program may lead to excess capacity, which may intensify the pressure for layoffs. 'Iron Law of Layoffs' expresses their term for this phenomenon, meaning that when productivity improvements are greater than the rate of sales growth plus the labor attrition rate, excess capacity is created. The more successfully an organization is in improving its manufacturing operations, the more intense the pressure for layoffs. The authors point out that this kind of problem is especially dramatic in mature, slow growth industries, and when economy is weak. Their advice is to convince

workers that its for their best interest to participate in improvement program, otherwise all of them might find the way out, or reverse the order of improvement program, starting with the slow-improvement process first, creating potential for growth, and only then moving to the easy projects, which provide excess capacity.

The authors' last observation about outside influence on improvement program is when demand is too high. This may occur when initial improvement program succeed, feeding back through the market to increase demand, and making it difficult to sustain the quality levels that led to this demand, thus damaging customers satisfaction, lowering demand.

Keating et al. conclude that improvement program fail many times because it is difficult to anticipate the wide-range effects of improvement programs on internal factors, as well as on external factors. The authors suggest managers to plan carefully the roll-out of a new program and all its consequences. They believe that in most, managers must become adept in understanding their organization as a dynamic system, especially being able to understand the long-term and distant side effects of their actions.

Oliva, Rockart and Sterman (1998) studied the implications of implementing multiple improvement programs simultaneously or in sequence in one site. They focused on the individual programs, and their interactions. Their purpose was to help managers to select and implement specific programs. These authors believe that in order to understand organization level performance, one has to understand the lower level of performance, and especially the problems. The authors reviewed the history of thirteen improvement programs, seven of which are described in this study. They analyzed these cases using causal loop diagrams to map the causal linkages within and across programs that contribute to their dynamic behavior. According to Oliva et al., "programs histories have clarified the importance of a few key resources and the central role of employee perception of the program value, in successfully launching and sustaining improvement programs" (p. 37). As the authors noted, complementariness in skills, tools, awareness, knowledge and capabilities increased the likelihood of program success. On the other side, competition for limited resources, attention, and credit had lowered the likelihood of program success and biased the chances of success across programs.

The authors articulated a set of dynamic hypotheses on how the structural elements of the organization interact with decision-making processes to generate the observed patterns of adoption, abandonment, and continuity of improvement programs. Their first dynamic hypothesis tries to capture the dynamic caused by limited resources for improvement. According to Oliva et al., there are three basic resources that appear to be critical in sustaining an improvement program. These sources are managerial time, employee time, and skill with program tools and techniques. Managerial support turns programs to be more attractive, thus enhancing the effort allocated to the program. As more effort is allocated to programs, the available managerial support may become inadequate, lowering program attractiveness and constraining the growth of effort. The authors comment that this dynamic stresses the importance of consistency in sponsorship for initiatives, and of continually examination of its adequacy.

The second limited resource is employee time. Its availability for improvement program effort is limited by the total available time and by the effort needed to achieve production throughput. There is a trade off between allocating time for improvement and for production. But it is important to recognize that the more resources are devoted to improving the process it self, more resources for improvement are liberated, creating a continuous and self-sustaining improvement mechanism. The authors point out that at this point, when employee and managerial time are freed by improvement efforts, acknowledgement of the possible dynamics that may result from several different managerial options is very important in order to act in a direction that will sustain growth.

The third basic resource that plays an important role in maintaining improvement programs according to Oliva et al. is program-specific skills held by employees. Skills are increased through experience with the program's tools, thus creating reinforcing loop. The more employees gain greater capability and confidence with the related skills, the more a program becomes attractive and opportunities to use the tools become more apparent. The authors emphasize that the skill creation process also needs to be managed; otherwise programs may lose momentum due to a lag between awareness, training, and implementation. The exchange between skilled employees and new employees due to turnover dispossesses the organization from its cumulative experience.

The second dynamic hypothesis Oliva et al., articulate has to do with the motivational driver. The authors believe that employees must believe in the value of a program in order for them to be effective participants. The authors believe that training and managerial support are only temporary drivers. They emphasize that even when command-and-control relationships are possible, without employees' intrinsic motivation to participate, the outcomes may not be as successful as desired. Employees who work by following orders may never take their time to truly understand the process, thus limiting their effectiveness. When command-and-control relationships are the reality, managerial supervision becomes a must, causing the improvement program to be very fragile to supervision presence and to staffing changes.

As the alternative to the command-and-control enforcement, the authors recommend to enhance long-term results-based belief in the program's value. The authors believe that this attitude might eliminate the cynicism and disengagement with the program, when perceived results are absence, as usually occurs in the beginning of any implementation of a new program. According to the authors, when a long perspective is employed in regard to the program's value, than as effort accumulates over time, the employees begin to trust their own experience with the program, have less need for managers' pushing. The more benefits can be observed, the more employees increase their perception of the program's value and the more motivated they are. The opposite is also true.

The third dynamic hypothesis Oliva et al. articulated is about the benefits from installing multiple improvement programs, when they are approached as complementarities. According to the authors, these benefits are many times overlooked or difficult to detect. Especially they mention the tools and skills leaned, and the mindset changes achieved, from one improvement program and transferred to the other. Also the authors especially point out the complementary bodies of knowledge created by one effort, which are then used by another program.

But the authors acknowledge the costs of competition and confusion when multiple programs are installed. Multiple simultaneous programs compete on limited resources like employee's or managerial attention. The authors point out that one apparent result is the low attendance of employees in many improvement teams. The

authors also found that multiple programs may increase the inability of employees to understand each other's mental-models due to different perceptions created by the newly acquired training. The authors understand that the obvious solution would be to train all employees in all programs to increase their awareness of the goals of other programs, but this kind of strategy may result in low skill levels and programs to be less effective.

Another problem the authors identified as being the result from the implementation of multiple programs is the unlikeliness of employees' attribution process of benefits to individual programs to be unbiased. In this sense, the authors realized that the total perceived improvements are likely to be less that the actual improvements, when multiple programs are implemented, and that there is a delay between the time a program were implemented, and the time benefits from it had occurred, causing employees to attribute the benefits to later installed programs. According to the authors, there are many other attribution errors caused by the perception of the relative success of new products or programs in comparison to the previous ones. The authors recognize also that new programs may gain credibility at the cost of older programs because of their more recent visibility.

Oliva et al. realize also that when programs begin to have a history of failure, cynicism and erosion of management's reputation increase, and employees tend to lower their efforts on programs they expect to disappear. This presents a difficult situation for managers who must continue to encourage employees.

In their next section Oliva et al. make an attempt to explore the many reasons organizations have for introducing new improvement programs. The authors believe that revealing these reasons, may help in understanding why some programs lead to strong positive outcomes, while others may only reinforce the problems they were suppose to improve.

One clear reason for multiple improvement programs according to the authors is the presence of multiple issues that cannot be addressed by one individual program. The authors believe that multiple issues need to be attended to at the same time, and that issues change and so should the attention to them, along with changes in strategy and market requirements.

Another reason for launching improvement programs according to the authors is the belief managers hold about the influence improvement programs have on values, focus, and communication patterns within the organization. Issues like creating lasting quality awareness and focus throughout the organization, or breaking down barriers to teamwork, or reducing the number of dysfunctional interactions among disciplines are some of the issues that may encourage managers to launch an improvement program.

Customers' influence on launching new programs is another reason identified by the authors for installing new programs, which is especially important where quality and reliability of suppliers has a large influence on cost and market performance. Improvement programs of this type are many times an attempt to close a performance gap. Once new performance levels have been achieved, customers' expectations adjust to the new improved levels and the whole industry is locked into a self-perpetuating race to continuously improve its performance.

The authors observed the dynamic caused by launching an improvement program on launching more programs. According to the authors, any improvement programs effects production by draining resources necessary for production, thus reducing the overall performance and leading to a perceived need for additional improvement programs. This dynamic is even more reinforced by the delays between the launching time and the capturing of the benefits, or by the pressure to close performance gaps.

Another reason for implementation of multiple programs, according to the authors, is the acknowledgement that there are only limited resources for a program, and therefore low expectations from program results are created. This leads to setting low goals, and therefore small teams to achieve them through more localized programs. According to the authors, programs with minimal resources and low goals are unlikely to achieve their potential, thus insuring that future programs will get even less resources, and have even lower goals, but launching still more small programs. This reinforcing mechanism, amplifies the number of programs.

Another dynamic that enhances introduction of new programs according to the authors relates to attributing benefits from previous programs to new programs. The authors believe that such attribution leads to the increase believe in the value of new programs, and therefore more programs may be introduced. Because of the enthusiasm

recognized with each new program, misinterpretation of the value of the new program follows, leading to more introductions of new programs.

The last reason for launching more new programs according to the authors is related to the awareness of improvement opportunities gained by people who scan the market in order to close gap performance.

Oliva et al. conclude that the order of introduction and the interactions among programs play an important role in how well the lessons of those programs were internalized by the company. The authors also realize that programs compete not only with each other but also conflict with existing norms, especially in respect to measures and metrics.

The authors recommend organizations to address multiple issues simultaneously and to acknowledge that a single program cannot cover them. They also believe that a framework is needed to inform the sequencing and timing of improvement efforts. Their recommendation for a starting point for the construction of such a framework includes the exploration of: "(1) the structural elements required sustaining programs, (2) the interactions among programs, and (3) the decisions for program launching" (p. 52). The authors recognize that it is practically impossible to optimize the process of introduction of programs, but they believe that it is possible to apply the managerial lessons learned to help individual program to succeed, to lower the costs and raise the benefits of program interactions, and to manage the program launching process.

A more theoretical investigation of the different relationships between the components of a quality improvement initiative is provided by Purnendu et al. (1998). These authors attempt to identify the important factors or variables and their relationships in the process of quality improvement. The authors apply the system dynamics modeling tools in conceptualizing a quality model, which describes the relationships and influences between quality improvement activities and the technical and management systems. The authors believe that a system approach to quality has to encompass improvement in all areas of business in order to enhance the quality of the firm. The authors chose to view the quality process as a process consisting of inputs and outputs and their attempt is to capture the integration, cooperation and coordination activities of all the different functions within an organization, because a comprehensive understanding of all these

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relationships and influences may help acknowledging how a change in any of the functions will impact the others. Purnendu et al., recognize that the whole transformation process through which quality inputs are converted to outputs can be broken into three distinct systems which include the human resource system manifesting itself through training, employee involvements, skill and employee motivation. The second system is the technical system, which impacts the quality improvement system through the consideration of inventory, process improvement, product improvement, defect generation, costs of quality, productivity, cycle times and others. The third system is the quality improvement system, which in turn influences both the human resource system through human support, innovation and motivation, and the technical system through operating environment, the level of technology, and technical support.

The authors relied heavily on the literature and on direct interviews with industry leaders in order to capture the relationships among the major factors influencing through and influenced by the quality improvement system. They identify through the literature eight prime quality areas, which include: the leadership function, training, process management, employee relations, product/service design, supplier quality management, quality department, and quality information system. For the purpose of this study, they consider the first four elements as the more critical ones, especially for production and manufacturing organizations. After they constructed the model, the authors presented it to six manufacturing companies for fine-tuning and validation.

The authors' major findings from their interviews include the fact that most organizations considered the level of commitment within organizations as one of the most critical factors in the implementation of quality management. Another important finding the authors report is about the strong link between quality initiatives and their impact on the human resources. Quality initiative reinforced employee involvement and training, which increased employees' satisfaction, which tend to produce higher levels of quality and productivity. According to the authors, people were considered an important part of the quality efforts, a fact that supports the findings that satisfied employees produce higher levels of quality and productivity. In relation to quality costs the authors noted that by-and-large, quality costs increased, but this conclusion was actually based on estimates since most companies do not measure quality cost directly, or they are expressed not in

monetary measures but with measures like units of defects. Another impediment for measuring quality costs is according to the authors the lack of accounting systems in place that account for the non-financial areas of manufacturing performance such as quality. The authors also revealed problem with suppliers especially the inability to rely upon them in terms of timeliness of delivery. Inventory levels were found also problematic because of their dependency on accurate forecasting.

Purnendu et al. conclude that the companies that were interviewed recognized that closing the quality gap is a major driving force in taking appropriate quality initiatives. They believe that this qualitative model provides much insight into the quality system, and may assist firms with a richer understanding of the relationships between quality, technical and human resource systems, and the management challenges in relation to design and implementation of quality initiatives. The authors also acknowledge that the model encourages a paradigm shift in how managers view the quality system, which is far away from a mechanistic view. This holistic view of the quality system, according to the authors, may enforce managers to focus on the whole system rather than on individual parts, thus supporting a greater chance to make quality decision.

The most important insight this line of articles provides is that improvement programs cannot be seen as standing alone. Their success or failure depends on the ability to see them as one component of a large system, where their actions are affected and affect all other components of the system. Only by becoming adept in understanding organizations as dynamic systems, better decisions about improvement programs may result, leading to greater chances for success. It is also important to note that much of the dynamics that takes place in organization concerning improvement programs has to do with mental models of people, which affect their motivation and their actions. It is of paramount important to reveal these mental models in order to make more suitable decision, which will promote motivation to take active participation in improvement programs.

2.2.3 Quality Culture

Most literature concerning quality culture deals with this issue in respect to TQM practices and implementation (Zeitz et al., 1997; Westbrook, 1993; Westbrook and Utley,

1995; Scheuing, 1991; Dellana and Hauser, 1999). It could be speculated that the research concerning the aspects of success and failure for TQM implementations, triggered the relevancy of organization culture for this endeavor. It was recognized in many of these studies that a certain need for a paradigm change in the concepts and attitudes prevailing in organizations is required in order for TQM to work. This observation had triggered the interest of researchers to find out what is actually a culture that promotes change initiatives, which are fundamental for TQM implementation. A quite different approach to this issue is presented by Detert et al., (2000). Detert et al., (2000) reviewed the literature in order to build a general framework of culture that can be linked to improvement initiatives in organizations. They concluded their study with a demonstration of the link between this framework and TQM' values and beliefs, but they noted that the same attitude could be used to any other improvement initiative. Gryna (2001) also makes an attempt to provide a general framework for quality culture, which is not specific to any comprehensive change initiative. I will review these two frameworks and add any important insight from the rest of the literature concerning quality culture, which is specific for TQM implementation, if it has any relevance to our discussion.

Detert et al., (2000) identified an existing gap between the research about the dimensions of organizational culture that are most related to implementation of change programs attempting to improve organizational outcomes, and between the widely accepted acknowledgments that culture is a key variable in the success or failure of organizational innovations. In this study, they developed a general framework of culture dimensions that can be useful in defining which aspects of culture are most appropriate for any change initiative or any other endeavor concerning improvement. They also illustrated the utility of this framework by linking it to a comprehensive set of values and beliefs that, according to the authors, represent the cultural backbone of successful TQM adoption. The authors argue that TQM is an adequate representative for many of the improvement programs, which may share most of the same cultural dimensions.

The results of the authors' extensive study of the general literature about culture revealed a list of eight dimensions most discussed in the culture literature. This list includes ideas about the basis of truth and rationality in the organization. This refers to the fact that people in organizations hold various ideas about what is real and what is not

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real and how what is true is determined, which may affect the degree to which people adopt either normative or pragmatic ideas. In the case of TQM, the approach to truth and rationality is based on the use of data, or facts. The argument is that in order to make quality decisions, one need to have them based on facts that can link effects to their causes. Central to this idea is the belief that trends, cause and effect, and interrelations among variables are too complex to be evident without such data collection and analysis.

The second dimension of culture is about the nature of time and time horizon. The authors found that the time horizon of an organization helps determine whether leaders and other organizational members adopt long-term planning and goal setting or focus primarily on the immediate business. The authors argue that in the TQM literature there is a great emphasis on the long-term commitment to quality, and the belief that short-term sacrifices are necessary to enhance quality in the long run.

The third dimension deals with beliefs about what motivated humans; whether they are motivated from within or by external forces, whether they are inherently good or bad, whether they should be rewarded or punished, and whether they can be manipulated in order to extract from them more effort and more output. The TQM philosophy rests upon the belief in people motivated intrinsically, and doing a bad job only because of systems' failures (Deming, 1986, 1994).

The fourth dimension has to do with ideas about stability versus change, innovation, and growth. In this respect, Detert et al. argue that like individuals' who have propensity toward stability or change and risk taking, organizations are also either risk takers, meaning they are open for change and innovations, or are inclined towards stability. It is obvious that one of the TQM's main concepts has to deal with continuous improvement, presenting a mindset in which things are never good enough, therefore change is inevitable and should be viewed positively, and without fear. This is also common for most quality initiatives, and is more aligned with the pace of change nowadays.

The fifth dimension has to deal with the centrality of work in human life and the balance between work as a production activity and a social activity. The authors argue that some individuals view work as an end in itself, meaning that they are task focused and concerned primarily on productivity. Whereas other individuals, view work as a

means to other ends, therefore productivity is less an important goal for them than the social relationships in the organizations. In respect to TQM the authors argue that earlier, Deming advocated the emphasis on process rather than on results, but lately the focus is on both, process improvement and results. The authors' conclusion about TQM is actually not aligned with the arguments in this dimension, in the way they articulated it, because focusing on the process is not parallel to viewing the work as a means to another end. Both focuses; on the process and on the results are in respect to the end, they only differ in the 'how'.

The sixth dimension is about working alone or collaboratively. It has to do with the beliefs about how work is most effectively and efficiently accomplished. TQM explicitly advocates cooperation and collaboration, believing that it leads to better decisions, higher quality, and higher morale. Teamwork, and quality circles are essential practices in TQM (Hackman and Wageman, 1995).

The seventh dimension is about the degree to which control is concentrated or shared. This dimension differentiates between tight control environment, where decision-making is centralized, and between loosely controlled organization, where power and decisions are shared throughout the organization, and flexibility and autonomy are appreciated. This distinction implies different needs for coordination in the workplace. TQM concepts also rest on the belief that the power in organization should be shared, and that all participants would be involved in the decision making about organization's vision and goals.

The eighth dimension considers the nature of the relationship between an organization and its environment. Detert et al. explain that some organizations assume that the key to organizational success is to focus on people and processes within the organization, like the present products, and the present workforce, while other organizations focus on external constituents, like customers, competitors, and the environment, look what they want and how they can contribute to the quest for new ideas. This last view is aligned with the TQM philosophy, which believes in customers' partnerships, and benchmarking.

The authors conclude that according to contingency theories not all values in the general culture framework will be of equal importance in the implementation of various

innovations. In the case of organizational learning, the authors indicate that a supporting culture would need to value collaboration, which without it no learning exists, shared decision influence, and fact-based decision making. They also argue that not all levels or departments in an organization need to adopt all these dimensions in the same degree. The authors also conclude that a gap may exist between the dominant coalition culture and the actual culture throughout the organization, and that this gap needs to be revealed in order to implement a change initiative successfully. This is referred to as the "fit" between the organization's culture and the culture that underlies a change program.

Gryna's (2001) approach to quality culture is more operational-oriented. He claims that in order to become superior in quality, we must pursue two courses of actions; develop technologies that meet customer needs, and stimulate a "culture" throughout the organization that continually views quality as a primary goal. Gryna argues that cultural issues apply to all levels in the corporation, management as well as the workforce, and that quality culture is actually an integral part of the corporate culture. In order to explore the aspects of culture that may enhance quality practices in the organization, he concentrates on the aspects of organization culture that relate to the quality of products and services. Gryna acknowledges that the first step in promoting quality culture is to assess the current culture of the organization. He believes that culture can be changed. He lists five paths as the means to change the prevailing culture to a quality culture. This list includes; providing quality goals and measurements at all levels, which are aligned with the mission, critical success factors, and quality strategy of the organization. Gryna believes that the goals need to be articulated through a collaborated effort of management and employees in order to foster an environment of internal commitment. Quality measurements are the means to achieve the goals and need to be sustained through continuous reinforcement.

The second path to quality culture is through evidence of management leadership. Gryna stresses that management commitment is important but not sufficient. Management leadership needs to be proven. Their role includes establishing, aligning, and deploying quality goals and strategies and then serving on quality council to lead quality effort. Management should take active part in quality improvement teams

The third path is through providing for self-development and empowerment. Gryna emphasizes that people must have knowledge of what they are supposed to do, have feedback on their performance, and have the means of regulating their work if they fail to meet the goals. These three elements provide self-control, which according to Gryna is a prerequisite to using behavioral approaches to motivate employees. Also, jobs need to be designed such as to provide more meaningful and satisfying challenges for workers. For empowerment, Gryna explains that it is not just delegating decision-making authority to lower levels within the organization. It means according to Gryna encouraging people to take initiative and broaden their scope, and it also means being supportive if mistakes are made.

The fourth path to a quality culture is achieved by providing participation as a means of inspiring action. Gryna explains that by participating personally in quality activities, people gain new knowledge, appreciate the benefits of quality processes and obtain a sense of accomplishment by being part of solving problems. These opportunities of participation, according to Gryna, leads to lasting changes in behavior and in overall attitude.

The fifth path is about providing public recognition of superior performance and about rewards such as salary increases, bonuses, and promotions that are given for superior performance against goals. Gryna believes that such expressions of esteem inspire people to invest in quality. This is very much in opposition to Deming's believes that rewards are bad practices for the long run and in a team-based environment, because they reinforce extrinsic motivation, not intrinsic motivation, and they deliver a negative message for teams (Deming, 1994).

Gryna concludes that these five paths to build a quality culture must be integrated with the methodologies and structure for quality. He acknowledges that it takes years to change culture, and it requires trust much more than techniques.

2.2.4 Why Quality Culture and not Quality

I chose to deal with quality culture as a larger framework than with a quality program, because I believe a certain program is usually aimed to fit certain problems and practices. On the other hand, a quality culture is a broader perception, aims to fit many

situations and settings. Advocating quality culture seems to be a more general framework. It may serve many kinds of practices in many different situations and in different periods of time, a fact that is very important in our present fast changing environment. As discussed earlier, it is mainly agreed that many quality initiatives require cultural change in order to be successful, because the changes aimed to be achieved rest upon different norms, values and behaviors than the current prevailing ones. If a quality culture is the prerequisite for implementing successful quality initiative, I would argue that we should aim to build a quality culture that will have a broad, adaptive, and flexible perspective, so that it may serve a host of change initiatives. By accepting this argument we already started to think in long-term perspective, as opposed to a short-term perspective, a paradigm that may be considered very important for nowadays. In the following section I will review the literature that discusses the relationship between of a quality culture and quality initiatives. It may highlight some more reasons for dealing with culture rather than with change programs or new management approaches.

2.2.5 Quality Culture as a Prerequisite for Quality Initiatives

As mentioned earlier, it was recognized in many studies that a certain need for a paradigm change in the concepts and attitudes prevailing in organizations is required in order for TQM to work. Issues like customers relationship, supplier partnership, employee empowerment, teamwork and others, needed a change in perceptions about how work is done and how work should be done. Westbrook (1993) recognizes that many underlying assumptions made by management and lead the practice and the norms in an organization have to be revealed so that their suitability with a new approach can be evaluated. Westbrook believes that trying to implement a philosophy or a new approach with no regard to the prevailing assumptions might be ineffective and destructive. But while a supportive culture is a prerequisite for a paradigm shift, Westbrook (1993) concurs that a culture change does not happen through the recognition of its need, nor can it be changed through words and intentions. It needs time and actions that will eliminate those elements that are counter supportive to the new approach and promote the positive aspects and components of the present culture.

In a later study, Westbrook and Utley (1995) were interested in studying the relationship between several attributes that according to them define TQM, and the organizational culture attribute. In this study, the authors came upon the conclusion that there exists a dual direction relationship between culture and quality initiatives such as customer focus, team orientation, problem-solving emphasis, continues improvement and measurement. While these authors recognize the importance that the first step should be management attempt to change those assumptions that lead to norms and behaviors in the organizations that are counter supportive for quality programs, they also acknowledge the fact that these changes need to be accompanied with actions and practices that are already part of the new approach. "Whether it is better to address culture first or in concert with other attribute is open for debate. The other attributes can be used to demonstrate that the culture is changing. An announcement by an organization that its culture has changed will do little toward that goal. Evidence will have to generate enthusiasm and redirection. Evidence of cultural change can be forthcoming from the other attributes of TQM such as team meetings, management emphasis on the internal and external customers, and restructuring the reward and measurement systems to reflect the new culture" (Westbrook and Utley, 1995, p. 34).

In this study, Westbrook and Utley (1995) postulated that a positive organization culture is the key to successful TQM, and that the other five attributes that define TQM according to them cannot be completely implemented without a supportive culture. The question that they raised was whether top management should embark on the process of assessing the organization culture and improving it if needed in order to improve TQM results.

The study they conducted attempted to determine if culture change does in fact precede TQM effectiveness and affect the length of time required for TQM implementation. They investigated 24 organizations through students that worked there. They evaluated the culture component, and each of the other attributes separately. Their results reveal that excluding the first year the evaluation of culture is lower in 16 of 21 sets, over all years of experience (some data points were excluded from the report because of the authors' suspicious that their values were improperly assigned). According to the students, the organization emphasizes on the other five attributes that are more

action/results oriented when they implemented TQM. The students believe according to the authors that the organizations assumed that success in the area of the five attributes would improve culture and this will increase the morale and the positive feelings, but this did not happened. Therefore the authors believe that culture can be seen as limiting to an effective implementation of TQM.

According to the authors' observations, in some organizations improvement over time in TQM effectiveness was very slow, and that could be attributed to the fact that culture did not improve. In overall, the authors acknowledge that the rate of improvement in the organizations studied is slower than it would be expected. The authors believe that this could be due to the limiting effect of culture. The authors found that in organizations where the value of culture is high, other attributes are correspondingly higher. The authors' conclusion therefore is that if the organization does not address the culture, the chances of successful implementation of the other attributes are doubtful.

As mentioned earlier the authors are questioning whether culture should be tackled the first or be accompanied by other actions that will present supporting evidence to management serious intentions about the new approach. But they definitely believe that culture can be considered an indicator for the success of a TQM effort. They strongly argue that a negative culture can hinder the process of a successful implementation, and that a positive culture can support and promote it. This dual direction relationship between culture and implementation of quality initiative is supported also by Saad and Siha (2000). They argue "to assure effective implementation [of TQM], management should give special attention to the many hidden and intangible factors that have a dominant impact on TQM success. These hidden factors are represented by management and labor behavior, as well as their perception and attitudes toward each other and toward the change process resulting from TQM. Based on practice observations, it is our conjecture that, in the long run, an organizational culture….is influenced by the quality policy used; but the opposite is true in the short run" (p. 1153).

Some authors argue that a program like TQM is actually a process for changing culture in an organization and not the other way around. Jenner et al. (1998) introduce an interesting study, which took place in China, and provides evidence that even though an organization is deeply entrenched in a culture that is the least supportive to quality

initiatives and to modern management systems, a conscientious effort on behalf of management can do miracles to the prevailing culture. These authors describe in length how China's fundamental culture could be considered in any aspect the opposite culture or the least suitable culture for implementing a program like TQM.

Jenner et al. research in depth a representative group of ten joint ventures between U.S. firms and Chinese state enterprises, all of which were managed by the U.S. partner. According to the authors, each of these firms had made some effort to introduce quality methods in their Chinese enterprise partner, but unfortunately, in nine cases out of the ten, all efforts fail. Only in one case, the organization had achieved a high degree of success in its efforts to restructure the Chinese enterprise and implement a TQM program. In this organization, the U.S. managing director employed TQM techniques from the inception of the joint venture, having a vigorous intention of creating a set of values and behavior patterns that would forge a common culture. This organization brought consultants into the joint venture and trained all personnel on TQM principles. According to the authors, TQM's concepts, terms, and tools constitute an effective framework through which all employees communicated. The authors argue that the Chinese employees have adapted these techniques and formed an efficient and effective workforce. It included team activities, production and planning activities, a cooperation atmosphere and a win/win business environment. The authors add that the U.S. manager did not stop at the production level. The management techniques were successfully transferred to the supply chains that accepted the joint venture's quality standards. Their goal were set to meet ISO standards and many of their products did receive certification. He also introduced contemporary human resource practices to the joint venture organization, practices that were far away in their concepts from the prevailing ones in China. He had also sent the head of the Communist party in the Chinese state enterprise associate to the U.S. to a Business school for graduate management training and on return he became an important functioning member of the management team. This manager according to the authors had also established a series of scholarships at a local prestigious university to develop future workers.

Jenner et al. conclude that although most scholars believe that organizational cultures embodied in Chinese state enterprises are not compatible with modern, quality-

centered, management and organizational practices, a substantial effort to introduce these techniques, when backed with a thorough support of management and organizational-wide training, may result in a substantial success. The authors believe that TQM embodies a set of values and behavioral standards that contain many fundamental components of a cultural system. They believe that management commitment to continual improvement of quality drives an organizational dynamic that encourages employee involvement in continual improvement, the organization of teams, free and open communication, and non-punitive and supportive environment. This dynamic according to the authors, essentially creates a new cultural paradigm.

Another approach to the same issue, the relationship between improvement programs and organizational culture is represented by Gore (1999). This author also views TQM as a mechanism that directly leads to creating a culture that supports change and improvement. The author list several initiatives that are part of a TQM effort as being the means for such a cultural change. This include according to the author participative management and openness (supported by encouraging employee involvement, empowerment, the use of teams, education and training, and extensive communication), a rational approach (fact-based decision making, clear mission, objectives, statistical tools and statistical process control, etc.), flexibility (customer focus, continuous improvement), and integrity (values and public responsibility). According to the author, other improvement programs like reengineering have not the same power for changing a culture in an organization, as does TQM. Therefore the author's overall hypothesis was "that an effective TQM initiative would lead to the development of an organization culture with specific elements and that culture would support successful process improvement. In contrast, organizations practicing reengineering would not develop such a supportive culture and would be less likely to experience process improvement success" (p. 168).

The author used a survey that was completed by middle and first-level managers representing 123 organizations. It intended to determine the presence of the specific cultural elements of a customer focus, employee involvement, and continuous improvement. The survey was also used to determine if there was a focus on TQM, if there was a process improvement effort, and if the organization practiced reengineering.

The results supported the hypothesis concerning the influence of TQM on the organizational culture and also tended to support the hypothesis that process improvement would be more successful where the three cultural elements were presented.

Gore concludes that the study shows that specific elements of culture are stronger in organizations practicing TQM than where there has been a reengineering effort. He also stresses that the study suggests that there is more likely to be success where these cultural elements are presented. The author believes that the results of this study underscore the importance of organizational culture and suggests that TQM provides a way to build a culture that supports improvement. The author believes that too often the need for quick returns on the effort leads to a focus on the "tools" rather than the on a supportive culture. He believes that this is exactly what happens with reengineering, where the emphasis is on outsiders and specialized personnel, a fact that works against employee confidence and involvement. Gore cites one of the reengineering founders as admitting that they forgot about people and that they weren't enough appreciative of the human element.

From the above discussion it is very clear that there exists a very strong link between organizational culture and the potential to succeed with quality initiatives. The way or the direction of this relationship works could be debatable. It probably depends on several factors. One of them is management support and especially management level of determination to implement a quality program. The stronger the management support, the less the need to rely on the cultural support, as it is seen in the case of the joint venture in China (Jenner et al., 1998). This conclusion can be supported strongly by Schein's observations (1996). Schein observed that three cultures might coexist in an organization, especially in relation to improvement efforts. He relates to them as occupational cultures. Schein stresses that two of these cultures are based on larger occupational communities and are therefore more stable in the assumptions they hold. The first culture he names the "operators" in which he includes the line managers and workers who make and deliver the products and services that fulfill the organization's basic mission. Schein believes that this is the target group for most management theories especially motivation theories. This group is the usual target of change programs according to Schein, and this is this group that discovers the systemic interdependencies among the functions and learns to deal with

then. But unfortunately Schein observed that the innovations and the effective operations found by this group hardly diffuses upward in the organization or last. The explanation to this comes from his observations about the characteristics of the other two cultures and how they interact with the "operator culture" (p. 236).

The second culture Schein distinguish is the "engineering" culture, in which he includes all the technocrats and core designers in any functional group (i.e., finance, information, etc.) According to Schein, this broad community's preferred solutions are solutions without people. According to Schein, "they prefer systems, machines, routines, and rules that are automatic and totally reliable" (p. 237). For them the need to build relationship and trust, and the need to elicit the commitment of employees is an unfortunate must. They would tend to ignore the operators' desires to work in team and their inclination for systemic approaches, and they would rather stick to technical solutions which operators greatly dislike because of the fear to lose their jobs as a result of the technical solution. Schein stresses that the resolution of the tension between these two cultures many times results in proposals for new machines or new training programs offered by the engineering culture and pushed up in the organization for approval, where a third culture exists.

Schein's third culture is the "executives" culture. In this world-wide group he does not include entrepreneurs, founders of companies or members of companies owned by families. In this group he refers only to those CEOs who have worked their way up the ladder and have been promoted into these positions. For this group according to Schein, financial accountability to the shareholders is the essence of their role coupled with keeping the stock price and dividends as high as possible. This group is driven according to Schein, by the capital markets and the need to remain financially viable. The rest of their concerns is mainly lip service like long-range strategy, or the important of the human asset. The reality for this group is that they believe they are the only ones to make tough financial decisions based on imperfect information, because they become isolated and find it harder to trust their subordinates' information. Schein recognizes that for this group, relying on rules, procedures, and systems like rewards and control, is more acceptable in managing large number of people. "People become "human resources" and cost factors rather than capital investments" (Schein, 1996, p. 238).

As Schein describe one consequence of the interaction between these cultures "when the operator culture attempts to improve effectiveness by building learning capacity, which requires time and resources, the executives disallow the proposed activities on the grounds that the financial returns cannot be demonstrated or that too many exceptions are involved that would undermine the control system. Executives thus unconsciously collude with the engineers in wanting to minimize the human factor. In effect, all the research findings about the importance of teamwork, collaboration, commitment, and involvement fall on deaf executive ears, because in the executive culture, those are not the important variables to consider" (p. 238). Schein comment that there are some organizations that manage to overcome this cultural conflict but that those organizations are still the exceptional rather than the rule, and he confesses, "we still do not fully understand how they did it" (p. 238).

If we accept Schein's observations than the discussion above, about the relationship between culture and quality initiatives makes a lot of sense. When the initial attempt to implement an improvement programs comes from the bottom, than it should rather be based on an adequate organizational culture to support it. If the initial initiative for such a program comes from management as we have seen in the case of the Chinese joint venture (Jenner, 1998), or in the case of Analog (Sterman, et al., 1997), than culture would probably follow the implementation of the new program, if management support will vigorously drive it. Still Sterman et al. (1997) case does demonstrate the problem of the engineering culture, which contributed in some aspects to the fail of the improvement program. This emphasizes even more the importance of the realization of the coexistence of these three cultures in an organization, and the importance of acknowledging the relationship between culture and improvement programs, no matter what exactly the direction of the relationships are.

2.2.6 Quality Culture Characteristics Needed for Supporting a Systems Approach for Quality in Organizations

Since one of the attempts of this study is to advocate a systems approach in improving the effectiveness of an organization, it would be advisable to review the literature in order to figure out the characteristics of the culture on which such an

approach can rest. For this matter, I will first summarize the key characteristics of systems thinking, as it is definitely considered a paradigm shift in the thinking process.

The first most obvious characteristic of systems thinking is the shift from the parts as it is in the mechanistic approach, to the whole (Carpa, 1996). This move reinforces considering the whole, as the only representative of the properties of the system, since properties are properties of the whole which none of the parts possess. These characteristics according to Carpa, rise from the order of the relationships between the parts, and they are destroyed when a system is dissected into isolated elements.

Another key characteristic Carpa mentions is the ability to shift one's attention back and forth between systems levels. Carpa means by that that one can apply the same concepts to different systems level, since systems nest within each other, and gain though these important insights. Carpa also mentions that the other side of this characteristic is the ability to differentiate systems that rest in different levels and usually differ in their complexity.

Carpa makes an important distinction between the Cartesian science approach and the systems science approach concerning the relationship between the parts and the whole. In the first approach, a complex system is analyzed in order to understand the whole. In the second approach, the assumption is that the whole cannot be understood by its parts, since the properties of the system are not intrinsic, but context related. This means that systems thinking is contextual thinking, or environmental thinking. A shift from the parts to the whole, according to Carpa is actually a shift from the objects to relationships. In the mechanistic view, there are objects that interact with each other, therefore there are relationships. Objects are the prime constituents of a system, while in a systems view objects are themselves networks of relationships embedded in a larger network. In this case, the relationships are the primary consideration

Another key characteristic of systems thinking according to Carpa, is "network thinking" (p.38), in contrast to the fundamental-based approach of knowledge. In this respect Carpa explains that the prevailing approach to knowledge as composed of certain building blocks, or firm foundations is replaced in systems thinking by a network of concepts and models, in which no part is any more fundamental than the others. The implication from this concept is that since there are no foundations in the network,

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physics can no longer be considered as the most fundamental level of science, and it is equally fundamental as biology or psychology, even though they belong to different systems levels, according to Carpa.

Another important characteristic that is an implication of the network view is the inclusion of the observer into the network. Carpa notes that in the Cartesian paradigm the objectivity assumption underlies the knowledge process, while in systems thinking it is acknowledged that objectivity does not exist, since the observer's methods of observation and measurements are already an integral part of the process of knowing and forming into a theory.

Carpa notes that all the above characteristics and concepts are part of what he names contextual thinking. He recognizes that there is another strand for systems thinking, which views it as process thinking versus the mechanistic approach to processes. According to Carpa, in the mechanistic approach, process is a result of fundamental structures and forces that interact with them and give rise to the process. In systems thinking the structure is the manifestation of the underlying processes. This strand is especially characterized by the use of feedback loops that describe the dynamic patterns of the system.

In short, systems thinking is a shift from a fragmented world to an holistic world, from a cause-and-effect relationships to nonlinear relationships, from a view that is limited in time perspective and space to a process that takes place through time and is not limited by space. This is an enormous transformation is thinking especially if one considers the impact of many years of education and how it molds and shapes our most fundamental structures of thinking. Therefore it would be very reasonable to articulate the cultural characteristics that would best fit and support this new paradigm of thinking.

I will first try to find out in what aspects the culture that supports TQM would be appropriate also for a systems approach, and would also use the differences between TQM and systems thinking in order to match the new required characteristics.

2.2.7 TQM and Systems Thinking

TQM claims to be a systems-oriented approach because supposedly all aspects of the organization are to be included in the change or improvement process. It is actually a

step toward a more holistic view of organizations but the tools used by TQM like flowcharts, histograms, Pareto charts, and process control charts are analytical tools, which separate the whole into its parts. These tools will probably have little use in an environment of systems thinking (Seigfried, 1998). Systems thinking looks for the synthesis of the constituent parts because the fundamental concept in systems thinking is that a system's characteristics are the system's attributes only as long as the system's parts are considered as a whole. If the system is divided to its parts, the parts are different entities and cannot represent the traits of the system. Therefore, when a system is decomposed into its components and each component is optimized, then the system as a whole will never be optimal (Kim, 1990). This means that the sum of the solutions of the parts does not make up the solution for the whole.

Also, TQM tools that were mentioned above are cause-and-effect-oriented and not relationship-oriented. The main assumption in TQM is that it is possible to reveal the cause of the problem and to tackle it and then the problem will be solved. This assumption ignores the interconnectedness between components and the feedback loops they create. Systems thinking acknowledges that these relationships are the essence of the behavior of the system, and they are to be considered in the effort to improve the system. The value of any component's work in a system is how it clusters with others to co-create an outcome (Seigfried, 1998). It is important to acknowledge that the learning one gains from experience with TQM tools, will not encourage systems thinking because the tools are not systems-oriented, thus they will only reinforce the current way of thinking.

TQM is a scientific approach, based on scientific methods of observations and measurements. The underlying assumption is that there exists a "truth" that can be explored, or in other words, there are ways to 'know' the system objectively. This approach disregards the role of the observer in the observation process, and the influence of other systems on the measured objective. In this respect, TQM has no means to correspond to the three different cultures that coexist in organizations and were identified by Schein (1996) earlier, but in systems thinking, the acknowledgment of this coexistence is important and their different approaches to observe events has to be taken into consideration. The assumption in systems thinking is that there is a network of concepts and models, and none of them is better or more fundamental than the other. In this respect

considering the psychology of the people, is not less important than the reliability of an instrument. Even though Deming (1994) agreed with this statement, in fact TQM is equipped to measure reliability of tools a lot better than to consider the psychology of the people. This gives rise to the necessity to make explicit the process of thinking and the mental models of people, in order to understand the system. It also points out to the importance of considering 'soft' data like time pressure, employee's resistance for change, etc.

TQM is mainly concerned with customer satisfaction and the creation of products or services free from defects. This is obtained by focusing on the process. Even though the definition of a customer is broadly defined under TQM, the focus is still on fragmented groups. Systems thinking's main concern is not quality; it is the improvement of the relationships between all components so that the system functions better and one probable outcome could be quality. While systems thinking focuses on system structure, TQM focuses on process. In TQM environment, a problem becomes the opportunity statement from which the actions are designed. In systems thinking a problem is a symptom of something larger, of the structure of the system, which is the manifestation of the relationships between the components of the system (Seigfried, 1998).

Another attribute of TQM is the consideration that time delays within systems are relatively short (Kim, 1990). When defects are to be traced back, the assumption is that the real-time data will suffice. Systems thinking acknowledges that cause of a problem may exist far in time and in space from its effect, and is not always possible to be traced, especially not with the tools provided by TQM.

Kim (1990) provides a list of "laws" that characterizes complex systems. This list of laws is a demonstration of the different perspective of systems thinking about organizations and the perspective hold by TQM:

- "Today's problems come from yesterday's "solutions".
- The harder you push, the harder the system pushes back.
- Behavior grows better before it grows worse.
- The easy way out usually leads back in.
- The cure can be worse than the disease.
- Faster is slower.

- Cause and effect are not closely related in time and space.

- Small changes can produce big results – but the areas of highest leverage are often the least obvious.

- You can have your cake and eat it too – but not at once.

- Dividing an elephant in half does not produce two small elephants.

- There is no blame" (p. 8).

Kim notes that a common characteristic of the "laws" is that they appear to be counter-intuitive, which he concurs that this is not a mere coincidence. According to Kim (1990), "counter-intuitive behavior is fundamental to the nature of complex systems" (p. 9). This is one of the reasons for systems thinkers to collaborate in the effort to solve problems through understanding of the behavior of the system because different views may contribute more to untangle the complexity of a system.

Using these differences between TQM and systems thinking, I will try to build a culture profile for systems thinking.

2.2.8 Culture Characteristics for a Systems Thinking Environment

In this attempt, I will use the framework proposed by Detert et al. (2000), which was represented earlier and is useful in defining the aspects of culture that are most appropriate for any change initiative.

The first dimension of culture, according to Detert et al. (2000) is the ideas about the basis of truth and rationality in the organization, meaning what is considered real and not real by the people in the organization, and how what is true is determined. In the case of TQM, it is the data and the facts that determine how decisions are made. According to systems thinking, data and facts are just part of the elements of the systems. The way they were collected or interpreted is part of them, and they are not less important. For systems thinking the mental models associated with the way this data was established, and the assumptions behind the interpretation, are the center of interest because they are the source for the behavior of the system and only by exploring them, a change can be made to improve the behavior of the system. In short, according to systems thinking, 'truth' is a relative construct and it lies in the mind of the people, and has to be revealed in order for the system to change. Data and facts get little attention in systems thinking. In this line, a

culture that would support systems thinking will mainly consider the 'soft' issues in the systems as the most important, meaning; the relationships, the mental models held by people, and their assumptions that underlie their behavior and their decisions. The Methods by which information are presented promote linear thinking. Sometimes people think in a nonlinear fashion, even though this is not typically supported by the organizational culture.

The second dimension of culture is about the nature of time and time horizon. In this respect, TQM considers a long time horizon as the basis for decisions, and the same will apply for a systems thinking approach. The only difference is the range of time in respect to the present. For TQM, considerations are from now on into the future. For systems thinking the past is as relevant to any consideration as the future, because it has the ability to provide explanations that can be carried into the future.

The third dimension deals with beliefs about what motivated humans; whether they are motivated from within or by external forces. The TQM philosophy rests upon the belief in people motivated intrinsically, and doing a bad job only because of systems' failures (Deming, 1986, 1994). In this aspect, a systems approach would argue the same, arguing that the relationships between the components of the systems give rise to the behavior of these components, the people.

The fourth dimension has to do with ideas about stability versus change, innovation, and growth. Systems thinking is basically founded on the idea that nothing is stable, because everything is effected by everything else, therefore there is a constant move toward balancing the system. This line of thought is very distinctive for systems thinking. This is why one of the laws mentioned above state that when someone pushes the system, it would always push back harder. Acknowledging the dynamic of systems is an important characteristic of the culture supporting systems thinking.

The fifth dimension has to deal with the centrality of work in human life and the balance between work as a production activity and a social activity. In a systems perspective, work can be viewed only holistically meaning that achieving the task can be only viewed as an end, which is a means to another end and so forth. In social systems the main concern is with the person, meaning that the person's achievements from accomplishing the task are the central concern. The relationship between achieving the

task and how it influences the personal life of the employee and how that feeds back to achieving the next task, is the concern of systems thinking.

The sixth dimension is about working alone or collaboratively. It has to do with the beliefs about how work is most effectively and efficiently accomplished. In this respect, TQM and systems thinking would require the same cultural characteristic. Both will argue for collaboration as a means to better end. Systems thinking especially acknowledges that humans are limited in their ability to understand systems, and also fundamental to systems thinking is the belief that different people observe reality in different views, and it is important to understand these different approaches in order to understand the system. Collaboration is not just a requirement in systems thinking, it is mandatory, there is no other alternative to comprehend relationships. This is especially important in regard to the level of complexity in organizations.

The seventh dimension is about the degree to which control is concentrated or shared. This dimension differentiates between tight control environment, where decision-making is centralized, and between loosely controlled organization, where power and decisions are shared throughout the organization, and flexibility and autonomy are appreciated. While TQM does have a preference for less centralized decision making organizations, I would argue that for a systems thinking approach, the consideration is not a certain trait of the system, but the system as a whole. Centralization and the division of power are a result of the structure of the systems. These considerations cannot be good or bad as standing for themselves; they need to be considered in relation to all other elements in the system. What would be important in a culture that supports a systems orientation is the flexibility in thinking, the ability to see more than one option.

The eighth dimension considers the nature of the relationship between an organization and its environment. Systems thinking is an environmental-oriented approach, the environment is part of the big system and is important to be part of the considerations.

It is very important to view the limitations of this framework for considering the culture profile for systems thinking. As Detert et al. (2000) confess, this framework was established using the current literature about organizational culture. This means that the framework is already based on the traditional thinking assumptions and concepts, which I

would suspect if they are relevant to be used in a different paradigm of thinking. The way the authors articulated this framework is by using linear thinking, a fragmented view of the world, and scientific tools that are analytically oriented. While their product is a result of an extensive effort, and is a contribution for the community that is interested in the issue of culture, it is doubtful whether this framework is suitable for a systems approach. Without having any other suitable framework, I used Detert et al.'s framework as the most appropriate one offered, but I recognize its limitations. There is also a certain benefit in using this framework. Comparing the characteristics of the culture that will be considered appropriate for TQM, with the culture that will fit a systems approach, by using the same dimensions, a better understanding of the differences as well as the similarities is gained.

Another important issue to dwell about is whether culture needs to precede system thinking or does culture follow the practice of systems thinking. I raised the same question in relation to quality and quality culture and concluded that they are strongly coupled and that it depends on some other elements like management support whether culture should be targeted before implementing a quality program or whether a program should start and the culture will come afterwards. In the case of systems thinking, the issue of what comes first is even more problematic. While in the case of TQM there exist plenty of tools that do not conflict with the prevailing way of thinking, and are acknowledged by the scientific world, the problem that latter raised the question of culture had to do with the role of people in the organization, with the attitude toward them and toward customers and suppliers. The soft issues in the organizations led the recognition that cultural change is important. So the question whether practice should follow cultural change or precede it is relevant, because in certain cases, practice could help in the transformation process of culture.

In the case of systems thinking, there is no acceptable methodology, nor is there any way to differentiate practice from concepts. They are all intertangled. The way one thinks is already the practice. Also, systems thinking is a major shift in thinking. It has no support in the prevailing educational materials, it is still not widely acknowledged, and the main problem – it conflicts with the traditional way of thinking, thus in order to practice systems thinking, one needs to make the shift conscientiously and deliberately. It

is a revolution in the way one perceives the world and in the way one participates with the world (Seigfried, 1998). Once one made the transition to systems thinking, he will experience a different reality of the world around him, a reality of interconnectedness, and interdependencies between everything surrounding him. And there is no way back to the old way of thinking. Systems thinking encourages people to acknowledge their weaknesses and their strengths with no feeling of blame or fear. It reveals the responsibility of people to their actions and behavior, but also makes them aware of how they are manipulated by the system. It is a great way to promote responsibility, accountability and self-awareness, if one chooses to grow and learn. In short it could be said that a culture that supports real learning and growth continuously is the culture that will support the transformation to systems thinking. But this is not enough. There is a need for tools that will enable the transition from thinking locally to thinking globally and have the insight of the long run implications of today's behavior and actions. There is a need for tools that may facilitate the process to understand complexity without dissecting the system into parts. I would argue that the method that can best facilitate this transition, and support a cultural transformation is systems dynamic modeling.

2.2.9 How Can System Dynamics Modeling be Helpful in the Cultural Transformation?

My premise is that system dynamics modeling can provide a vehicle to move from a linear, fragmented, local way of thinking towards a holistic, system-oriented, non-linear thinking. System dynamics can also provide the tools to understand complex systems, design better operating policies, and guide effective change (Sterman, 2000, 2001). In this respect, system dynamics can act as a cultural change facilitator, and as a method to apply the systems thinking approach. According to Sterman (2000, 2001), system dynamics enhances learning in a complex world, and helps to develop "management flight simulators" (p. 4, p. 10) through which a better understanding of dynamic complexity can be achieved. It is also useful in understanding the sources of policy resistance, and design more effective policies. Sterman adds, "System dynamics is fundamentally interdisciplinary. Because we are concerned with the behavior of complex systems, system dynamics is grounded in the theory of nonlinear dynamics and feedback

control developed in mathematics, physics, and engineering. Because we apply these tools to the behavior of human as well as technical systems, system dynamics draws on cognitive and social psychology, organization theory, economics, and other social sciences" (p. 5, p. 10).

Sterman (2001) explains that complexity arises from humans' inability to understand the long-run impact from our present decisions, coupled with our lack of understanding of our own and others' mental models. This disadvantage gives rise to policy resistance, according to Sterman. In real systems he clarifies, any intervention creates a feedback, meaning that the results of our actions define the situation we face in the future, and the new situation alters our assessment of the problem and impacts the decision we do next. But our actions are not done in a vacuum. Our actions may trigger unanticipated side effects like policy resistance, which may act to restore the balance we disturbed. If we don't understand these feedback processes, we are likely to attribute blame to some events or actors in the system and restore to helplessness by concluding that the world is unpredictable and uncontrollable.

Time delays cause another kind of a problem, which is associated with dynamic complexity. According to Sterman, delays contribute to the instability of systems and their tendency to oscillate, which drives decision makers to continue to push the system, and the system to push back. Sterman adds that people have difficulties in understanding stocks and flows processes: the accumulation and dispersal of resources. According to Sterman, our mental models are not 'designed' to understand feedback behavior, nonlinearly, time delays, so we ignore much of the information that is available for us, and we tend to attribute the behavior of others to their character flaws instead of attributing their behavior to the structure of the system in which these people are embedded.

According to Sterman, system dynamics provides tools that enable us to capture the feedback processes, stocks and flows, time delays and other sources of dynamic complexity. The most important tools of system dynamics are the feedback loops that enable us to represent the dynamics of the system. There exists two kinds of feedback loops; the reinforcing feedback loop that amplifies whatever is happening in the system, and balancing loop that counteracts and opposes change, and tends to restore equilibrium.

But in every system, multiple numbers of these loops interact, and no intuition is capable to figure out the behavior of the overall system. This is when system dynamics turns to computer simulation. Simulations are virtual worlds in which managers can develop decision-making skills, conduct experiments, and play. The simulation tools provide immediate results and can be changed and modified according to the will of the user, thus shortening the time required seeing the results of decisions. According to Sterman, these tools provide a means to improve our mental models and design more effective policies.

Sterman cautions that the process of designing through system dynamics does not prevent people from defensive mechanisms, nor does it prevent groupthinking. He believes that people, who are not accustomed to scientific reasoning and to an open, trusting environment with learning as the goal, need to build these skills before using system dynamics tools.

This brief description of system dynamic tools and features offers us some insights about the capabilities of system dynamics in changing the present culture to a more systems-oriented culture and to provide the tools for practicing systems thinking in the organizations.

2.3 Employee Health

2.3.1 Introduction

In this part of the literature review, I will first provide a brief overview on the evolution of the issue of employee health in organizations throughout history. I will discuss the reasons for organizations care about their employees' health and realize the connection between workforce health and organizational effectiveness. Organizational initiatives to support employees to carry a healthy life style not always last for a long period of time. I will point out the reasons for that, linking the environment to the health of the individual through stress, and explain the importance of regarding health in a systems view. A system-oriented definition for health will be provided, and the description of the health care system and its advisable approaches will be discussed. The recent model of healthy organization will be described and its shortcomings. The use of system dynamic will be suggested and I will conclude with illustrating the effectiveness

of the system dynamics tools in building a systems thinking environment that will be supportive to a healthy organization.

2.3.2 The Evolution of Corporate Health Functions

Shephard (1991) traces the roots of occupational fitness and health promotion back to the early era of the 17th century, when it was acknowledged that cobblers and tailors suffered from poor health in comparison to the health of peasants, proving the importance of the occupation on the individual health and life. According to Shephard, the industrial revolution in the late 18th century did not contribute to the workforce health, since industrialists were more concerned with maximizing their output, letting workers working under extremely adverse conditions for long hours each day. Shephard mentions that only very few idealists were concerned with their employees' health and welfare and established various programs to support and promote their workforce health. In the scientific management era, according to Shephard, management acknowledged that in order to keep a certain level of quality output, employees had to have certain relaxation allowances, and proved that even these brief relaxation breaks made a positive contribution to industrial performance.

During the early 1920s, due to organized labor's concerted efforts to improve unhealthy and dangerous working conditions, schools started to train doctors to protect the health of workers. These medical physicians were initially occupied in combating industrial hazards such as excessive physical demands, high noise levels, extreme heat and exposure to toxic substances, not having any time to focus on fitness or health promotion (Wolfe et. al., 1994a).

By the late 1930s, public concern over dangerous working conditions led to the establishment of governmental agencies such as the National Safety Council that addresses safety and the development of safe conditions at work (Ilgen, 1990). From the safety model evolved the ergonomic model, where workers were included in the attempts to improve the safety of the workplace. Employees were trained in safe behaviors and were encouraged to keep health and safety issues in their mind while on job (Ilgen, 1990).

In the mid-1950s, an association between a low level of occupational activity and an increased risk of death from ischemic heart disease was recognized (Shephard, 1991). It was soon observed that automation was progressively decreasing physical activity at work and therefore there was a need to provide physical activity through other programs and facilities (Shephard, 1991). This demand and the fact that employees were less exhausted from their work due to automation motivated the establishment of work-site fitness programs. Such programs decreased the most common barrier to exercise - the lack of time (Wolfe et. al., 1994a). It turned out later that such programs contributed to the organization image and thus promoted recruitment, enhanced satisfaction, decreased absenteeism, turnovers and injuries, and more.

In early 1970s the North America's economy came to realize the economic challenge it has to face from Japan. The decline in economic growth and the growing Japanese competition on the market had indorsed attention to the Japanese practices. It was found that Japanese companies were introducing mass physical activities for their employees, and the question about the correlation between health, fitness and productivity was raised by Western industries (Wolfe et. al., 1994a).

In early 1980s wellness programs were introduced more widely. Two major changes differentiated these programs from the previous approaches. First, wellness shifted primary concerns for health from preventing injury or harm to encourage health. Second, wellness shifted the responsibility on health issues from the organization to the employee, from environmental conditions on the job to behavioral-oriented characteristics of style-life. Instead of looking for causes of unhealthy outcomes and attempt to change the conditions or train people to deal with them, the wellness approach focused on changing employee behaviors that are believed to affect his health in the future. Typical health-related behaviors targeted by wellness programs are diet, exercise, smoking cessation, and stress management (Ilgen, 1990). The design of these program primarily focused on the white collar rather than on blue collar workers (Wolfe et al., 1994b), but later, the specific needs of blue collar workers and hourly workers were considered and programs of team sports were suggested as having more appeal to this group of employees.

Currently, according to Aldana (2001), approximately 90% of all workplaces with 50 or more employees have some form of health promotion programs. Aldana explains that there are many reasons for companies to invest in health promotion programs. Some organizations believe that it is essential for their corporate climate and culture. These companies will go to great efforts to make employee satisfied and to create a sense of community in the workplace. In these organizations health promotion programs are focused on helping employees stay healthy, satisfied, and productive. For these companies, according to Aldana, having a positive return on investment in not a requirement. Many other companies, according to the author, use health promotion programs as a reactionary effort to restrict their ever-increasing employee-related expenses, which are mainly health care costs and lost productivity.

2.3.3 Workforce Health and Organizational Effectiveness

It is common sense to acknowledge that a healthy employee would contribute to organizational effectiveness more than an employee with a poor health condition. This common accepted assumption is far from being easy to research and to prove quantitatively. The literature concerning the relationship between health initiatives and organizational effectiveness is far from being consistent or accurate with the methods, terms, approaches to measure and evaluate organizational effectiveness and what influence it. In the following literature review, this problem will be very obvious. The most frequently term used is *productivity* rather than *effectiveness* or *performance*. Even when authors use the word *productivity,* for most time they actually refer to one measure they believe represent productivity – absenteeism. They do acknowledge this shortcoming, but in most cases they explain it by the lack of methodologies for measuring productivity differently and by the many obstacles in trying to do so. The literature chosen to be reviewed here is composed of articles that try to look into this issue and offer some insights to resolve this problem. Some articles were chosen for their special linkage with other factors, or some other issues that are relevant for this study. The vast amount of the literature in this area deals with the impact health initiative has on organizational financial outcome, especially those related to health costs. In this respect, health prevention and health promotion interventions have a substantial impact on

lowering costs associated with health care. This issue is less of an interest for this study, even though it has an impact on organizational performance, especially because recently costs associated with health care amount to a huge percentage of organizations budget. But these costs are an outcome of the organizational behavior, and its employee's behavior, rather than the source of the problem. My assumption is that it will be taken care of, if we resolve the former.

Riedel, et al. (2001) reviewed the relevant literature between 1993 and 1998, in order to find out the relationship between health initiatives in organizations and related productivity outcomes. The authors realize in their search for articles dealing with the relationship between worker health and performance that not much exists in this research area. They point out that a large and growing number of companies perceive that improving worker health may result in significant productivity gains, in addition to gains in health status and medical cost-benefit, but that this research field is still in its infancy.

Riedel, et al. (2001) point out that there is a lack of objective, commonly accepted measurements for productivity throughout the jobs, therefore it is impossible to evaluate the true impact of poor health on job performance and on organizational outcomes. These authors note that the only available data from most of the research in this area is absenteeism, as a measure for employee productivity and this measure if far from being comprehensive, or representative for measuring productivity.

The authors looked at fourteen disease prevention and health promotion interventions, which are at the top of the list of health expenditures and concluded that very few studies have documented the time frame required to achieve an impact on performance loss. They did find evidence to the positive effect on health benefit of early detection and behavioral change programs, and some evidence for positive return on investment concerning medical costs, but evidence on performance is for most cases, unknown. The exception is depression, which according to the authors shows a short-term benefit. The authors found some evidence for short-term performance loss savings of five interventions including depression screening, back pain exercise programs, smoking cessation, adult vaccination for influenza, and care-seeking programs for minor illnesses.

The authors concluded that disease prevention and health promotion programs might in general have long-term payback for direct medical costs but short-term payback for performance improvements, or vise versa. Also, methods for measuring the relationship between health status and worker performance are scarce. The authors acknowledge that the evidence for a performance-based cost-benefit is very limited and, when addressed, is primarily extrapolated from excess absenteeism assumed to be related to health risk-related illnesses. For the most, there is strong evidence that health intervention improve personal health status, which influences health-related costs. The authors point out to two major challenges of health promotion programs: one is getting high participation rates and second is maintaining behavior change over time.

In their attempt to understand the linkage between worker health and productivity, the authors also tried to identify leading practices that can shed light on innovative approaches that found how to express and measure the relationship between employee health and productivity. They found ten themes that were common for all these best practice firms. These themes include beside others: management strategies of health and productivity were aligned with business strategies using an interdisciplinary approach; leaders or champions existed who show vision and determination to make things happen; interdisciplinary team members were enthusiastic of the health and productivity management; senior management were strongly invested in the integrated approach and provide resource support; business operations managers were key members of the team; prevention and health promotion staff were integrally involved; improving the quality of life was expected to improve productivity and costs, and constant improvement and learning from others kept the firms on the cutting edge.

Riedel, et al. (2001) also mention some factors beside many others, which are affecting the health/productivity evolution. Among them they note the issue of work and family life. There is a growing interest, according to the authors, in the relationship between workers' lives on and off the job. It was found that the two most powerful predictors of productivity were the quality of workers' jobs and the supportiveness of their workplaces. The authors found indications in the literature those burned-out feelings at the job and insufficient time and energy for workers own self and for their families, usually spill back into the workplace, limiting job performance.

Another issue these authors found important to notice is the growing use of complementary and alternative medicine. According to then over one-third of the population has used at least one alternative therapy in the last year. These visits amounted to approximately $13.7 billion of which most of it was paid out-of-pocket. The authors suggest that more attention to these therapies and their role in terms of health status improvement, medical cost-benefit, or performance improvement is required.

The authors conclude their study by providing a decision framework for quantifying productivity by estimating organizational costs and performance losses. They acknowledge the fact that when we monitor humans we know more about costs than about losses when compared to say, machines. Not like machines, human's performance is affected by morale, autonomy, team dynamics, and other social, emotional, or mental influences. These "softer" issues, according to the authors, are the causes for the difficulties researchers have in identifying and describing what productivity means, and what should be done to optimize it. "Productivity cannot be reduced to simple accounting or presence on the job or volume of work output, although these certainly are factors. Simple representations of work and production misrepresent the reality of work life, in which we experience gradients of output along several dimensions. A simple, dichotomous representation of work – such as absent or not, injured or not, flawed or correct – loses the continuum of performance that extends beyond the absolute boundaries of these incident-based definitions" (p. 186).

The framework the authors propose can be used in any situation for any level of performance, and can either be represented as present work production compared to the ideal ("half-full"), or as the amount of performance absent ("half-empty"). Their framework dimensions describe the relative contribution of different influences on productivity, even if they are vastly different.

On the part of organizational costs, the authors do not elaborate much because they believe this part is usually easy to quantify. The only point out that cost has several dimensions that characterize the full magnitude of the expense and that all costs can be classified on these dimensions. It is therefore important to take into account for any expense the duration or frequency of the expense; the magnitude of the cost for unit or event; and the prevalence of the problem/cost in the population. The product of these

three dimensions is the total volume of the expense. Any increase in any one of these dimension, will result in an increase of organizational costs.

The authors indicate that one key presupposition of their model is that for most cases the direct expense is the results of employees' behavior in response to the perception of their state of illness or wellness, in the broader sense of the term, and this is especially important for performance loss. The authors also avoid using the terms of indirect or direct in their mode, they only refer to expenditures out or loss of potential effort in. They presume that for most cases, they can estimate each dimension within acceptable degrees of error.

In relation to performance loss, the authors admit that this part is more difficult to measure and to quantify. Therefore the authors suggest to ignore temporarily the measurement difficulties and to focus on the issues of optimal performance. In a similar way as they constructed the organizational costs model, they assume that performance loss would also have three dimensions. The way they look at performance loss is as if a portion of the time an employee is being paid for is spent with energy focused elsewhere. This approach results in the following dimensions for organization losses: "the *degree of reduced work capacity* (conscious or unintentional – absent or under productive); the *time away from task* (hours or days/person, with energy going elsewhere), and *prevalence* (number of people affected). This framework enables to consider productivity loss of people who are present at work but are not productive, or the time spent by a worker who sits in another employee's position loses his own productiveness, and contributes a little for the sit-in position. As the authors indicate, performance loss can be attributed to a short-term interruption like an office move, or an ongoing bother like bad communication with a boss. The authors acknowledge that social influences could produce considerable productivity loss as in the case of lay-off rumors.

According to Riedel, et al., this model can apply to any reason why employees might be distracted from, or prevented from, putting their best and fullest effort and energy into their work during paid work time. Even before addressing the issue of measurements, the authors view these three dimensions as providing a useful context for understanding the nature of productivity loss and interventions designed to enhance it. Questions that can be asked in relation to *time*: Is the intervention designed to get the

person back on the job sooner or to spend a greater portion of their time on task? The question about *capacity* as amount and as quality; is the intervention designed to make the person better able to produce better or more outcomes? And about *prevalence*: Is the intervention designed to reduce the number of people whose well-being or capacity are negatively influenced by this issue? The authors conclude that this framework is mainly a learning tool and "as with any estimation tool, the results are only as good as the assumptions made", but until more information about performance losses due to employee's behavior are available, they believe that this tool may be useful in addressing broad business and health issues.

Berger, et al. (2001) examined the indirect costs (i.e., work loss and productivity costs) of employee illness from the employer's perspective. The authors posit the question about how should employers measures the gains and costs of their health investment decisions so that it will be useful for decision makers. Indirect costs according to the authors are costs incurred from mortality (i.e., employee replacement, value of lost future income), morbidity (i.e. lost wages, disability, lost leisure time, idle employer assets) and the reduced productivity (i.e. teamwork and communication, effect on family members) while an affected employee is still working. The authors discuss the issue of indirect costs as a matter of perspective (individual worker, societal, and employer), and propose that only the employer's perspective is useful in the valuation of indirect costs, since only the costs that are incurred by an employer should be included as it should be in the case of morbidity and mortality costs. The valuation of work loss according to the authors may include higher wage costs, lost production, idle assets, and other non-wage costs incurred by the employer.

The authors critique two currently used methods for measuring indirect costs and propose a new conceptual framework that attempts to position health status in relation to other aspects of an employee's well-being and an employer's need for on-the-job productivity from employees.

In their conceptual framework that authors assume that the employer's goal is to maximize their profits through their investments, and that employees balance their leisure time and work time according to their individual preferences. Implicit in this assumption is that employee selects a job on the basis of these internal preferences. These two

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attitudes; of the employer and of the employee would create a balance. The authors assume that besides the traditional investments of wages, and in the work environment or training, an investment in maintaining the health status of the employee will contribute to the feeling of well-being for the employee and of productivity for the employer. The authors believe that individuals are given an initial measure of health, which depreciate over time. This initial measure of health can be maintained by investment in health-related activities. Each job, according to the authors may help or hinder health status through many factors like stress, fatigue, and so on. The authors believe that workers place a value on health, and health factors directly affect their decision when choosing a job.

Berger, et al. propose that health status is one of the most important factors in enhancing and maintaining productivity in the workforce. It determines the amount of time one can devote to work, and the quality or productivity of the employees. Indirectly, it may affect the efficiency of the use of capital. The authors acknowledge that the work an individual provides is inseparable from him. Thus, investment in the source of the work, the employee, will affect the workplace productivity in a similar way as other investment in human resources, which have a positive impact on productivity. But this investment is a complex issue for both; the employer, and the employee. Whatever the firm provides the employee, he can consider it as an extra benefit, since he can spare his own spending of time and money on it. From the employer point of view, he gains by attracting and retaining better workers at comparable wages (or lower).

The authors discuss several paths through which productivity is affected. They believe that on-the-job training is positively affected by healthier people, which will affect productivity through utilizing more efficiently the newly acquired skills. In the same vein, they believe that investment in health interacts with many other dimensions and none of these effects can be disentangled from that of another. They also acknowledge that several factors influence health like education that can help people change their health behavior by changing their attitudes and beliefs, environmental factors may have long-term effects on health. Berger, et al. state "What is clear is that health, as measured by health status, has an impact on employee prosperity and working skills that ultimately influences productivity" (p. 23).

The authors acknowledge that many factors play a role in the effect of health on productivity, and propose that future research will focus on these interrelationships between health, working environment, and productivity.

Ho (1997) aimed to determine the impact of corporate wellness programs in Singapore organizations on employee outcomes such as job satisfaction, work stress, and absenteeism. The author also tested the degree to which these three employee outcomes influence one another. Six companies participated in the study; three of them had wellness programs and three did not have. The sample included 188 employees from these six firms. Their findings indicate that organizations, which offer wellness programs, are perceived more positively by their employees in terms of their attitudes towards the organizations, job satisfaction levels and satisfaction with fringe benefits. In relation to the impact on employee medical costs, employee stress levels, lower absenteeism, the author conclude that the programs that were evaluated in this study were still in their infancy stage, thus no significant results were observed. These outcomes need a longer-term perspective in order to evaluate their results.

The author concludes that corporate wellness programs are not only beneficial for employee well being, but also for organizational well-being. According to the study, wellness programs have a positive effect on employees' perception on their company, and on job satisfaction, which leads to lower level of stress and absenteeism, which leads to a more productive workforce. The author strongly believes that organizations can no longer afford to assume that employee health is a private matter. It is increasingly an important management concern. The author believes that employee health is a requirement for running a successful business.

Aldana (2001) reviewed the literature on the relationship between lifestyle behaviors, health promotion programs, and financial outcomes on absenteeism and medical care costs. Two of the author's goals among others were to determine if costs are higher for those with unhealthy lifestyles and if health promotion programs save money. From the seventy-four studies that met the inclusion criteria, the author found good correlation data to suggest that high levels of stress, excessive body weight, and multiple risk factors are associated with increased health care costs and illness-related absenteeism. On the other hand, the association between seat belt use, cholesterol, diet,

hypertension, and alcohol abuse and absenteeism and health care expenditures are either mixed or unknown. According to the author, all of the eighteen intervention studies he reviewed found that absenteeism dropped after the introduction of the health promotion program and the six studies which reported cost benefit ratios averaged savings of $5.07 for every dollar invested. Twenty-eight of the thirty-two intervention studies found that medical care costs dropped after the introduction of a health promotion program. The author rates the overall quality of the literature as "indicative" meaning that even though the relationship is probably causal, a statement of causality is premature until larger scale studies with randomized control designs are completed.

The author concludes that no matter what the reasons are for the apparent effectiveness of health promotion programs, the important conclusion from this review is that it appears that health promotion programs are associated with reduces absenteeism and health care costs, and therefore he recommend that health promotion programs should be considered a viable and effective method for helping employers reduce employee-related expenses.

2.3.4 Attempts to Identify the Problems in Promoting Workforce Health in the Workplace

The health promotion literature is mainly interested in solving two problems they view as their primary challenges (Reidel, 2001) for becoming more effective. These challenges are achieving a higher rate of participation in the programs, and maintaining a longer-lasting behavioral change by the participants. The implicit assumption made here is that the programs' approach to improving employee's health in the workplace is effective, and assumption that is not entirely supported by the literature (Aldana, 2001).

In this part of the review I will try to figure out the sources for these problems. My main questions are: what causes people not to participate in a health promotion program, and why do people abandon a behavioral change after a while practicing it, and cannot adopt it as a new routine of their life. I will also question the effectiveness of health promotion programs in promoting employee health.

Several authors provide some explanations and offer suggestions. Allen J. Robert believes that any behavioral change needs two important elements for lasting success: the

individual initiative, and a supportive cultural environment. Individual initiative can only arise from intrinsic motivation, a personal desire for change. One of the most prevailed practices in the health promotion function is the use of rewards and incentives to encourage people to participate in the program (Bertera, 1990, Ziegler, 1997). Though the intention is rationale, the practice is not aligned with long-term thinking. In order for workers to abide in the new adopted lifestyle, considering that only many years of adoption of the new life style will create a real change in the health status of an employee, it implies that organizations should strive to encourage the intrinsic motivation of workers. If workers will participate in the program for a monetary bonus or another incentive, they will abandon the program as soon as the incentive will lose its attraction (Zolkos, 1996). Luthans and Stajkovic, (1999) even argue that rewards might drive to the practice of the unwanted behaviors, the opposite of their intention.

In a supportive culture, Allen and Leutzinger (1999) explain, five factors work together to shape long-term individual behavior. These are: organizational values, organizational support, peer support, and organizational climate. According to Allen and Leutzinger values are heartfelt beliefs about the appropriate way to approach living. Norms are expected and accepted behaviors, or as these author claim: "the way we do things around here" (p.2). Organizational support includes factors such as; modeling, rewards and training that provide ongoing support for the desired behavior. Peer support is the assistance from family, friends, coworkers and immediate supervisors in the form of emotional encouragement, and actual help. Organizational climate according to the authors is constituted from three social atmosphere factors: a sense of community, shared vision and positive outlook.

Allen and Leutzinger approach is supported by Riedel et al. (2001) who found in their study that only when management strategies of health and productivity were aligned with business strategies using an interdisciplinary approach, and when the climate was conducive to health as represented by leaders and managers attitude, were the health promotion programs effective. This is probably not the case in many other organizations, as can be inferred from Aldana's (2001) study.

Karasek and Theorell (1990) have another point of view on the notion of organization's role and responsibility in the behavioral change of the individual and the

role of the individual himself. According to them, the environmental factor is the ultimate factor and the most important one in the behavioral change process of the individual in the workplace.

In their view, our models of modern industrial organizations, as they are designed to yield the greatest good for the greatest number, are actually forcing us to trade off our psychological well being for material affluence, instead of enhancing both. Karasek and Theorell believe that there is a way to redesign work so that job stress and its consequences can be reduced dramatically. This implies considerations of psychological and social aspects of work. Their premise is that by doing so the risk of stress-related illness will be reduced and aspects of productivity associated with creativity, skill development, and quality will increase.

The authors' goal is to identify the psychosocial factors of the work environment that influence worker's health and organization productivity. One of their most important finding is that health (in their case, heart disease) is mostly affected when work is both psychologically demanding and low in latitude to make decisions, specifically the worker's discretion over use of skills on the job. If the worker's skill is being utilized and developed, the worker is more likely to feel in control of the many different situations that may arise. According to them, the primary work-related risk factor appears to be lack of control over how one meets the job's demands and how one uses one's skills.

In contrast to the prevailing attitude in the USA, to offer solutions for stress-related illnesses through interventions that change the individual behavior, Karasek and Theorell concentrate their effort on dealing with the causes, the environment, rather than dealing with the symptoms. They believe that individual-based solution are temporary solutions, that are not only very expensive (figures are given on page 7,p. 26 and throughout the book), but also lead to victim blaming and reduces the ability to solve the real cause of job stress. A good example for this is the intensive effort to reduce smoking, almost entirely aimed at personal behavior change, while very little is done to aim at stressful periods on the job, that are the direct trigger to light a cigarette. Work environment tensions represent forces that cannot be made to disappear through individually oriented coping strategies. Therefore the authors' model is a staged model in which personal causes are linked to environmental factors in stepwise fashion. In this

respect comes to play their very first inquiry, whether we now compromise for material affluence by personal well-being, which is actually a dilemma also confronted by management: "in many of the most technologically advanced manufacturing industries, labor costs now represent less than 10 percent of expenses, and yet the use of old management models, based on labor cost cutting, may be significantly increasing the health cost burden" (p. 157).

The authors' findings that not the demands of the work itself is related to risk factors, but the organizational structure of work is the one that plays the most consistent role in the development of stress-related illness. The authors strongly believe that interventions to redesign jobs can produce the desired change in both; health and productivity.

Karasek and Theorell found that in many jobs workers' skills are insufficiently developed or not utilized, which leads to lost productivity, and unmotivation attitude and vise versa, jobs high in decision latitude (as in managerial and professional occupations) actually pushed workers beyond their training. But more important is their evidence (Chapter 5) that increased job demands lead to productivity increases only when the demands are combined with high decision latitude. When possibilities to control were perceived to be small, high levels of demands were associated with low productivity and stress symptoms. So actually job stress affects productivity directly through lower performance, and indirectly through economic costs of job-related illness. The authors therefore posit the possibility that solutions to the productivity problems of work can be the same as the solutions that enhance employee health. If jobs could be redesigned with high decision latitude, meaning with greater opportunities for taking responsibility through participative decision making, than demand would be seen as a challenge and would be associated with increased learning and motivation, with more effective performance, and with less risk of illness. An important observation the authors make is that "Productivity cannot be considered the sole justification for a healthy workplace. Workers' health must be a separate goal in its own right. From the standpoint of the worker as consumer, health is the obvious prerequisite to obtaining satisfaction from material consumption: it is hardly possible to be a happy consumer in the evening after being an unhealthy worker all day long" (p.12). This view is very much aligned with

Berger's et al. (2001) view, which is underlying their proposed framework to measure employee's outcome and organizational outcome in the workplace. This observation encompasses the main concepts of the delicate linkage between what we consider the quality of private life and the quality of work life, and how they influence each other. It also contrasts the more prevailing performance-oriented approach to health promotion program, as it is expressed in the above articles; where the main initiative of management for these programs is improving organizational performance rather than viewing it as a humane necessity (Trice and Beyer, 1984).

Karasek and Theorell coined the term *work reconstruction* to distinguish their theory about work from job redesign. Work reconstruction implies a broader social, economic, and political process than job redesign, including more precise measures of health and well being, as well as more humane measures of production output. It calls for a more varied group of professionals to participate in the process of reconstructing the work. The authors also emphasize that employees must be part of the design team of the new work environment. They believe that a new organization of tasks that is imposed from above may not work because it lacks the necessary worker and staff advocates. Their model's strength lies in the centrality of the concept of control. Since patterns of control are central features of an organization's social groupings, reward structures, and information structures, the involvement of control as one of the goal of their solutions, and also as part of the process of obtaining them demonstrate that the ends and the means in their model are difficult to separate.

If we consider most existing worksite health promotion strategies (Bertera, 1990; Wolfe and Parker, 1994; Breslow *et al.*, 1990; Heirich *et al.*, 1992), which rely on personal behavioral change, work reconstruction involves environmental considerations, addressing the causes rather than the symptoms of health problems. Karasek and Theorell explain the tendency in the USA to blame the individual for his behavior rather than seek environmental explanations, as a cultural pattern emphasizing individual initiative, which also places responsibility for health on the individual. In contrary, they mention that in Sweden, there is less emphasis on individual blame and more emphasis on social causes of illness. The authors believe that the answer for these different approaches lies in a joint theory focusing on both; individual differences and on environmental circumstances. An

example for this situation is provided by the authors (p. 141), where a habitual, moderate cigarette smoker is exposed to an excessively demanding job situation where he is given no real decision opportunity. He increases his daily cigarette smoking, and after a while he is diagnosed with a coronary heart disease. According to the authors, most experts in this field would regard a heart attack as a result of the cigarette smoking, regardless of whether or not the smoking habit has been influenced by socially determined risks such as job factors. Even when medical experts admit that job strain may play some role in the development of diseases, they disregard the contribution of job factors, believing that conventional factors are sufficient causes and also easier to change. Karasek and Theorell challenge this notion and provide evidence that it is difficult to change smoking and eating habits in large segments of the population, and those efforts to promote health would benefit if public and occupational health officers knew more about people's reasons for smoking and eating unhealthy diets. Unfortunately expert ignore the role smoking have in coping with stress; lower feeling of stress, increase the capacity to cope with stress, or calm down during upsetting situations.

In contrast to the prevailing belief that the most common problem is executive stress, Karasek and Theorell provide evidence that high incidence of health problems are more prevailing among low-status workers who bear equally heavy psychological demands but lack the freedom to make decisions about how to do the work. They argue that for most people decision making freedom appears to aid in coping with the heavy psychological demands of work, but for high-level managers, it represents an additional job demand. These findings are the base for the solution the authors propose: to equalize the decision making opportunities of managers and workers within work organizations, thus reducing an unhealthy burden on high-level executives and professionals and also providing health enhancement and skill development opportunities for lower-status workers.

Some of the obstacles Karasek and Theorell mention to work reconstruction include the resistance from institutional groups and universities to recognize job stress as an important consideration in their curricula, whether it is the engineering or physicians training. They also believe that the tendency of each scientific discipline to specialize in the advancement of its own field creates an expanding scientific gap in multidisciplinary

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knowledge, causing a "collective myopia" (p.17) about real work problems. But the greatest barrier to redesigning work in their opinion is the preference of researchers and businesses to emphasize on easily quantified, short-term productivity results.

Using an historical perspective about patterns of work organization, the authors conclude that there are many forces for change of the work environment today in comparison to the past: There is now a higher percentage of psychologically demanding jobs than of jobs involving heavy lifting or jobs involving dirty work, also cost of illness attributed to the work environment is increasing in the psychosocial areas, and preventive health care is not delivering its ultimate goal as long as it does not focus on eliminating the existing causes for problems, but instead focuses on changing workers' 'life-styles'.

Another set of forces for change stem from the industrial revolution that production and technology themselves are undergoing. They imply the need for changes in the most basic concepts, including development of new measures of the value of output from productive enterprises that transcend simple utilitarian approaches. The social relationship components are becoming more important while its physical components are becoming increasingly limited, and the service industry is just one example to this changing attitude, where social relations between the client and the server are more important than unknown measures of output. According to the authors' definition the production of goods involves adding value to inanimate objects, whereas services involve adding value to a person or to an organization, both entities that can grow. Since goods production involves the use of physical resources that can be strictly limited, and poses a risk of catastrophic pollution at present scales of production, new forms of production emphasizing social relationships and development of human capabilities rather than material output, could be an important contribution to an healthier environment. Now the most pressing economic problem for industrial economies, according to the authors, is to keep their populations employed in the face of overcapacity in everything, a problem that each country tries to solve by increasing its own relative productivity, and thereby producing greater overcapacity, which in turn leads to job insecurity.

The concept of labor itself has changed. While once being only an input to production, it is now an item of consumption (people 'need' a job). Also creative

challenges, skill utilization and development are becoming more important consideration at work, since skill surpluses, when combined with rigidly hierarchical organizational systems, lead to dissatisfaction, boredom, or disengagement from work.

The authors believe that in order to produce new models of work organization for these new conditions, a collaborated effort of many disciplines like medicine, engineering, and social sciences need to take place.

The authors propose a two dimensional model to describe the psychosocial work environment: decision latitude, a combined measure of skill discretion and decision authority, and psychological demands. The interactions of these two dimensions create four distinctly different kinds of psychosocial work experience. The first are ***high-strain jobs***, those that create the most adverse reactions of psychological strain (fatigue, anxiety, depression, and physical illness). This occurs when the psychological demands of the job are high and the worker's decision latitude is low. When the objective requirements of a situation cannot be routinely discharged, an unintended outcome may occur. Social activities with other workers may relieve strain, but they are also many times restricted. Lack of freedom for informal activity or relaxation may act as another form of constraint. The second group contains the ***active jobs***. These jobs are intensely demanding, but workers have a strong feeling of control, and freedom to use all available skills. Workers in this group, where psychological demand is high and decision latitude is high are found to be very active in leisure and popular activity outside of work, in spite of heavy work demands. The authors predict optimistic outcomes from such jobs; learning, growth, and high productivity. In these jobs, stress energy converts to actions through the individual decision latitude, leaving no residual strain to cause disturbance. The third group of jobs is the ***low strain*** jobs, with few psychological demands and high levels of control. For this group the authors also predict low risk of illness. These people are actually made both happier and healthier than average by work. The fourth group contains the ***passive jobs***. These are low demand and low control jobs. For this group the authors predict negative learning or gradual loss of previously acquired skills, leading to lower-than-average levels of leisure and political activity outside the job. Such work setting cause workers to be unmotivated and unproductive and the authors hypothesize an average level of psychological strain and illness risk. It is important to notice that active jobs lead

to active life outside the work environment, while workers with passive jobs do not compensate for them with active leisure but instead carry over socialized patterns of behavior from work to leisure.

Karasek and Theorell view control as a moderating variable that determines whether a psychological strain will turn out to be a learning opportunity, or on the other hand, a negative stressor, which inhibits learning. When an individual is faced with a challenge or demand and have the opportunity to exercise his decision-making capabilities he will probably gain a learning experience, which he can later reuse, thus making him or her more skilled to coping with stress in the future. The authors believe that these incremental additions to competence occur most often when the challenges in the situation are matched by the individual's control over alternatives or skills in dealing with those challenges. "In mastering them [anxiety, boredom, pain, and trouble], the individual experiences an increased range of responsibility for exercise of choice" (p.92). The authors even found psychophysiological linkages to this phenomenon, which can explain why some kinds of strains (positive challenging stress, coupled with control) are associated with physiological repair and regeneration and thus are health-promoting responses (*anabolic response*), and other kinds of stressors coupled with low control, ignite the catabolic response of the body, leading to physical illness.

But the authors also observed that at the very highest status levels decision-making may become a significant contributor to strain instead of a moderator because the capacity of controlling is not unlimited, which leads to the conclusion that some workers will be better off with more decision opportunities, while others will benefit if they will have less stressful decisions. This implies that a more equal sharing of decision power is obviously more desirable.

According to the authors, when demand and control are matched at a low level, illustrating a passive situation, a reverse process of learning occurs: skill atrophy and unlearning. Hackman and Wagemen (1995) refer to it as the capability of human organisms to adapt to the many problems that life inevitably brings. They believe that "human organism is capable of learning to make do even under conditions of profound disappointment and adversity" (p.330).

Karasek and Theorell observation that political participation declines as jobs become passive implying a gradual withdrawal from political participation by the majority of workers and an increasingly dominant role in social decision making by the few who retain active work opportunities in their jobs. The authors conclude that passive jobs may not support an active economy, and that income allocation is not the only work-related distributional problem in modern society.

This model implies that some designable items at work can contribute to or inhibit learning. Stress is found to be an inhibitor for learning, and diminishing opportunities for learning promote stress. On the other hand, control promotes learning, and learning, is conducive directly to more control, or indirectly through skill acquisition.

Karasek and Theorell expand their model to include physical demand and social support. The authors found that in general, workers with low decision latitude also have high physical demands. For some low decision latitude jobs the physical exertion has been transferred to psychological demand, representing a high-risk group for heart disease.

In relation to social support and the way it affects psychosocial health the authors mention that social support can refer to buffering mechanisms between psychological stressors at work and adverse health outcomes. Also, social contact and social structure affect the basic physiological processes important to both maintenance of long-term health and acquisition of new knowledge. Social support can facilitate active coping patterns that affect health through second-order effects, and also affect productive behavior as well.

Karasek and Theorell strongly advocate the importance for organization to consider their employees' well-being and health as a first priority consideration: "Worker well-being must be at least as important a goal for the future as profit. It can no longer be made as intermediate step on the pathway to profitability of the firm…While firms must make a profit to survive, it is even more important that the population itself survive, and in a healthy state" (p. 161).

One of the main reasons that cause organizations to overlook at the consequences of health issues at work is the difficulty to get real data about these costs, since the traditional cost analysis does not fit these kinds of calculations. Traditional cost analysis

breaks down a system into its elemental components, attaches a price to each, and adds them up. The value of the whole is no more than the sum of the prices of its parts. But in the systems theoretical model the authors discussed earlier, they found that it was the interactions between the system's components, which were the primary determinants of strain and learning phenomena. This reductionism approach of cost analysis inhibits the understanding of the system's function as a whole. The authors show that many costs can never have a dollar value, and that most of the costs are unknown. The figures the authors provide (pp. 165-167) are huge anyway and the authors conclude that besides being huge they tend to escalate rapidly. The approach can be applied to cost of productivity losses. All the estimations reach the same conclusion that misutilization of skill, whether it is costs of absenteeism, turnover, sabotage, or stress impaired workforce, are huge and create big losses for a firm.

Karasek and Theorell propose the use of the demand/control model for productivity analysis. Their model predicted that when decision latitude is low, the worker might not be able to transform the potential energy of the stress of heavy job demands into desired action. Constrained by time-paced operations and arbitrary rules, the worker may repress this energy internally, where it may manifest itself as mental and physiological strain. Motivational energy that might otherwise be available to accomplish tasks is transformed into adverse stress reactions when workers are not free to exercise reasonable levels of decision-making. Therefore they propose that jobs should be designed to match workers' potential skills: they should use all skills available and provide a platform for further skill development consistent with growth of self-esteem.

Since the authors identified that the old definition of productivity acts as a barrier to include new measures of values that are not production quantities and labor cost, they offer a new definition for productivity. This definition has to include "a value system that reflects human needs to grow creatively, to develop and use skills, as well as business needs for productive innovation. It must recognize the importance of social processes… It must stimulate socially sanctioned and constructive challenges. Finally, it must go beyond object-based value (materialism) in a world where our physical resources are limited and our environment increasingly fragile" (p. 189). The authors coin their new definition of productivity as *New Value*. They see five major differences between New

Value and conventional monetary output value: (1) unlike economic value, New Value is not "zero-sum", the value of what is transactioned, is not lost to its producer during the exchange (i.e., education). (2) New Value creates desirable new needs, rather than satisfying biological needs. In the case of conventional output value, creating biologically unnecessary needs is often looked on with disfavor. The new needs created by New Value arise out of new skills that have been learned, skills which need to be used. The use of skills leads to the need to learn more. This process of creating and satisfying needs keeps the New Value portion of the economy going. (3) New Value is process oriented, not product oriented. Feedback from the user allows the producer to utilize and then increase skills by satisfying the user's dynamically developing needs. Feedback processes also provide the user with creatively evolved products that encourage their own further uses. New Value's focus on the interaction between individuals and components of the production process means that it is system-oriented. Its value is not additively, but comes from a desirable combination of components. (4) New Value reflects long-term, rather than short-term value. (5) New Value resides in the person not in the object. Producing New Value involves adding value to a person or to organizations, both entities that can grow in the form of skills or capabilities.

These characteristics can be summarized in the form of a new definition of production output: the New Value component of output is the part that can facilitate the development of new skills or capabilities in the user. Because the new skills are associated with growth of capabilities by the user, they will usually lead to a new set of needs, stimulating the user to use even more sophisticated, tool-like goods and services in the future, increasing economic output and stimulating still further skills in the producer.

The authors believe that New Value provides a normative platform for an economic model that positively evaluates active participation, self-determination and growth of skills, including broad forms of decision authority and skill discretion. The new customer/producer linkage can be considered a foundation for development of a positive sense of self-esteem, or social identity.

The authors acknowledge that conventional economic value will continue to exist, but it will be supplemented by the New Value, that has the capacity to deal with the

development of human capabilities and social processes, and can promote the establishment of work environments that are healthier and more effective.

Karasek and Theorel's approach to improving health and productivity in the workplace is a broader view than the view held by most health promotion programs that focus only on the individual behavior and on life style changes. It views the individual as part of a society or the environment and the relationship between them are considered as the determinants of health and productivity.

Capra (1983) offers a more complex approach to health, which he defines as the systems approach to health care. His ideas can shade some light on why health promotion programs have difficulties with the participation level, and why people abandon their lifestyle behavioral changes after a while. It will also help us to understand the problem associated with health promotion programs' effectiveness.

Capra makes an important observation, especially for our purpose. His observation is that any system of health care, including modern Western medicine is a product of its history and it exists within a certain environmental and cultural context. The interpretation of this observation for our purpose is two-folded: first, it means that a health care system is not an objective phenomenon and people in different environments will require different experiences with their health care system. Second, the perception of a health care system is culturally based; a change in culture may result in a change in attitude toward the health care system. It is worthwhile in this respect to elaborate on the relationship between the individual and the social world, as it is perceived in the Western culture. Sampson (1989) explains that the modern era is characterized by conceiving the individuals as separate entities from their community, having a priority over it. This means that everyone is free to choose his own goals and purposes in life according to his desires. The role of society, government or management is to ensure free persuasion of goals with no interference. According to Sampson, with the emergence of the individual as the center of life, also emerged the interest to understand this individual as the unit of study, which gave rise to psychology as the discipline to study this unit. In a culture where the individual is the center, Sampson clarifies people are not responsible to collective assets, nor are they responsible to anyone else's behavior, since everybody cares only for himself. This is many times a source for exploitation of collective

resources and results in the fact that the majority pays for the minority misbehavior, as it is with medical care benefits. This is important to understand why people may be indifferent to change their health habits, since they will receive medical care whether or not their own behavior has been guided by principles of healthful living. In such a culture, it is also questionable whether an organization has the right to interfere in the individual's private issues like health behavior and for some individuals it may induce resentment and resistance to any efforts to influence their behavior (Zeigler, 1997).

In order to understand Western medicine, Capra steps back to the Hippocratic medicine that lies at the roots of Western medical science. Capra explains that at the core of Hippocratic medicine is the conviction that illnesses are natural phenomena that can be studied scientifically and influenced by therapeutic procedures. This means that medicine can be practiced as a scientific discipline, based on the natural sciences and should take care of prevention of illnesses, as well as their diagnosis and therapy. According to Capra, this attitude is until the present day, the basis of scientific medicine although it never reached the breadth of vision and the depth of philosophical thought as it is manifested in the Hippocratic writings. Capra explains that according to the Hippocratic writings, health requires a state of balance between environmental influences, ways of life, and the various components of human nature. They also emphasize the interdependency of mind and body. In respect to healing, Capra states that Hippocrates recognized the healing forces inherent in living organisms. The role of the physician was to assist these natural forces by creating the most favorable conditions for the healing process. This defines the role of the physician as an attendant, or assistant in the process of healing.

In order to understand better systems of health, Capra also reviews the historical evolution and practice of the Chinese medical school. He recognizes that many of the above concepts are also accepted by the Chinese tradition of medicine. But not like the mechanistic approach to the human body accepted by the Western culture, the Chinese idea of the body has always been, according to Capra, predominantly functional and concerned with the interrelations of its parts rather than with anatomical accuracy. Not only was the body accepted as a whole functional system that has to be considered in its totality, but it has also to be considered in relation to its corresponding environment.

Chinese saw the network of relationships as intrinsically dynamic, and hey view health as a state of balance. They believe according to Capra that diseases become manifest when the body gets out of balance, which may be caused by multiple factors like poor diet, lack of sleep, lack of exercise, disharmony with one's family or society, seasonal changes as well as emotional states. Illness is not conceived as an intruding agent but as a mechanism of the body to restore balance. Health and illness are not considered opposites but parts of a continuum. They are aspects of the same process in which the individual organism changes continually in relation to the changing environment. Health in this concept is not the ultimate goal of the healing process. According to Capra, "the aim of the Chinese medicine is to achieve the best possible adaptation to the individual's total environment" (p. 315). In the Chinese view the individual is responsible for the maintenance of his own health and even for the restoration of health when the body gets out of balance. This puts an emphasis on prevention and maintenance of health rather than curing. The role of the doctor here is of a specialist, who owns a wide perspective of knowledge, but his entire diagnosis relies heavily on subjective judgments based on his own senses and his close interaction with the patient. All the therapies that the doctor might offer to the patient are designed to stimulate the patient's organism in a way that it will follow its own natural tendency to return to a balanced state. Therefore therapies will always be as mild as possible and will always be an ongoing interaction between the doctor and the patient. All the treatments are aimed at restore the body's balance and not to treat a symptom.

Capra in his quest to develop a holistic approach to health questions whether the Chinese model is holistic. In this respect he distinguishes between two kinds of holism. "In a somewhat narrow sense, holism in medicine means that the human organism is seen as a living system whose components are all interconnected and interdependent. In a broader sense, the holistic view recognizes also that this system is an integral part of larger systems, which implies that the individual organism is in continual interaction with its physical and social environment, that it is constantly affected by the environment but can also act upon it and modify it" (p. 317). His conclusion is that Chinese medicine is holistic in the first sense, but not in the broader sense, even though it is theoretically acknowledged. The role of stressful events that stem from psychological and social

background are recognized as a source of illness, but doctors do not attempt to include this part in their therapeutic process in order to bring changes in these levels.

Capra points out that the main difference between Eastern and Western approaches to health is the level of acceptance of subjective knowledge: while it is highly valued in the Eastern approach, it is not at all recognized as valid in the Western approach. This difference is an immediate result from the way each stream views the living organism, whether it is a sum of parts or a living systems composed from emotions, feelings, and physical organs as well. Capra believes that the Western culture obsession with rational knowledge, objectivity, and quantification, left no decent place for intuition and subjective knowledge, even though every good physician uses them constantly. Capra suggests that we have to adopt a more balanced attitude toward rational and intuitive knowledge, which implies the integration of psychology and social measures into the system of health care. "In our society… a truly holistic approach will recognize that the environment created by our social and economic system, based on the fragmented and reductionist Cartesian world view, has become a major threat to our health. An ecological approach to health will therefore make sense only if it leads to profound changes in our technology and our social and economic structures" (p.320).

Capra looks for establishing a common conceptual basis when talking about health, in order for all the different groups who practice health care will have a way to communicate and coordinate their efforts. For this reason, he tries to define health, but agrees that health is a subjective experience whose quality can be known intuitively but can never be described or quantified. He believes that different models of living organisms will lead to different definitions of health, thus all the related concepts of illness, disease, and pathology are not well-defined entities and depend on the relationships among multiple aspects of life. If the concept of health is acknowledge to be relative and subjective in nature, than it also become clear according to Capra that the experience of health and illness is influenced by the cultural context in which it occurs. Culture influences the accepted norms of healthiness and sickness, normal and abnormal. It also influences the way people behave when they get sick, how they communicate their problems, and what kind of treatments they look for. Capra acknowledges that an effective framework for health needs to be rooted in the prevailing culture and be

compatible to the dynamics of the society and its evolution. In this sense, Western culture is about to evolve from the mechanistic view of the human body and the definition of health as the absence of disease, to a systems view of living organisms that emphasizes interrelatedness and interdependence of all phenomena. Capra explains that a systems view of health is mainly ecological and is therefore in harmony with the Hippocratic tradition upon which the Western medicine is rooted. Since systems thinking is a process thinking, Capra states that health will therefore be conceived as an ongoing process, and not as a static state as it is many times defined. This concept of health implies that there is no absolute level of health. "The continual changes of one's organism in relation to the changing environment will naturally include temporary phases of ill health, and it will often be impossible to draw a sharp line between health and illness" (p. 322).

Capra views health as a multidimensional phenomenon involving interdependent physical, psychological, and social aspects. Each one of these aspects can be affected and affect the well-being of the individual. These multiple dimensions of health will affect one another and well-being is experienced when they are balanced and integrated. Capra notes that according to this view three interdependent levels of health can be discerned: individual, social, and ecological, and what is unhealthy for the individual is in general unhealthy for the society and for the ecosystem. Capra acknowledges that in order to be healthy a system needs to be flexible, meaning that it has to have many options for interacting with its environment. Flexibility, according to Capra can be expressed through many paths like physical, mental, social, technological or economical. This notion leads to the dynamic definition of health as "an experience of well-being resulting from a dynamic balance that involves the physical and psychological aspects of the organism, as well as its interactions with its natural and social environment" (p. 323). This view acknowledges the healing forces inherent in every living organism, the tendency of the organism to reestablish itself in a balanced state when it has been disturbed. Some of the mechanisms the body can use are minor illnesses, crisis, and severe illnesses. This implies that in order to be in a dynamic balance, the organism will go through temporary phases of illness that can be used to learn and to grow.

Another kind of balance Capra refers to as important for health is the balance between one's individual autonomy and one's capacity to integrate itself harmoniously

into the larger systems. This balance creates the dynamic, flexible, healthy relationships between the different levels of systems.

Capra recognizes the important role stress has in the creation of imbalance between the organism and the environment. Stress, according to Capra is the organism's response to changes in the environment and to threats and is transitory phase until balance is regained. Prolonged or chronic stress can be harmful and plays a significant role in the development of many illnesses, especially if the individual has no way to take actions to release the organism from the stressful state. Stress can generate physical and psychological symptoms like muscle tension, anxiety, indigestion, and insomnia, which will eventually lead to illness. Capra also acknowledges that a key element in the link between stress and illness is that prolonged stress suppresses the body's immune system and its ability to defend the body against infections and other diseases. He recognizes that this fact is still not fully recognized in the medical research and when it will be recognized there will be a shift from preoccupation with microorganisms to a careful study of the host organism and its environment. Capra emphasizes that it is unfortunate that our culture has produced an accelerating rate of change in all areas, but has failed to teach us how to cope with the stress resulting from it. He recognizes that stress plays the role of "problem solver" (p. 326). When people find themselves in a situation where they cannot release their stresses, they choose unconsciously to get sick as a way out. In such circumstances, curing the disease will not make the patient healthy as long as the stressful situation persists. A medical intervention may only worsen the condition, since the "escape route" (p. 326) was blocked, or may shift the person's response to a different mode. Therefore Capra points out that "a holistic approach will have to look at health from this broad perspective, distinguishing clearly between the origins of illness and its manifestation" (p.326).

Capra views illness as a "message"; an opportunity for introspection, in order to bring the original problem and the particular escape route to the conscious level so that the problem can be resolved. This is where psychological counseling and psychotherapy can be helpful, according to Capra. This is where mind and body interdependence affect health and illness. Until recently, Capra explains, people only realize that psychology has

an important role in getting sick, but very little attention has been given to the role of psychology in getting well.

Acknowledging the continual interplay between physical and mental processes that reinforce one another through a complex network of feedback loops, and the dynamic of healing and balancing through illness and health implies a different framework for health care, according to Capra. "Health care will consist of restoring and maintaining the dynamic balance of individuals, families, and other social groups. It will mean people taking care of their own health individually, as a society, and with the help of therapists. This kind of health care cannot just be "provided", or "delivered" – it has to be practiced" (p. 332). Capra believes that there is an important interplay between the individual health status to that of the social and ecological systems he is embedded in. The change of one will not last, unless the other will change accordingly. In order for a health care system to be effective it will have to balance and resolve the stressful situations at all levels, individual as well as socials. The interplay between all levels of the society and its influence of the health of each level is the moral justification for organizations to get involved in the person's behavior that affect his health. This notion is aligned with Sampson's (1989) theory about the fact that this era is no more suited for the liberal individualistic assumptions, which view the individual as the center and above of society. Sampson argues that in our globalize world, persons are increasingly becoming parts of the thoroughly linked, interdependent global world system, where actions in one segment of this system have consequences for all, and therefore a community or an organization does have a stake in what occurs in the individual's life because it influences the health of the organization. This view is also supported by Karasek and Theorell (1990).

The most important part of an effective future health care system, according to Capra, is a well-integrated system of preventive care, which will be party the responsibility of the individual and partly the responsibility of the collective environment. This collaborated responsibility has to be supported by a change in the conception of the role of the individual in the society, as well as the role of the society in the individual' life, which is supported by Sampson (1989) ideas. Capra assigns an important role to the individual in conserving his health status though his behavior relating to food, sleep,

exercise, and drugs. Professionals are to assist the individual in doing so. But Capra acknowledges the constraints of the individual responsibility to his own health. "Individuals can be held responsible only to the extent that they have the freedom to look after themselves, and this freedom is often curtailed by heavy social and cultural conditioning. Moreover, many health problems arise from economic and political factors that can be modified only by collective action. Individual responsibility has to be accompanied by social responsibility and individual health care by social actions and policies" (p. 333). Capra terms the notion of "social health care" (p. 333) as the appropriate term for policies and collective activities dedicated to the maintenance and improvement of health. He views two basic parts for this social health care system: one is health education, which its aim will be to make people aware of how their behavior and their environment affect their health, and to teach them how to cope with stress in their daily lives. In this respect, Capra points out that health education should also aim at fostering corporate responsibility to the health of the individual. The second part of the social health care is the health policies that need to be established by the government in order to provide an environment that would encourage and make it possible for people to adopt healthy ways of living. Capra recognizes that such new policies will require a different social and economical system in order for this health care to be successful. This will also imply the restructuring of the health institutions, since the present health institutions are based on the narrow biomedical approach to the treatment of diseases, and are fragmented in the way they are organized, and thus are ineffective.

Capra assigns the most important role in the healing process on the interaction between the patient and the therapist. According to his view, the initial step in the healing process is the revelation of the causes, the context, and the extent of the imbalance. He believes that this recognition in the web of the interrelated patterns, which led to the disorder, is by itself highly therapeutic, since it relieves anxiety and gives hope and self-confidence and initiates the process of self-healing. Capra believes that this initial part of the process is the role of the psychologist, and its main purpose is to educate the patient about the nature and meaning of the illness, and about the possibilities of changing the patterns in his life that have led to it.

The aim of any therapy according to Capra is to restore the patient's balance. He believes that since the organism's innate tendency to heal itself is acknowledged, the treatment's intrusion needs to be minimally and kept mild as much as possible. The therapy itself must be multidimensional, and carried out by a health team representing many fields but share the same holistic view of health. The notion of a multi disciplinary team is also raised by Karasek and Theorell (1990). This kind of health care will require new skills some of which may not be associated with medicine. Doctors in this system will act as specialists like some other team members.

As far as the therapeutic model, Capra suggests that the health team will have to decide for each individual patient, which approach is most suitable and most efficient. In this respect, Capra recognizes that there are already some therapeutic models and techniques that go beyond the biomedical framework and are consistent with the systems view of health, and can be suitable to this new health care system. He acknowledges that more research and more study have to be done to support the establishment of this health care system in order for it to be an integrated coherent system.

Karasek and Theorell (1990) as well as Capra (1983) had point out to the complex relationship between employee's health and organizational effectiveness. Berger et al. (2001) also realize that any approach to health needs to balance between the employer and the employee's outcome and perspectives. Viewing each of them separately is not effective, since there exists a mutual dependency between them. Health promotion programs traditionally have focused on individual factors that affect health, ignoring the organizational factors that support individual health. Employee's health can be recognized as part of employee's outcomes in the workplace, while organizational effectiveness is one of the measures for company performance's outcomes. When companies strive to optimize organizational outcome without considering the effects on the workforce, stress builds up and employees' health deteriorate, causing the organization to spend more for health care and other behavioral outcomes like absenteeism and turnover. "Stress is a biopsychosocial variable that intervenes between workplace factors and individual health. It arises from the mixture of the pressure of demanding work conditions and individual responses to that pressure" (Rosen, 1995, p. ix). Stressing on individuals to change lifestyle behavior while ignoring the environment

will lead nowhere and add frustration to workers and expenses for the organizations. On the other hand, focusing only on employees' health would probably not result in improved organizational practice since the primary goals of the organization may not get the adequate attention and the overall performance of the organization may suffer. This discussion leads us to the understanding that a balanced approach that will look for ways to optimize both ends of the equation; organizational outcomes and employees' outcomes will be a lot more beneficial. This is the approach used by the Healthy Work Organizations model, or HWOs model.

2.3.5 The Healthy Work Organizations Model

Before explaining what a healthy work organization is, Rosen (1992) describes many practices that transform a work environment to be an unhealthy and unproductive place. As a result from current reality, where change is inevitable, and resources are scarce, managers and workers feel less secure, more fearful, and are less committed to their workplace. The pressure for short-term results pushes managers to be more controlling and self-centered. The more employee look for themselves, and care less about the company, the more the company struggles with escalating costs of labor and benefits, which cause the decline in productivity and morale due to more absenteeism, turnover and less innovation. This situation creates a downward cycle of the relationships between the participants, and deteriorates organization's effectiveness and workforce's health in the same time. According to Rosen, the focus of companies on the hard results led them to ignore the soft issues like values, emotions and relationships, viewing them as not relevant to the business. Some of the consequences of an unhealthy company, as the author lists include job dissatisfaction, poor morale, decreased commitment and motivation, diminished work quality and quantity, accidents, unnecessary turnover, tampering and sabotage, burnout, lateness, excessive medical costs, fatigue, mental blocks, poor communication, absenteeism, reduced productivity and more.

Rosen provides a description of what is considered a healthy company. A healthy company according to Rosen is a company that embodies people and practices that combine and coordinate to produce an exceptional performance. The main bonds in these organizations are the humanistic values at the core of the company that binds healthy,

successful employees with healthy, productive workplaces. These values determine the heath of the employee as well as the health of the whole organization. They enable the organization to "continuously grow, evolve, and renew itself, reinforcing what is productive and positive while sloughing off the unhealthy and unworkable. In short, the causes and effects among values, people, and companies are not linear but circular"(p. 10). Rosen believes that the convergence of these values generate a synergy, that result in something greater than the sum of its parts "a vital business that lives and breathes a healthy philosophy, that treats people as more than profit-producers, views relationships as more than simply financial contracts, and regards the workplace as not just a setting for business but as a holistic environment that nurtures, stretches, and empowers people" (p. 11).

The author lists those values that are mostly appreciated in healthy organizations: commitment to self-knowledge and development, firm belief in decency, respect for individual differences, spirit of partnership, high priority for health and well-being, appreciation for flexibility and resilience, and passion for products and process. According to Rosen, in healthy companies products and profits are not the immediate goal; they are the result of doing everything else right. The organizational success, the improved quality, the better service, and their competitive advantage are the by-products of their shared values and collective effort. Rosen believes that one starts with applying these values to his own life and immediate environment and it than spreads out to the entire company. Rosen points out that the workforce health has to be woven into the corporate culture and to be tailored to the needs of the employees in order for such an effort to be successful. Managers and leaders need to play role model, but in the same time acknowledge and respect the diversity of the workforce and the individual right for different approach to health, this is very similar to the list of bests practices Riedel et al. found in organizations where health promotion initiatives have succeeded (2001). Like Karasek and Theorell and Capra, Rosen recognizes that the first attempt to improve employees' health is to eliminate the effects of environmental stressors.

The aim of healthy work organizations is to look for practices that promote personal health and well-being, while in the same time facilitate organizational effectiveness. This can be considered as an extension to the notion of effectiveness, by

including the care for the employees in the goals of the organization. Jaffe (1995) tries to explore four theoretical-research approaches to the healthy work organizations model, and also to find out the relationships among three areas of interest: organizational productivity and effectiveness, employee commitment, motivation, and growth, and employee health and well-being. The author acknowledges that healthy organizations need to balance the needs and expectations of all stakeholders, which means balancing control, influence, and sharing of rewards among the different constituencies. The main question the author posits is for whom the company should be healthy. Her list includes five categories: an organization can be healthy for itself, for its stockholders, for its employees or part of them (for instance; executives), for suppliers and customers, or for the community. The author realizes that accommodating all these different level of health is not easy, since their needs many times conflict and differ.

Jaffe searched for studies concerning these both ends, but found almost no research on organizational effectiveness as it relates to employee health. She did find in many related fields four lines of research that seemed relevant. The first line is the study of work stress, in which the work of Karasek and Theorell (1990) is the most important. The author notes that most stress research focused on individual coping and adapting to stress rather than on work environment as Karasek and Theorell emphasized. Jaffe does recognize one limitation of their study, which is their focus on "job" design rather than on workplace as a whole. She believed that a job is not enough for creating a real change especially in the present reality where jobs are continually changing. While Karasek and Theorell looked at the link between job design, stress and health, she believes that a model must include also the link between organizational design and job design. The second line of research, according to Jaffe is about organizational redesign especially focusing on how to create effective workplaces that influence people's motivation, satisfaction, and effectiveness at work. Much of this line of research is devoted to employee participation and self-management teams as a path to self-motivation and job enrichment. The author notes in this respect also the organizational learning approach as a model for continual learning and growth. The author points out that in this line of study, the researchers did not look on how workplaces produce health and well being. The third line explores corporate policies and the workplace culture that contribute to individual

and organizational health. Culture defines the norms and the behavior in the organizational as well as how people treat and respect each other and how work is done. These norms have an effect on both individual and organizational health and also on the policies and practices in the organization. Jaffa's fourth line of research is the social-psychodynamic paradigm. In this line of research, it is believed that the founder of the organization or the leader's personality, values and character affect the organizational values and norms. This approach is in contrast to the assumption that organizational culture affects employees' attitude and behavior. According to this theory, leaders cause the organization to be functional, healthy, or dysfunctional. It is believed by this line of study that healthy organizations arise when healthy people start them and, in turn, selects healthy people for healthy reasons to do the tasks needed to grow the organization.

Jaffe aims to integrate these four paradigms, which evolve separately in different disciplines, not having any relationship with each other. She found that core issues that arose from the stress literature like commitment, control, and social support are also central to the work redesign literature. The author acknowledges the contribution of the psychodynamic paradigm that emphasizes the important role of leaders and managers' personality and personal values and stresses that "if individual managers cannot learn to understand the consequences of their own behavior, then no amount of policies or programs can produce health within an organization" (p. 36). Jaffe also notices that the motivational assumptions are common to all four paradigms. All of them see working people as having complex needs, desiring to make a difference, and searching for meaningful work. According to the author, "the more organizational norms, policies, behaviors, and culture support human needs for security, personal growth, participation and involvement, and meaning, the healthier the organization will be. These factors will also lead to greater productivity and effectiveness" (p. 36). The author notes that this model of employee – organization relationship is more like the social contract of a democracy, which underlies many theories about promoting health in individual and organizations.

Since the human resource management practices in an organization have an important influence on organizational performance and on employee's perceptions about the organization and therefore also about his behavior in the workplace, Browne (2000)

looked for studies about human resource practices that balance a concern for organizational-level outcomes with employee-level outcomes but had little success. His assumption was that the healthy work organization concept would be useful in identifying HRM (human resource management) practices that simultaneously correlate with macro-level measures of organizational outcomes (i.e., organizational effectiveness) and micro-level measures of employee well-being (i.e., employee job stress and job satisfaction).

In this study, the author used a survey that he distributed to twenty-five different plants of the same organization, and employees that represented all plant personnel had responded to it. The survey contained twenty-nine questionnaire items that represented eight HRM practices, which previous studies have correlated to measures of organizational effectiveness. The author tried to find out how these practices relate to employee's outcome as measured by job stress and job satisfaction. The results from the multivariate regression analyses demonstrated that five out of the eight of the HRM practices operationalized in this study were positively and significantly related to measures of organizational effectiveness and job satisfaction. Also four of these five HRM practices were significant predictors of employee job stress. These five practices include employee communication, recognition, training, internal career opportunities, and continuous improvement. Only internal career opportunities were found not significantly related to job stress.

The author concludes that these HRM practices can serve as initial guiding principles within a larger set of management practices for a healthy work organization.

The concept of healthy work organizations, according to Browne (2002), has been accepted by the National Institute for Occupational Safety and Health (NIOSH) as part of the national strategy to prevent the negative effects of occupational stress on employee well-being. Browne presents their model for HWOs, which include three organizational characteristics: management practices, organizational culture/climate, and organizational values, that lead to organizational health, which is manifested through two kind of outcomes: organizational performance outcomes, and worker health/satisfaction outcomes. Browne's intention in this study is to validate this model. The results obtained from his study had limited empirical support for the hypothesis that stated that the organizational characteristics of the HWOs model (i.e., management practices,

organizational culture, and organizational values) would be positively correlated to measures of organizational health at both the organizational level (i.e., organizational effectiveness) and the individual level (i.e., self-reported measures of employee stress). The author found that only several variables from each organizational characteristics were significantly good predictors of both criterion measures of organizational effectiveness and stress. These variables include *continuous improvement* and *career development* as management practices, *innovation* and *conflict resolution* as organizational climate variables, and *commitment to technology* as an organizational value.

The author's conclusions from this study are that the results support the healthy work organization model, and that the organizational characteristics that were identifies under the dimensions of management practices, organizational climate, and organizational values, hold promise for preventing work-related stress while simultaneously promoting organizational effectiveness.

The studies above that research the concept of healthy work organizations provide support to this framework as being a useful framework to balance through several organizational characteristics the outcomes of the organizations with the outcomes for the employee. It is very obvious from these studies that the prevailing linear and fragmented thinking of cause and effect and of separate relationships prevent them from viewing the total dynamic of the interconnectedness and interrelationships between all of the variables and the outcomes. Management practices, organizational culture, and organizational values are not separate entities that can be looked in isolation and measured in relation to the organizational and employees outcome, nor can the organizational outcome be detached from employees' outcome, since they are deeply interrelated. So even though the proposed model and their inquiries are relevant and of importance to be explored, for both; organizations and individuals, they lack the ability to capture the entire dynamic of work life and organizations' reality. As Capra (1983) pointed out, in complex systems, especially in complex social systems like organizations, systems thinking can provide a better and more useful approach to capture the dynamic of the system. In the next section I will explain the advantages in using system dynamics tools in perusing healthy organizations.

2.3.6 The Usefulness of System Dynamics in Promoting Organizational and Employee Health

It would be very useful to find out how similar are the effectiveness construct and the health construct in their characteristics. If such a similarity will be found, we would be able to generalize from one construct to the other, and we will be able to learn from one construct on the other. We will probably be able to use the same logic or approach to manage both of them. In order to view their similarities, we would need to use systems thinking or process thinking, rather than linear thinking.

Both individual health and organizational effectiveness are not dichotomous constructs. There is no total in healthy person or totally ill person; and there is no effective organization or a non-effective organization. Both are continuum constructs. Therefore, measuring them at a certain time point is not always very efficient. They would rather be better treated with a description of the direction of their behavior over time. This continuum, which characterizes both of them, is a result of the changing process of the individual or the organization as an adaptation mechanism to the environment. This characteristic is expressed in both definitions when a systems approach is utilized. Beer (1980) defined effectiveness as "the extent of fit between the organization's environment and all the internal components of the social system. The more congruity that exists between the internal social system components and the environment, the more the organization is likely to exchange favorably with its environment" (p. 39). Capra (1983) defined health as "an experience of well-being resulting from a dynamic balance that involves the physical and psychological aspects of the organism, as well as the interactions with its natural and social environment" (p. 323) Both definitions emphasize the dynamic characteristic of the construct rather than viewing them as a static state, and both are concerned with the relationship with the environment, meaning that these constructs do not stand alone, they are part of a larger system, which affect them and which they affect in return in an ongoing process. There is no absolute level of health or effectiveness. Because of the ever-changing environment both construct will always experience temporary phases of decline. When systems go through phases of decline, this period can be used to learn and to grow, a fact that is true

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for health and for effectiveness as well. The acknowledgement of this continuum and the recognition of the importance of stages of illness or ineffectiveness can contribute to an environment without blaming and therefore with little or no anxiety.

Neither health nor effectiveness are objective constructs. The way they are conceived is always related to their cultural context. What is consider effective to a certain organization in a certain situation or environment could easily be considered ineffective in a different situation. The same holds for health. Health is a subjective experience (Capra, 1983). As Capra argues that we need a more balanced attitude toward rational and intuitive knowledge when dealing with health, we could also argue that a more balanced attitude toward rational and subjective knowledge in relation to effectiveness would also benefit organizational effectiveness. When we consider any social system we have to take into account psychological and social measures, beside the objective, quantitative measures we are all used to.

Both health and effectiveness are multidimentional phenomenon involving interdependent physical, psychological, and social aspects. Each one of these aspects can affect the individual health or the organizational effectiveness, or be affected. These multiple dimensions of health and effectiveness will affect one another and will bring the system to its optimal state only when they are balanced and integrated. Like health that can be experienced in several levels individual, social, and ecological, the same three levels also characterize effectiveness. These three levels interact and affect each other in relation to health and in relation to effectiveness. This interaction between levels implies that flexibility is an important valuable characteristic for both; health and effectiveness. A change in one level will not hold unless the other levels will change accordingly.

Both health and effectiveness have to be viewed using a long-term perspective. Things that we do today may have their effect in both of them only in a very long run, which makes it difficult to evaluate them on a short-time basis. This is one of the reasons changes are difficult to implement because it is difficult to convince people to participate in activities that their results will be seen only after a long time or not be visual or measurable at all. The soft dimensions of both; health and effectiveness are difficult to conceptualize and to evaluate in the short-run. The way our culture directed us in both aspects, we would rather choose the short-term objectives than the long-term objective,

especially because we tend to misunderstand the long-term consequences of our short-term actions.

All these similarities point to the fact that the prevailing linear thinking prevents us from being able to capture the full dimension of the behavior of the system of health and the system of effectiveness. This is why so many attempts to improve organizational effectiveness or employee health fail. It is difficult to improve a system when we have only a partial knowledge about the system. We need to use systems thinking in order to capture the breadth and depth of the entire system. For this reason, system dynamics approach and tools may be very helpful to understand how each of these constructs changes through time because of their specific structure (relationships, interdependencies, etc.).

From the above discussions we also acknowledged that not only are health and effectiveness similar in their characteristic and behavior, in a social system like an organization, they interact and influence each other. As Rosen (1992) describes one of the possible dynamic behaviors of an unhealthy company is that when change occurs and resources are scarce, managers and workers feel less secure, more fearful, and are less committed to their workplace. The pressure for short-term results pushes managers to be more controlling and self-centered. The more employee look for themselves, and care less about the company, the more the company struggles with escalating costs of labor and benefits, which cause the decline in productivity and morale due to more absenteeism, turnover and less innovation. This situation creates a downward cycle of the relationships between the participants, and deteriorates organization's effectiveness and workforce's health in the same time.

2.3.7 Conclusions

System dynamics tools enable us to slowly change the personal and the organization's culture from a linear, fragmented, static way of thinking to a more holistic, dynamic, nonlinear way of thinking, which is important in the quest to understand the behavior of social systems. Also as noted by Forrester (1993) "System dynamics provides a common foundation that can be applied wherever we want to understand and influence how things change over time." So what we learn from one system's behavior we can

apply and use in another system, which accelerates our learning in such systems. System dynamics modeling builds upon the mental models information-base of the people in the system, and through an interactive process, which includes testing the assumptions made using relevant data and revising the model, reveals an acceptable and useful model. In this manner, system dynamics modeling combines quantitative and qualitative measures, and uses objective and subjective knowledge in a balanced way, which gives rise to a better understanding of the behavior of the system. By using these combined sources of information, system dynamics describes a system the way it is now, not the way it should be, but through simulation, different situation can be described and analyzed. By using simulation, different policies that intend to solve the problem can be experimented with, and their consequences can be observed. This process will improve the decision making process because of the use of more relevant information with more insights to the situation in interest. Simulation can reveal behavior that we did not expect, which will change our insight about the real system (Forrester, 1993).

System dynamics can provide a framework to deal with the time dimension, with complexity, and with detailed facts (Forrester, 1993) that are inherent in social systems, and are the source of our misunderstanding of the counterintuitive behavior of the system.

All these characteristics of system dynamics modeling will be beneficial in solving many of the problems researchers in the area of organizational effectiveness and employee health are encountering. Problems concerning lack of data, timeframe, and measurements as mentioned by Riedel et al (2001) and Aldana (2001), can be approached by system dynamics modeling, using simulations. Soft issues that were found to be of important influence for a healthy organization such as organizational values, management practices, and culture (Browne, 2002) can be captured and integrated in the model, using system dynamics. Different kinds of interventions can be modeled, simulated, and their long-term effect can be analyzed and compared to other interventions. The many different interactions between variables in the system as mentioned by Berger, et al. (2001) can be captured in the model and their complex effect can be exposed. Stress and its effects on human health and on organizational effectiveness can be realized, and lower the ignorance about its existence. The call for integrating subjective knowledge (Capra, 1983), finds an answer under the system dynamics approach.

Above and beyond all these benefits from using system dynamics modeling in the workplace, the main power of system dynamics is to identify key contributors on employee's health. The involvement of a person in a system dynamics process may enhance his/her learning abilities, his/her understanding of the situation, his/her acceptance of his/her responsibility for the situation and the feel of control she/he may experience to change the course of events. All these abilities and the new understanding are, according to Sapolsky (1994), a good source for ways to lower stress and promote healing. Also the team-based process of system dynamics modeling is a contributor to satisfaction, which enhances health.

In the same manner, the system dynamics approach has also a direct influence on organizational effectiveness. By the simple act of exploring the behavior of the system through the interactive and collaborate effort of many members of the system, many of the underlying and hidden forces that had a negative effect on organizational performance are revealed and exposed, and thus can be eliminated by the new mutual understanding of system's members, and this can happen through a nature process that creates no resistance.

Chapter 3

Methodology

3.0   Introduction

I intend to model an organization that seeks to improve its effectiveness. I will concentrate on improving organizational health by improving quality and employee health at the organizational level. I will use system dynamics as the modeling approach.

3.1   Research Design

The initiative for this research has evolved through a thorough reading of the literature in two main areas: the literature concerning quality management and the literature concerning employees' well being. I have recognized that employees' health is not a major concern in the literature of quality, and that quality management is not discussed in the literature of employees' health. On the other hand, organizational effectiveness is considered the main issue in both these areas. I articulated the problem definition from these findings: What is the nature of the interaction between organizational effectiveness, quality culture and employee health, and what practices and management decisions can positively influence all these three constructs?

I recognized the fact that many factors take place in the relationships between these three constructs and that linear relationships may not be able to describe such a system. Therefore I chose to use the system dynamics approach as the method to describe the system. The hypotheses are therefore dynamic and they articulate the relationship I have in my mental model about the system of organizational effectiveness, employees' health, and quality culture. There are many variables that interplay between these elements. All the dynamic hypotheses were based on the literature.

As mentioned above, I chose the system dynamics approach to describe my dynamic hypotheses. The system dynamics approach also serves in this research as the methodology to build the conceptual model and the formal model. It also provides the dynamic to eliciting the knowledge from those who participate in the group.

The system dynamics framework actually combines two approaches that usually work separately in research design: the qualitative approach and the quantitative approach. The qualitative approach according to Leedy and Ormrod (2001) is typically used to answer questions about the complex nature of phenomena, which occur within its natural context. Leedy and Ormrod explain that "the qualitative research process is more holistic and "emergent", with the specific focus, design, measurement instruments (e.g., interviews), and interpretations developing and possibly changing in the complexity of the situation and interact with their participants." (p. 102). As these authors point out, qualitative researchers use mostly inductive reasoning when they draw inferences about the phenomena from the observations they make. Yin (1989) argues that two main conditions are the essence of qualitative research: the use of close-up, detailed observation of the natural world by the investigator, and the attempt to avoid prior commitment to any theoretical model. This is the framework for a system dynamics modeling approach and is true for its qualitative elements and quantitative elements as well. The system dynamics approach combines and makes use of both approaches, in order to achieve the advantages of both, resulting in quantitative outcomes that can be measured and compared. The strategy to pursue the objectives of this research is through an action research strategy. Action research is a form of a case study. The case study serves to demonstrate the theory and hypotheses that were developed through out this research from the literature. According to Yin (1989) case studies may be considered the most appropriate research method to deal with and understand complex social phenomena. A case study allows an investigation to retain the holistic and meaningful characteristics of real-life events such as organizational and managerial processes (Yin, 1989). Case studies are the most relevant research strategies for situations in which "a "how" or "why" question is being asked about a contemporary set of events, over which the investigator has little or no control" (Yin, 1989, p. 20). Yin provides a technical definition for case studies: "A case study is an empirical inquiry that:

- Investigates a contemporary phenomenon within its real-life context; when
- The boundaries between phenomenon and context are not clearly evident; and in which
- Multiple sources of evidence are used" (1989, p.23).

Some of the most important applications of case studies in evaluation research include explaining the causal links in real-life interventions that are too complex for the survey or experimental strategies and the description of the real-life context in which an intervention has occurred (Yin, 1989).

3.1.1 Action Research

"Action research is a flexible spiral process, which allows action (change, improvement) and research (understanding, knowledge) to be achieved at the same time. The understanding allows more informed change and at the same time is informed by that change. People affected by the change are usually involved in the action research. This allows the understanding to be widely shared and the change to be pursued with commitment" (Dick, 2002).

In action research the decision makers and the doers are not separated. Those who have to carry out the actions are part of the decision making process. This fact promotes the two important ingredients of this strategy: 1) The actions, through enhanced commitment that is achieved by participating in the decision-making process, and 2) Research, meaning knowledge gained, which is achieved through the participation of the doers who possess in their mind most important knowledge relevant to the situation (Dick, 2002).

Action research is used when you wish to achieve understanding and change at the same time. It is a spiral process, which alternates between actions and critical reflection while moving forward all the time. The present situation and past actions are reviewed critically, using reflection and then an informed planning of the next actions follows.

The action research process is a flexible and a responsive process. One starts from a certain understanding of the situation and accordingly designs the research. With the advancement of the process, more learning about the situation is achieved, thus providing the opportunity to refine the research design to fit the situation better and then to proceed. "Action research provides enough flexibility to allow imprecise beginnings while progressing towards appropriate endings. A cyclic process gives more chances to learn from experience" (Dick, 2002). The action research approach does not require the

developing of measures that might or might not be relevant to the situation. The development of measures can be done parallel to the process of learning throughout the research. Dick (2002) points out that several characteristics of action research allow it to pursue rigorous understanding:

- "The involvement of all interested parties provides more information about the situation
- Critical reflection in each cycle provides many chances to correct errors. This is especially so when there are cycles within cycles within cycles, and where the critical reflection is characterized by a vigorous search for disconfirming evidence
- Within each cycle the assumptions underlying the plans are tested in action."

Dick and Swepson (1997) acknowledge the fact that causal explanations are not the central interest of action research. The emphasis is on actions. These authors believe that since many variables interact among themselves, it is too cumbersome to map their relationships. This is where the system dynamics approach fits in and provides a helpful method to model the relationships within a system. Also, Dick and Swepson (1997) point out that action research is not suited for global generalization. "Generalisability might be regarded as global relevance - the ability to apply a finding from one experimental setting into other settings. Action research then pursues local relevance, if necessary at the expense of global relevance. Experimentation often achieves global relevance, but at the cost of being difficult to apply practically to local situations" (Dick and Swepson, 1997). When several such cases of action research in different situations and settings give rise to the same causal relationships then the generalization it may produce, is more valid than generalizing from a single experimental study.

The process undertaken by a system dynamics modeling approach is an action research paradigm, which aims to build a model that will represent the situation or the problem in question. The model is created by a collaborated effort of the decision makers with the facilitator, in which their mental models are revealed and challenged. System dynamics will be effective to the extent that one will be able to involve the decision makers in the process of building the model, a process which is known as group model-

building. The process is an iterative process, moving from actions to learning to actions again continuously, until an acceptable model is produce. Actions in this context refer to the model outcomes that represent the way the decision makers view the system. This process is the opportunity organizations have to share divergent views on a problem. Divergent views are the result of selective perception and selective memory. Through this process the participants have an opportunity to examine their views critically in an effort to create a shared and better understanding of the problem (Vennix, 1996).

3.1.2 Models

A model is a substitute for an object or system (Forrester, 1968). We use models as a method for communication and clarification. Our thinking process depends on models, through which we are able to conceptualize and reorganize the world around us. Much of this conceptualization is done automatically in our mind and is the essence of our mental models. Our mental models are representations of the real system, modified and filtered through our experience (Forrester, 1968). Mental models are our general ideas that shape our thoughts and actions and lead us to expect certain results (O'Connor and McDermott, 1997). Mental models are so ingrained in our mind that we tend to confuse them with facts, and mistakenly believe everybody shares them. Many of our mental models are implicit and, as long as they are such, we cannot change them or argue about them. In order to have a chance to make a change happen, we must have the ability to reveal our mental models, make them formal, explicit, arguable, and discussable.

3.1.3 Why Modeling?

When dealing with complex social and technological systems, the human mind is not adequate for constructing and interpreting the dynamic behavior over time of the system (Forrester, 1968). Therefore we resort to computer models that have the ability to aid our mental process in dealing with such systems. A formal model has two advantages over our informal models on which our decisions are based (Richardson and Pugh, 1981). Since formal models are explicit, they are communicable, whereas mental models mostly are not. A system dynamics model exposes the decision-makers' assumptions about the problem, so that they can be criticized, experimented with, and reformulated. Mental

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models are mainly based on intuition and are therefore fuzzy, adaptable, incommunicable, and many times inapplicable.

Formal models can handle complexity more easily by utilizing the computer and have the ability to trace through time and work out a huge amount of computations in a short while. A formal model may expose emotional bias, wordiness problem, and the fuzziness, which characterize the process of communicating mental models.
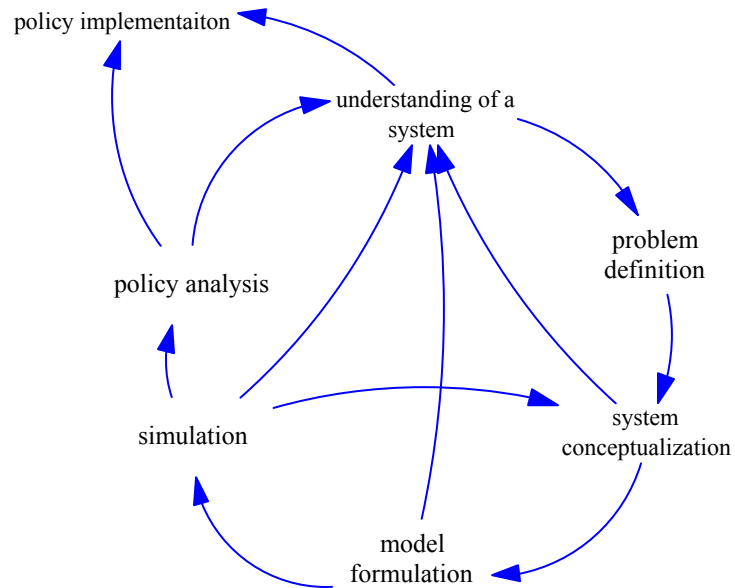
3.2   Overview of the System Dynamics Approach

The system dynamics approach relies on the premise that feedback structures are responsible for the behavior of the system over time and therefore the sources of its problems are within the system (Richardson and Pugh, 1981). System dynamics assumes that people tend to ignore feedback processes and dynamics in systems, especially if they are not trained to do so, and provides a method accompanied with tools to facilitate this thinking process. System dynamics is useful in communicating what our language fails to do (Vennix, 1996). "In order to be able to use this method effectively one has to be familiar with (a) the system dynamics method, (b) the way to set up a group model-building project, and (c) the way to facilitate the group model-building process" (Vennix, 1996, p. 41). These three issues will be discussed in the next sections.

3.3   The System Dynamics Method

The system dynamics modeling approach is a dynamic process by its nature and consists of several stages that interact among themselves and feed back to each other while the model evolves, changes, and is refined, until the ultimate goal of understanding the behavior of the system is reached (Richardson and Pugh, 1981). The system dynamics modeling process starts and ends with the understanding of the system and its problems, while in each stage of the process the understanding of the problem is enhanced, and this understanding aids the modeling effort. As Randers (1980) stresses, modeling is a process of trial and error as is any product development process, and its goal is to achieve a reasonably consistent degree of progress throughout the recursive process. This iterative

process is captured in the following feedback map (Adapted from Richardson and Pugh, 1981, p. 17):

Figure 3-1: Overview of the System Dynamics Modeling Approach

3.3.1 Problem Definition

In order to build a model, one needs to have a clear understanding on the purpose of the model and one needs to focus on the problem rather than on the system. The problem is taken as a starting point but it is studied from a systems point of view, meaning that all elements that are necessary to understand the problem will be included (Richardson and Pugh, 1981; Vennix, 1996). Randers (1980) notes that in the initial stages of the modeling process it is more important to concentrate on the behavior, what he calls, the social process, than on the structure, the social system. This approach is more useful in making the right choice of selecting the slice of the real world that is in our interest.

Since system dynamics is concerned with the dynamic behavior of problems; i.e., the change in the system or in the behavior of the variables over time, created by the feedback structures in the system, it entails two kinds of efforts. One effort deals with identifying the problem, which is usually visualized as the change in behavior over time. The problem definition includes the articulation of the reference modes, and the time horizon of the problem under study. The second effort is the identification of the

important variables in the system that gives rise to the problem and to recognize important feedback structures. This is the problem conceptualization part.

3.3.1.1 Reference Modes

In order to internalize dynamic thinking, one needs to view a problem in terms of a graph that depicts the patterns of behavior of a variable over time. "Graphing variables over time forces us, rather obviously, to identify those variables in a system that are the symptoms of the problem we wish to study" (Richardson and Pugh, 1981, p.19). Graphs over time of important variables become the reference behavior modes for the study. In the modeling effort they will be referred to over and over again. Graphs are very helpful in viewing the long-term dynamic consequences of certain actions or policies. They can demonstrate patterns of growth and decline, peaks and valleys in the behavior of a specific variable. These graphs are also helpful later in formulating the formal, quantitative model.

3.3.1.2 Time Horizon

The definition of the time horizon, the period of time over which the problem under study plays itself out, is a very important element in the problem identification. The time horizon affects the way the problem is studied ((Richardson and Pugh, 1981; Vennix, 1996). The decision about the time horizon affects the length of time over which a simulation will eventually be run. Different time horizons define different aspects of the problem for the same system, thus defining the time horizon helps to define the particular problem being addressed (Richardson and Pugh, 1981).

3.3.2 System Conceptualization

In the conceptualization stage the modeler strives to explore the "mental model", which describes his way of understanding the real world (Randers, 1980). In order to do so effectively, one needs to define precisely the model purpose, accordingly decide about the system's boundaries, identify the relationships among the various variables in the system and state the dynamics hypotheses he believes describe the behavior of the system.

3.3.2.1 Model Purpose

Model purpose is not identical to the problem definition. Statement of the model purpose focuses more on the audience for the study, potential leverage points for policies, and on the implementation, and less on the nature of the problem (Richardson and Pugh, 1981).

Articulating the model purpose helps the modeler to concentrate his effort on the questions to be answered, thus he is able to choose the variables that should be included in the study and those which need to be omitted from the system. This is useful for defining the system boundaries.

3.3.2.2 System Boundaries

System dynamics is concerned with closed causal-loop systems. An important effort of the model builder is to define at an early stage what is significantly important for the problem under study and should be included in the system and what should be excluded. Any element that can be omitted without misrepresenting the behavior of the system can be left out of the system boundary. Richardson and Pugh (1981) add that one of the first criteria for a correctly drawn system boundary is closing the feedback loops in the system, and whenever open loops are present, it implies that the boundaries are improperly drawn. "We try to include inside the boundary all quantities that are dynamically significant for the purposes of the model" (Richardson and Pugh, 1981, p. 43). Variables that are within the boundaries of the system are considered endogenous variables. System dynamics seeks to rely on endogenous explanations for the behavior of the system, especially to explore the relationship between policies and system's structure (Sterman, 2000). Variables that are out of the system boundary are considered exogenous variables. Changing policies will not affect exogenous variables, thus they can provide no information about the behavior of the system (Sterman, 2000). The narrower the system boundary, the more reliance is provided for exogenous variables, which implies less control to change the behavior of the system. On the other hand, a broad model boundary may cause the model to be too complex and less useful. The modeler has to consider the model purpose and seek simplicity as long as it is not at the expense of misrepresentation of the problematic behavior. Variables can be added, deleted or aggregated in the process of defining the system boundary. System boundaries are subject to changes in the process

of modeling. Richardson and Pugh (1981) provide further guidance for what to include within the system boundary by asking the following three questions:

- "What are the physical processes in the system that are relevant to the problem?
- What are the perceptions of those processes and how are they formed?
- How do those perceptions combine to create pressures influencing the physical processes?" (p.52).

3.3.2.3 Identifying Feedback Loops – Dynamic Hypotheses

After the boundaries of the system have been drawn, the conceptualization of the system is accomplished in a visual way, using certain symbols that depict the relationships among variables and diagram the feedback loops, which are responsible for the behavior of the system. These diagrams are referred to as causal loop diagrams (CLD). Causal loop diagrams are maps that show the mechanism responsible for the behavior of the system, through the causal links among variables with arrows from a cause to an effect. The verbalization of these feedback loops creates the dynamic hypotheses the modeler theorizes. In other words, "The dynamic hypothesis in a system dynamics study is a statement of system structure that appears to have the potential to generate the problem behavior" (Richardson and Pugh, 1981, p. 55). Dynamic hypotheses are subject to changes through the process of model building when more learning and understanding of the system behavior is gained.

Feedback loops are consistent with the endogenous approach that explains the behavior of the system, because it looks for the inward view of the system and for the relationships between policies and the system structure. The dynamic hypotheses are tested using simulation; and, if the results are similar to the reference modes, then the dynamic hypotheses are considered valid. In any other case, the dynamic hypotheses will be adjusted until they satisfy the expectation as they were articulated in the reference modes and are agreed upon by the decision makers and the modeler.

CLDs are very useful in communicating interdependencies and feedback processes. They are especially important in the initial stage of modeling to capture the mental models of the decision makers and the modeler. But CLDs have several limitations that can easily mislead the users and impair the learning process of the

participants (Richardson, 1986; Vennix, 1996; Sterman, 2000), much of which has to do with different rate of accumulation of some variables and with the linkage between rates and stocks. Richardson (1986) explains that CLDs are more appropriate representations for information links, but when it comes to physical flow, than CLDs may cause confusion. This is where the role of stock and flow diagrams have an important contribution in the model building effort. Stock and flow diagrams are the path through which the model can be formulated.

3.3.3 Model Formulation

"Formulation is the process of translating model structure into equations. It is the transformation from an informal conceptual view to a formal, quantitative representation" (Richardson and Pugh, 1981, p. 133). Only after we transform the model into equations we are able to simulate it and learn about the behavior of the model in many situations, or answer the question of how different policies will affect its behavior. Simulation is important because real-world experiments are usually impractical and infeasible. Beside the importance of simulation, formalizing a conceptual model generates important insights, helps to recognize ambiguous concepts and resolve contradictions that went unnoticed in the conceptual phase (Sterman, 2000). Several steps are taken in formalizing a model. First, it is important to identify the stocks and flows in the system. Then, equations need to be formalized for all the variables in the system. For the initial conditions and parameters, we have to estimate their values. Only after these steps are completed, one can run a simulation for the model and change conditions to learn about their influence on the behavior of the system.

3.3.3.1 Identifying Stocks and Flows

Stocks and flows are the second central concept of system dynamics theory. Stocks represent accumulations. The level of stock is the information input, which is important in management decisions and action considerations. Stocks are the source of delays in the system. The delay stems from the difference between the inflow to the process and the outflow (Sterman, 2000). Although it seems obvious what is a stock and what is a flow, it is many times difficult to distinguish between them, a fact that contributes to the misunderstanding of complex systems, leads to underestimation of time

delays, a short-term focus, and policy resistance (Sterman, 2000). Stocks permit a system to stay in a disequilibrium state, since they absorb the differences between inflows and outflows. Inflows and outflows usually differ because they are governed by different decision processes (Sterman, 2000).

In order to distinguish between stocks and flows, one needs to think about stocks as quantities of material or other accumulations. Flows are the rates at which these system states are changed. While stocks are measured in countable units, rates are measured in the same units per time period (Sterman, 2000). Sterman (2000) proposes the snapshot test to help in identifying key stocks in a system "Stocks would be those things you could count or measure in the picture, including psychological states and other intangible variables" (p. 199). Flows are not instantaneously observable or measurable.

There is a major difference in the flow of material in the system and in the flow of information in the system. While the content of the stock and flow material networks are conserved in the sense that items are not lost in the system, they may only flow from one stock into another, the information flow is not conserved. Even when information flows from one element of the system to another, it is accessible to both and the usage of it does not use it up or make it unavailable to others (Sterman, 2000).

Constants are state variables that change so slowly that instead of being stocks, they are considered constant for the time horizon of interest in the model (Sterman, 2000).

Stocks can be aggregated if they are relatively short-lived with respect to the time horizon and the dynamics of interest (Sterman, 2000).

Sources and sinks for the flows are the out-of-boundary stocks, and are considered as having an infinite capacity. These assumptions, meaning if something is a stock or flow, according to Sterman (2000), need to be challenged and tested.

3.3.3.2 Formulating Equations

An important step in the model-building process is to specify mathematical equations for each of the relationships in the model and to quantify the model's parameters. The structure of the equation for a stock is similar to all stocks and is straightforward. Stocks integrate their flows; the net flow into the stock is the rate of change of the stock:

Stock = INTEGRAL (Inflow – Outflow, Stock$_{t0}$)   (1)

Where Inflows represent the value of the inflows at any time between the initial time t_0 and the current time (Sterman, 2000). Stating it differently, the net rate of change of any stock, which is its derivative, is the inflow less the outflow (Sterman, 2000):

d(Stock)/dt = Inflow(t) – Outflow(t)   (2)

Equations for the flows and auxiliary variables are not always straightforward (Vennix, 1996), and in formulating a model, each case requires its own fresh look at the way information combines to produce the change expressed in the model (Richardson and Pugh, 1981).

An important issue in formulating a model is the consideration of its internal consistency. As for any mathematical equation, the left side and the right side of the equation need to have the same dimensions (Vennix, 1996). Vennix (1996) warns that "when constructing a system dynamics model this dimensional consistency check has to be conducted for every equation in the model … Only, and only if, all equations in the model are checked and the model is shown to be internally consistent can it be used for further analyses" (p.84). The dimensions that are chosen for the variables have to make sense in the time horizon of the model.

3.3.3.3 Parameter Estimation

In order to simulate a system dynamics model, one must first assign values to all the constants and stocks, which are present in the model. This is known as parameter estimation. We use the term estimation because the exact numerical value of the parameter is unknown (Vennix, 1996). Two issues are important in parameter estimation. One is the selection of the parameters, and the second is the process of determining the initial values of system stocks. It is also important to note that a modeler should estimate parameter values only to the degree of accuracy required (Richardson and Pugh, 1981). The degree of accuracy depends most of the times of the purpose of the model. Since most system dynamics models are intended to analyze policies, and if the

degree of accuracy is not that important, then from the modeler's point of view, the parameters do not need to be estimated with any more accuracy than required (Richardson and Pugh, 1981).

There are many different kinds of parameters. There are constants, reference parameters, conversion factors, growth or aging factors, adjustment times, and more. Each type of parameter calls for different estimation strategy (Richardson and Pugh, 1981).

For all parameters, the system dynamics approach insists that they should have a clear correspondence to a real quantity or concept. This kind of observability can be maintained by specifying the units of a parameter (Richardson and Pugh, 1981).

Graham (1980) indicates that there are many parameter estimation techniques and the appropriateness of them depends upon the entire context of the model-building process, especially on how the model variables have been selected, and how the model will be tested.

Graham (1980) presents three parameter estimation techniques: Estimation using data below the level of aggregation of the model variables, using a single model equation and estimation using several or all model equations. In general he recommends that modelers should not favor the equation-based techniques over the use of unaggregated data on the basis of accuracy. The following are his recommendations for system dynamics practitioners:

- "Use a model structure that is detailed and realistic enough to allow participants in the system to supply data below the level of aggregation of model variables.

- Whenever possible, estimate parameters with data below the level of aggregation of model variables and reserve data at the level of model variables for validity testing.

- Use techniques based on model equations only as secondary techniques since they are vulnerable to systematic error.

- Use simulation to identify the equations and parameter values that are critical to the outcome of the modeling effort and focus subsequent efforts on those equations and parameters" (p. 159)

3.3.4 Model Testing and Sensitivity Analysis

The primary goal of the model is to increase the modeler's understanding of the behavior of the model and gain more insight in the system under study. Simulation experiments provide us with the opportunity to "play" with the model so that more learning is achieved. The main idea is to learn about the relationship between structure and behavior. Structure is manifested in the feedback loops of the model, and behavior is the outcome of the simulations and the system structure.

3.3.4.1 Model Testing

Tests can be run on isolated feedback loops, combinations of them, and on the whole model with a variety of changes. While any test can add some insight about the system, it is really advisable (Richardson and Pugh, 1981; Vennix, 1996) to plan ahead of time the sequence of tests so that maximum learning can be achieved. Richardson and Pugh (1981) advise to start by focusing on a particular element of the system structure, analyze in advance the model behavior that is expected for each experiment, write down the hypotheses, and compare them to the model behavior. Vennix (1996) adds to this notion that "conducting a test without previous estimation of what will happen is almost useless, because in retrospect the outcome is quite logical and of course one knew all along that this behavior would result" (p.87).

At the start, it is recommended to establish a base or standard run, which replicates the reference mode of behavior as hypothesized by the modeler (Vennix, 1996). This standard run is needed as a base of comparison. In the standard run standard values are used for parameters. The following runs are conducted by changing one thing at a time and studying the results of changes in the system structure on the behavior of the model by comparing the outcome with the base run. These tests include combining different feedback loops, and deactivating certain feedback loops and gaining insight on their influence on the overall behavior of the system.

3.3.4.2 Sensitivity Analysis

Sensitivity analyses serve two important functions. First they are useful to better understand the model, and second they are capable to locate sensitive parameters in the model (Vennix, 1996). Richardson and Pugh (1981) observe three different kinds of

sensitivity: (1) numerical sensitivity, which is exhibited by all quantitative models, (2) behavioral sensitivity, where a change in a parameter causes a change in the behavior of the model and in system dynamics experience shows that the model is rather insensitive to parameter changes, and (3) policy sensitivity which is about whether model-based conclusion change with changes in the model. Richardson and Pugh (1981) present such a case where a change in the model's parameters makes a significant change in the policy conclusion. On the other hand, these authors argue that what matters is that the model will be policy insensitive. "If the purpose is policy analysis, then it makes no difference if a model is numerically sensitive (they all are), or even behaviorally sensitive (system dynamics models tend not to be), as long as the policy conclusions are robust in the face of parameter changes" (p.279).

In the case that a sensitive parameter has been located, there are three possible ways for responding (Richardson and Pugh, 1981): 1) One might place more attention to estimate this parameter because it obviously has a large effect on the model's behavior. 2) One might decide to reformulate the model in order to better capture the real system which was aggregated in the parameter. 3) This parameter might be recognized as a leverage point in the system, meaning that it has a potential to affect drastically the behavior of the system.

3.3.5 Policy Analysis

The goal of policy analysis is actually the goal of the whole effort of modeling: to understand better the behavior of the system in order to make better decisions about which policies to implement in order to improve the problematic behavior of the real system. Two kinds of changes may result from changes in decision functions: parameter changes, and structural changes. In any case, the final objective of the model is to find robust policies so that variations in the models parameters or structure do not influence the policy. "Policy robustness is vital because no model, mental or quantitative is identical to the real system. The real problem will always have aspects that are not captured by a model" (Richardson and Pugh, 1981, p. 351).

3.3.5.1 Parameter Changes as Policy Alternatives

Changing a value of a parameter may act as a test for policy change in the real world. Some parameters in the model can be classified as policy parameters. This means that their values are within the control of the decision makers in the real world (Richardson and Pugh, 1981). It is important to uncover the reasons for the effects of a policy, because a model is not the real world, and people will not be convinced only form the model experience. Only after a fundamental understanding is achieved of why a particular policy improved model behavior, it has a chance to lead to a change in policies in the real world. Richardson and Pugh (1981) warn from trying to implement impossible parameters values in the real world and caution the modeler to stay within reasonable boundaries. Some guidelines for locating sensitive policy parameters include being very much familiar with the behavior of the model under many situations, locating the feedback loops that dominate the behavior at various times, and identifying parameters that influence positive loops, since positive loops tend to destabilize the system (Richardson and Pugh, 1981).

3.3.5.2 Structural Changes as Policy Alternatives

Feedback patterns tend to be the strongest determinant of the behavior of the system over time. Most of the time policy improvement in system dynamics involves adding new feedback loops that alter or extend the present feedback structure of the system. Some of these options include adding policy parameters, changing a policy parameter in the midst of a simulation test, or adding new loops representing new actions or information flow that improved system's behavior.

3.3.6 Policy Implementation

Even though it would be logical to think that implementation of a robust policy will naturally proceed the study of the model, quite often the world of organizations does not follow this sequence as expected. "Organizational changes (or decisions or policies) do not instantly flow from evidence, deductive logic, and mathematical optimization" (Roberts, 1978). Implementation needs to be considered from the beginning of model building and be part of every stage, so that the actual implementation will appear as natural as any other part of the project (Roberts, 1978; Richardson and Pugh, 1981). Therefore the selection of the modeling project, the development of the model and the

design of change recommendations, all need to be planned while implementation is consciously in mind.

3.3.6.1 Project Selection

When selecting a project it is important to look for solving a real problem that exists in the organization, so that there will be motivation from the corporate side to implement the model recommendation later. This problem should be considered important by the decision makers in the organization, and the objectives of the project should seem credible by the client. The client should have the ability to vision the change in his perspective and be capable to devote the required resources to its implementation. The techniques that are going to be used for solving the problem must be understandable to the management people involved. Failing in fulfilling these requirements in the early stages of model building process will eventually lead to implementation failure (Roberts, 1978).

3.3.6.2 Modeling Process

It is important that in the modeling process the client would be involved as much as possible. Client is considered here as the decision maker and the people who will carry out the recommended changes later. The more the organization can rely on in-house skills and effort, the more likely the project will be implemented.

Another important recommendation is that the modeler will be prepared with an initial model of the problem already in the early stage of the project so that early results can be visualized, and the development of a model will expedite. Any later version needs to be developed in collaboration with the decision making group.

Also important in this stage is the level of aggregation. The model should include enough details to be persuasive to the client, and in any case since the client is the boss, any level of details he requires, need to be provided by the modeler.

Last issue for the modeling process concerning implementation is the validity issue. Validity testing of the model must be geared to the level that will give the client assurance that the model is adequate, no matter what kind of technique or criteria is used (Roberts, 1978).

3.3.6.3 Recommendations for Change

When potential recommendations are considered, the organization's ability to absorb the associated change must be assessed. A compromise between the optimum solution and the most suitable change in relation to corporate ability is advisable

Any recommendation for change needs to take into account possible unanticipated consequences in other parts of the organization. This means that interdependencies in the organizations need to be considered so that system dynamics will not exhibit a non-system approach. Although the boundaries of the model were considered with the focus on a specific problem, still there are always interdependencies that were left out for the sake of the specific case. The question of how new policies will impact other parts of the organization is always relevant and important.

Since most of the recommendations for change tend to be strategy-oriented and broad in scope, it is advisable to accompany then with reeducating program for management or explicit decision rules. In most cases one need to do both, reeducate and also make decision rules and action plans explicit (Roberts, 1978).

3.3.6.4 General Considerations

It is advisable that from the outset of the work everybody associated with the project should have an implementation orientation. From the very beginning of the project the implementation issues like group composition, problem analysis method and others, should be considered.

It is important that the people who had commitment from the beginning of the project to its development would also be involved and responsible for its implementation until it is achieved.

Finally, it is important to create an environment that enables the implementation to go forward. This issue may need to involve professionals from other areas like behavioral scientists, and applied psychologists and others (Roberts, 1978).

3.3.7 Model Evaluation and Validation

There is probably confusion in the literature over the meaning of verification and validation. Law and Kelton (1982) define verification in relation to simulation as the act that determines whether a simulation model performs as intended, i.e., debugging the computer program. When we consider the complexity of such programs in models, this is

not an easy task at all. Validation is defined as the act that determines whether a simulation model (not the computer program) is an accurate representation of the real-world system under study.

Naylor and Finger (1967) and others (Schrank and Holt, 1967) assert that simulation models pose the same problems in relation to validation as any other scientific hypothesis; therefore in this discussion there would be no distinction between models, and simulation models.

3.3.7.1 Philosophical Issues Regarding Validation

Naylor and Finger (1967) explore three major methodological positions concerning the problem of validation. They use these three positions from the field of economics, believing that they are relevant to any other disciplines. The three positions include: rationalism, the position that holds that there is one truth in world, and this truth, as expressed by a theory or model needs not to be validated or empirically experimented since its trueness is obvious to everybody. Empiricism is in complete opposition to rationalism. Empiricists regard empirical science as the ideal form of knowledge, and not mathematics. Empiricism refuses to admit any assumptions that cannot be independently verified. The third position is a stand to compromise between these two former points of view, and is called positive economics. This approach, as argued by Milton Friedman asserts that the validity of a model depends not on the validity of the assumptions on which the model rests, but rather on the ability of the model to predict the behavior of the dependent variables which are treated by the model.

Naylor and Finger (1967) propose the fourth approach, which is actually the combination of the three approaches. They named it the multi-stage verification. This is a three stage procedure that incorporates the three position discussed so far. According to them, the first stage calls for the formulation of a set of hypotheses describing the behavior of the system of interest, the second stage calls to "verify" the assumptions on which the model rests, and the third stage consists of testing the model's ability to predict the behavior of the system under study.

The authors also consider a number of measures and techniques for testing the "goodness of fit" of time series generated by computer models to observed historical series.

McKenney (1967) critiques the Naylor and Finger (1967) approach saying that they ignored the fact that people resort to use simulation when they handle a system that consists of large numbers of simple entities, which when combined make it impossible to understand the behavior of the total system. They also did not relate to the fact that these systems are usually dynamic, which makes their present state always in part dependent upon the previous state. These two notions make it essential when dealing with such problems, to define a priori their purpose in order to create a productive simulation model.

McKenney (1967) lists four kinds of purposes that he believes urge people to resort to simulation. In three out of these four, McKenney shows that the purpose dominates the acceptable assumptions, the measures of the environment, and the outcomes to be predicted. Therefore the author concludes that a simulation model is a specific theory for a well-defined purpose. His criterion of success is whether the model fulfills its purpose. But he recognizes that the modelers will continue to "play" with the model until it reaches its purpose. This "play", according to McKenney, consists of adding assumptions, taking new measures, and operating the model. Thus the resolution of the model is improved in an iterative fashion. The author concludes that the issue of validation is not "is the model true or not", but "will it allow reasonable estimates of an anticipatory nature". McKenney proposes that validation may be achieved by comparing the data generated by the model to that of the real world. This makes the issue of validation an issue of 'what did the model intend to predict'.

Schrank and Holt (1967) in their critique propose to consider Popper's criterion to verification of scientific hypothesis. According to Popper as expressed by Schrank and Holt and by others (Sterman, 2000; Kleindorfer, *et al.*, 1998), theories (or models) should be continuously subjected to tests capable of showing them to be false, and as long as the theory is not falsified, it is considered acceptable, until another theory proves it wrong.

Schrank and Holt (1967) suggest that when using this criterion in relation to simulation models, one needs to arrange these tests in order of importance, because of the large numbers of hypotheses that represent such models. They offer a *usefulness* criterion for ranking the tests for validation. By doing that, they shift the emphasis from conception of the model abstract truth to the question whether the errors in the model

prove it to be too weak to serve the intended purposes. Since computer simulation models intend to recommend a new course of actions or policies for a given situation, the validation problem here is to predict whether this particular model is reliable concerning the results it generates. The authors also claim that even if the model was found to be false, it would usually not be rejected until a better model is available. This is another argument against the true-false dichotomy in working with computer simulation models.

Another important notion Schrank and Holt (1967) raise, is that every model has some strengths and some weaknesses in relation to other models, and these characteristics are in relation to the objectives of the model, therefore they need to be evaluated in association to the objectives for which the model was developed.

The authors acknowledge that simulation models serve mainly two distinct purposes: to determine the anticipated state of the system if no action is taken or to determine the response of the system to certain actions. Therefore, they recommend considering a framework for a validation theory, for the analysis of the intended use of the model.

Even though Kleindorfer, *et al.*, (1998) wrote their article about thirty years later than Naylor and Finger (1967), their concern is still the fact that there are no methodological correct guidelines or procedures for validating simulation models. They attempt to trace back the evolution of thinking on the issue of validation, to compare the objectivist approach with the relativist approach and to propose a new direction in the philosophy of science, known as *hermeneutics*. They try to describe the implications of this new approach and the surrounding debate to the validation problem in simulation. I will focus on the debate between the major stances; the objectivism and the relativism, and in their light, I will explain his opinion regarding the *hermeneutics* and their relevance to the issue of validation.

According to Kleindorfer, *et al.*, (1998) the main belief of the objectivism is that there is a unique ultimate basis, either in experience or rational thought, into which a model or theory must be resolved if it is to be validated. An extreme objectivist believes that "model validation can be divorced from the model builder and its context" (p. 1097). Relativism on the other end, acknowledges that judgment and decision-making cannot be avoided. The extreme relativist believes that the model and model building are

inseparable, and as such, "all models are equally valid or invalid and model validity is a matter of opinion" (p. 1097). The authors recognize that many philosophers today are not comfortable with this either/or debate, and therefore they propose a new approach. They use the philosophy of the Hermeneutics as their fulcrum. This philosophy believes that rationality is constituted so that understanding, interpretation, and application are simultaneous. In simulation, it describes "there is a continual play back and forth whereby our understanding of general principles is increased as we interpret the particulars in a given application. In light of that understanding, we simultaneously begin to see the particulars more sharply and are better able to give them meaning. Furthermore, there is the recognition that "playing" with a theory or simulation model is a way of effecting its validation. The interaction between the modeler and the client in mutually understanding the model and the process establishes the model's significance; that is, its warranty" (p. 1097).

Kleindorfer, *et al.*, (1998) argue that both the objectivism and the relativism are right and wrong in their approach and that many practitioners adopted a middle ground in this debate. They believe that the hermeneutic position in this debate would assert that the validation of a model could be achieved in any reasonable manner. Reasonable would mean that through a dialogue, judgment, and practical discourse, the people involved are able to distinguish between what is good and what is bad. This approach supports an open dialogue with all the interested stakeholders, concerning the model in question.

3.3.7.2 Practical Issues of Validation

Law and Kelton (1982) adopted the three-step approach of Naylor and Finger (1967), but they enhance the approach by giving specific recommendations and examples of how to carry out each of the three steps. The first step is to develop a model, which on the surface, seems reasonable to people who are knowledgeable about the system under study. In order to achieve this objective they recommend including every meaningful information in building the model like; conversations with "experts", existing theory, observations of the system, general knowledge, and intuition.

The second step is to test the assumptions of the model empirically. The authors propose some quantitative tests like; assessing the adequacy of the fit of the theoretical probability distribution of the data, use of sensitivity analysis to check how much the

output would vary with a small change in an input parameter, or to determine the level of detail required for a certain subsystem.

The third step in this procedure is to determine how representative the simulation output data are, how closely it resembles the output data that would be expected from the actual system. It usually requires another set of data to compare to, if possible, from the real-world system. The authors acknowledge the fact that such comparisons are very difficult to carry out, and they offer as an alternative; to ask whether or not the differences between the system and the model are significant enough to affect any conclusions derived from the model.

The authors also propose to validate the model's ability to predict system behavior, later on, after a while of use, in order to increase confidence in the validity of the model.

Contrary to Law and Kelton's (1982) structured approach to validation, Sterman (2000) goes into a detailed discussion about how validation and verification are impossible and that all models are wrong. Many of his arguments are similar to the relativist arguments. Sterman (2000) does provide reasons for doing some model testing but the reason behind it is that he believes that no matter how wrong models are, leaders and managers will always continue to use them, whether they are mental model or formal models. Therefore the question to be asked is which is the best model for a given purpose. Sterman (2000) believes that good modelers focus the client on the limitation of the model so it can be improved and so clients will not misuse it.

Some practical advice for a better modeling development process are provided. Sterman (2000) emphasizes the importance of documentation to ensure that the results can be understood, replicated, criticized, and extended by others. He also stresses the importance of replication, which provides an opportunity to check and reveal errors to improve the transparency of the model. He distinguishes between protective and reflective modeling and strongly advocates the use of reflective modeling as a process designed to uncover errors, which helps build confidence in the model.

Sterman (2000) offers a list of tests system dynamics modelers have developed to uncover flaws and to improve models. Some of what he specifies include boundary adequacy, structure assessment, dimensional consistency, parameter assessment, extreme

conditions, and others. He insists that model testing is iterative and multidimensional and begins at the start of the project. Model testing needs to be built into the budget and into the time line in order to provide enough resources to better assist the quality of the process. He concludes that it is always important to remember that the selection of the most appropriate model is a value judgment to be made by reference to the purpose, therefore not the trueness of the model is in question but its usefulness.

3.4   Designing Group Model-Building Projects

There are several issues to consider when designing a group model-building project. Even before starting the project, one needs to find out whether a system dynamics approach suits the specific problem and the specific organization. Assuming that the answer for this question is positive, one needs to consider several more issues. The first one is whether to go for a qualitative approach or a quantitative approach when a certain problem and organization are already in mind. The second is about participant selection: how many people to involve in the group modeling-building sessions and who should they be. The third issue deals with the question whether to start the project from scratch or from a preliminary model, and the fourth important issue deals with how to prepare sessions (Vennix, 1996).

3.4.1 Qualitative or Quantitative System Dynamics?

Qualitative system dynamics refer to the stages of problem identification and system conceptualization. Quantitative system dynamics includes also the formalization stage and the simulations. Both aim to identify the feedback processes causing the behavior of the system, which will increase the understanding of the relationship between the structure of the system and its problematic behavior. It is unquestionable that the more one 'plays' with the model, the better understanding one gains, and therefore the more stages one is involved with, the more one learns about the influences of potential decisions or policies over the long-run behavior of the system, a difficult accomplishment to achieve if simulation is not incorporated (Ford and Sterman, 1998; Vennix, 1998). More 'playing' with the model is not achieved without a price. It takes more time and costs to do that. Therefore the question is when should one be content with the qualitative

part of the modeling effort, and when one should seek to achieve a full formalized model. The answer to this question needs to take into account three issues: 1) What is the goal of the modeling effort, 2) How much resources are dedicated to this effort (Vennix, 1996), 3) Who is the audience for this modeling process and results (Wolstenholme, 1999).

If the goal of the modeling effort is to achieve a full understanding of the system's behavior, then a quantitative model is required. If the aim of the modeling is to change management perceptions, to create a shared language for mutual understanding, to foster consensus and commitment with a decision, or to improve the way decisions are made, then a qualitative model may suffice (Vennix, 1996).

If the time and resources devoted to the model-building process are limited, then a qualitative approach might be considered, especially if the nature of the problem and the goals of the modeling effort are of the kind a qualitative approach suits (Vennix, 1996).

Another important consideration is the kind of audience involved in the modeling effort. If participants are more inclined to analytical thinking than a qualitative approach, that will help them to gain more intuition and more holistic thinking abilities. If the audience lacks the abilities required for analytical thinking, then a formalized model may help them to acquire the skills associated with mathematics and analytical thinking (Wolstenholme, 1999).

3.4.2 Who to Involve in the Model Building Sessions?

The two main issues concerning the selection of participants in a model-building process are how many people to involve and how diverse should the group be. Vennix's recommendation for these issues includes having those present who have the power to act, meaning those who can implement a decision. Also he recommends, "increasing the group size will be beneficial to create a larger organizational platform for change and commitment with a decision, but it simultaneously decreases participation and satisfaction of group members" (p. 113). Vennix suggests the number of five participants in a group model-building as the best size from his experience, but each case need to be dealt with specifically. The larger the size of the group, the more structured the sessions need to be. In relation to group diversity, Vennix (1996) acknowledges that "Increasing a group's diversity will be advantageous with regard to the model's quality, but it might at

the same time create more tension within the group, which in turn reduces group performance" (p.113). As a solution to this problem, one of Vennix's (1996) suggestions is to start the project by employing a preliminary model.

3.4.3 With or Without a Preliminary Model?

Starting with a preliminary model may speed up the model-building process and may cut into participant's time investment. Also it is easier to start the group discussion when a preliminary model is available (Vennix, 1996). On the other hand, the use of a preliminary model might decrease the degree of ownership over the model as experienced by the group; and low ownership leads to low commitment (Vennix, 1996). The problem of ownership might be tackled by avoiding being defensive in relation to the proposed model and by preparing it as little as possible so that flaws and corrections can easily be made and thus ownership regained (Vennix, 1996).

A preliminary model cannot always be employed. There are situations where no information is available ahead of time. Sometimes a preliminary model is not necessary, especially when the model-builder is very experienced and is able to create a model from scratch in the first session (Vennix, 1996). The more it is the effort of the team, the more it creates ownership feelings and therefore leads to more commitment.

Starting from scratch may turn out to be very time effective because no interviews have to be scheduled, but may be ineffective in terms of time investment from participants. It also may entail certain dangers, because one might not be aware of the specific circumstances surrounding the project (Vennix, 1996).

In most cases when no previous experience with modeling is available, the best approach is to start with a preliminary model, spread the model building over more than one session, start with a qualitative model, and do most of the quantification through backroom work (Vennix, 1996). The following chart illustrates the choices one has in designing group model-building projects (Adapted from Vennix, 1996, p. 103):
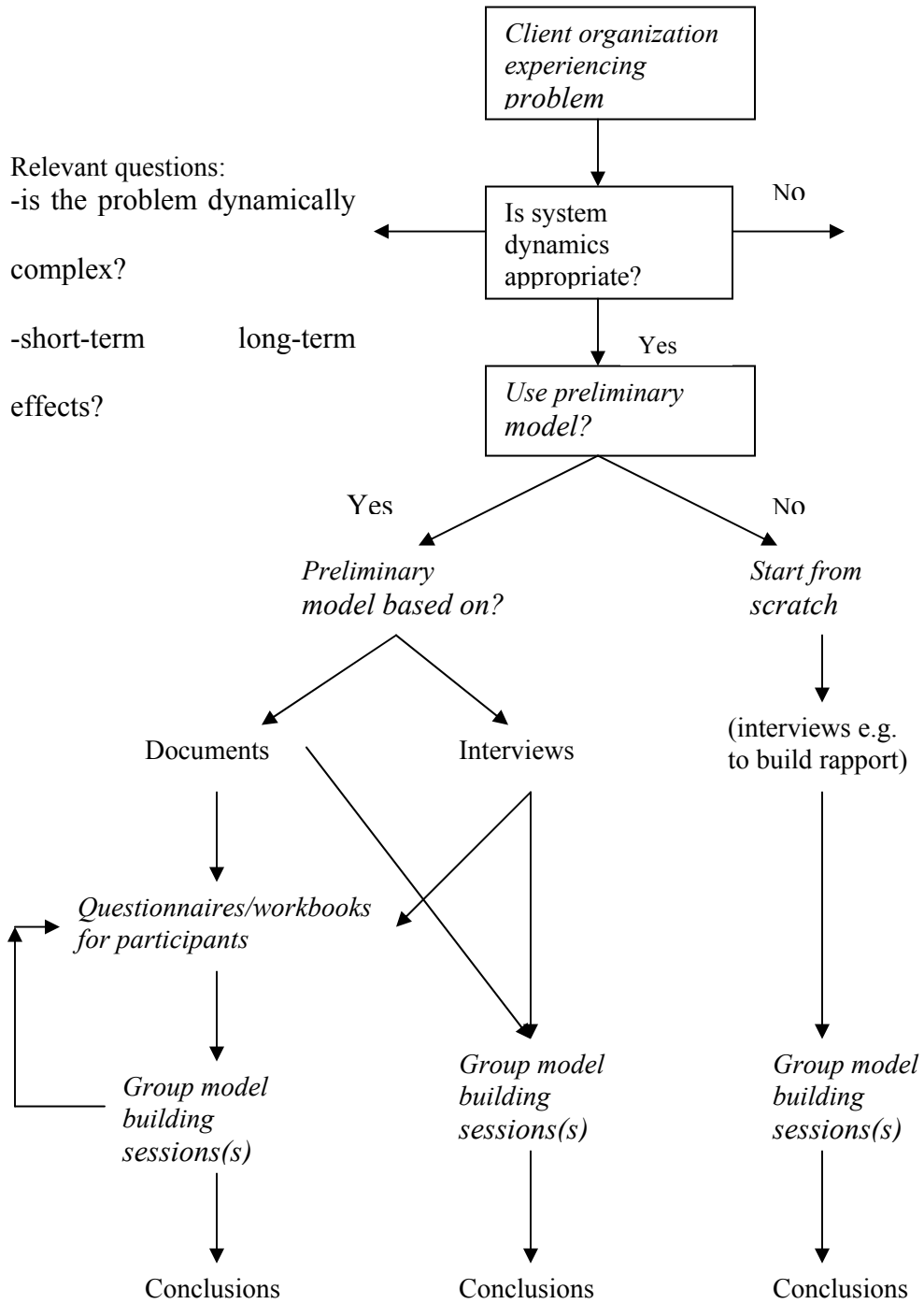
Figure 3-2: Choices to be made in the Design of Group Model-building Projects

3.4.4 How to Prepare Sessions?

In preparing for a session, there are some considerations that need to be taken care of. These considerations include assigning the different roles to group members, defining the purpose and the outcome of the session, and planning and carrying out all the logistics.

3.4.4.1 Roles in Group Model Building

There is a general agreement in the system dynamics literature about five essential roles in the group model-building process (Richardson and Andersen, 1995; Vennix, 1996; Andersen and Richardson, 1997). These five roles explicitly separate the distinct roles involved in the group model-building process (Richardson and Andersen, 1995).

Facilitator: This is the most visible role in the group. The facilitator needs to pay constant attention to group processes, to roles of individuals in the group and has to take care on the tasks of drawing out knowledge and insights from the group.

Modeler/Reflector: This person serves the facilitator and the group and focuses solely on the model that is being explicitly and implicitly formulated by them. He reflects the information he sketches back to the group, restructures formulations, exposes unstated assumptions that need to be explicit, and refines the important aspects of structure and behavior.

Process coach: This person is responsible for the group process and group dynamics. He usually reflects back on his findings to the facilitator during breaks and helps the facilitator to identify strategies to keep the group effective.

Recorder: This person writes down or sketches the important parts of the group proceedings. His notes and drawings combined with the modelers sketches and the facilitator's notes enable the reconstruction of the thinking of the group.

Gatekeeper: A person from the client organization, who is responsible for the project and does all the preparatory work like initiating the project, helping in framing the problem, identifying the appropriate participants, working with the modeling support team to structure the sessions and participate as a member of the group. He is very influential in motivating the people in the organization to contribute to the process and his efforts are crucial to the success of the project.

It is advisable that the persons also serve as the facilitator, modeler and recorder have good experience as system dynamics modelers. Clearly, these roles can be combined or further divided, according to the particularity of the situation and the problem.

3.4.4.2 Purpose and Outcome of the Session

It is crucial in every session that the influential people in respect to decision-making and taking actions will be present in the room. As Andersen and Richardson (1997) state: "The rule of thumb is that all the key stakeholders and players must be willing to devote up to two full days, without interruptions, to the modeling task" (p.109).

Another important issue is the clarity of deliverable products at the end of the modeling session. Whether it is a stock-and-flow diagram or a full running model, the intended goal of the session needs to be stated and aimed in advance (Andersen and Richardson, 1997). Vennix (1996) recommend allowing a certain degree of flexibility in relation to the desired outcomes. He believes that preparing ahead several potential contingencies helps to relax participant mind so that they are more productive and less concerned about a specific process.

3.4.4.3 Logistics

Room layout is considered a every important issue in system dynamics approach, because of the important of communication between participants. From their experience, Andersen and Richardson (1997) advise to have swiveling chairs arranged in a semi-circle. Small tables may be useful for the participants to cluster around in groups and for use when writing tasks are assigned. Andersen and Richardson (1997) found that large erasable whiteboards are more helpful that the computer screen for demonstration and knowledge elicitation purposes. Projection equipment and computers are useful for certain presentation and therefore recommended.

The room itself should be located somewhere were participant can be the least disturbed by other work tasks and by other responsibilities (Vennix, 1996). Since sessions are long, it is important to care for food and beverages, whether they are accessible within the close location or are provided by the client organization.

3.4.5 During the Session –Issues and Recommendations

The followings are issues and recommendations assembled from Vennix (1996) and Andersen and Richardson (1997) who provided many suggestions from their experience about the sessions themselves.

3.4.5.1 Types of Group Task Structure

A key to a successful group modeling session is selecting the most appropriate type of group (i.e., individual, small-group, plenary-group) and group task (i.e., divergent, convergent, ranking) for each point in time in the modeling conference. An appropriate selection that will yield a fruitful and focused discussion is a real challenge for the session planners. Andersen and Richardson (1997) provide several recommendations. For divergent thinking tasks such as getting as many ideas as possible they recommend the use of the Nominal Group Technique (see description of this technique in the knowledge elicitation section). According to these authors, the nominal group approach enables each subgroup to contribute and comment before any subgroup has given its full lists of variables, thus no subgroup dominates and no subgroup is left with little to contribute, and ideas tend to emerge in order of importance. For convergent thinking, meaning tasks that require the group as a whole to design or define something, Andersen and Richardson (1997) provide several scripts. As a general rule they recommend that when tasks needs to be repeated then it is preferred to work in a facilitated plenary session so that all members of the larger group can ask questions about and better understand the task. For ranking and evaluating tasks, which are convergent tasks, the authors recommend using simple voting procedures. Presentations of the modeled/reflector might be arranged at infrequent but critical times during the day, and they go best after a break when the group is fresh.

3.4.5.2 Planning the Agenda

Vennix (1996) provide several guidelines that are useful in planning the agenda. The first stage of the session is the introduction of all participants and it is advisable to have everyone place his/her name in front of him/her. The next step is to discuss the agenda. If this is the first meeting one may need to provide a short introduction on system dynamics. It is important to find out if there is consensus in the group about the problem that needs to be modeled. The problem definition should be recorded and placed where

everybody can see it. In case this is not the first session, reports and conclusions from previous session need to be provided. Clarifying what is expected from the group in this session and what outcome is anticipated is important for participants to reduce anxiety. It is important to ensure that there are facilities that enable recording what the group is designing, and as a general rule Vennix (1996) advises not to write anything before testing whether the group agrees on it. It is advisable to have the group cycle back and forth between the problem and the model. This means that there can be silences when people reflect on what has been accomplished and on how the group ought to proceed. Breaks are important to plan ahead. Finally, it is important to record preliminary and final conclusions and insights and leave the participants with a simple but clear picture of the insights, which were gained through the model-building process.

Andersen and Richardson (1997) recommend planning the time so that the needs of those present are met, while time availability and the purpose of the intervention are considered. There should always be room for flexibility. They believe that planning for every 15 minutes blocks of time, keeps the group alert, on task, and helps to make progress.

Andersen and Richardson (1997) believe that it is important to maintain visual consistency, meaning that one sort of iconography or vocabulary for discussing the problem under study should be used for the entire modeling conference, in order to ease the learning effort. They also believe that it is important to strive for visual simplicity since visual complexity easily emerges in modeling conferences. Andersen and Richardson (1997) suggest avoiding long talks of one-to-many as much as possible. They avoid explaining anything to the group that cannot be discovered first by some other form of group process. An important exception to this rule is the brief and focused description and summary of what the group has completed and decided.

Another important issue raised by Andersen and Richardson (1997) is facilitator's responsibility to always respond to the concerns being raised by the group. The facilitator needs the ability to distinguish between important insights and other important comments that do not contribute to the modeling task and write these important insights so that the modeler can use them to structure dynamics relationships. The rest can be written in another place on the board.

Andersen and Richardson (1997) also advise to allocate time for the members of the group to develop a group sense. They provide some examples of "Ice breaker" exercises, and recommend working closely with the gatekeeper to engineer the composition of small groups so that cliques are avoided. Their final recommendation is to allocate the last hour or half hour to summarize the whole day effort in order to build climax and to leave the conference with an accomplishment feeling.

3.5   Facilitating Group Model-Building Sessions

3.5.1 What is Group Facilitation?

A group facilitator is a person who assists a group in their effort to accomplish their tasks. His concerns are about the process and the structure of the work that is being done rather than the content of the work (Phillips and Phillips, 1993). A facilitator is not supposed to be an expert in the problem that is being solved, but it is good when he has some knowledge so he can follow the discussion (Vennix, 1996). In system dynamics, a group facilitator is the person who helped the group to build a system dynamics model in order to increase insight into a problem and potential courses of actions (Vennix, 1996). In the case of system dynamics, the facilitator needs to have a thorough knowledge of system dynamics and extensive model-building skills in order to be able to ask the right questions during meetings (Vennix, 1996). Phillips and Phillips (1993) argue that one of the most important tasks of a facilitator is to see and understand the group life. By understanding what is going on in the group, the facilitator is able to guide the group in more productive ways of working through being flexible and accommodating to the needs of the group members.

3.5.2 Why is Group Facilitation Important?

The phenomenon of working in a group is relatively a new experience for most people. As it is in any new endeavor, it is extremely difficult to manage the two aspects of this framework simultaneously: the process and the content. Even those who participated in groups several times, the nature of this kind of effort is not similar from one time to the other, not in content and in most cases, not in the participants, thus each

time the experience is different. Since the participants have to be familiar with the problem in question, and since the best for them is to concentrate solely on the content, the facilitator takes the role of looking for the process and structure, which is expected to result in a more efficient process. There are guidelines for working in groups but they don't work well for most groups (Vennix, 1996). To add to this complexity, when dealing with messy problem as it is in most organizational life, especially in the context of system dynamics, the overall challenge people face; mentally, socially, and emotionally does not leave much space to deal with an extra issue which is the "how-to-do" thing. The separation of the roles contributes to the success of the group (Vennix, 1996). Vennix (1996) also argues that "the interaction process affects the quality of the outcome and thus process may be considered equally critical as the content" (p. 143).

According to Vennix (1996), a facilitator also acts as a role model for the group participants. Vennix believes that the way a facilitator behaves will foster a different social reality in the group, which might create more favorable conditions to affect the quality of the process and its outcome.

3.5.3 How to be a Good Facilitator?

In order to be a good facilitator one needs to have the right attitudes and certain skills.

3.5.3.1 Facilitation Attitudes

Attitudes affect the way people behave in certain situations. The way a facilitator responds to a situation will determine the group process and its effectiveness.

Helping Attitude: The main responsibility of a facilitator is to help group members thus a helping attitude is an important behavior for effective performance. It is important to have in mind the right helping attitude, which brings people to be able to do things by themselves and not to be dependent. If help causes people to rely on the facilitator, the help attitude is counterproductive. In order to help, one needs to be patient and take enough time to learn what exactly is the client's problem (Vennix, 1996).

Authenticity and Integrity: Authenticity and integrity are of great importance to build trust between participant and facilitator. According to Vennix (1996), authenticity implies being you and displaying genuineness in interaction with other people. Since

social reality is the creation of our own actions, facilitator integrity and authenticity will influence participants' behavior and create a favorable climate in organizations that promote the group performance (Vennix, 1996)

Attitude of Inquiry: Asking questions with an attitude of exploring alternative perspectives and attitudes is an important and a powerful intervention to use by the facilitator. Most people in a discussion tend to focus on providing answers and opinions and to care less about what exactly was said or proposed. The facilitator can raise these questions and thus be a role model for the rest of the group in asking questions and look for explanations. Inquiries also give the people an opportunity to explain their thoughts and to scrutinize these thoughts. In order to inquire with the attitude of exploration and not with the attitude to convince others in his/her own opinion, one needs to have the interest to look for others' opinions with the readiness to be open to different perspectives and approaches (Vennix, 1996).

Neutrality: A facilitator must be neutral with respect to the content of the discussion otherwise he turns to be one of the group members and not an outsider, and thus his role is useless. Neutrality is also important in relation to people. A facilitator needs to show no preference to participants in order to create a climate of trust.

3.5.3.2 Facilitation Skills

A facilitator needs to posses certain skills in order to be able to carry out his work. In a system dynamics model building group the most important skill for him is to have the ability to build a system dynamics model. The following is the list of several of those skills.

Group Process Structuring Skills: The facilitator needs to introduce structure in the group task and in the communication process. This can be accomplished by breaking down the decision making task into number of smaller steps. In the communication process, groups can be divided into smaller groups to ease communication and also structure the process of communication.

Conflict Handling Skills: Vennix (1996) distinguishes between personal conflicts and cognitive conflict. For personal conflicts there is not always a way to resolve the issue. Some people just tend not to get along with some others. In such a situation group effectiveness is very low unless the facilitator is able to resolve it. Sometimes the

facilitator can depersonalize the conflict by focusing on the problem. Cognitive conflict involves differences of opinion or viewpoints. Up to a certain level cognitive conflict if managed effectively may promote the quality of group decision because of the diversity of decisions that require consensus, but if not managed well it may cause early consensus, which damage a decision's quality.

Communication Skills: Communication is the means through which group members exchange their views about the problem and share their understanding of the problem and get to make decisions (Vennix, 1996). Vennix counts three inhibiting factors in good communication: people tendency to evaluate and judge, people inability to listen, and people inclination to be defensive. One of the most important skills a facilitator ought to have is the ability to create an atmosphere of open communication. In order to achieve open communication, one needs to insist on clarification and ensuring that everybody is still on the discussion and one needs to be an active or reflective listener. These two skills will encourage other team members to behave alike and communication will be improved.

Concentration Skills: Discussions have the tendency to go off track. A facilitator needs to be able to bring the discussion back to deal with the model and with the problem. Vennix (1996) argues that in the group process there are two important cycles, which have to be covered by the facilitator. The micro level cycle goes from discussion to model and back to discussion and so forth. The macro cycle goes from model to problem and back to model and so on. "Going through these cycles is also important from the point of view of ownership of the model. You as a facilitator have to make sure that the group owns the model" (p. 162). Summarizing is one way to bring the group back to the main issue, while comparison to the original model is another way to get back on track.

Team Building Skills: In order to become a team, participants need to feel as sense of belonging and participating. A facilitator needs to keep inviting people to participate in the discussion so that they get the feeling of ownership and commitment to the model (Vennix, 1996). It is the facilitator responsibility to create a safe environment in which people have the ability to express their opinion freely and comfortably, which will encourage people to participate more in the discussion. Using the term 'we' frequently may foster a sense of unity in the group. A facilitator can navigate unbalanced

conflicts by supporting the person who is attacked so that he or she is lifted from their solitary position. This helps people to state deviant opinions more easily (Vennix, 1996).

Skills to Build Consensus and Commitment: An important factor to create consensus is to give each individual the chance to participate in the discussion. The more a facilitator takes seriously members' input, the more agreement on the final product is received, and more commitment to the model is achieved later (Vennix, 1996). Commitment is also a by-product of ownership feelings. To create ownership feelings, a facilitator needs to know when to step back and leave the group to take over. This is sometimes not easy, because a facilitator may feel offended, but this should be replaced instead with feeling of accomplishment (Vennix, 1996).

Intervention Skills: Intervention skills according to Vennix (1996) aim to handle problem people. The most difficult persons to handle are the dominant talker, the shy participant and the rambler. Vennix suggests four kind of interventions: exploratory intervention, which encourages a person to go on talking (good for the shy person), diagnostic intervention, which aims at getting the participant to think about something (good for the dominant talker), action alternative intervention, which focuses on what can be done about something, and confrontive intervention, which aims directly at the behavior of the person. This last intervention is the most dangerous one and is not recommended to use, only when the rest of the possibilities were exhausted. Vennix (1996) recommends using NGT for many situations; encouraging the shy person, or quieting the rambler and the dominant person. Another powerful option he suggests for stopping the rambler and the dominant person is to ask them how his/her remarks fit into the model.

Handling Types of Cognitive Tasks: According to Vennix (1996) the process of constructing a system dynamics model involves a wide variety of activities and cognitive tasks. Vennix distinguishes two types of tasks: generating information and evaluation information. For generating information the most popular technique employed by organizations is the brainstorming technique. Vennix argues that brainstorming has not been found effective and recommends that if productivity is important, " the cognitive task of generating information can best be done by individuals in isolation (e.g. at their office) or in nominal groups" (p. 168). For evaluating tasks, interacting groups are very

useful. There are two kinds of evaluating tasks: judgment and choice. Quantitative judgment involves estimating the value of a parameter. For these kinds of tasks, a group can produce better results than one-person estimation. If there is an option to locate the person whose estimate is the most accurate, then this might be a better estimate then the group's estimation. In the case of choice, i.e., the selection from a set of alternatives, this involves in most cases multiple criteria. Computers and simulation can ease this task for the group and there is some software to help in this task (Vennix, 1996).

3.6   Knowledge Elicitation in Group Model-Building

The system dynamics modeling process is mainly based on revealing the knowledge and the mental models residing in people's mind. The model evolves and is designed through a collaborate, interactive, and authentic group dynamic process. This model represents the problem of interest in the real world as the client views it. The model is then experimented in the virtual world and the results and outcomes influence the decision-makers' policies in the real world. The experience in the real world then leads to changes and improvement in the virtual world and in participants' view of the problem, which affect the model and so on (Sterman, 2000). The formal modeling process consists of several stages and tasks to be carried out (Richardson and Pugh, 1981; Sterman, 2000; Roberts et al. 1983). From a methodological stand point, all these stages and tasks of the system dynamics modeling process are mainly based on three working techniques: the first is the group participants' interactions to eliciting knowledge and revealing participants' mental models or in short, group decision-making processes. The second technique involves the use of system dynamics tools to create the conceptual model of the problem, using feedback concepts. The third technique is the conversion of the conceptual model through the use of mathematical formulations to a computer simulation model and simulating the model in order to capture the behavior of the system over time. While each of these three methods is important and essential for the modeling process, the group decision-making processes are the most paramount in defining the quality level of the entire modeling process. The entire process cannot be better than the information gathered in the group sessions. The outcomes of group dynamics are the

input to any other process, and therefore influence their initial quality and their outcome's quality.

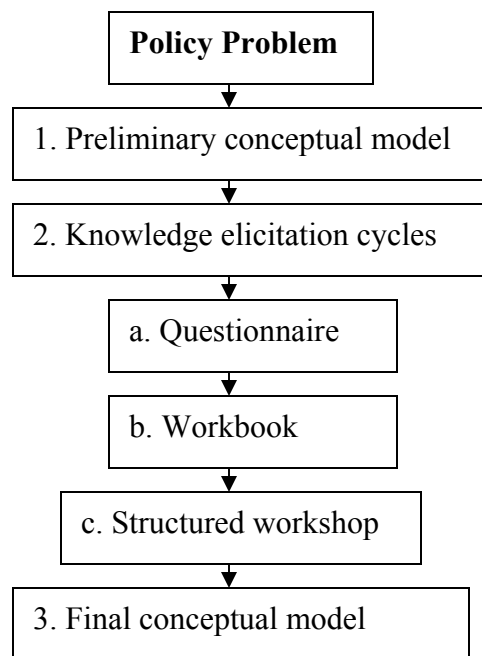### *3.6.1 A Proposed Process for Knowledge Elicitation in Model-Building*

In order to develop a useful model that has credibility in the eyes of the managers, modelers must elicit knowledge from these experts about system structure and about governing policies. This information is then used to develop the model (Ford and Sterman, 1998). System experts are those people who participate in the process directly in operational or managerial roles (Ford and Sterman, 1998). Knowledge elicitation from the mental models of participants in client-oriented model building can be divided into two different endeavors: the knowledge elicitation for the conceptual model, which includes the early phases of modeling: problem articulation, boundary selection, identification of variables, and qualitative causal mapping and the knowledge elicitation for the formal model, which includes the estimation of the parameters, the initial conditions and the behavior relationships that must be specified precisely (Ford and Sterman, 1998).

Two main problems are associated with client-oriented model building (Vennix and Gubbels, 1994). The first problem is related to time investment of the client group. Time is always a scarce resource for managers and policy makers. Therefore it is important to find out how to structure the model-building process so that time investment is as low as possible. The second problem is related to the techniques to elicit relevant knowledge, so that the outcomes of the process will be of the required quality, and not with bias caused by many factors (Vennix and Gubbels, 1994).

As for the conceptual model building, Vennix and Gubbels (1994) point out that there are several requirements to meet in determining a procedure for interactive modeling and knowledge elicitation. The process must be tailored to the iterative character of the model building, it has to reduce the time investment of participants when compared to interviews and interacting groups, it must allow structured debate on participants' assumptions about reality, and the resulting model should be kept simple and not complex. Vennix and Gubbels (1994) propose a procedure combining elements

of three group process techniques: Delphi, Nominal Group technique (NGT), and Social Judgment Analysis (SJA), so that the above requirements are met.

Their approach builds upon the SJA approach, where participants are encouraged to explore the differences in their underlying assumptions and was found to be very useful for interactive model building. This would result in a Conceptualize- Feedback-Talk process with one or two iterations, to meet the first requirement. In order to achieve the second requirement the authors propose two ways. Instead of starting from scratch, a preliminary model can be constructed and then can be adapted by the client group. Also by including elements of Delphi, like mailed questionnaires, instead of interviews, time consuming can be reduced. In order to satisfy the third requirement, one or more group sessions will have to be organized, in which participants can discuss their opinions and ideas. By using causal diagrams, these sessions can be more structured. To prevent the model from being too large, a rank-ordering process can be applied as in NGT to meet the fourth requirement. The final procedure Vennix and Gubbels (1994, p.126) offer could be captured in the following illustration:

Policy Problem

1. Preliminary conceptual model

2. Knowledge elicitation cycles

a. Questionnaire

b. Workbook

c. Structured workshop

3. Final conceptual model

Figure 3-3: Stages in Knowledge Elicitation

Some useful insights the authors provide from their experience include the fact that the preliminary model should not aim to be perfect. In contrary, it should serve as a

"trigger" for the knowledge elicitation process and to motivate the participant to suggest their ideas to create a feeling of "ownership" over the conceptual model. Also, an important issue is the selection of participants in the modeling process. It is important to look for participants with a variety of backgrounds in order to avoid one-sided, biased information.

In relation to the questionnaire, the authors suggest to take several precautions to avoid low response like providing useful information in the questionnaire, or pointing out the need for their expert opinion. Also, in order to elicit causal arguments, they translated the preliminary dyadic relationships into verbal statements and asked the participants whether they agree, partially agree, or disagree with the statement, and then asked them to indicate why, which actually provoked causal arguments from the respondent's mental model. The questionnaire was also divided in a number of sections each of them dealing with one "dependent" variable. Each section contained a number of statements and "why" questions. Respondents were asked to add variables affecting the dependent variable. The most important variables were later added to the model as submodels around a dependent variable.

The workbook they propose as the second cycle included more explanations about the process of model-building and diagramming tools, the questionnaires results, and the submodels. Participants were invited to comment on them. The completed workbooks were reviewed before the workshop in order to determine the topics for discussion.

In the workshop the authors employed several recommendations from the literature about small groups. One is the recommendation to structure the group activities, which improves group performance, and second is the use of small task groups and a group facilitator to structure plenary discussions.

To structure subgroup activities several aids were used. Each group member was assigned a role with accompanying responsibilities (i.e., time management, result presentation). Submodel diagrams were provided as a potential starting point for discussion. Also, workbooks were returned to participants to aid in the discussion.

Vennix et al. (1994) acknowledge the fact that there are many knowledge elicitation techniques available and provide guidelines for how to choose a right technique. They identified five factors that help the modeler to select the appropriate

knowledge elicitation technique. The first factor is the phase of the modeling process and the type of task. The authors stress that from a psychological point of view, eliciting, exploring and evaluation tasks require different approaches. The eliciting task requires divergent thinking, and usually is best performed by individuals or in nominal non interacting groups. Evaluating tasks are best performed in structured group sessions, and exploring tasks are not well developed in the literature, and in some cases individual modelers can outperform groups.

The second factor is the purpose of the modeling effort. Since model building is also a process of learning through changing mental models of the participants, it will always be important to include methods that allow interaction and discussion in order to improve mental models and to clarify the problem. Therefore group model building is an essential part of the learning process.

The number of people involved in the modeling building process influence the decision about the preference of the elicitation techniques. The smaller the group, the less structured the technique may be. The larger the group, the more laborsaving techniques may become necessary to use like questionnaires and workbooks in order to save time.

The amount of time the group can spend on the task is another criterion for the technique to be chosen. The less time they have available for active participation, the more the process will have to be carefully structured and prepared.

The last factor to consider in choosing the knowledge elicitation technique is the costs associated with the preferred technique. The modeler has to select the most appropriate technique under the cost constraints.

Vennix et al. (1994) recommend employing various techniques in order to come up with the best combination for this complex process of knowledge elicitation.

In relation to the formal model, Ford and Sterman (1998) recognize that formal modeling requires more precision than conceptual modeling. It requires specification of stock and flow structure, functional forms, and numerical estimates of parameters and behavioral relationships. Ford and Sterman (1998) view the creation of the formal model as the eventual product of the modeling effort, and they hypothesize that pushing experts to describe relationships at the simulation model helps them to clarify and specify their knowledge more than they would do for the conceptual model alone.

The knowledge elicitation method, according to Ford and Sterman (1998) is divided into three sequential phases: the positioning, description, and discussion phases. In the positioning phase, the context and the goals for the description process is established. This phase contains three steps. The first step is establishing the context by describing the model purpose, major subsystems and their interactions. The second step is to focus on one relationship at a time. The third step is the illustration of the method, which includes an explanation of the process and the set of relationship description. This will be accomplished through the use of a close example with same kind of relationships.

The second phase is the description phase. This phase intend to guide experts through the sequential development of four different descriptions of the relationship, all of which serve in transforming experts' tacit knowledge into usable form. During this phase experts are encourage to disengage from each other. The four phases include: visual description, verbal description, textual description, and Graphic description.

The third phase is the discussion phase. This phase seeks to test, understand and improve the descriptions of different experts. The authors recommend using the technique of estimate-feedback-talk as described by Vennix and Gubbels (1994), because it focuses on the assumptions underlying tacit knowledge, and they believe it serving to better understand the variety of ideas instead of just building consensus. There are two steps in this phase: the individuals explain their graphic description through their verbal description, and then the differences between the individuals' graphics are discussed, leading to reveal their mental models and assumptions used in their description of the relationship.

The above method provides several advantages over interview-based or group modeling approaches to knowledge elicitation (Ford and Sterman, 1998):

- "Information losses during elicitation are reduced compared to single-step processes through the use of several small, separate, and explicit formal transitions.
- The generation of multiple descriptions in different formats by a single expert allows testing and improvement through triangulation.

- The generation of multiple individually generated descriptions through comparison with the views of other experts while reducing the potential for group-thinking and premature convergence" (p.317).

3.6.2 Common Techniques used in Knowledge Elicitation

There are several useful and common techniques to elicit knowledge from knowledgeable people in the area of organizations. I will review here the 'interview' as a method to elicit knowledge from an individual and 'The Nominal Group Technique' (NGT) as a method to elicit knowledge in a group forum.

3.6.2.1 The Nominal Group Technique

"The Nominal Group Technique (NGT) is a special-purpose behavioral science technique that is useful in situations where individuals ideas and judgments need to be tapped but where a group consensus is the desired outcome. The NGT is essentially a very structured and therefore very effective and efficient mechanism for idea generation and group consensus seeking. It is useful when a specific task or question already identified requires a group's ideas and judgment" (Sink, 1983, p.173). Sink adds that although the NGT is actually a participative data collection and a consensus-forming device, it is also an important component of participative, group-oriented programs.

According to Sink (1983), there are several steps to follow when executing the NGT. The first step involves silent generation where participants are required to silently write down all the ideas they have in mind concerning the problem that was raised. In the second step participants expose their ideas in a round-robin fashion, each one of them in his turn presents one idea from his list until all the ideas of everyone are exhausted. Each idea is written on a flip chart and is given a sequential number. The charts are then taped up on the walls in full view of participants. The next step is a group clarification session where each recorded idea is explained. The group is asked to scan the list and to find overlapping ideas, missing ideas, ideas that need to be combined or deleted. There is an attempt to look for hierarchy between ideas and to reach hierarchical consistency. In the fourth stage individuals are required to vote on the ideas using an index card. Each participant can vote on several items according to the facilitator decision, which is based on calculating a certain percentage of the total number of ideas. Each participant selects

his or her several most important or highest priority ideas from the list. On each card, one idea is written in the center of each card. The sequential idea number from the flip chart pages is recorded in the upper left-hand corner of the card for each of the ideas. Each idea is also ranked privately by the participant. The process of ranking can be paced by the facilitator. The last step is a discussion of the results. Consensus can be reached in two ways: either by counting the number of votes or by considering their strength as expressed by their ranking.

The end product of the NGT is a prioritized list of responses to a particular task statement of question, but as Sink states, its primary value lies in its capacity for developing commitment and other behavioral outcomes that encourage people to act on behalf of the required effort. The discussion may end with recommendations for further actions concerning the prioritized problem.

3.6.2.2 Interview

Interviews are routinely employed by system dynamicists, especially to prepare group model-building sessions (Richmond, 1987; Morecroft and Sterman, 1994). There are several different reasons for the usefulness of interviews. The first is to gather information in order to build a preliminary model (Vennix, 1996). The second is to provide the modeler with the opportunity to get to now the team members (Richmond, 1987) and to become familiar with the topic (Vennix, 1996). The third reason is to build rapport with the participants, which might prove useful during subsequent sessions, especially if the subject matter is politically sensitive (Vennix, 1996). The fourth reason is to secure each team member's confidence in advance of the session, so that they will feel comfortable to reveal themselves, their ideas, and their information base to the facilitation team (Richmond, 1987).

The interviews, which are employed for the purpose of model-building, are either an informal conversation or an interview guide approach (Vennix, 1996). In the informal conversation there are no predetermined questions prepared in advanced and topics arise naturally during the interview. The greatest disadvantage of the informal conversation is that it might elicit different information from different respondents, especially if more than one interviewer is involved. This approach is more useful when the purpose is to get to know the participants or when the desire is to build rapport.

The guided interview employs a list of predetermined topics, but the interviewer is free in determining the sequence of topics and the wording of questions (Vennix, 1996). This list helps to organize different interviews around the same list of topics.

Vennix (1996) recommend to think about the purpose of the interview before starting it and to think about the questions to be asked. This preparation enables the interviewer to introduce the topic and the objectives to be discuss in the interview, and "the better the interviewee understands the relationship between the questions and the purpose of the interview the more motivated he/she will be to continue the interview" (Vennix, 1996, p. 117).

Questions should be formulated so that they are open-ended, neutral and clear (Vennix, 1996). He recommends to avoid 'why' questions because they are difficult to analyze.

It is best to start the interview with noncontroversial topics in order to get acquainted and to build rapport (Vennix, 1996). Once this is accomplished more complicated opinion and questions can be introduced (Vennix, 1996). The sequencing of questions should follow the logic of the problem in question. When a model is to be built than the best is to identify the list of variables, than to identify the relationship between them.

Vennix (1996) comments that it is important to acknowledge that "interviewing is a two way process, it is an interaction in which both interviewer and interviewee contribute to the results. To a large extent the quality if the interaction will determine the quality if the information elicited from the respondent" (p. 121). The interviewer is the one that is responsible on the quality of the interview, and the question is how he can ensure high quality communication. Clarification of purpose and ensuring that the interviewee understands what is required from him are two important steps an interviewer should take. Both, interviewer attitude and interviewer skills are important for the quality of the interview. It is important for the interviewer to be neutral with the regard to the content of the discussion. It is also important that the interviewer does not place any value on what a respondent says. The interviewer needs to demonstrate interest in other people's idea and opinions (Vennix, 1996). The most important skill for a interviewer is to know to listen and especially to be able to do reflective listening (Vennix, 1996).

The last important issue about interviews concerns their recording and reporting. It is not recommended to make extensive notes during the interview. Using a tape recorder is much wiser. Using a tape recorder needs to receive the interviewee's approval. After all interviews have been conducted, the project team will have to summarize their findings in order to report them back to the group session. The way to summarize and report depends on the specific task and type of information gathered. It is important to report similarities and differences and to keep track on information that might be found useful for later steps (Vennix, 1996).

3.7   The Case Study Research Site

3.7.1 Company Description

The firm is a food manufacturing company. The firm refines nature's raw materials into alternative uses like Fructose, Glucose, and Starch. It was established in 1940 for the exclusive purpose of producing and supplying these important products to the country's growing industrial and consumer sectors.

The firm prides on itself being a company that continually leads. They are the first enterprise to have been granted both HACCP and ISO 9002 certification from the NSF in the country. In addition, the firm bears GMP certification. Their professionally trained technologists make sure that the firm's philosophy of consistency in quality is constantly adhered to.

The firm heavily invests in their 200 employees, providing them with ongoing training and updating. As a result, their staff is composed of highly qualified professionals with a deep commitment to their high standards. The firm is also committed to preserving the environment, and to ensuring that their entire production process is ecologically safe. Part of their success is due to the heavy emphasis they place on R&D. The firm is in close contact with universities and research institutes involved in raw material refinement. In addition, their R&D team works side-by-side with their customers. From the initial concept stage to the final product delivery, their R&D team partners with their clients to develop tailor-made products.

The firm's products are sold worldwide serving the paper, corrugated board, food and various other industries. Its yearly revenue is about $50 Million.

The firm has three separate manufacturing facilities: The Glucose and Starch facility, whose processed products are mainly for inland market, the Fructose facility, whose products are exported to Europe and Japan, and the most recent opened facility – the Mix and Packing facility, which is the smallest one of the three.

3.7.2 Site description – The Mix and Packing Firm

The Mixing and Packing facility was founded in 1980. It provides customers with an important, all-inclusive service of mixing powdered blends and packaging at the Mixing & Packing GMP approved packinghouse. The firm specializes in a wide variety of consumer packs, such as health formulations, baby foods and baking products. This facility employs about forty individuals from various sectors of the country society.

The vision of the Mixing and Packing firm is: "Provide mixing and packing services to the food industry, while using advanced technology and adhering to the highest international standards".

Like the mother firm, the Mixing and Packing firm follows the highest international quality standards. These standards involve the implementation of high levels of personal and operational hygienic. Furthermore, the Mixing and Packing firm uses modern technology that complies with the microbiology requirements of the food industry.

The Mixing and Packing firm produces private label products, meaning private brand name for leading companies, starting from product development, the stage of packing design, and through the final product, which is delivered to the customers' storages. They also produce talcum substitutes without asbestos whose contents have been approved to be used in the food industry.

In the year 2002, the firm bought a food company that specializes in producing special authentic products, mainly from Southern-America, such as Dulce-de-Lache.

The Mixing and Packing firm yearly revenue is about $ 2 Million, and is growing constantly.