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The Dutch IOR Approach to Organizational Design: An Alternative to Business Process Re-engineering?

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This paper presents the current Dutch sociotechnical design approach to integral organizational renewal in a contextual way. Both its design theory and intervention processes are reviewed and some aggregated empirical evidence is presented. Next, the paper compares the ideas developed in the Dutch approach to those presented in its American, Scandinavian, and Australian counterparts. It is concluded that, at a meta-level, they all share the ideal of participative democracy, while at the conceptual level, these distinctive approaches appear quite incompatible. Notwithstanding substantial diversity, it is presumed these approaches can be seen as local manifestations of a single sociotechnical paradigm.

KEY WORDS: integral approach to organizational design; sociotechnical systems; participative democracy.

INTRODUCTION

The very roots of the Socio-Technical Systems Design (STSD) paradigm are meticulously reconstructed in the second volume of *The social engagement of social science: A Tavistock anthology* (1993). Although its title suggests a retrospect, the book—edited by the late Eric Trist, Hugh Murray, and Beulah Trist—is also about the present state of sociotechnical systems design. Reviewing this voluminous piece of work, Scarbrough (1995) started to question the vitality of STSD in this day and age. This urged Emery (1995) to comment on him rather critically, forwarding a graph of yearly output of publi-

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cations based on Van Eijnatten et al.'s (1994a) sociotechnical bibliography, which shows decisive contradictory evidence.

This article serves a similar purpose: First, it brings forward additional facts to falsify Scarbrough's (1995) tombstone hypothesis. Next, this paper predominantly lays out the sociotechnical landscape, to include the achievements in The Netherlands. Apparently, although it conspicuously differs from the mainstream approach, Dutch STSD still is not that well known abroad. In order to change that situation, this article will provide a rough outline of this approach.

By 1995, the history of the Socio-Technical Systems Design (STSD) paradigm has already spanned almost half a century. During that time, STSD unfolded its potential in the direction of all points of the compass. Several STSD approaches developed during the course of time. In a survey of STSD literature (Van Eijnatten, 1993) a division into three development trajectories was suggested: (a) Pioneering STSD (1949–1959), (b) Classical STSD (1959–1971), and (c) Modern STSD (1971–present). The modern phase can be further split up into four distinct parallel tracks: (1) Australian STSD or "Participative Design" (PD), (2) Dutch STSD or "Integral Organizational Renewal" (IOR), (3) Scandinavian STSD or "Democratic Dialogue" (DD), and (4) North-American Consultancy (NAC). For a graphic illustration of phases and episodes see Fig. 1.

We think it is good practice to discuss similarities and differences in terms of value. Resulting from a systematic comparison, based on the literature (cf. Van Eijnatten, 1993), the following strong and weak points of Modern STSD variants can be identified:

- Scandinavian STSD ("Democratic Dialogue"): Strongest points: Emphasis on the wider scale by creating interorganizational networks (quality of industrial relations), the development of democratic communication strategies, scientific documentation of cases. Weakest points: Few operational changes at the workplace level, no measurable contribution to the strategic goals of firms.
- Australian STSD ("Participative Design"): Strongest points: Elaboration of a "Do-it-yourself" analysis and design approach (quality of work) based on participative democracy, very successful diffusion strategy. Weakest points: Degree of elaboration of structural design theory, and scientific documentation of cases.
- Dutch STSD ("Integral Organizational Renewal"): Strongest points: Degree of elaboration of structural design theory, measurable contribution (bench-marking/quality of organization) to the strategic goals of the firm, the active role of logistics and control theory in creating an integral approach. Weakest points: Degree of elaboration

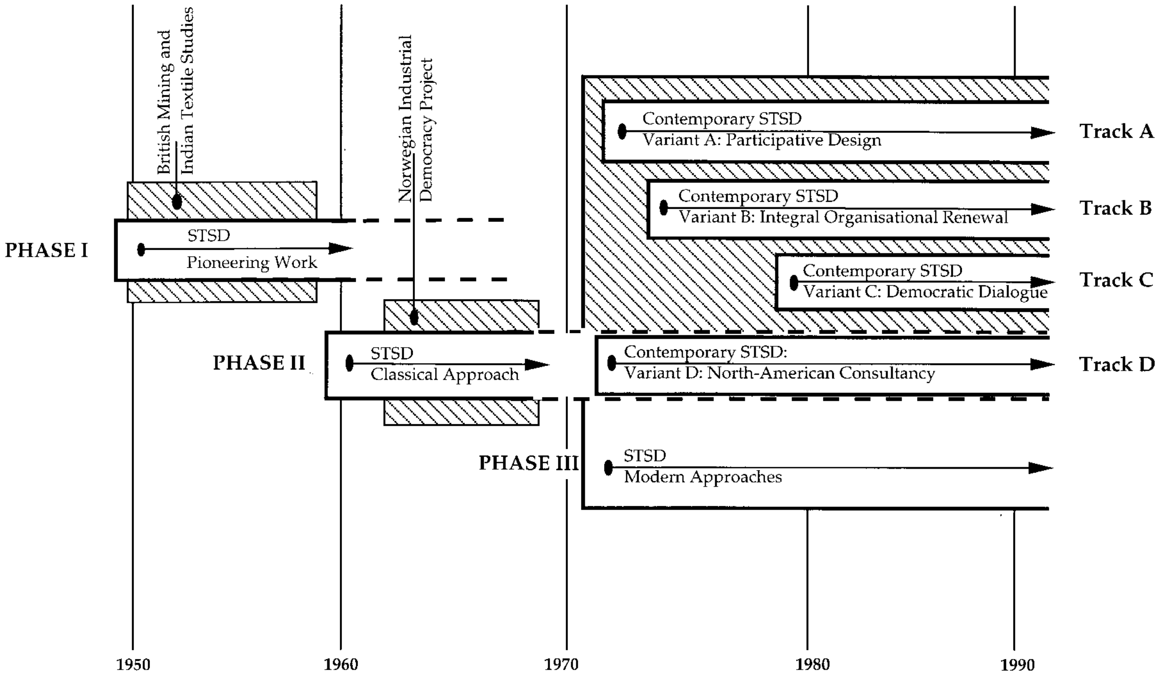

Fig. 1. The phases and milestones in the development of STSD (Van Eijnatten, 1993, p. 19, reprinted by permission of Van Gorcum Publishers).

of the implementation process, and scientific documentation of cases.
- American STSD ("American Consultancy"): Strongest points: Development of expert methods and change techniques, scientific documentation of cases. Weakest points: Degree of elaboration of structural design theory, degree of participation of workers in analysis and redesign efforts.

Of course, this list has to be subjected to careful validation by respective representatives of the distinct STSD approaches. In the nineties, the abovementioned four STSD variants have been found to be merging (Van der Zwaan, 1994; Mathews, 1994; Van Eijnatten, 1995b). This merger can also be observed in The Netherlands, where social and logistic parameters are increasingly dealt with from an integral perspective. We believe this is not only the case in STSD, but also applies to other approaches in the realm of organization theory and management science. Many authors currently proclaim an essentially similar "new" production concept (Drucker, 1993; Suzaki, 1993; Mohrman, 1993; Galbraith, 1994). More than once, original pathfinding STSD ideas appear to be echoed in highly commercialized approaches such as Business Process Re-engineering, Total Quality Management, and Total Productive Maintenance. Today's turbulent environment often calls for the implementation of self-managing teams, a suggestion the STSD paradigm first articulated almost half a century ago (Trist & Bamforth, 1951).

THE DUTCH SOCIOTECHNICAL CONNECTION

In the long history of STSD, Dutch researchers have played prominent roles. Back to the Tavistock phase, both Hans van Beinum and Mauk Mulder participated in the informal European network group, and in several pioneering projects (Van Beinum, 1963; Mulder, 1959). In the sixties, the Philips company experimented with new forms of sociotechnical work organization (Van der Does de Willebois, 1968; Den Hertog, 1976). In the seventies, an alternative sociotechnical model was conceived by Ulbo de Sitter, that was further developed by action research in the eighties and resulted into an integrated body of knowledge comprising both analysis methods and (re)design rules (De Sitter, 1973, 1981b, 1994).

Looking back at three decades of Dutch STSD, we are fully entitled to use the noun "theory" in this respect. Nowadays, in Holland, it is customary to use the adjective "modern" as a standard prefix to "sociotechnical theory" because of these major efforts. Its further diffusion has been strongly supported by formal education (cf. Kuipers & Van Amelsvoort, 1990; Van Eijnatten, 1996); compulsory courses at several universities and vocational training institutions, government support (research stimulation programs), and dedicated implementation by specialized STSD-inspired consultancy firms and (action) researchers. So we can speak of a well-spread methodology. Nowadays, the sociotechnical ideas are used in all sorts of enterprises (both industrial and service organizations). Even the new Dutch Working Conditions Act (ARBO) was based on it (Van der Zwaan, 1991). It follows that Modern Sociotechnical Theory (MST) became a common phrase in organizational renewal in The Netherlands, during the eighties and nineties.

MST not only is an "empirical" theory (explaining how the processes and mechanisms really work, particularly on the shop floor), it is—predominantly—a design theory, specifying what rules, principles, criteria, etc. should be applied in re-engineering production and service delivery organizations. So, MST also is a normative theory. Its explicit design ambition sets MST apart from the mainstream of social science—after all, the latter discipline mostly shows analysis—either empirical or theoretical. Usually, e.g., in Labor Process theory (Van der Zwaan, 1994), social science draws upon very rough technological indicators at best, which explain social phenomena. Sociology and psychology never dealt with the specific operations' management logics underlying (i.e., conditioning) the social variables. MST, instead, chose to deal explicitly with the production structure (i.e., the "technical system," as it originally was called at Tavistock).

The actual design approach that was based on MST is called "Integral Organizational Renewal" (IOR). IOR's analysis and design start off by considering the physical lay-out, material flows, and operational routes. IOR takes it as its necessary point of departure that the production structure parameters constitute the very infrastructure of all social and psychological dimensions. This is not to say that IOR suffers from an isolated, narrow-minded industrial engineering focus. On the contrary, the original sociotechnical ideal of integrating social and technical aspects remains the heart of the IOR approach. One could simply state that IOR adds a more explicit re-engineering attitude to the original Tavistock approach. Commentators addressed this negative, as an incidence of surrender, as clearly being infected by the production and operations' management ways of thinking (Emery, 1993). But—in practice—it actually worked out to be a positive characteristic. When attempting to explain and re-design production processes, MST considers the social variables "derivatives" of the system's lay-out and logistics. It does not mean MST ignores the social aspects. It only says that to improve the human condition, the production aspect-system should first be re-engineered. After that, the construction of working tasks, the formation of teams, and their adequacies as regards human capabilities have to be addressed. Summarizing this argument, we can state that Dutch STSD's deviation from mainstream social science is twofold:

- IOR (as an approach) owns an explicit design orientation, displaying a clear engineering attitude.
- MST (as a theory) claims a pivotal position for the "production structure," whereas it certainly does not neglect the human factor.

Obviously, these are the reasons why in Dutch universities STSD is closely linked to the fields of, for instance, Industrial Engineering, Information Technology, and Production Operations Management (POM) to represent the typically Dutch discipline of "Bedrijfskunde." MST can be conceived of as a relatively well-developed, promising theory within the field of this "Bedrijfskunde" discipline (Van der Zwaan, 1994; Van Eijnatten & Van der Zwaan, 1995). In the following section, we will present some main points of MST, while at the same time assessing its benefits and shortcomings. The following concepts will be discussed:

- The concepts of "production and control structure"
- The concept of "balance"
- The concepts of "control capacity" and "latitude"

To further delineate these concepts, the following English-language documents are referred to: Van Eijnatten (1993); De Sitter (1973, 1981a, 1993); Van Eijnatten and De Sitter (1989); Van Eijnatten et al. (1994a); De Sitter et al. (1990); and Van der Zwaan (1994). We also borrow from several Dutch-language documents (cf. Van Amelsvoort, 1992; Hoevenaars, 1991; Van Eijnatten, 1995a; Van Eijnatten et al., 1994b; De Sitter, 1978, 1981b, 1994, 1995; De Sitter et al., 1986).

MST CONCEPTS

Aspect-Systems

MST as a theory rejected the conventional definition of a "sociotechnical system" as consisting of both social and technical "systems," viewed as subsystems, as is done in Classical STSD and North-American Consultancy (cf. Emery, 1959; Trist, 1981; Taylor & Asadorian, 1985). Even the name of the classical STSD paradigm was based on this primary distinction. The reason this central concept was given up certainly warrants further explanation. Basically, it has to do with the systemic potencies to build an integral model (Van der Zwaan, 1975, 1993; De Sitter, 1993; Van Eijnatten, 1993; Van Eijnatten & De Sitter, 1989; Van Eijnatten et al., 1992).

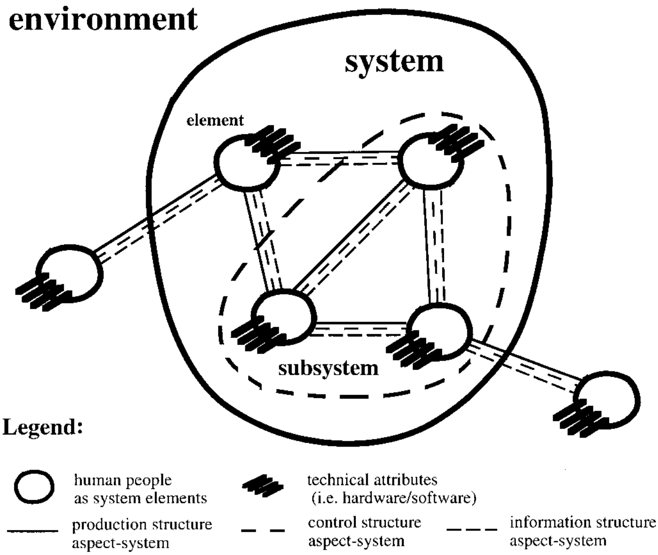

Fig. 2. New definition of a sociotechnical system (Van Eijnatten, 1995b).

As with all contemporary sociotechnical models, MST's notions have gained from systems theory and control theory (Van Eijnatten, 1993; Van der Zwaan, 1994). It follows that one should see a production system as a set of related elements. Although we might attach the status of element to machines, materials, departments, people, and even to decision centers, nodal points of information, or logistic flows, MST chose to restrict the term element to the human actors in the system, independent of whether they carry out production work (execution) or do managerial or control work (planning and conception); cf. Van Eijnatten, 1993; De Sitter et al., 1990; Van der Zwaan, 1994. This is done mainly for parsimony reasons (Van Eijnatten & De Sitter, 1989). All other constituents, such as raw materials, machines, information, etc. must be considered the means used by the elements (workers and managers), in order to perform the operations and transformations required. Hence, machines and information should theoretically be regarded as attributes (of the workers) (see Fig. 2).

According to De Sitter et al. (1990): "the conventional sociotechnical definition of the social and technical 'systems' as subsystems contradicts the notion of a production system as an integral functional system. The relations that constitute a real production system are functional relationships in which matter, energy, and time are involved. The separation of social and technical system elements into subsystems, transforms these functional relationships into nominal ones" (p. 6). An integral approach should focus on the system's total structure. In order to construct a parsimonious model, Van Eijnatten and De Sitter (1989) have proposed to define a sociotechnical system as a holon, including human actors as system elements only, and to consider "technology" as a part of their attribute structure, just as their attitudes, values, and norms are (see Fig. 2).

The original Classical STSD distinction between social and technical subsystems constitutes a nominal classification only, that is likely to prevent rather than stimulate the development of an integral approach to design. In Classical STSD, the concept of "joint optimization" was developed to stimulate the act of integrating. According to Emery (1993), that concept " . . . only becomes meaningful if one is studying the coupling of different kinds of systems. The coupling of unlike systems is inherently nonlinear but, as Sommerhoff has illustrated, their study need not be less scientific, just different" (p. 136). We do not criticize this, but we think it will not result in a parsimonious theoretical model. The analysis of time- and goal-oriented relations between men and machines is easily camouflaged using such a framework. "The choice for an integral approach implies that the focus should be on studying the manner in which a systems's structure determines its capacity to select, develop, coordinate, reconcile, and balance a *multitude* of input–output functions with respect to a *multitude* of interaction partners within and between systems in each of which cognitive as well as evaluative and technical dimensions are implied" (De Sitter et al., 1990, p. 7, italics added). So redesign should be aimed at facilitating, and even enforcing higher quality of work, quality of organization, and quality of industrial relations at the same time (De Sitter, 1981a).

Production and Control

To better enable the building of such an integral model of a production system, MST defines the following pair of aspect-systems (De Sitter, 1994, cf. Fig. 2):

(a) Production Structure (P aspect-system): The grouping and coupling of performance activities with respect to the work flow (operations).

(b) Control Structure (C aspect-system): The grouping and coupling of control activities (regulations).

The Information Structure (I aspect-system) can be added to the P and C as the content and form of information to be registered, and the way in which it is stored, processed, and transmitted (Van Eijnatten & Loeffen, 1990; De Sitter, 1994). Being aspect-systems, in a real-life system P, C, and I are not separable; they actually relate the system elements (people) to each other (cf. Fig. 2). Moreover, it should be emphatically stated that the P and C aspect-systems may not be considered equal to the current Operations Management concepts of lay-out and control, respectively. In both our P as well as C aspect-systems, the workers play a pivotal role, as has been repeatedly stressed before.

In every organization, a multitude of available operations has to be arranged, i.e., sequenced and routed: They should be carried out in certain (variable) temporal orders and allocated to certain (variable) production locations and channels. The concept of "production structure" comprises the complete set of all possible sequences and routes along which operational processes can be carried out. The production structure is the set of all available operations, including their interrelations in terms of their contingencies and compatibilities, allowing for operational routes and sequences. These interrelations can be technical, informational, or operational. The interrelationship can even consist of error transmission only. Needless to say, people constitute the very carriers of the production structure described.

The routing and the sequencing of operations, however, are not automatic processes. They are subject to regulation or control. This implies that the place (e.g., machine) where, and the serial order in which the operations take place, are deliberately chosen. This is done on the basis of principles of efficiency and effectiveness. Here we merely want to stress and clarify that every production or service-delivery system, by virtue of its control needs and means, comprises a "governance structure." It is distinct from and "on top of" its operational or production structure. The governance or control structure is required to enable the system to deliberately regulate the operations. The control structure is the set of all available means of regulation, including their interrelations. Here the concept of structure, as an aspect-system, relates to the composition and distribution of all kinds of control, including authority and competence, with respect to logistics, quality, product development, personnel, and maintenance. We explicitly repeat here, that again the employees form the basis of this control structure.

Design Rules

In every organizational redesign project, MST requires that the production structure be tackled first. It is only after this intervention that the control structure can be overhauled. This is the first and most important design rule of the IOR "logic." The structural parameters of the P aspect-system in most contemporary organizations are: Functional concentration, performance differentiation, and performance specialization (De Sitter et al., 1990). Some structural parameters of their associated C aspect-system are: Control specialization, control differentiation, and division of control functions in the control loop. The structural parameters of the P aspect-system in sociotechnically redesigned organizations are: Functional de-concentration (in parallel production flows), performance integration (preparation, supporting, and manufacturing), and performance de-specialization (De Sitter et al., 1990). Some structural parameters of their associated C aspect-system are: Control de-specialization (combining quality, maintenance, logistics, etc.), control integration (strategic, structural, and operational), and integration of control functions in the control loop.

Balance Model

MST's criticism of common practice is that it largely features production structures that are not at all controllable. One reason for this is an unneeded complexity of the production structure. In other words, the large majority of production situations are so differentiated and highly complex, that they require more means and measures of control than there are actually available. The control structure is not "balanced" with the production structure. We refer to all situations dealing with the consequences of an extreme division of labor, as is the case in all Taylorist organizations. We will not go into further detail here. The main conclusion to be drawn is that MST's central criticism holds, that nowadays the majority of enterprises in industry and service delivery still suffer from a far too complex production structure, and thus from a permanently insufficient control capacity. This is exactly the same message as Business Process Re-engineering tries to tell us (Hammer & Champy, 1993). The remedy for this shortcoming is straightforward: Either the control capacity has to be enlarged, or the production structure's complexity has to be reduced. MST recommends the latter to cut back all potential disturbances at their source, thus restoring the balance between control needs and control potencies (cf. Fig. 3).

Integral Organizational Renewal Design Method

Whenever one tries to control the operational processes, a clear picture of the production structure is needed first. It is impossible to control matters in the appropriate way, if the knowledge of what has to be controlled is insufficient or entirely absent. That is why IOR, unlike current social science and unlike some operations management approaches even, advocates thorough reviews of the very production structure. IOR strictly requires such analyses, even before starting to work on the redesign of the control structure or of the support systems. Thus, we can point out the

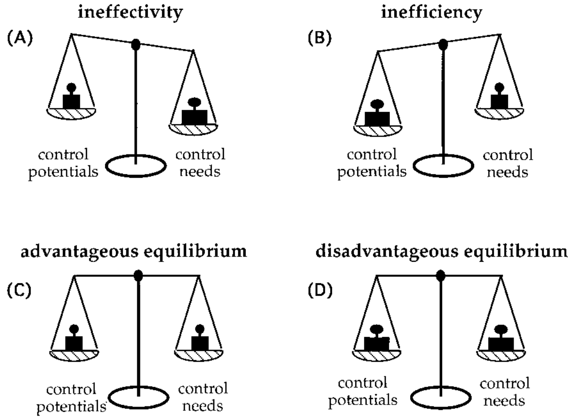

Fig. 3. A graphic representation of the "balance model." (Hoevenaars, 1991, p. 20, reprinted by permission of the author/publisher).

successive steps that are necessary in every project of intervention. One should consecutively carry out the following steps (cf. De Sitter et al., 1986):

1. Analyze and evaluate or diagnose the existing production structure as to operations, routings, and sequencings.
2. Redesign and foremost simplify the production structure as much as possible in accordance with the strategic choices made in relation to market requirements, starting at the enterprise level (top/down implementation).
3. Redesign the control structure and tune it in strict congruence with the production structure redesign, starting at the workplace level (bottom/up implementation).
4. Redesign the support systems (commonly called "technical systems," e.g., information system, maintenance system, accounting system, etc.) and integrate them into the control structure.

A critical point is the connection of steps two and three. From a "degrees of freedom" point of view, this means that the control structure's redesign has to follow the production structure's redesign and definitely not the other way around! Building a new model of a production structure, one should bear in mind that it should be as simple as possible, so as to provide a production structure that will in turn require a simple control structure. It is a matter of operations management economics!

Ashby's Law of Requisite Variety (ALRV) (cf. Ashby, 1956) urged Socio-Technical Systems Design (STSD) to bring the system's viabilities for control into line with the environmental demands. Notwithstanding which

STSD variant is used—Classical STSD, Participative Design, Scandinavian or North-American STSD, or Integral Organizational Renewal—the very act of redesigning will normally result in an ALRV equilibrium state (see Fig. 3). But the absolute levels of their balances differ considerably. Because Emery apparently accepts the environmental variety as given or unchangeable, his boosting operation to increase the "internal systems variety" necessarily adds up in a more heavy-weighted balance—so less efficient equilibrium—than De Sitter's. IOR's recommendation to parallel workflows will decrease the input variability of each production subsystem dramatically, at each particular level of environmental turbulence. Applying ALRV to this redesigned situation will result in a more light-weighted balance—so more effective equilibrium (cf. Hoevenaars, 1991). For a graphic illustration of this argument, see Fig. 3C and D. In order to be able to design high-quality jobs for people, this operation appeared to be an essential preparatory step.

Streamlining

Decreasing input variability is done by creating parallel subflows. This requires a breakdown of all the firm's products and services. According to Van der Zwaan (1994, p. 15) this breakdown is based on a detailed analysis of all the operations related to each product, and it finally results in a detailed matrix of the firm's product range by its range of operations. This overview is need for a classification of the operations, which is carried out in such a way that so-called families of products can be assessed. Particular products (or services) are qualified as a family as soon as their distinctive ranges of operations show seriality, proximity, or interference dependency. These families are then allocated to "dedicated" production flows that prevent interference with other product flows. This IOR design method is called "parallelization," since it results in a number of parallel streams in the primary process. The method basically derives from the so-called "Group Technology" approach (Burbidge, 1975)—well known in workplace engineering. After parallelization, each subsystem accounts for only a part of the original (environmental) variety. Just partitioning the original workflow into two parallel subflows already causes a dramatic drop (up to 83%) of the required internal variety. This intervention has a major impact on the overall complexity of the system's structure (see Fig. 4).

This "streamlining" of the production structure does not mean one should do away with Self-Managing Teams (SMT's). After parallelization and segmentation, there is still enough variety to account for in each subflow. Due to the reduced need for control, SMT's can control a larger part of the paralleled production flow. By controlling rather large segments of

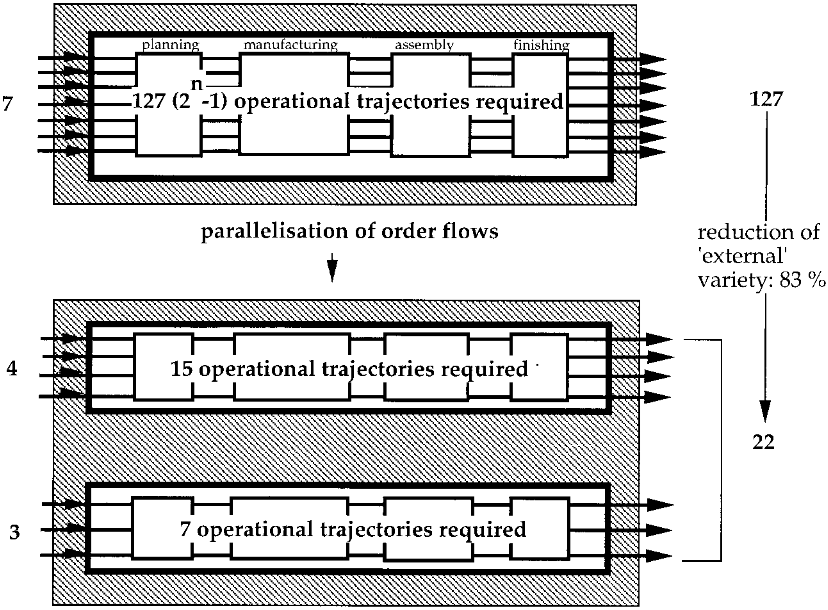

Fig. 4. Parallelization: Reduction of "external" variety by streamlining the production structure (De Sitter et al., 1990, p. 14).

the flow, the groups will become real "whole task groups." Many Dutch authors have addressed this issue in practice (cf. De Sitter et al., 1986; Hoevenaars, 1991; Van Amelsvoort, 1992; Haak, 1994).

This idea of parallelizing workflows to enable team design is also vigorously expressed in Mathews (1994) under the title "segmentation by product or process" (p. 56), while its effectivity is transparently demonstrated in the case of Bendix Mintex (Mathews, 1994, p. 118; Mathews et al., 1993).

CONTROL CAPACITY, PARTICIPATION, AND LEARNING

In fact, broadly defined, MST's main object of redesign is the organization's architecture of the division of labor. In order to systematically develop new production systems, it relates to and differentiates between several aspect-systems. Their interaction is crucial. MST formulates planning and decision making as the control structure aspect-system. It contains all feasible control relations between the human system elements. An important integral concept is the control loop in which all different control aspects merge.

Modern Dutch Sociotechnical Systems Design uses a theory that actually integrates both "the social and the technical." The earlier discussion of its main concepts thus far might give the impression that MST actually overemphasizes "the technical" at the cost of "the social." Because MST lacks any familiar social-scientific jargon, commentators have argued that MST loses the human factor. Of course, this is not true. MST pays ample attention to the "social aspects," but in the context of a systems approach, as we shall illustrate.

MST defines people as system elements, i.e., "nodal points" in an interaction network. As a consequence, self-managing teams are viewed as "wholes" that embody all sorts of aspect-systems that continuously interact with one another to produce favorable output functions. These outcomes can be summarized as both material/physical (i.e., productivity, product quality, efficiency) and social/psychological (i.e., team and individual effectiveness, personal work motivation, worker qualifications, autonomy, involvement, and self-actualization). In MST, in a team, "the social and the technical" are always intertwined.

Having streamlined the production structure, we must then consider the control structure, and the control capacity in particular. The latter has to be in balance with the former, as we mentioned before. Control capacity can be described as the potential of a system to reduce interference (De Sitter, 1994). The MST notion of control capacity essentially differs from the notion of control in Production and Operations Management (POM). The former includes people (the workers) by definition, whereas the latter provides only abstract models of planning and routing while completely refraining from the humanware. Control capacity comes close to worker autonomy. Control capacity is the potential of the control aspect-system to solve the disorders/disturbances of the production aspect-system. This capacity needs to match all production structure variability. Control capacity ("autonomy" in classical jargon) can be described as the potential a person (worker or manager) or a group can use to successfully reduce interference (De Sitter, 1994). Two types of capability can be distinguished: The power to regulate one's own labor process, using routine or nonroutine procedures, and the power to coordinate one's own work with that of fellow workers up or downstream in the process, using routine or nonroutine procedures. Especially the nonroutine regulation variants of control capacity can be powerful instruments in the hands of workers or teams. By constantly managing their own work, they also start rediscovering unused control potentials, and learn to change regulation procedures and norms whenever necessary (Van Eijnatten, 1985; Van der Zwaan, 1992, 1994). One of the central features of the control capacity concept is the emphasis on discretion: The freedom to act according to one's own judgment. Controllability instead of control is the aim: The generic capacity to adapt and innovate in a balanced, multifunctional matter. In applying the concept of

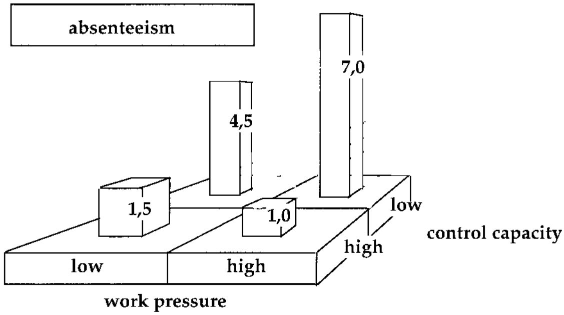

Fig. 5. Some explication of Karasek's (1979) findings in MST (De Sitter, 1994, p. 28, reprinted by permission of Van Gorcum Publishers).

control capacity, MST uses synonyms like "elbow-room," "leeway," "latitude," or "manoeuvering space" (Van Eijnatten, 1985). According to De Sitter (1995) "elbow-room" is a special case of ALRV: More complex relations require more latitude. This concept corresponds to, but does not duplicate, the "equifinality" concept in Classical STSD.

The previous paragraphs clearly show that the social sides of sociotechnical system design certainly have not disappeared from MST at all. Instead, they have theoretically been accounted for in a modern holistic framework. Further circumstantial evidence comes from the explication of Karasek's (1979) findings in the literature elaborating MST. As we already stipulated, control capacity bears a clear resemblance to the concept of "(responsible) autonomy," that is used in other STSD approaches. But in MST its meaning has been "liberated" from the capsule of mere psychological connotations. One of the effects of control capacity can be illustrated by reference to the work of Karasek (1979). Close analyses of his data showed autonomy (control capacity) and workload (as perceived by the workers) could be successful predictors of absenteeism: Absenteeism is highest in case workers who experience high workloads but are offered low control capacity (De Sitter, 1994, see also Fig. 5).

Aside from people's autonomy at work, there are a number of other social phenomena that are similarly dealt with, such as power, organizational culture, work motivation, learning, and intervention. Just as examples, we would like to have a look at the concepts of intervention and learning, so as to briefly demonstrate once more that humans are not overlooked in MST.

As far as intervention is concerned, Van Beinum (1993) claimed that organizational development and redesign can only be authentic and effective under the condition that the very process of redesign shows the same features as the final state, i.e., participation, self-regulation, and local autonomy. Or, to put it in other terms, the process leading to the end result of "minimum critical specification" or "task redundancy," must itself be defined, first and foremost, by the very criteria of involvement and participation of the workers whose concern is at stake. A properly working sociotechnical structure can only result from a design process in which the workers themselves continuously produce essential inputs, from the very beginning. For an identical message we also refer to Emery (1989, 1993) and Toulmin and Gustavsen (1996). This is a plausible thesis, if not an evident one. Though, in The Netherlands we have come across the complaint that MST lacks an adequate intervention method more than once. Critics contend that MST omits the workers, and by doing so seems to foster a technocratic and a blueprint approach to organizational renewal. Such criticisms have, for example, been voiced by Fruytier and Van Amelsvoort (1991), Van Klaveren and Kooistra (1991), and Van der Zwaan (1995). This might have been true a decade ago, but today this no longer is the case. De Sitter (1994) advocates exactly the same idea as Van Beinum (1993) did. Another clear example of the full recognition of the participatory principle during all design stages is given by Boonstra et al. (1996). Their book explicitly deals with developing, monitoring, guiding, and supporting MST processes of change, whether they concern new products, new production systems, or new organizational structures. Comparable messages are voiced by Van Eijnatten (1996), Van Amelsvoort (1996), Huijgen and Pot (1995), Van der Zwaan and De Vries (1996), and Van der Zwaan and Molleman (1995). So, both in MST theory and practice the human factor is dealt with extensively.

Emery (1989, p. 90) has portrayed the pattern of causal determination (i.e., democratization of the work itself leads to commitment, commitment leads to multiskilling, and multiskilling leads to productivity and quality) that would explain the effects of sociotechnical renewal projects, at least in Australia. MST's explanation scheme follows a similar course and even elaborates on it (cf. De Sitter, 1981a). According to Van Eijnatten (1993): "De Sitter recognized the functional relevance of participation in decision making as a vehicle for industrial democracy" (p. 60). "He was the first to connect such themes as quality of working life, efficiency and effectiveness, as well as social binding and cooperation in a model" (p. 59). The allocation of control capacity at the shop floor level eventually results in more symmetrical power relationships between management and workers. Besides that, the exceptionally favorable labor relations between employers and employees in The Netherlands may boost workers' commitment even more. In the eighties and early nineties, MST tried to create a major change in culture by strongly advocating "self-design by knowledge transfer" (De Sitter, 1993). As a first step, members from all levels in an organization were invited to get acquainted with the sociotechnical design concepts, and consequently were asked to start actually using them in their own work at their own discretion. Often, only the actual change processes were monitored professionally. Although it appeared to be an effective strategy in the long run, in the short run many actual change processes turned out to be inefficient; real progress was slow. The speed of development of positive norms, values, and behavior was predominantly triggered by the individual's personal learning processes. Nowadays, MST successfully has incorporated the learning aspect in its design theory, and is ready to experiment with self-managed individual learning processes in integral organizational renewal projects (cf. Hoogerwerf, 1998).

MST IN PRACTICE

Although exact statistical data are lacking, the IOR-approach is broadly used in Dutch industry and service-delivery organizations. Furthermore, an increasing number of managers are attending the workshops and conferences about self-managing teams and integral organizational renewal. No less than 200 sociotechnical projects are systematically documented in the literature (cf. Van der Does de Willebois, 1968; Den Hertog, 1976; De Sitter et al., 1986; Van Eijnatten et al., 1992; Van Eijnatten, 1993; Van Eijnatten et al., 1994b; Van Hooft, 1996). And a multitude of projects is actually being carried out. Most of them are still under way and have not been mentioned in the literature. As a result of STSD's strong presence in the higher educational system in The Netherlands, the diffusion of MST ideas in industry has been quite successful. The majority of Dutch firms know about sociotechnical design, and most of them are experimenting with or have already implemented sociotechnical forms of work organization in the past few years. Some of them became real "success stories," and have been documented extensively in the literature. Although systematic evaluation studies are scarce, there are positive exceptions, i.e., the study of Haak (1994), see the Appendix.

There are other indicators of the success of Modern STSD in The Netherlands. As was already mentioned in the previous paragraph, part of the Dutch working conditions legislation was based on MST, while the governmental control agency ("Arbeidsinspectie") uses specially designed sociotechnical analysis instruments to control the actual abidance to this law. A study carried out by the Dutch Social-Economic Council—joining the Dutch Government, Employers, and Employees Organizations—revealed that the implementation of Self-Managing Teams really pays off (Joosse et al., 1990). In all sorts of reports, the following maximum measures are reported: 70% throughput time reduction, 60% cost reduction on the basis of smaller stocks, 50% reduction of defects, 40% reduction of customer complaints, 25% reduction of indirect work, 15% increase in productivity (Van Eijnatten, 1994). At the same time, workers reported improved commitment, involvement, and a more stimulating organizational climate (improved on-the-job learning opportunities, better human resources mobilization, implementation of (nonfinancial) group renumeration, and enhanced social affiliation). These "social" outcomes are as important as the "technical" outcomes mentioned before.

To further diffuse integral organizational renewal, the Dutch Social-Economic Council produced a videotape, demonstrating best practices (COB/SER, 1993). Mention should also be made of the government-instigated research stimulation program TAO (Technology, Work, and Organization), which was completely aimed at a further spread of IOR among the Dutch industry and service sector. From 1989–1994, it triggered all sorts of sociotechnical projects in all sorts of organizations (cf. Den Hertog & Ramondt, 1994).

Although no large-scale evaluation studies have been carried out in The Netherlands, many case studies have been documented in the literature. All sorts of sociotechnical solutions are reported, based on MST, using (parts of) the IOR approach. Van Eijnatten (1993, p. 67) listed 28 well-documented cases in the period 1982–1993. A small evaluation study ($N = 13$) of recent projects showed that locally developed sociotechnical design solutions were actually implemented by most of the companies (Van de Kuil & Van Eijnatten, 1995). Recently, nine sociotechnical projects were reported in some detail (Van Hooft, 1996). More rigorous empirical evidence came from several in-depth studies concerning the Dutch sociotechnical approach (cf. Hoevenaars, 1991; Van Amelsvoort, 1992; Boonstra, 1992; Roberts, 1993; Ten Have, 1993; Haak, 1994; Peeters, 1995; Fruytier, 1995; Loeffen, 1997; Hoogerwerf, 1998).

COMMON CHARACTERISTICS AND SHARED IDEALS IN STSD

Having presented some highlights of Dutch STSD, we can now address the problem of how different the Dutch approach is from the other representatives of Modern STSD. We will try to consider the problem at different levels. At the conceptual level Dutch sociotechnical theory is quite incompatible. As we have mentioned, the systemic redefinition of a sociotechnical system resulted in a rather unique set of concepts. However, at the practical workplace level there is much more congruence: Self-Managing Teams are a common denominator in all Modern STSD variants. Also there are similarities at a more abstract level: The following shared ideals between the aforementioned STSD variants become apparent:

1. One of the most characteristic features of "global STSD" is action research as a typical way of working among sociotechnologists (Whyte, 1988; Gustavsen, 1992; Van Beinum, 1993; Ramondt, 1996). The actual practice of action research is most clearly observed in the Scandinavian variant of (Modern) STSD. But it is fair to say that in the evolution of Dutch, Australian, and American approaches, action research also played a cardinal role. The ideal is to develop local sociotechnical outcomes that maximally accommodate the "tacit knowledge" of the company workers involved. Actually, the real secret lies in combining a set of innovative design principles with most valuable local experiences. This requires a participative process. In Australian and Dutch STSD, the communication about concepts starts with sorts of "briefing sessions." PD is giving some training in using its basic conceptual framework in both Participative Design Workshops and Search Conferences (Emery, 1993; Emery & Purser, 1996). IOR organizes "knowledge transfer" courses for both management and workers of the companies in which a sociotechnical project is started (De Sitter, 1993). Using the conveyed concepts, actual redesign is done by the people whose work is under revision, in both variants. Most of the time, the resulting sociotechnical solutions are tailor-made and highly context-specific endeavors, successively urging researchers to tap and study these local variants to document them.

2. Another common feature of the various STSD approaches is the use of an open-systems model. Although the degree of sophistication may differ considerably, such a model is exploited as a basis for all contemporary STSD variants. In (Modern) Dutch STSD the open-systems model is usually elaborated from a design-technical point of view; in Modern Australian STSD, the model is left quite simple and, by implication, is communicated more easily. In mainstream American STSD, the model is closest to the Classical STSD prototype, while in more recent attempts people are using "chaos theory" models and "participative design" as well (cf. Purser & Pasmore, 1991; Emery & Purser, 1996). In original Scandinavian STSD, the use of the classical open-systems model is evident, but in the current approach it goes unobserved.

3. A third striking similarity between distinct STSD approaches is the creation of what is erroneously called a "learning organization." In Scandinavian STSD, theoretical emphasis is placed on the restructuring of language/communication, facilitating interorganizational learning by applying the dialogue conference method (Engelstad & Gustavsen, 1993). Australian STSD is explicitly based on an educational approach toward learning, culminating into an array of STSD "do-it-yourself" participative analysis and

design methods (Emery, 1993). Dutch STSD actually contributes to organizational learning by specifying structural conditions (De Sitter, 1994). Currently, more learning-oriented process extensions of IOR are being developed as well (Hoogerwerf, 1998). Due to its original emphasis on expert consultancy, organizational learning was just one of the themes in American STSD. In more recent years, it definitely became a core issue (Purser & Pasmore, 1991; Emery & Purser, 1996).

4. All Modern STSD variants create remarkably similar work structures in practice. Actual best practices of STSD show that there are no obvious differences between those who are using the traditional twin-concept of "social and technical subsystems," and those who apply MST's "production- and control aspect-systems." It is particularly at the theoretical level that specific advantages/disadvantages come to the fore. The two strands have led to different sets of concepts, and different approaches over nations/continents. Emery's original conception of "social and technical subsystems" was long the best available alternative. It still is very attractive because it is easy to communicate. The approved explanatory power seems to originate from this "intuitive credibility," as is the case with the whole "Participative Design" approach. In Classical STSD, the idea brought about rather complex design concepts (such as "joint optimization," and "directive correlation"). De Sitter's conception of "production and control structure"—in contrast—is rather arduous to communicate. People are first required to understand the quite abstract "aspect-systems" concept. But once mastered, the idea of practically inseparable, but analytically decomposable "relationships" proved very economical in advocating integral design. In summary then, if one is interested in systematically developing a STSD knowledge base, one should judge the systemic sophistication of both distinctions, and choose accordingly. If one is just interested in achieving best practices, and in communicating effectively, one should choose models that are most convenient in actually motivating people in a local change situation.

5. A shared ideal in all STSD approaches is "participative democracy in the workplace" which is aimed at "locating responsibility for coordination clearly and firmly with those whose efforts require coordination" (Emery & Emery, 1989, p. 100). Acknowledged as a dominant world view, this ideal can join together all sociotechnologists on the globe: Each local action can be seen as a step toward the superordinate goal of simultaneously improving both the qualities of work, organization, and society. Completely different from the more generally known representative variant, participative democracy (or direct democracy) in the workplace urges ordinary people to take responsibility for their work, and to make governance and continuous learning part of their jobs. Thus, it is far more than just influence. It completely reshapes the allocation of tasks between management and workers, actually

changing the balance of power. It improves workers' competence and consequently at the end it expels all forms of authoritarianism. Both American, Australian, and Dutch STSD try to establish participative democracy in the same way: By creating self-managing teams. Scandinavian STSD is trying to establish it by initiating a democratic dialogue between management and workers (Gustavsen, 1992). All STSD variants believe in direct democracy, but they also know that the shift from autocratic to democratic work structures is a very demanding and time-consuming process. But once established, it will be the main "engine" to all improvement and renewal work. Participative democracy in the workplace will be the killer of old Taylorism. It enables managers and workers to use their abilities to their full capacities. Participative democracy is basically used here on an individual and (inter-)organizational level. For a broader treatment of the concept see Pateman (1970), Emery (1974, 1989), and Van Beinum (1993).

ARGUMENTS AND INDICATIONS FOR A SINGLE STSD PARADIGM

Of course, it would be careless to suggest all "local" conceptions should fit in one and only STSD *approach*. Because of regional differences in political and cultural systems, the actual form of measures will remain different. The Australian approach is predominantly pragmatic and easy to diffuse, while the Dutch approach is more elaborated at an advanced theoretical level, and by implication difficult to communicate. The question remains, what counts more: Clear communication and motivation, or scientific sophistication in model building? Or can we do both: Using a more popular language to initiate change, while at the same time developing a formal systems language to explain redesign principles in a parsimonious way? To us this discussion should not lead to clashes between different "schools of thought," nor to reproaches for treating "participative democracy" the same way as "social engineering." Both approaches, PD and IOR, proved real representatives of STSD!

In the previous paragraph we stated on a more abstract level that these distinct approaches could be regarded as family-linked endeavors of a single master STSD paradigm. What we advocated there was, that on a higher level of abstraction the distinct approaches share a common goal: To reach the ideal of "participative democracy." It is only at the strategic level that the STSD variants distinguished are compatible. Additional evidence for a single STSD tradition is that sociotechnical scientists from all over the world continue to meet each other to discuss common topics (for instance, the 1995 Melbourne colloquium). They share the same attitudes and goals, although their concepts differ considerably and their approaches resulted from different epistemological/ontological backgrounds and world contexts (Van Eijnatten, 1993). Because of this, it is our conviction that developing a single STSD *approach* is neither desirable, nor practical. More than any other theoretical argument actual practice should provide the norm to declare different STSD approaches related. Sociotechnologists from all points of the compass share that typical emancipation/action research attitude to change. In the context of an ever-increasingly changing world, the unambiguous drive to create a desirable future discreetly identifies different STSD approaches as clear representatives of a single sociotechnical paradigm.

Moreover, in recent years, basic ideas about structural organizational renewal alternatives have seemed to converge. In this paper, four alternative Modern STSD variants are discussed. They were developed during the seventies and eighties. In the nineties, these variants are merging! We believe this is not only the case in Modern STSD, but also applies to alternative approaches in the realm of organization theory and management science. Many authors are currently proclaiming a remarkably similar "new" production concept (cf. Mohrman & Cummings, 1989; Hammer, 1990; Davenport & Short, 1990; Prahalad & Hamel, 1990; Harmon & Peterson, 1990; Drucker, 1991; Quinn Mills, 1991; Davenport, 1993; Hammer & Champy, 1993; Mohrman, 1993; Suzaki, 1987, 1993; Galbraith et al., 1993). More than once original pathfinding STSD ideas appear to be echoed in approaches such as Business Process Re-engineering, Total Quality Management, and Total Productive Maintenance. At the same time, different "world-class" practices show remarkable similarities in actual work organization: Parallel workflows, all sorts of teams as instances of whole-task/self-managing work groups, the integration of staff with production activities, and the development of networks. Under these circumstances, we wonder if there will be any further need for a continuation of the STSD paradigm. The following three arguments plead in favor. First, behind the facade of fashionable management hypes there could be a hidden variant of old-world Taylorism, as is the case in Lean Production, or in some instances of recent workflow management systems. Second, in most bestsellers, the prophecy predominates, while the actual redesign methods and techniques remain relatively unspecified, as is the case with BPR (cf. Eijnatten et al., 1996). Due to the absence of a straightforward approach to change, it is quite easy for organizations to use these new buzzwords just to re-label their traditional work processes, while actually changing nothing! Third, STSD should continue to adapt to new developments, such as the invalidation of the "unity of time, place and action," caused by modern Information Technologies (Electronic Highway), creating completely new opportunities for sociotechnical work organization, because people can process/(re)work in different stages of the same document at distinct locations at the same time, etc.

It is our conviction that STSD should proceed with defending the ideal of "participative democracy," and try to get this vital function incorporated in each emerging integral approach to organizational renewal.

APPENDIX. Analysis and evaluation of IOR at Philips' Semiconductors B.V., Stadskanaal (Haak, 1994, pp. 112, 152)

In this plant, eight discriminating group characteristics that can be derived from the comparison between "high score" and "low score" groups seem to be crucial for implementation of the concept of the whole task group. Other differences between the groups, however, also seem to be important for implementation of the concept. The "high score" groups have more stability in their teams and/or in their production processes, whereas in "low score" groups either the teams or the production processes are in a transition stage or encounter problems in their production processes. This comparison suggests that stability, resulting in the possibility for internal control, is an important condition for the implementation of the whole task group concept.

Group members, group supervisors, and top management in this plant have different perspectives on the implementation of group characteristics. Group supervisors are generally more positive about the implementation of the characteristics than their group members. Top management and group supervisors differ in their perspective on general intentions toward the sociotechnical model, their interpretations of our results, their definitions of the whole task group, and the influence of the reward system. These differences in perspectives mean that the sources for data collection in an alternative study could strongly influence the results, and thus should be chosen carefully.

Although the comparison between the perspectives of group supervisors and group members should be interpreted with caution, the results suggest that group supervisors are more positive about the presence of group characteristics in their groups than their group members. There could be three reasons for their different perspectives. First, group supervisors are partly responsible for implementation of the whole task group concepts, and therefore assess their own "achievements." Second, group supervisors seem to refer more to improvements compared to the traditional situation, whereas group members refer to the improvements compared to their original (high) expectations. Third, group supervisors seem to refer to the opportunities that are offered to their groups, whereas group members reflect upon the extent to which the opportunities are actually recognized and/or used by their group.

Team building is a very important aspect in all the task groups. Through the process of developing a sense of membership, developing common values and norms related to group performance and group behavior, a whole task group can become a team. The design principles describe the group characteristics that are conditional for the development of teams. Group sessions to develop common norms and values and to develop a "team spirit" can facilitate the process of "team building." However, this continuous process can only start after the conditions have been fulfilled, as described in the design principles.

CONCLUSIONS

The six clusters of group characteristics provide insight into the relationships between group characteristics and show the priorities of this plant in its implementation of the whole task group concept. Our results show that this plant lacked focus on "leadership" and the "reward system," but instead focused on implementing the characteristics concerning "information and communication" and "team building." The clustering of related group characteristics also shows that the ten design principles describe six aspects of whole task groups, and that group characteristics are related. However, the present clusters could be enriched with additional characteristics to further complete the description of the concept of the whole task group.

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