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TAMING THE DECISION TIDE WITHIN ORGANIZATIONS:  
some theoretical considerations and experimental results

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ABSTRACT

A STELLA model of a simple production organization is used to investigate the effects of different types of coordination on the adaptation of the organization to its changing environment.

1. Introduction

Today's business organizations are in the midst of the information revolution. Information technology drastically changes the organization's environment. Not only does it affect the economic and technological characteristics of existing industries, it also generates opportunities for whole new businesses (Porter and Millar 1985). In order to survive, business organizations have to find ways of coping effectively with the uncertainty that accompanies this increased environmental turbulence, and in this respect decision making is a key process, because changing industry structures and the emergence of completely new industries demand timely decisions; decisions which may eventually result in effective responses and adaptation of the organization to its altered environment. But as increased turbulence requires more frequent decision making, decisions have to be made faster.

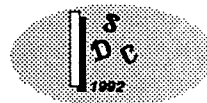
Traditional command-and-control organizations seem rather ill-equipped to deal with the requirement of faster decision making. In this type of organization unforeseen problems, which arise from the increasing rate of environmental change, are usually referred to higher echelons, thereby forcing top management not only to make strategic choices, but tactical and operational as well. Moreover, operational problems that reach the top levels will receive the highest priority as they immediately affect the profitability of the company. If top management increasingly has to deal with operational and tactical decision making, it will spend less time on strategic decision making, and it will take more time before strategic choices are made and implemented. Consequently, a structural adaptation of the organization to its changing environment will take longer, which means that the organizational viability is at risk.

In sum, information technology poses severe threats to traditional command-and-control organizations. Fundamental changes are required in order to secure their existence. In order to understand what these changes look like, organizational decision making has to be discussed in more detail; section 2 will be devoted to this topic. In section 3 a simulation model of a simple product organization will be described. In section 4 this model will be used to conduct some simulation experiments in order to test some of the theoretical considerations presented in section 2. In section 5 the outcomes of the simulation runs will be discussed, and in section 6 some conclusions will be presented.

2. Decision making in organizations

An individual organization member who has to make a decision requires information concerning the relevant characteristics of the problem he is facing. Information is data that, after it has been processed by the decision maker, has acquired meaning. In other words: information is meaningful data (Davis and Olson 1985). It follows that decision making depends on the acquisition of data and on the processing of data into information. Accordingly, faster decision making can be achieved by increasing the speed of the acquisition and processing of data.

As decision makers are members of organizations, the latter statement applies to two different levels of analysis, namely the level of the individual and the level of the organization. Faster decision making therefore can be realized by increasing the speed of data acquisition and -processing both at the individual and the collective level.



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Investment in information systems, or better, data systems, can be regarded as an example of increasing the speed of data acquisition and processing at the level of the organization (cf. Galbraith 1973; Applegate et al. 1988). The use of data systems will result in the faster acquisition, processing, and storage of more data at the organization level. At the individual level, this means that the decision maker will receive more data (in the form of reports, memoranda, notes, etc.) in a shorter period of time. Yet, the decision maker is not interested in data as such, but in data that have meaning with respect to the problem at hand. He therefore has to process the data that is channelled to him, and has to generate the information himself. Accordingly, his decision making capacity, i.e., the number of informed decisions a decision maker can make in a given period of time, depends on his cognitive data processing capacity, which is limited (see Simon 1985; March 1988).

Thus, the central problem is how to overcome the decision maker's cognitive limitations. One might argue that only relevant data, i.e. information, should be acquired and presented to the decision maker. Unfortunately, it is often impossible to determine in advance what is relevant and what is not, especially in the early stages of a decision making process when the problem is not quite clear yet (Mintzberg et al. 1976, Mason and Mitroff 1981, Nutt 1984). Therefore, it is not possible to determine in advance what should be labeled as information and what not.

Another way of increasing the speed of data acquisition and processing at the level of the organization is the hiring of (additional) staff personnel. They might help the decision maker in detecting environmental threats and opportunities. They can also play an important role in the generation and evaluation of feasible solutions to the perceived problems. The staff findings have to be reported to the decision maker. Usually, this is a rather time consuming process, which means that with an increasing environmental turbulence, managerial decision makers can devote less time to other activities and become overloaded again. Taking into account the considerable costs involved in hiring staff personnel, it becomes understandable why this alternative for the reduction of data overload is disfavoured by many business organizations.

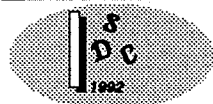
A third strategy that can be pursued to improve the speed of decision making is formed by the reduction of the number of hierarchical levels (Drucker 1988). By reducing the number of hierarchical levels, it will take less time to channel information to the decision maker. However, like the former strategies, this strategy cannot overcome the limited cognitive capacity of the individual decision maker.

In conclusion: the decision maker forms a major bottleneck in organizational decision making processes. More and faster data acquisition and processing at the organization level can easily exceed his cognitive capacities, which means that data overload will occur, and the risk of making badly informed decisions, or of making decisions too late will rise. Accordingly, the adaptation of the organization to its altered environment will be endangered.

An essentially different approach is asked for. Taking the limited cognitive capacity of individuals as a starting point, the alternative approach focusses on the number of decision makers, i.e., faster decision making is realized by increasing the number of decision makers. Two alternatives can be imagined, namely (1) hiring additional decision makers, and (2) transferring decision making powers to organizational positions that did not possess these powers before. With regard to the first alternative, two options exist. First, additional decision making positions can be created, which means that additional hierarchical levels are created. In the second option the number of positions possessing decision making powers remains constant, but the number of incumbents of the positions is increased.

One may doubt the effectiveness of both options. Increasing the number of hierarchical levels can negatively affect the timeliness of data. Increasing the number of incumbents of a formal position, though in theory a possibility, gives rise to potential competency and responsibility problems. In addition, both options are costly.

The second alternative, which aims at the transfer of decision making powers to positions that did not have these powers before, fundamentally affects the organization, because it implies a shift in coordination principle (coordination being the hallmark of organization). Based on (1) a distinction between superior and subordinate positions, and (2) a distinction between decisions concerning *what* activities must be carried out and decisions concerning *how* implementation has to proceed, three different coordination principles can be distinguished in the literature on organizations (see Scheper 1991: 149ff.). The first principle can be called the command-and-control principle. It is characterized by a rigorous division between decision making and implementation of decisions: decision making is carried out by the incumbent of the superior position, while implementation of the decisions is performed by the



incumbents of subordinate positions. Coordination is entirely in the hands of the superior, who gives orders and controls the implementation by monitoring the subordinates' activities. This coordination principle, which is graphically shown in figure 1a<sup>1</sup>, is the dominant principle in so-called command-and-control organizations (cf. Drucker 1988). In the literature on organizations, Fayol (1916), Taylor (1947), and the Aston group (Pugh et al. 1963) provide examples of this coordination principle.

The second principle that can be distinguished is called the cybernetic coordination principle, because it is based on insights from the field of cybernetics. Both superior and subordinates are responsible for coordination: what should be done is decided by the superior, how it is done is decided by subordinates. As the superior does no longer decide how activities should be carried out, he can no longer control by monitoring the individual activities of the subordinates. Control has to be achieved in a different way. Cybernetics provides a solution. A fundamental insight from cybernetics concerns the control of a system: it is possible to control a system without knowing the system's inner structure. By monitoring the system's output and affecting the input if the output departs from a prespecified standard, it is possible to control the system. Translated into an organizational context this means that the superior does not have to monitor the activities of the subordinates who constitute the system he has to control; monitoring their output suffices. Organization models in which use is made of cybernetic insights can be found in the work of Katz and Kahn (1968), Galbraith (1973), and Emery (1976). Figure 1b is a graphical representation of the cybernetic principle.

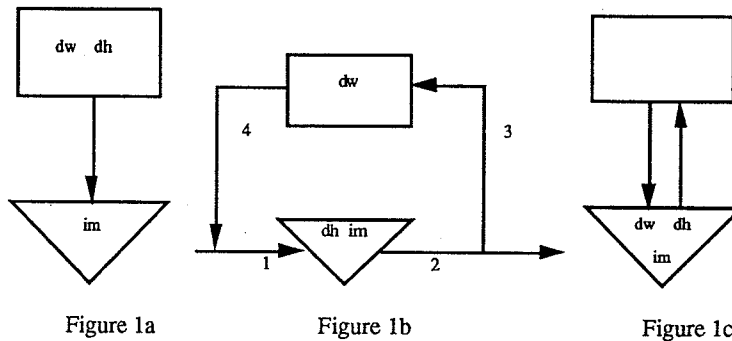


Figure 1. Coordination principles

The third coordination principle that can be found in the literature is called the competence-principle. It is named after Max Weber's concept of the competence (Weber 1976: 125). A competence comprises a task domain and decision making powers. The incumbents of subordinate competences possess a high degree of autonomy, as the superior does not have the right to interfere in matters of content of subordinate competences. This means that both superior and subordinate possess decision making powers concerning the what and the how. For example, a department of a university can be regarded as a competence-based organization. In a university department, coordination is achieved by the development of programmes, both in research and in education. The head of the department is responsible for the quality of research and education of the department. Given the impossibility of direct interference and the relative autonomy of subordinates, negotiations are required to assure good quality of both programmes. By drafting lists of priorities, which is a process involving superior and subordinate(s), an overall framework can be constructed for both programmes. Subsequently, subordinates can specify their contributions in detail using the general frameworks as guidelines. After the specific contributions have been specified, they are compared with the general frameworks in order to test whether the general conditions they had to satisfy, are met indeed.

In organizations based on the competence principle, peer control is essential. It should, however, be noticed that the superior possesses disciplinary powers, which can be used when subordinates exceed their

<sup>1</sup>The rectangle represents the superior position, the triangle denotes the subordinate position. 'Dw', 'dh', and 'im' stand for 'decision making powers concerning what activities have to be carried out', 'decision making powers concerning how activities have to be performed', and 'implementation', respectively.



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powers. Representatives of this type of organization models are Beer (1979) and Peters (1989). A graphical representation of the basic assumptions of this type of organization model is given in figure 1c<sup>2</sup>.

With regard to the possibility of data overload, it can be argued that data overload is more likely to occur in a command-and-control organization than in organizations based on cybernetic or competence principles. In the former type of organization all unforeseen problems will automatically reach the superior's desk, whereas in the latter types of organization subordinates are supposed to solve (many of) the problems themselves. Moreover, as control takes place at a less frequent pace in both the cybernetic and competence based organization than in command-and-control organizations, another source of the superior's overload is diminished.

We have to remark that cybernetic and competence based organizations require the superior to fulfil tasks that are related to the creation of 'unified vision', 'shared vision', or 'common understanding' (Drucker 1988; Wimmer 1991: 381; see also Kolodny 1986). Since subordinates are relatively autonomous, they may perform activities that turn out to be counterproductive. By creating unified vision, which serves to guide the common interpretation of key events, it is attempted to reduce their potentially disadvantageous behavior. Unfortunately, the literature is not very helpful in assessing the time a superior has to invest in the process of creating shared meaning. Authors on this subject seemingly assume that applying cybernetic or competence principles together with processes of creating shared understanding is less time consuming than using command-and-control principles. A further difficulty concerning shared vision should be mentioned. That is, the conceptualization of concepts like shared or unified vision is, from a theoretical point of view, not without severe problems (see Scheper 1991, ch. 3).

For these two reasons we will not include processes of creating shared vision in the following two sections, in which the theoretical analyses presented in this section will be implemented in a simulation model. We will, however, readdress this topic in section 5.

Due to the impossibility of conducting field experiments concerning coordination principles within existing organizations, we will use a simulation model containing the theoretical considerations presented in this section, and confront the model with empirical data. As cybernetic principles are more often applied than competence principles, in the next sections only command-and-control coordination and cybernetic coordination are compared by means of a simulation.

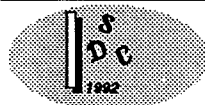
### 3. Simulation Model of a Simple Production Organization

In the previous sections it has been argued on theoretical grounds that a change from command-and-control coordination to cybernetic coordination within organizations may reduce decision making strains and delays at the top management level and, consequently, may enhance the adaptability of organizational operations to environmental disturbances. The postulated effects of this change in coordination principle will be empirically investigated by implementing it in the specification of a system dynamics model of an organization. The system dynamics model represents a theoretical model of a simple production organization. This does, however, not imply that the organization model specified has no connections with reality. The model has been checked with a descriptive analysis by Hage (1990) of current problems faced by the Dutch division of the Heineken company, called Heineken-Netherlands, which is a large lager-beer producer for especially the Dutch and American consumer markets.

The model has neither been constructed to reproduce historical time series of observations of specific organizational processes in reality, nor to make predictions of these processes in the near future. Its purpose is to explicate and illustrate the theoretical arguments presented in the former sections. Due to its simplified theoretical specification, the system dynamics model cannot be expected to possess any explanatory or predictive power; this is not to say, however, that the specified system dynamics model does not serve some scientific purposes. It explicates the assumptions contained in our theoretical

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<sup>2</sup>The superior's rectangle should, of course, also contain the symbols *dw*, *dh*, and *im*. We did not include these elements for explanatory purposes, i.e., we wanted to show the development from classical instrumental theory to competence-theory and its accompanying transfer of discretionary powers.



arguments, which are open to further testing and eventually to falsification. The model also overtly defines the organizational characteristics under investigation, thereby delimiting the area to which our arguments apply. Furthermore, the specified causal relationships among variables representing various organizational characteristics elucidate the feedback cycles contained in the model. Finally, simulation experiments with the model provide insight into the dynamics of decision making, implementation of the decisions into operations, and operations themselves within the production organization.<sup>3</sup>

The specification of the system dynamics model of the production organization to be presented is only concerned with the production of lager-beer for the Dutch consumer market. Since the early 80's the yearly Dutch consumption of beer has stabilized at around 12 million hectoliters. Furthermore, the Dutch beer market can be characterized as a market with open competition among various suppliers. Because of the open competition on this market, the only feasible short-term policy to be pursued by the production organization modelled is to improve its marketshare by allocating extra budgets into marketing, i.e. pricing and promotion (advertising). This policy is based on the expected short-term profits to be gained in the near future, which in turn are based on the profits earned in the recent past. The development of such an expectations pattern occurs in a temporarily stable environment like the Dutch beer market since the early 80's. So, in our model it is assumed that the production capacity is constant in the short-term and is fully utilized. Changes in consumer demand reflect themselves in changing sales and inventories of finished products, and thereby in changing profits. These latter changes are counteracted by setting other product prices and changing expenditures on advertising. This situation also characterized Heineken-Netherlands during the period 1983-89. Its marketshare declined from 57.8% in 1980 to 51.7% in 1989 in a virtually constant Dutch beer market. Only after nine years the board of directors of Heineken-Netherlands got alarmed and reconsidered its strategic policy. It was then forecasted that if Heineken-Netherlands would continue its existing policy, marketshare would be lost and the Dutch division of the Heineken company would become a lossmaking organization in 1994 (see Hage, 1990). The production organization specified is schematically represented in figure 2. A more detailed specification of the model in STELLA™ (Richmond et al. 1987) is presented in the appendix to this paper.

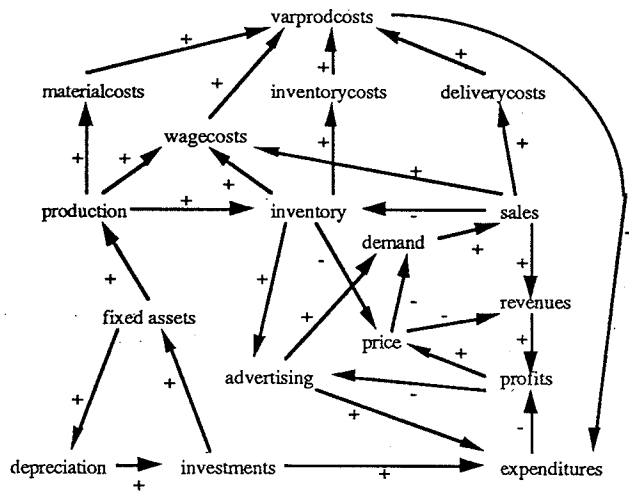


Figure 2. Causal model of a simple production organization

In figure 2 profits perform a key role in bringing production into line with sales, while it is tried to keep the inventory of finished goods at a minimum, both by price-setting and advertising. Both policies are

<sup>3</sup>A more detailed discussion of the scientific value of system dynamics models can be found in Hall & Menzies (1983).



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decided on by the top management depending on the amount of profits realized. From the STELLA model in the appendix it can be deduced, that if, due to whatever external cause, demand declines, it takes two time periods via sales, revenues, profits, pricing, and advertising before the level of demand will be accommodated again to the level of production. In the meantime revenues have become less, while the expenditures increase due to the costs of a growing inventory of finished goods. Consequently, the delay in the adaptation of demand to production is a costly aspect of an organization coordinated in a command-and-control mode. If demand changes frequently, the levels of production and consumer demand will be continuously out of equilibrium. Deviations from the dynamic production-demand equilibrium trajectory result in permanently lower revenues and higher costs, and, consequently, in smaller profits. And smaller profits represent a risk to the long-term viability of the production organization.

The central cause of these problems is the delay in adaptation of prices and advertising budgets to changes in consumer demand, which results from the centralized command-and-control coordination. As the top management has to make relatively many decisions (what- and how-decisions), the decisions concerning the price of lager and the budget for advertising are taken on a three months basis instead of, e.g., a monthly basis. Quarterly data on profits, inventory of finished goods, and consumer demand provide the input to this decision making process. The result is a three monthly adaptation of the price of lager and the budget for advertising. This delay in adaptation to externally induced changes in consumer demand disables operations to react timely and adequately to environmental changes. This delay in response to externally induced changes in consumer demand and, consequently, in expected profits, and in the inventory of finished goods is specified in the STELLA model as updating the price of finished goods and the budget for advertising in accordance with the monthly average change in profits, inventory, and demand after every subsequent three months period. When profits show a negative trend over the last three months, the price of lager is lowered and the advertising expenditures are increased. When the ratio of the levels of the inventory of finished goods and consumer demand shows a positive trend over the last three months, the price of lager is additionally lowered, whereas the advertising expenditures are additionally increased. A positive trend in profits leads to a higher price of lager and less expenditures on advertising. In addition, a decline of the inventory-demand ratio leads also to a higher price of lager and to less expenditures on advertising. If the level of consumer demand exceeds the level of production, the level of consumer demand is tried to be reduced by setting higher prices of lager and by cutting down the budgets for advertising.<sup>4</sup> Without tempering consumer demand the discrepancy between consumers' demand for the product and the availability of the product on the market will grow continuously. Such a growing discrepancy may lead to such an unsatisfied demand of consumers, that consumers become frustrated and definitely change over to another brand of lager. The latter effect endangers future market potentials of the simulated organization, and thereby its viability.<sup>5</sup>

In order to overcome the problems created by the delay in adaptation to environmental changes mentioned above, it has been argued in the former sections that a change from centralized command-and-control coordination to decentralized cybernetic coordination may help. Such a change in coordination implies a segregation of the combined decision making powers concerning *what* activities should be undertaken, and *how* these activities must be carried out. Following the argument presented in section 2, this means that top management should decide *what* activities should be undertaken, whereas decisions about *how* these activities must be carried out are made by lower level decision makers. In the STELLA model this segregation is specified as follows. The top management adjusts at the end of every three months period the price of lager and the budget for advertising for the next three months period on the basis of the average monthly change in profits realized during the last three months period. In the meantime, the lower level decision makers can introduce minor monthly changes in the price of lager and the budget for advertising, which are set by the top management for a three months period, in order to keep the

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<sup>4</sup>It should be noted that a relatively high price elasticity is assumed.

<sup>5</sup>If the production capacity is not continuously fully utilized an excess of demand can be counteracted in the short-term by increasing the degree of utilization via an extra shift of labour. Tempering demand via higher prices and less advertising is not necessary then. This situation is, however, not considered as we assumed full utilization of the production capacity. If the excess of demand seems to become a long-term perspective, a strategic policy is called for in the form of plans for investments, financing, marketing, etc. (see also section 5).



inventory of finished goods at a minimum during each three months period. Whether the change in coordination principle within the modelled production organization has the hypothesized effects on improving the adaptability of the organization's operations to externally induced changes in consumer demand, which is reflected by a higher rate of profitmaking, will be analyzed in the next section.

#### 4. Simulation of Centralized and Decentralized Coordination

The STELLA model of the production organization has been used in several simulation experiments for studying the effects of the proposed change in coordination principle. Each experiment covers a simulation period of 48 months (4 years). The initial values of stock variables and the estimates of parameters in this model have been derived from data on Heineken-Netherlands for 1989 (see Hage, 1990). In all simulation experiments the model is ran during the first three months without changes in consumer demand, the price of lager, and the budget for advertising, in order to build up a quarterly figure of the profits realized under the assumption of no change in organizational policies. The baserun is the simulation run with the STELLA model presented in the appendix containing the data just mentioned. In the baserun it is assumed that (1) there are no externally induced changes in consumer demand and (2) the adaptation of the price of lager and of the budget for advertising occurs at the end of every subsequent three months period. This baserun will be referred to as BR. BR forms a reference for analyzing changes in the dynamics of the model resulting from a change in the coordination principle described in previous section and externally induced changes in consumer demand.

In the first simulation experiment the speed of adaptation of the price of lager and of the budget for advertising to consumer demand is accelerated from once in every three months period to once a month. This scenario is labeled as SC1, and it represents the cybernetic coordination principle. The rates of adaptation of once in every three months period in BR and once a month in SC1 are also implemented in the simulation experiments SC2a and SC2b, respectively, in which the level of consumer demand declines *ceteris paribus* as a linear function of time by 2.5% over the last 45 months. In the simulation experiments SC3a and SC3b the level of consumer demand does not decline as the result of a linear function of time, but changes *ceteris paribus* as the result of the function depicted in figure 3 (where the value 1.000 indicates no change).

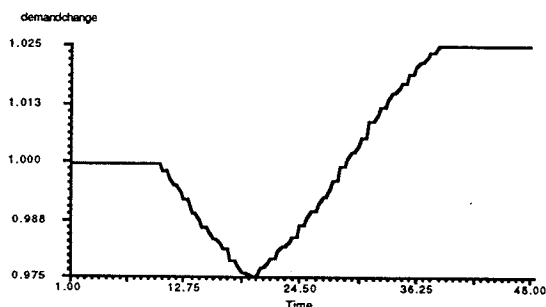


Figure 3. Change in consumer demand in scenarios SC3a and SC3b

The simulation experiments BR, SC1, SC2a, SC2b, SC3a and SC3b will be compared and analyzed on the basis of the following indicators: accumulated profits, consumer demand, and inventory of finished goods (labeled inventory 2). The values of these indicators taken during each simulation run are presented in figures 4a-4f.

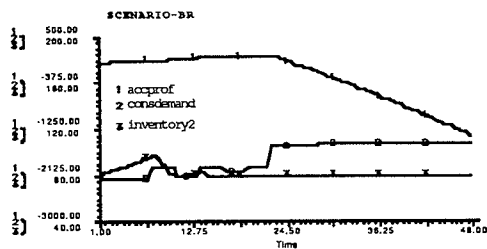


Figure 4a

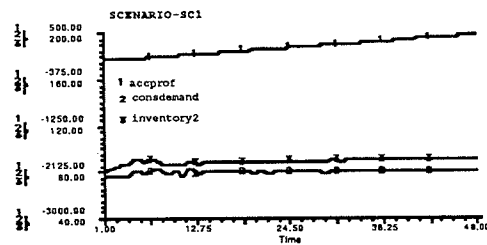


Figure 4b

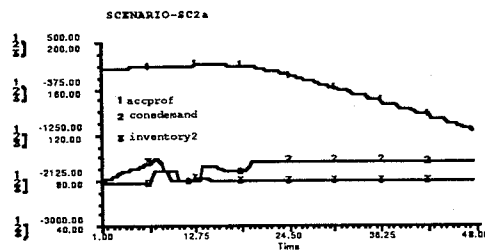


Figure 4c

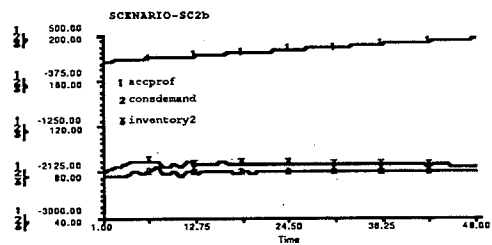


Figure 4d

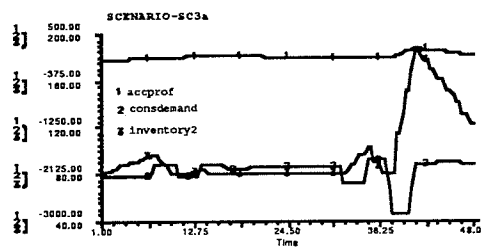


Figure 4e

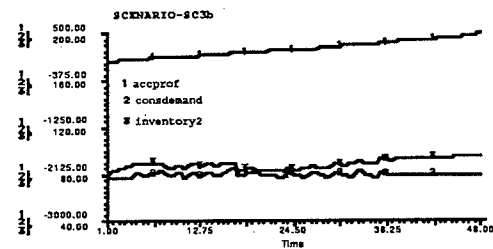


Figure 4f

From these figures the following conclusions can be drawn. The modelled organization becomes a lossmaking within 4 years if command-and-control coordination is pursued under relatively stable market conditions (scenario's BR and SC2a; see figures 6a and 6c). Furthermore, the application of the cybernetic coordination principle within this organization leads in all cases of (no) externally induced changes in consumer demand to higher profits than the application of the command-and-control coordination principle. These higher profits result from a better adaptation of the level of consumer demand to the level of the inventory of finished products and, consequently, from lower promotion related costs. This is best seen in figures 6e and 6f. The externally induced change in consumer demand, depicted in figure 3, is better counteracted in figure 4f than in figure 4e. Figure 4f represents the situation in which lower level decision makers are authorized to decide on deviations from the price of lager and the budget for advertising set by the top management, in order to counteract the swing in consumer demand more quickly than the top management could do. Another implication of this situation is that the top management does not need to take into account changes in the ratio of the levels of the inventory and consumer demand in their decisions concerning the price of lager and the budget for advertising. This means that their decision load is reduced from two issues to one (i.e. the change in profits). So, our theoretical arguments favouring the cybernetic coordination principle over the command-and-control



coordination principle to be applied within organizations facing a turbulent environment are not falsified by the results of the simulation experiments.

### 5. Discussion of the Model Structure and its Simulated Dynamics

The theoretical problem dealt with in sections 1 and 2 boils down to *how* and *why* a change from command-and-control coordination to cybernetic coordination does represent an answer to the problems resulting from increasing environmental turbulence due to the emergence of information technology. In order to "test" the postulated positive effect, a theoretical model of a simple production organization has been specified. In the basic specification of the model, decision making and the implementation of decisions is coordinated in a command-and-control mode by the top management. So, the specification of the model is based on theoretical arguments and is not the result of datafitting.<sup>6</sup> The estimates of the unknown parameters and initial values of stock variables in the model have been derived from public data on Heineken-Netherlands (see Hage, 1990). Consequently, the results of the simulation experiments were not *a priori* forced to disapprove the hypothesis of no effect of a change in coordination principle. The empirical cycle of scientific research has been followed as close as possible.

From the results presented in figures 6a-6f one might draw the conclusion that with respect to profitmaking cybernetic coordination performs better than command-and-control coordination within an organization. There is, however, a threshold, under which command-and-control coordination performs better than cybernetic coordination. The argument in favour of this statement goes as follows. If the externally induced changes in consumer demand follow quickly upon one another, and if these changes outweigh each other in the long-term, immediate counteractions as a result of cybernetic coordination to offset the effects of these changes put a large strain on the organization itself as well as on its finances. Enormous sums of money will be spent on pricing, in the form of lower revenues, and on advertising, in the form of higher expenditures, in order to stimulate demand directly after it has fallen randomly. As the positive and negative changes in demand outweigh each other on the long-term, three monthly counteractions as a result of command-and-control coordination will only partially take into account the counterproductive changes in demand. With this coordination principle the sums of money spend on pricing and advertising will be less than with cybernetic coordination. These points are illustrated by the results of simulation experiments, in which (a) command-and-control coordination is applied (figure 5a), and (b) cybernetic coordination is applied (figure 5b), with random disturbances between -10% and +10% of consumer demand after the third month. Yet, it must be noted that these results can only be regarded as tentative and experimental and that further research into the question of a lower threshold between the effectiveness of cybernetic coordination and command-and-control coordination within an organization is needed.

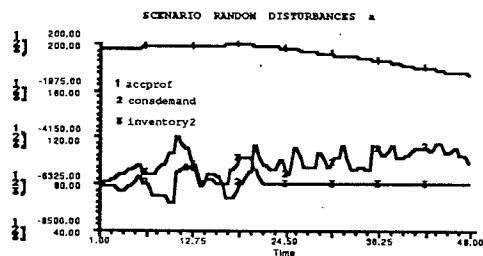


Figure 5a

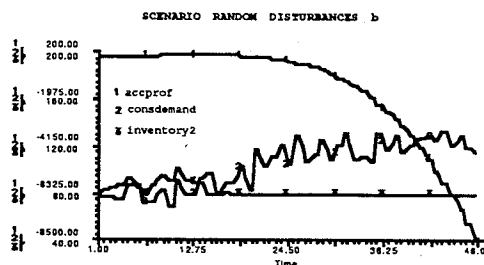
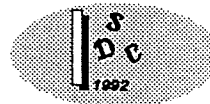


Figure 5b

<sup>6</sup>The descriptive analysis of current problems faced by Heineken-Netherlands as presented by Hage (1990) contains no detailed information on its organizational structure and dynamics.



In the model presented in section 3, the improved speed of adaptation of organizational operations to externally induced changes in consumer demand, as a result of changing from command-and-control coordination to cybernetic coordination, has been specified. We should, however, make an additional comment. In section 2 it was argued that adopting cybernetic or competence principles must be accompanied by processes of creating unified vision, because a common construction of reality is regarded as an essential condition for concerted action in organizations in which these principles are applied. Since the literature does not provide any adequate clues regarding how to create unified vision, we did not explicitly model these processes, nor did we model coordination problems among lower level managers, which can occur if a shared situation definition is absent, i.e., a small degree of commonality may lead to contradictory decision making by lower level decision makers.

In order to illustrate this notion, scenario SC1 has been expanded by incorporating a three monthly adaptation of the level of production<sup>7</sup>, which is inversely related to the average monthly change in the inventory of finished goods during the previous three months period (see figure 6a). Next, the three monthly adaptation of the level of production to the change in the level of inventory of finished goods is changed into into a monthly adaptation (figure 6b).

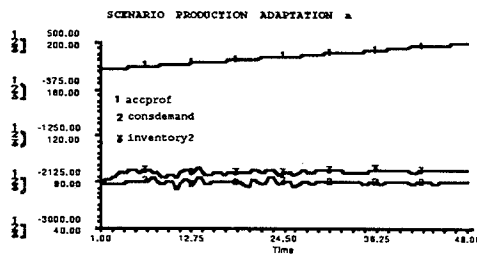


Figure 6a

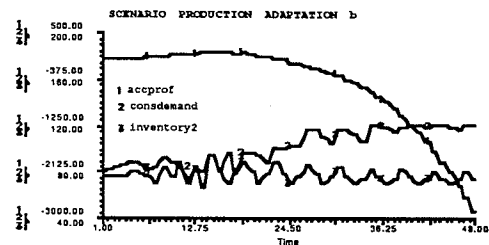


Figure 6b

Comparison of figures 8a and 8b leads to the conclusion that the monthly decisions and their implementation by lower level managers in the production and marketing department are counterproductive. Figure 6a illustrates the situation that if lower level managers in the marketing department do not succeed in bringing the level of consumer demand into line with the level of production *within* every three months period, lower level managers in the production department will bring the level of production into line with the level of consumer demand *after* every three months period. So, coordination of decision making at lower levels of management is crucial for the modelled organization to operate successfully. Following Drucker (1988), we might argue that unified vision, understood as a shared construction of reality, is a valuable asset in this respect.

## 6. Conclusions

In traditional command-and-control organizations, an increasing rate of environmental change forces top management to devote more time to strategic, tactical, and operational problems. Since data overload easily results from these increased decision making strains, the organizational viability is at risk. In order to develop and evaluate possible alternatives which might lighten the decision burden of top management, it proved necessary to distinguish between (1) data and information, and (2) the individual and the organization. As such, the approach presented in this article differs from the classical study of Galbraith (1973) in which these distinctions are not explicitly made.

We argued that in decision making processes, the major bottleneck is formed by the limited cognitive capacities of the individual decision maker (section 2). Accordingly, increasing the number of decision makers by transferring decision making powers to levels that did not possess these powers before was

<sup>7</sup>In this scenario the assumption of full utilization of the production capacity has been relaxed (cf. footnote 4).



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seen as the most appropriate alternative. In order to test whether implementation of this alternative results in faster and better adaptation of the organization to its changing environment, a simulation model was constructed, and several experiments were run. It was shown that, when confronted with a changing environment, cybernetically based organizations perform better than command-and-control organizations. Yet, a lower threshold seems to exist. Finally, application of cybernetic coordination seems to require the creation of a shared construction of reality among the lower level managers. Further empirical research must be conducted to study this phenomenon in more detail.

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APPENDIX: STELLA™ model of a simple production organization

