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Study of sociotechnical framework

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ABSTRACT

In the definition of sociotechnical systems, every organization is made up of a "socialsubsystem using tools, techniques and knowledge (the technical subsystem) to produce a product or service valued by the environmental subsystem. In this paper, we introduce sociotechnical systems and it's subsystems; then analysis the principles of sociotechnical systems theory. Three are central to the design and continued adaptation to change of STS organizations. These are joint causation, joint optimization, and joint design, all of which involve the organization embracing a holistic systems approach. Finally, we summary of sociotechnical systems Interventions.

KEYWORDS

Sociotechnical Systems;
Sociotechnical Subsystems;
Principles of STS theory.

INTRODUCTION

Sociotechnical systems theory has been used for decades as a framework to design and understand organizations, and has been applied in practice as a framework for organizational change. In the definition of sociotechnical systems, every organization is made up of a "social subsystem (the people) using tools, techniques and knowledge (the technical subsystem) to produce a product or service valued by the environmental subsystem (of which customers form a part)[1,4]. This framework divides the organization into three interdependent subsystems: social, technical, and environmental. Each must be aligned and work together so the organization can function optimally.

THE SOCIOTECHNICAL SUBSYSTEMS

The characteristics of each of these subsystems have been operationally defined over the course of many decades of action research. The social subsystem is the human element of the organization capable of innovation and adaptable to change[2]. At the micro level, the social subsystem embodies characteristics such as individual motivation, group performance, communication, flexibility, involvement, autonomy, commitment and satisfaction[2]. At a macro level, the social subsystem represents organizational culture and organizational design. The technical subsystem holds the tools, knowledge base, and technology required to acquire inputs, transform inputs into outputs, and provide outputs or services to customers in the organization[3]. According to[2] summary of the effects of technology on organizational behavior, the technical subsystem will have different direct or indirect effects depending on the level of analysis within the organization. At the individual level, the technical subsystem affects work design, produc-

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tivity, self-perceptions, and psychological contracts. At the functional unit or department level, the technical subsystem affects roles structures, physical layout, interaction patterns, and supervisory behavior. At the organization level, the technical subsystem affects relationships among departments, organizational structure, reward systems, organizational flexibility, and overall competitiveness. Therefore, at each level of analysis the technical subsystem has a different type of interaction with the social subsystem.

The technical subsystem is affected by the environmental subsystem at a strategic level[1,4]. An organization will choose the technology it requires to service its customers and to compete in its business environment. How the organization competes and what customers the organization targets impacts the technology it chooses, affects the employees the organization hires, and impacts how employees are trained, supervised, and compensated[2]. Therefore, the environment impacts the organization's social subsystem through staff selection[2]. Scanning and adapting to the environment is an important function of managers who have an impact on the strategic direction of the company. Lower level managers will be impacted by changes in the environment through changes in the technology in the technical subsystem and by adaptations to those changes in the social subsystem.

THE PRINCIPLES OF STS THEORY

Several principles guide STS theory. Three are central to the design and continued adaptation to change of STS organizations. These are joint causation, joint optimization, and joint design, all of which involve the organization embracing a holistic systems approach. Other STS principles that affect work design are the principles of minimal critical specification, information flow, and power and authority defined earlier in the introductory chapter.

Decades of STS interventions have applied these principles to varying degrees to achieve organizational improvement through redesign. The principle of joint optimization focuses on meeting the needs of both the social and technical subsystems so the organization at any level of analysis can function optimally. Joint optimization has been misinterpreted by many as "a modification of a technical design for social considerations[5]. However, operationalizing the principle of joint optimization involves focusing on the interrelationship between the social and technical subsystem. A change in the design in either subsystem has a cause and effect relationship with the other. Design changes which do not take into account the interdependent relationship of these subsystems run the risk of sub-optimizing organizational performance.

SUMMARY OF STS INTERVENTIONS

In Beekun's[2] meta-analysis of sociotechnical systems, he presented a comprehensive study of variables involved in effective STS interventions. Workgroup autonomy, a variable common to many STS interventions, is based on the principle of minimal critical specification. Beekun reported that providing workgroup autonomy involves adjusting the social subsystem in all or any of the following ways:

- reducing the degree of external supervision,
- increasing the level of multiskilling in the organization by training employees,
- allowing employees to choose their coworkers and work pace, and
- increasing the level of input workers have in decisions affecting them.

In the area of technological change, Beekun's analysis reported very few interventions involved in simultaneous adjustments to both the social and technical subsystems. In the few studies which actually stated the variables used during STS interventions, task interdependence and workflow routines were the two technical variables manipulated when changing the technical subsystem (Beekun, 1989). These two variables were highly related to level of complexity and innovation, which according to[1,4] were key organizational design elements in the technical subsystem.

More recently[1,4], reported on STS theory and organizational choice in manufacturing. In their study, they noted that implementation of advanced manufacturing systems in the U.S. lags behind that of Japan, West Germany, Switzerland, and Sweden, mostly due to managerial problems and not technical ones. According to these authors, the problems that U.S. organizations faced while implementing advanced manufacturing systems came from the "incompatibility of new technologies with organizational structures, decision tech-

TABLE 1 : A Sociotechnical System Based Comparative Examination of Four Levels of Advanced Manufacturing Systems

Key Organizational Elements	Level 1 Stand Alone	Level 2 Cells	Level 3 Linked Islands	Level 4 Full Integration
Technical System				
Level of Complexity	Low	Moderate/High	High	High
Innovation	Process Innovation	Mostly process with limited product innovation	Moderate innovation in both product and process	High innovation in both product and process
Environmental System				
Complexity and Stability	Stable, simple, with low to low moderate uncertainty	Limited turbulence, complex, with moderate to high uncertainty	Turbulent complex, with high uncertainty	Turbulent complex, with high uncertainty
Technical/Environmental Interface				
Strategic goals	To replace an existing machine, group of machines and/or workers	To facilitate some required changes in the firm's product mix; capacity, lead time process	To provide competitive advantage by developing synergy in the production	To become a true competitive force in the marketplace
Risk	Low	Moderate/High	High	High
Relationship with vendors	Bureaucratic control of vendors and suppliers	Semi-bureaucratic control of vendors and suppliers	Vendors and suppliers are linked to the organization	Vendors and suppliers are an integral part of the organization
Social System				
Skill Requirements	High specialization, with routine and repetitive tasks	Limited multiple skill requirements	Multiple skill requirements	Low specialization, with multiple skill requirements
Employment Requirements	Relatively stable	Semi-flexible	Flexible	Flexible
Work Design				
Individual or Group Task Design	Mostly individual task design	Semi-autonomous work group design	Semi-autonomous work group design	Autonomous work groups design
Structure	Rigid/mechanistic	Semi-organic	Organic	Organic/ networked
Integration	Limited local integration	Local integration	Semi-integrated total system	Total system integration
Information flow	Manual exchange of information	Restricted exchange of information	Semi-automatic transfer of information	Automatic transfer of information
Control	Bureaucratic	Semi-bureaucratic	Semi-self-regulated	Self-regulated
Rewards	Individual- based	Individual - or group-based	Group-based	System-based

Adapted from Advanced Manufacturing Systems and Organizational Choice:Sociotechnical System Approach, Shani, A.B. Grant, R.M Krishnan,Thompson, E.

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niques, management systems, and employee attitudes" (p. 91). Although their discussion of manufacturing technology is focused on the point of implementation, their study has significant implications for the day-to-day success of technology in the organization. Shani et al. identified sociotechnical systems as a unifying framework to guide the organizational transformation process. More importantly to this research, they classify manufacturing technologies into four categories: (1) Stand Alone, (2) Cells, (3) Linked Islands, and (4) Full Integration. These categories were compared to understand how each affected key organizational elements. Key organizational elements were defined as follows:

1) Technical System : level of complexity and in novation
2) Environmental System : complexity and stability
3) Technical/Environmental Interface : strategic goals, risk, and relationship with vendors
4) Social System : Skill requirements, and employment requirements
5) Work Design : Individual or group task design, structure, integration, information flow, control, and rewards

The comparison in TABLE 1[1,4] provides information about optimal sociotechnical design for each classification of manufacturing technology. According to these authors, managerial implications for manufacturing organizations are as follows:

(1) "incremental joint-optimization of sociotechnical systems appears to be an attractive strategy for mature, complex companies seeking to upgrade their manufacturing technologies. (p 108)"
(2) critical management problems come from the adjustment of the social system and not from the adjustment of the technical system.

From their research, [1,4] concluded when organizations make the transformation to a new sociotechnical system, the time frames for adjustment in the social subsystem will be much longer than those in the technical subsystem [9] study on manufacturing supervision supports the hypothesis that in order to maintain a sociotechnical system, once it has been established, equal amounts of time must be spent on both the social and technical subsystems. The tendency, however, is for managers to pay more attention to technical rather than social innovation (Pasmore & Khalsa, 1992) and focus more on the technical subsystem.

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