ENCOUNTERING ELECTRONIC WORK GROUPS: A TRANSACTION COSTS PERSPECTIVE

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INTRODUCTION

The design of effective systems for cooperative work must be based on a thorough understanding of the forces that shape cooperation and influence the productivity of the work group. We argue that cooperative work is not a straightforward social process whose stability can be taken for granted. On the contrary, each case of work group formation and process is uniquely influenced by its contextual forces. The appropriate type of information technology for the work group, and the impact of the technology on work group performance, are also determined in part by that context.

The objective of this paper is to investigate the organizational context of cooperative work. We have chosen a particular model of organizations, the transaction costs model, to characterize broad classes of economic and organizational contexts for

cooperative work. We then describe several cases of information technology used for work group coordination, as examples of application of the transaction cost model. Finally we suggest implications for the design of information and communication systems which may support or alter different types of cooperative work groups.

In the remainder of the paper, we will use the terms "teamwork" and "work group" rather than "cooperative work" or "collaboration". We are conscious of the ongoing debate surrounding choice of terminology to define this emerging field. We make no assumptions about "cooperation" in a team; it will be seen that cooperation is a defining characteristic of certain types of teams. We assume a team involves multiple people working toward at least one shared goal. (There may be other conflicting goals of individual team members.)

THE NATURE OF TEAMWORK IN ORGANIZATIONS

Why is teamwork important? From an economic standpoint, teamwork is justified because the collective output of a team is greater than the sum of the outputs of each member taken separately (Alchian & Demsetz, 1972).

Teamwork takes place in a variety of settings: a clerical operation of a bank, a research and development laboratory, a

university faculty, a workers' cooperative. Each setting is characterized by a social "force field" (Lewin, 1941). Examples of force fields in the organizational context of a work team are: the hierarchical authority system, formal communications channels, the reward system, peer pressures, competitive forces, etc.* The life of the team and nature of group process are conditioned by these forces and the reactions of individual work group members to them. Thus even if members are willing to be fully cooperative, external and internal pressures may push them beyond the limits they perceive to be fair and equitable for their participation. Individuals may react differently. Some may withdraw or reduce their efforts temporarily, while others may withdraw from the team permanently. Some may continue to participate under stress, with the quality of their contribution having deteriorated. Others may hide their dissatisfaction and simply shirk responsibilities.

The communication structure of the group, the key element of coordination of activity, must be able to elicit and signal problems so that the team can respond adequately before teamwork collapses. Specifically, the communication structure can improve the sharing of information, thus increasing the transparency of individual efforts (Marschak & Radner, 1973). It can signal the

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*To be sure, psychological forces are also at work in team formation and process. In this article we take a perspective that looks only at the structural-economic forces. This limits the scope of our analysis to the "structural architecture" of teams.

beginning and completion of tasks to all group members. It can support the renegotiation of the terms of explicit or implicit contracts that link team members. It can uncover shirking of responsibilities. It can filter out false information used for coverups. It can provide a forum for discussing and exploring the limits of cooperation. It can make the team more open to external incentives and signals such as competitive pressure. On the other hand, it can buffer the team from external pressures regarded as potentially disruptive to group performance.

The communication structure described above is not necessarily electronic. The physical proximity of team members and availability of channels determine the medium: face-to-face, telephone, memo, electronic mail, etc. However, introducing a more advanced system to support work group coordination can have a significant influence in at least two ways. First, it can impact the contents of the messages exchanged. For instance, it might transform the format of a message or enrich its comprehensibility. Second, the system can impact the nature of group process and group organization: the reciprocal contractual arrangements of group members, methods for solving interpersonal conflicts, etc.

In the remainder of this paper, we concentrate on the effect of communication structures on the latter, group process and

structure, using as a framework for analysis transaction cost theory (Williamson,1975; Ciborra,1987).

TEAMWORK STRUCTURES: A TRANSACTION COSTS VIEW

The transaction cost model of economic organizations is one of several models of organizations as information processors which can help us understand the organizational context of work groups and the role of information technology in work group support. Specifically, transaction costs are the costs of setting up, enforcing, and maintaining the reciprocal obligations, or contracts, that keep the members of a team together. These contracts can be set by a central coordinator or authority, or they can be the result of ongoing negotiations directly between group members. Transaction costs represent the "overhead" of the team and they are linked to the resources (time, skills, etc.) employed to allow a work team to produce more than the sum of its parts.

The goal of information technology is to reduce transaction costs through improving information handling and communication. This may be accomplished by reducing the amount of information required in a transaction (e.g., through standard procedures or programmed decisions) or, alternatively, by adding value to the information communicated (e.g., through effective utilization of

distribution channels). In the next section we will discuss the role of information technology in more detail.

There are two main factors in the organizational context that influence work group process and structure: task uncertainty and goal congruence among group members. Task uncertainty varies in that the more uncertain the task, the greater the amount of information required to be processed by team members for coordination purposes (Galbraith,1977). Sources of task uncertainty may be internal to the group (e.g., lack of experience with a new manufacturing technology) or external (e.g., market turbulence).

Goal congruence among members may be thought of as trust. Low levels of trust increase the risk that individual members will shirk their responsibilities or exploit opportunities for individual gain at the expense of the group. As a consequence, more resources are required for monitoring performance in order to ensure group members' confidence in fair treatment. With a high level of goal congruence, a work group can be relatively self-reliant and self-motivated and require little external monitoring.; a group of this sort can be considered "cooperative". Transaction cost theory indicates the most efficient (i.e., with lowest overhead) organization of a given team in its organizational context, characterized by competitive forces and the degree of both task uncertainty and goal

congruence (see Figure 1). Three different stereotypical organizational structures and contexts for team work can be identified(Ouchi,1980; Williamson,1975) :

1. Market-like: When task uncertainty and goal congruence are low, the market is the most straightforward arrangement for team organization: arm's-length spot contracts are sufficient to coordinate and control the activities of group members; rewards are allocated according to current prices for service delivered. Competition takes care of shirking and opportunistic behavior. The role of a market structure as an effective coordination and control mechanism in general requires a large number of participants exchanging standardized services. When this model is applied to individuals supplying products and services, the rules of cooperation are set by market forces, i.e, price. Requirements for coordination among individuals are low and thus overhead costs are low. The individuals supplying products or services are not a "team" in the normal sense because they compete on the basis or price rather than work together to accomplish a common objective.

2. Clan: If task uncertainty is high, the most efficient work group arrangement is one based on high levels of trust; a clan reinforces the sharing of values and goals that facilitate joint problem solving in complex, ambiguous situations. Flexibility in the face of new, uncertain events is facilitated if members are able to rule out at the outset costly haggling and suspicion of cheating from their mutual dealings. The overhead costs of setting up and maintaining a clan are high, but they may be necessary due to high task uncertainty.

3. Hierarchy: These arrangements are best suited when shirking cannot be completely ruled out a priori, i.e., the level of trust is intermediate, and task uncertainty is neither high enough to require an inordinate amount of exception handling, nor so low that a market mechanism to handle coordination is more efficient. Consequently, the overhead costs of maintaining a hierarchy are intermediate.

Transaction cost theory provides a contingency view of efficient team arrangements, but it does not exclude the possibility of arrangements that do not match a particular combination of task uncertainty and goal congruence. If an organization does not

match these conditions, the theory of transaction costs predicts that an extra amount of resources (overhead) will be required in order to buffer a team from external competitive forces and keep it viable the way it is.

Thus, for example, a hierarchical arrangement may exist where a clan would be more efficient; in this case, the hierarchy will be bogged down by exception reporting and handling activities, and group members (who have high goal congruence) will have to put up with unnecessarily formal and rigid procedures. At the other extreme, in an environment with low goal congruence, the requirements of a clan-like organization will be costlier in terms of slower decision making.

EFFECTS OF INTRODUCTION OF WORK GROUP SUPPORT SYSTEMS

If an information system purportedly designed to support work group coordination is introduced into a team, what happens? The transaction cost model suggests a contingency view: it depends on whether there is a good fit between the two factors and team structure prior to introduction of the new system. A system, if it responds to the needs of the work group, will facilitate changes by acting on the fundamental transaction costs themselves.

There are multiple possible design goals, either explicit or implicit, that might be pursued in the introduction of a system to support a team, all resulting in some reduction in transaction costs:

* To standardize tasks, thus reducing task uncertainty;
* To standardize interfaces between execution of subtasks, thus streamlining coordination;
* To facilitate reporting, monitoring, etc. of performance, thus reducing shirking;
* To encourage communication through creation of new channels or improvement of existing ones, thus reducing hierarchical barriers and allowing new ideas to flow more easily (Sproull & Kiesler, 1986).

A system may be explicitly introduced to decrease transaction costs and thus facilitate a particular organization structure. For example, communication channels might be improved to reinforce a clan-like structure. Project management tools might reduce task uncertainty, thus helping the organization operate more efficiently as a hierarchy or even move closer to a market-like structure (Dhar & Olson, 1987).

Another alternative is that a system for supporting communication may be introduced into a relatively stable structure with no explicitly mandated change in organization structure; the results of the introduction of the system are dependent on the adequacy of the existing structure and team members' needs for alternative ways to accomplish their tasks. For example, an electronic mail system may be provided as a bonus by the vendor

of an MIS package, and the use of the extra feature (e.g., for lateral communication) may even run counter to the existing hierarchical structure. The use of the system, then, if at all, would be largely informal for at least a period of time. Thus, the system will have an impact on the organization, but the changes will go largely unnoticed and informal modes of communication will coexist with more traditional, hierarchical routines.

SAMPLE CASES

In order to illustrate the analytical use of transaction cost theory, we now discuss some cases of introduction and/or use of information technology to support coordination. These cases are also meant to illustrate the variety of possible outcomes of introduction of such systems. All but the last of the cases are based on our own empirical investigations.

The Hidden Network

Several years ago, the R&D Department of a European computer manufacturer was assigned the task of developing the proprietary operating system of a new computer line. To increase productivity and improve the organization of work, two major innovations were introduced. The first was a structured methodology for streamlining software development; i.e., a set of guidelines to

organize work into stages, define goals and activities for each stage, etc. The second was a 'software factory'; i.e., a computer network connecting hundreds of workstations on which software to support programming tasks could be run.

The first innovation, the structured methodology, failed. Its purpose was to standardize interfaces between execution of subtasks. From an organizational perspective, the structured methodology would have reinforced the existing hierarchical division of labor for systems development. Its use required adoption by all development personnel, who did not see it as helping them do their work more effectively.

Once the software factory was introduced, however, it became the basic infrastructure for the daily work of hundreds of programmers. Much of the coordination of work took place via the electronic mail and software tools. The messaging system provided an informal channel for direct communication between programmers and allowed the integration of different pieces of code; the network supported large work groups, so that the real tasks, roles, and communication lines were no longer governed by the formal structure. The real organization was the product of informal cooperation and bargaining taking place through the network. Interestingly enough, however, all the agents seemed to ignore the emergent work organization and to operate as if the

formal hierarchical structure were still operational (Ciborra & Lanzara,1987).

Implications: In this case, the existing hierarchical structure was inadequate to the immediate coordination needs of the members of the work group. These were characterized by high uncertainty of the task of developing a complex software product. The group did not adopt a system designed to simplify coordination, but they did adopt that part of it to facilitate greater sharing of information. However, the part of the system that was adopted was not explicitly consistent with the existing organizational structure. Thus the network impacted transaction costs within the hierarchy by creating lateral channels of communication. This fact not being acknowledged resulted in slack; i.e., a "pasted-up" and redundant set of coordination modes.

Creating a Wired Alliance

Apple Computers and Benetton are two companies operating worldwide in different markets, with their homes in completely different contexts, the former in Silicon Valley, the latter in the province of Venice, Italy. Yet there are striking features in common. They are both innovative and young companies; they owe their success to brilliant initial ideas about the product and its distribution and to unorthodox management approaches. The visions and charismatic leadership of the owners have been an

important cultural trait of both companies. In both companies the management structure was established only after their staggering expansion. Finally, they both emphasize a flat organization with wide distribution of authority and information sharing at all levels.

SAFA is the joint venture of the two companies in the financial services sector. SAFA is a "wired alliance" in the sense that it sells financial services, such as leasing contracts, loans, and insurance contracts, through Applelink, the dedicated network that connects Apple personnel worldwide (and specifically the Apple shops in Italy). In each shop where a customer enters to buy a personal computer, peripherals, networks, and software the salesperson can sit down with the customer at a terminal, present the financial services available, and actually fill out all the forms needed. At the other end of the network, Benetton provides the actual services. In this way the financial services division of Benetton through Applelink has access to the new market of personal computer buyers.

Implications: In this case, a network serves as the infrastructure for the joint venture of the two companies, reducing transaction costs in the chain linking the final customer to the financial services supplier. Thus we can speak of a network used for the purpose of supporting an electronic market between the two companies and the customer (Malone et al,

1987). While it is not an example of work group support per se, it does illustrate the use of networks to reduce transaction (i.e., communication) costs in a market-like arrangement.

An Electronic Clan

A well-known West Coast research laboratory created an "experiment" to help them understand coordination requirements of a work group when face-to-face coordination was not possible. They created a "new" subgroup 400 miles away from the original laboratory. Within any given project, goals, deadlines, and subtasks were only very loosely defined and constantly changing based on new discoveries in the process of research.

A particularly difficult problem was instilling in group members, especially new ones, a sense of what were the most appropriate projects to work on and how to spend their time. Modes of appropriate behavior needed to be provided and reinforced across a distance. Therefore, the tools the group migrated toward were video-based; they established an interactive audio and video link between the two sites. In essence they tried to broaden the communications channel between the two sites as much as they could, so that all kinds of information, much of it behavioral cues rather than specific requests or commitments, could be transmitted. There was little demand for more structured coordination tools such as project management systems, which

would standardize or simplify coordination requirements, since requirements were constantly changing.

Implications: This organization has high task uncertainty, because projects and directions are constantly redefined through discovery. It also has relatively high goal congruence, and typically in this type of organization, attention needs to be constantly paid to maintaining that congruence and maintaining a clan-like structure. Thus the system tools chosen to keep the two sites in congruence may generate slack (they are often underutilized and are expensive), but support the organization's existing needs in terms of maintaining a communications infrastructure which is rich in behavioral cues.

Coping with Uncertainty and Complexity

A leading East Coast computer manufacturer is well known for its highly matrixed, fluid, organizational structure. The information technology most commonly utilized to support the organization is electronic mail, which facilitates lateral communication within and between organizational units. There are few systems, such as traditional management reporting systems, utilized to reinforce vertical hierarchical authority.

The organization utilizes multiple channels for meeting coordination requirements: electronic mail, computer

conferencing, etc. However, it also still relies heavily on face-to-face meetings and persuasion. The coordination tools utilized, while rudimentary, have been an accepted method of doing business for a long time. The organization also exists in an environment which, while constantly in flux, always provides a high degree of task uncertainty. Furthermore, goal congruence is ephemeral; very high level goals are accepted but the ways they should be translated into operational strategies are hotly contested. Thus there is a constant set of negotiations between groups within the firm (e.g., between marketing and engineering). The organization acts as a loosely defined hierarchy with heavy emphasis on lateral channels of communication; electronic mail, computer conferencing, etc. facilitate lateral communication and are highly critical to daily operations.

Implications: This organization operates as a clan-like structure, with significant overhead (transaction costs) involved in maintaining goal congruence of organization members. Electronic messaging to support lateral communications within and between groups is essential to its operation. It is, in a sense, a "networked organization" whose telecommunications networks reflect its complex, matrixed organization structure.

An Electronic Hierarchy

Mrs. Fields' Cookies is a well publicized case of the use of information technology to support a unique organizational structure. The company has experienced rapid growth, going from one to 500 stores, all wholly-owned, in three years. The company has essentially a two-layer hierarchy with centralized control; each store coordinates extensively with headquarters, and there is little or no lateral communication between stores. The company uses information technology heavily to maintain centralized control. The systems have two important characteristics: if a machine can do a task it should do a task, and there should be a single centralized database. Thus each store has a personal computer with a limited database of store records; each computer is directly linked with the headquarters computer. Headquarters monitors store production and sales hourly, dictates batch size, and orders ingredients centrally. But other features, particularly voice mail and electronic mail, bring the stores into closer contact with the CEO for issues that are not in the database. Thus the network helps to accomplish two things: "It gives top management a dimension of personal control over dispersed operations that small companies otherwise find impossible to achieve. It projects a founder's vision into parts of a company that have long ago outgrown his or her ability to reach in person." (Richman, 1987).

Implications: This is an example of explicit use of information technology to design a certain organizational structure. Although task uncertainty is relatively low, a hierarchical structure is preferred by the owners to a market-like arrangement. They utilize information technology explicitly to support a very flat structure with centralized control. In addition, they recognize the need for a degree of goal congruence and fully utilize current communications technology to reinforce that.

CONCLUSIONS

The transaction cost approach allows an economic understanding of the nature and dynamics of work groups under the influence of competitive forces. The framework also has predictive value in anticipating the possible impacts of computer-based systems that support various forms of work groups (market-like, hierarchical, and clan-like). To be sure, the cases have shown that there is not a direct, deterministic link between the use of a computer-based system and the arrangement of the team that uses the system. The actual impacts are instead the outcome of the interaction between the characteristics of the technology, the pre-existing organization, environmental pressures, and the choices group members and the surrounding organization make. Moreover, even initial plans and designs can be turned upside-

down if the technology has some side effects which were not initially anticipated.

Implications for System Design

The transaction cost approach allows some normative statements regarding the design of systems to support work groups. First, one should not take a team as a stable set of social practices. In order to work as a team, members continuously solve the structural problems of coordination and control and manage to work out the subtleties of staying together. The complexity of such problem-solving depends on the communication structure, the level of trust, the ambiguity of the goals and tasks, and the external pressures the team has to face. In an economic context, the analysis of the nature of transactions that link the members of a work group among themselves and with their external environment provides a good start in understanding the specific solution that people give to the problem of "surviving as a team". Complexity of transactions is evaluated in terms of transaction costs; these are basically the costs of acquiring, making sense of, storing, and communicating information about performance, tasks, outcomes, behaviors, etc.

Thus a system for work group support should be designed to fit the nature of the transactions of the specific work group. Alternatively and more creatively, it could be used to transform

the work group. Here, the transaction cost approach would be of help in pointing to the possible limitations of too-ambitious designs or the relative efficiency of alternative socio-technical solutions. Thus, the approach would warn system designers of the limitations of setting up an electronic market in a clan, or it may indicate that one could substitute a hierarchy with an electronic market.

Implications for Organization Design

In the broader context of organization design, transaction cost theory is one framework for considering how information technologies to support coordination affect organization structures themselves. In each one of the cases, information technology was used to facilitate coordination and information sharing, rather than to simplify tasks or standardize communication as more traditional management information systems do (Galbraith,1977). We conclude that the technologies designed to support work groups also facilitate organization structures that would be inefficient or ineffective without the technology. In one firm, a highly fluid matrix structure is maintained through a telecommunications network and electronic messaging. In another, centralized control is maintained over a very wide span. In a third, an alliance between firms is established and maintained efficiently.

Transaction cost theory defines two dimensions which determine appropriate organization design: task uncertainty and goal congruence. Our sample cases show how information technology expands the range of organization design alternatives around these two dimensions.

Thus work group support is a reflection of organization design and vice versa. Work groups of the future will look different: they will not be constrained by space and time in their ability to coordinate and be productive. Organizations will reflect the same removal of constraints: the "networked organization" of the future may be more centralized, or more matrixed, or more characterized by inter-organizational linkages than the traditional hierarchy of today.

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