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Organization Design And The Knowledge Worker

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ABSTRACT:
The field of organization design is changing rapidly, reflecting contributions from managers and diverse organizational consultants. One of the most recent developments is in the design of non-routine systems. Explores non-routine systems design from a socio-technical systems (STS) perspective. Includes a brief discussion of non-routine systems and an examination of alternative methods for diagnosing and redesigning organizations composed of knowledge workers. The results of two STS case studies provide new learnings and point to special design principles for non-routine systems. Concludes with implications for both managers and STS consultants interested in management of knowledge workers.

Introduction

Competitive trends of the global business environment are causing executives to rethink traditional design configurations and work design. One of the key challenges for managers and organizational scholars in the 1990s is to ensure an adequate business response to global competition. Early indications are that the response includes movement from mechanistic to organic forms of structure, from functional to interdisciplinary project work, from individual worker to team-based structures and towards self-management and experimental network organizations. Increasingly, these innovations are being utilized with knowledge workers and non-routine organizations.

The importance of modifying organization designs to fit and support new business competitive strategies is a familiar theme in management. Increasingly, management and organization consultants are being asked to participate in improvement efforts that focus on organization redesign. A variety of models, design principles and change processes can be found in the management literature.

A recent comparison of organization design perspectives identified five "comprehensive" orientations (Stebbins et al., 1994). Each perspective offers a guiding model for viewing organization design, provides a set of design principles and outlines a process that managers and employees can use to study and redesign the enterprise.

All five perspectives have an established research record of applications within organizations, including non-routine systems. The five schools of thought are: organizational hologram theory - an integration and advanced development of the organization audit and analysis design orientation (Mackenzie and Holder, 1990); managing beyond the quick fix - an integrated application of multivariate analysis, participation and structure (MAPS) technology or organizational change (Kilmann, 1989); information processing theory (Galbraith, 1977; Nadler and Tushman, 1988); socio-technical systems (STS) theory and it various perspectives (Hanna, 1988; Kolodny and Stjernberg, 1986; Pasmore, 1988; Taylor and Felten, 1993); and, finally, self-design (Mohrman and Cummings, 1989). The most active dialogue on design and non-routine work can be found in the STS literature.

The potential application of socio-technical systems theory and principles to non-routine work settings was first suggested in the early 1970s (Emery and Trist, 1972; Herbst, 1974). However, enhancements of STS theory and diagnostic methods were required before practical applications could be tried. A broadening of STS theory to include open systems scanning, market and strategic matters (Hanna, 1988; Shani and Elliott, 1989; Taylor and Felten, 1993), adjustments in technical system analysis methods to accommodate non-linear throughput and knowledge work (Shani et al., 1992; Taylor et al., 1986), and identification of key issues in non-routine work situations and "deliberations" on the key issues (Pava, 1983) are illustrative of the enhancements. Combined with the work of Pasmore et al., and new attention to the high involvement of knowledge workers in the design process (Pasmore and Purser, 1993), we can now be optimistic about extending STS design to the white-collar world.

This article explores non-routine systems design from a STS perspective. After an initial discussion of non-routine organizations, a STS redesign process for knowledge work is presented. Two cases of STS application - one for a chemical company's R&D division and the other for a teaching hospital - are explored, followed by a discussion of special issues and the identification of new design principles. A discussion of implications for managers and STS consultants concludes the article.

Non-routine organizations

It has been often repeated that we are in an era of post-industrial society, with a new emphasis on computers, telecommunications and other information technology innovations. New information technologies, such as groupware, change the nature and dynamics of the work organization. Organizations depend on more non-linear

transformation processes in core work areas, and have more departments that can be classified as non-routine. Non-routine organizational units face a high number of exceptions (unexpected situations, with frequent problems) in the course of carrying out work, and problem resolution is complex or unknown at the outset (Perrow, 1967). The combination of high task variety and complex or unanalysable conversion processes are the hallmarks of non-routine work. Examples of non-routine tasks and organizations include basic research, new product development, strategic planning, medical diagnosis and software development.

At the most basic level, non-routine organizations are composed of a social sub-system (the people with knowledge, skills, attitudes - all that is human), a technical sub-system (the inputs and the technology which converts inputs into outputs - or product-in-becoming) and an environment sub-system (including customers, competitors and a host of other outside forces). Organization design seeks to pull the three sub-systems together through a better strategy, conversion process, structural configuration and organizational support processes.

STS design process

Several STS redesign models and design processes can be used with non-routine organizations. For simplicity, we will adopt the Taylor and Felten (1993) four-phase design process, but will substitute specific tools and elements found to be useful with knowledge workers. The phases include discovery, systems understanding or diagnosis, ideal organization and implementation.

0. *Discovery*
   . *education about STS*
0. *project planning*
0. *management commitment*
0. *project start-up issues*
0. *Systems understanding*
0. *create steering and study groups*
0. *plan and implement diagnostic methods*
0. *analyse environment, technical and social subsystems*
0. *Creating the ideal organization*
0. *involve constituents in creation of alternative designs*
0. *test designs against goals and criteria*
0. *create provisional design*
0. *Implementation*
0. *planning*
0. *involvement of people affected*
0. *operational design*
0. *evaluation and fine tuning*

As shown discovery involves education about the socio-technical systems' paradigm, as well as project planning, management commitment and other start-up issues. Systems understanding involves creation of redesign steering and working groups, planning and implementation of diagnostic efforts such as an open-system scan of the environment, separate technical system and social system audits, data consolidation and feedback to various constituents. The ideal organization phase covers efforts to involve people in the creation of the ideal design and testing how well the new design advances the organization's purpose, controls key variances, contributes to quality of work life and meets other design criteria. Finally, implementation covers efforts to gain widespread involvement in the implementation of all aspects of the ideal strategic design, operational redesign, evaluation and continuing adjustment.

Beyond the basic STS design process, the list depicts special design elements associated with non-routine work. At the discovery phase, much more attention is given to involvement of the knowledge workers than of executives who normally sanction and fund typical STS programmes (Pasmore and Purser, 1993). Programme design must be done in collaboration with knowledge workers, who are typically quite autonomous. Pasmore suggests bringing all the employees together at one time to explore STS concepts and to determine what the knowledge workers value. Multiple meetings may be needed to gain consensus that redesign is worthwhile. Participation of this form at the front-end greatly complicates usual discovery activities, but leads to a stronger sense of partnership throughout the programme.

Significant changes are also evident during the second phase - systems understanding. During routine organization STS redesign, technical sub-system analysis focuses on the transformation process or interplay between input-throughput-output components and the human agent. Technical variance analysis provides a view of the transformation process, as depicted in a variance matrix. In many forms of non-routine work, especially in basic research and the early phases of projects, it is difficult to chart the component steps. Because of the non-linear and uncertain conversion process inherent in knowledge work, additional technical analysis tools and

processes are needed. To date, the most promising analytical tool has been the study of "deliberations". As in phase one, widespread involvement of knowledge workers is needed to identify deliberations worth studying, and to conduct the deliberations' analysis itself.

Deliberations are reflective and communicative behaviours concerning a particular topic or issue. They are patterns of exchange and communication among people to address the topic, and may take the shape of formal meetings or informal desk-side discussions. Deliberations are not the same as discrete decisions or project milestones in that they encompass informal human interactions and the ebb and flow of information related to the topic over time (Purser et al., 1992). Completion of knowledge work tasks involves multiple deliberations. Deliberation topics can be ranked in importance, and the more important deliberations can be fully analysed. Analysing deliberations involves scrutiny of structured and unstructured deliberation forums. The analysis can be performed by STS consultants, or knowledge workers can be trained to conduct it themselves.

While the methods of analysing deliberations are relatively new, they show promise for understanding non-routine conversion processes. Deliberation forum structures and processes can be analysed in each work situation. Variables include forum size, membership (managers and other formally-designated players, informal players, customers, etc.), openness in sharing information versus competition among forum members, spirit of inquiry versus advocacy, knowledge of the task and technical transformation process, and time pressure. All potentially affect the quality of deliberations that take place. Additional complications include the stage of development (assuming a project exists), and number of information gaps or unknowns. Table I provides a brief glossary of terms associated with deliberation analysis.

Table I. Glossary of Terms For Deliberations Analysis

0. *Deliberation:*
0. *Pattern of exchange and communication among people concerning a problematic topic*
0. *Deliberation Forums:*
0. *Unstructured to structured discussions or meetings that deal with different topics*
0. *Deliberation Analysis Variables:*
0. *Deliberation topics, purpose and goals of forums, connection to formal hierarchy, size of group, individual forum members, member attendance records, people left out, values and biases of individual members, individual member contributions, whether information shared is used or not used, missing information (not collected or shared by any member), coalitions among members, degree of co-operation, group process methods utilized, time constraints*
0. *Key Deliberations:*
0. *Deliberation topics can be ranked in priority. The deliberation analysis can then be restricted to the more important topics*
0. *Discretionary Coalitions:*
0. *Established in new design, to balance divergent positions and to make deliberations more productive*

The social system audit is also enhanced by the deliberation analysis method. Focus is on the knowledge utilized during deliberations, which is in part determined by member needs, personal influence, professional disciplines and perspectives and other individual and group variables. The analysis identifies knowledge adopted and discarded, along with barriers to learning. Results of the deliberation analysis are used at the redesign or ideal organization phase to better align knowledge with influence in decision making, and to identify improved formal structures for integration of knowledge work. The remaining design activities in phases three and four of the list follow familiar STS patterns. Again, they are highly participative, following the notion that high involvement leads to high commitment to redesign solutions.

Case studies

A brief overview of the organizations and projects The first case involved the R & D division of a large high technology firm which manufactures both consumer and industrial products. The company suffered from increased domestic and foreign competition, with declining market share. High product development costs and delays led the new CEO to seek changes in the way products were conceived, managed and introduced. A design team was established to work full-time over a one-year period to co-ordinate the STS programme.

The second case involved redesign of a university-based medical rehabilitation hospital. The hospital faced moderate competition in the marketplace, and was mainly preoccupied with internal issues related to quality of health services and teamwork among different health care providers. A parallel learning structure (Bushe and Shani, 1991) was created to guide the redesign project.

Comparative analysis

The two organizations can be classified as non-routine systems. The tasks pursued were highly technical and dependent on a continuing influx of knowledge. The chemical company case covered highly-educated scientists, technicians and managers, while the hospital case involved medical school faculty, other health-care providers and hospital support-department personnel. High specialization was a factor in both cases, along with the need for continuing education for new knowledge and skills. Table II provides a snapshot of the organizations using the STS framework.

The environment sub-systems showed considerable variation, with the chemical firm facing many competitors and other external factors that changed rapidly (turbulent environment), while the hospital faced less competition but high scrutiny by outside accreditation agencies. Uncertainty was high and moderately high for the two organizations, respectively. Outside pressures were catalysts for deliberations on regaining market share in the chemical firm, while the audit activities of the accrediting agencies were catalysts for deliberations about quality of care and improved co-ordination among providers.

Deliberation topics in the chemical firm included basic research and product development issues of a technical nature, acquisition of knowledge, internal dissemination of knowledge and knowledge application. Deliberation forums in the chemical firm ranged from unstructured to semi-structured, in that informal meetings were the norm within technical discipline and project work units, while most significant topics were covered in large monthly review meetings, where diverse expertise could be shared. In addition to the stable forum membership, other project and functional experts attended when their projects were on the agenda.

Analysis of the social system in the chemical firm revealed a host of problems related to knowledge utilized. While the large forum format was appreciated by the scientists, certain barriers to full utilization of knowledge were identified by divisional employees. Barriers included lack of product system knowledge in managerial ranks, inadequate discussion and premature decisions on technical research approaches to be used, personal biases of scientists, and other factors shown in Table II. In brief, hierarchical arrangements and decision-making processes were not always well-aligned with knowledge. Analysis of the technical and social systems in the hospital produced a different scenario partly through greater emphasis on the hierarchy and formal hospital procedures. Deliberation topics concerned technical discussions about medical treatments and alternative ways to provide health-care delivery. On a total systems level, an administrative forum composed of hospital department heads and directors of clinical specialties dealt with everything from hospital policies and procedures to professional development and training. This forum was also the main channel for dissemination of information, and attendees typically held their own staff meetings following the hospital-wide sessions. While the administrative forum was judged to be effective by participants, some problems related to full participation and utilization of knowledge were identified.

At the medical care level, multi-disciplinary groups composed of faculty, students and clinical team providers conducted bedside sessions for treatment and teaching purposes. Interviews identified multiple problems in the clinical teams (past attempts to develop a standard approach to team functioning had failed). Problems included negative attitudes towards working in interdisciplinary teams, poor team processes and lack of shared expectations. In brief, many team members were concerned only about their technical contribution to the patients' care, rather than a group effort for rehabilitation. This issue stimulated efforts towards system redesign.

Business system redesign - the hospital

Medical rehabilitation work-processes in a teaching hospital are complex, and treatments for patients are problematic, particularly when multiple maladies are involved. The hospital had followed a pattern of assigning providers on an individual basis, but there were controversies about which specialists ought to be represented as well as about the capabilities of individual providers. For example, some administrators felt that a mental health provider ought to be assigned to every patient. Also, there had been attempts to assign non-physicians as team leaders for certain patients and this was not accepted by the physicians involved. Information from the diagnostic phases of the study increased top management's resolve to improve clinical team health-care delivery.

Table II. STS Comparison of Two Non-Routine Organizations

(A) STS Design Elements for R&D Division Chemical Firm

0. *Environment Uncertainty:*
0. *High; Turbulent environment; High competitive pressures; Technology-driven changes*
0. *Environment Deliberation Catalysts:*
0. *Domestic and foreign competition; Flat sales and declining market share*
0. *Technical System Deliberation Topics:*
0. *Technical topics at different stages of the product development cycle*

. *Technical System Deliberation Forums:*
0. *Semi-structured to structured project and management meetings to share information and expertise; Informal forums within functional and project units*
0. *Social System Deliberation Forum Participation:*
0. *Stable membership; Over 40 scientists and managers attended project and administrative meetings; Project and functional experts added to meetings as needed;Small (three to ten persons), informed project and functional unit meetings for scientists and technicians*
0. *Social System Knowledge Utilized:*
0. *Semi-structured to structured meetings allowed different scientists and managers to share knowledge at different stages of the product development cycle; Barriers included lack of conceptual and product system knowledge, premature decisions on technical approaches to be used, time pressures, lack of technical documentation, personal biases of scientists, missing information, and quality of deliberation processes*
0. *Business System Redesign Strategy Changes:*
0. *Division-wide emphasis on getting new products to market more quickly*
0. *Business System Redesign Structure Changes:*
0. *Creation of integration groups, separate from the hierarchy; Group members represented relevant disciplines and were empowered by their peers to integrate the activities of different work units in the system*
0. *Business System Redesign Progress Changes:*
0. *Processes used to accomplish work were made more explicit; Integration groups were able to set goals, allocateresources, and involve subject-matter experts in decision making; Learning also formed to acquire, disseminate and apply knowledge*
0. *Business System Redesign New Deliberation Forums:*
0. *Integrator groups provide new forums for knowledge-related projects, support topics, and long-term knowledge acquisition, processing and application*

(B) STS Design Elements for Medical School-affiliated Hospital

0. *Environment Uncertainly:*
0. *Moderate; Semi-stable environment; Moderate competitive pressures*
0. *Environment Deliberation Catalysts:*
0. *Requirements of teaching hospital; External audits by accreditation agencies; Concern for quality of health care; Some attention to other health-care competitors*
0. *Technical System Deliberation Topics:*
0. *Technical discussions concerning alternative ways to provide health-care delivery and best medical treatments for individual patients*
0. *Technical System Deliberation Forums:*
0. *Structured administrative meetings covering policies, hospital processes, information; Informal bedside sessions for treatment and teaching purposes*
0. *Social System Deliberation Forum Participation:*
0. *Stable membership; Over 25 hospital department participation heads and directors of medical specialties attended administrative meetings; Medium-sized (10 to 20 persons) informal patient conferences; Assigned clinical team members for each patient, medical faculty, students attended bedside sessions*
0. *Social System Knowledge Utilized:*
0. *Structured meetings allowed sharing of different perspectives, expertise; Barriers to contributions from individuals included rank in hierarchy, single discipline versus interdisciplinary focus, status and personality variables; Barriers to effective functioning within clinical teams included attitudes towards working in interdisciplinary teams, poor team processes and lack of shared expectations*
0. *Business System Redesign Strategy Changes:*
0. *Top management commitment to improving clinical team health-care delivery*
0. *Business System Redesign Structure Changes:*
0. *Parallel learning structure (study group) created for design project became institutionalized; Senior managers used parallel structure to create and implement additional design and training interventions*
0. *Business System Redesign Progress Changes:*
0. *Process model of team health-care delivery created; Training and orientation around interdisciplinary team groups approach conducted on experimental basis*
0. *Business System Redesign New Deliberation Forums:*
0. *Original design study group became steering group for ongoing organization diagnosis, design and training activities; New groups became representative forums*

The design study group offered three options for improvement, ranging from hospital-wide trans-formation, based on a new team approach, to modest experimentation. Top management chose the most conservative option,

believing that it would take a scientifically-controlled experiment to convince physicians of the interdisciplinary team approach advantages. Budgetary, cultural and political forces blocked extension of the programme to other providers. While the change programme did not move beyond the experimental phases, the parallel learning structure continued to sponsor diagnostic, design and training activities during succeeding years. The parallel learning structure was institutionalized and temporary groups were formed to create and implement new projects. Hospital management learned how to create and run improvement groups, co-existing with the regular hierarchical groups.

Business redesign - the chemical firm's R&D division

From the outset of the STS redesign project, upper division management hoped to develop and move new products to market more quickly. Management felt that both structural and procedural changes were needed to accomplish this objective. Following the diagnostic phase of the project, the design team recommended that an ideal product development organization would contain "integration groups", separate from the hierarchy. The integration groups would be composed of people who had relevant expertise and who had skills to integrate the activities of different work units throughout the system. The idea was to better align decision making with technical and product system knowledge. Integration groups were to set goals, allocate resources and involve subject-matter experts in deliberations and decision making. They were to maintain close relationships with management and to be included in management decision making. Integration groups were to be formed around research topics and short-term projects. Longer term learning groups were also formed around acquisition, dissemination and application of knowledge. The integration groups were implemented as planned, eventually displacing the existing 40-member forum and changing the existing process for gaining input to management decision making.

Learning from the case studies

It is noteworthy that both STS redesign projects produced new deliberation forums to supplement the formal hierarchy. In the R&D division case, the structural change was adoption of multiple integrator groups linked to the existing hierarchy. The advantage over the existing forum was that work could be done more quickly in parallel with stronger ties to scientific expertise and product system knowledge. The structure also showed promise for alleviating existing barriers, such as quality of deliberation processes. After the change, forums were composed of people with relevant expertise who also had clear interest in advancement of the topic, in contrast to use of a single large forum where interests varied and competing experts and strong personalities often dominated discussions. After the change, promising ideas could surface earlier and be examined in a more friendly setting. Longitudinal results of the changes have not been reported.

Similar changes were initiated in the hospital case. The parallel learning structure became the steering group for diagnostic, training and other improvement programmes occurring in the hospital. Since the steering group included medical providers, representatives of several management levels and support employees, multiple perspectives on problems and opportunities were offered (Stebbins and Shani, 1988). With approval from top management and the existing administrative group, the steering committee had freedom to identify and launch new programmes. Early reports from administrators indicate that the new forums provide a responsive mechanism for early identification and resolution of cross-departmental problems. No longitudinal results are available.

Design principles

The cases summarized in this article, along with the body of literature on management of non-routine organizations, point to a number of special design principles. The new principles are viewed as supplementing existing STS theory by providing guidelines for use with knowledge-worker populations. The principles can be grouped into three categories: principles related to macro-STS design theories; principles concerning what the new business design should accomplish; and, finally, principles connected with initiating and implementing STS design programmes (design process).

STS design theory

0. *The fundamental framework for design of non-routine systems includes attention to the environmental sub-system, the technical sub-system, the social sub-system and business redesign.*
0. *Key design elements for the environmental sub-system include the degree and nature of uncertainty and driving forces for change (deliberation catalysts).*
0. *Key design elements for the technical sub-system include investigation of deliberation topics and examination of deliberation forums. Deliberations analysis can either supplement traditional STS variance analysis or replace it.*
0. *Key design elements for the social sub-system include evaluation of formal and informal deliberation forums,*

and examination of knowledge utilized during these forums. Scientific knowledge and human dimensions co-exist within the individual; both technical and social considerations determine whether and how knowledge will be shared and acted on.

0. *Beyond existing STS attention to business strategy, structure and organizational processes, special attention should be devoted to the creation of new formal deliberation forums and innovative deliberation forum processes. Deliberation forums can be better planned and better integrated with business decision making.*

Principles to help evaluate new business designs

0. *The new design should provide a better fit between business strategy, organizational structure and expert knowledge. Strategic vision and structural configurations must be aligned with knowledge.*
0. *The new design should provide mechanisms for the generation, dissemination and application of knowledge.*
0. *The new design should promote self-learning competence for individuals, team and work units.*
0. *The new design should provide both routine hierarchical and non-routine parallel learning structures and processes.*
0. *The new design should promote integration of routine hierarchical and non-routine parallel learning structures.*

Design process

0. *Redesign of non-routine organizations requires large-scale involvement of knowledge workers from the outset. All stages of the design process must provide significant involvement of employees - including the discovery phase - attention to preliminary planning and commitment to the project.*
0. *Consultants and managers must give over control of the design process and diagnostic methods to the knowledge workers. While the basic STS framework applies, knowledge workers must be given autonomy during the design process. To fully utilize their capabilities, knowledge workers must have the opportunity to think things through for themselves.*
0. *Existing change theory recognizes the importance of cultural, political and technical forces for change. In non-routine organizations, all three sets of forces are more potent, given competing scientific disciplines and intelligent and capable individuals. Consultants should expect more political dynamics, interpersonal conflicts and clashes of technical ideas throughout the programme. More time for the system understanding and ideal design phases may be needed to manage conflict.*
0. *The authors have noticed that redesign projects in non-routine organizations often show significant differences between the ideal design options and designs that are implemented. Contrary to STS design process theory, design teams are sometimes dismissed before the projects enter the implementation phase, providing freedom for executives to tinker with the ideal design and to staff the new organization according to their own preferences. In keeping with STS theory, implementation should be managed jointly by design teams and executives, so that rich elements of ideal designs are not lost and a good fit between people and position.*

Conclusion

In classical STS theory, organization design is centred on the core production process. Pava's (1983) pioneering work on deliberations helped us see that the core production process in non-routine organizations is not always clearly identifiable and that new diagnostic methods and redesign tools were needed. Pasmore and Gurley extended the shift away from traditional STS variance analysis by expanding the deliberations analysis method to cover how knowledge is generatedand used. Recent case studies, including those reported here, both confirm the value of this focus and provide tools for analysing and redesigning organizations in other non-routine settings. We expect that further work on deliberations will produce fruitful and interesting results in the 1990s and beyond.

The design principles proposed in this article reflect case evidence and the authors' consulting experience with systems engineering, semi-conductor, academic, medical and scientific research and development organizations. Early indications are that the most significant modifications to STS theory relate to principles that can be used to evaluate new designs for knowledge workers and principles to guide the redesign process itself. Clearly, redesign projects for non-routine organizations will be increasingly participative; this may also mean that they will be increasingly conflict-ridden. We have also noticed a trend towards adoption of parallel learning structures and temporary forums in non-routine organizations and believe that these mechanisms show high promise for better integration of technical knowledge and business needs. One key to success may be managerial willingness to support multiple structural configurations and forums, and to align them with managerial decision making and other fundamental organizational processes.

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