8 Illustrations of interactive dynamic order

8.1 Introduction

8.1.1 In this chapter we will illustrate the principles of interactive dynamic order as described in Chapters 5 through 7. The basic questions as addressed in these chapters are:

- Why and how do the existing systems break down;
- Why and how does interactive dynamic order emerge / not emerge / disappear;
- Why and how does networked learning emerge;
- Why and how should networked systems be managed and controlled.

8.1.2 Because of the kind of questions asked and the qualitative and explorative nature of our research, we chose to illustrate these questions and the principles of interactive dynamic order through a number of case studies. While we do not claim these case studies to provide full empirical validation of the concept of interactive dynamic order, we believe that they provide adequate practical illustration and will in this way enhance understanding of the concept.

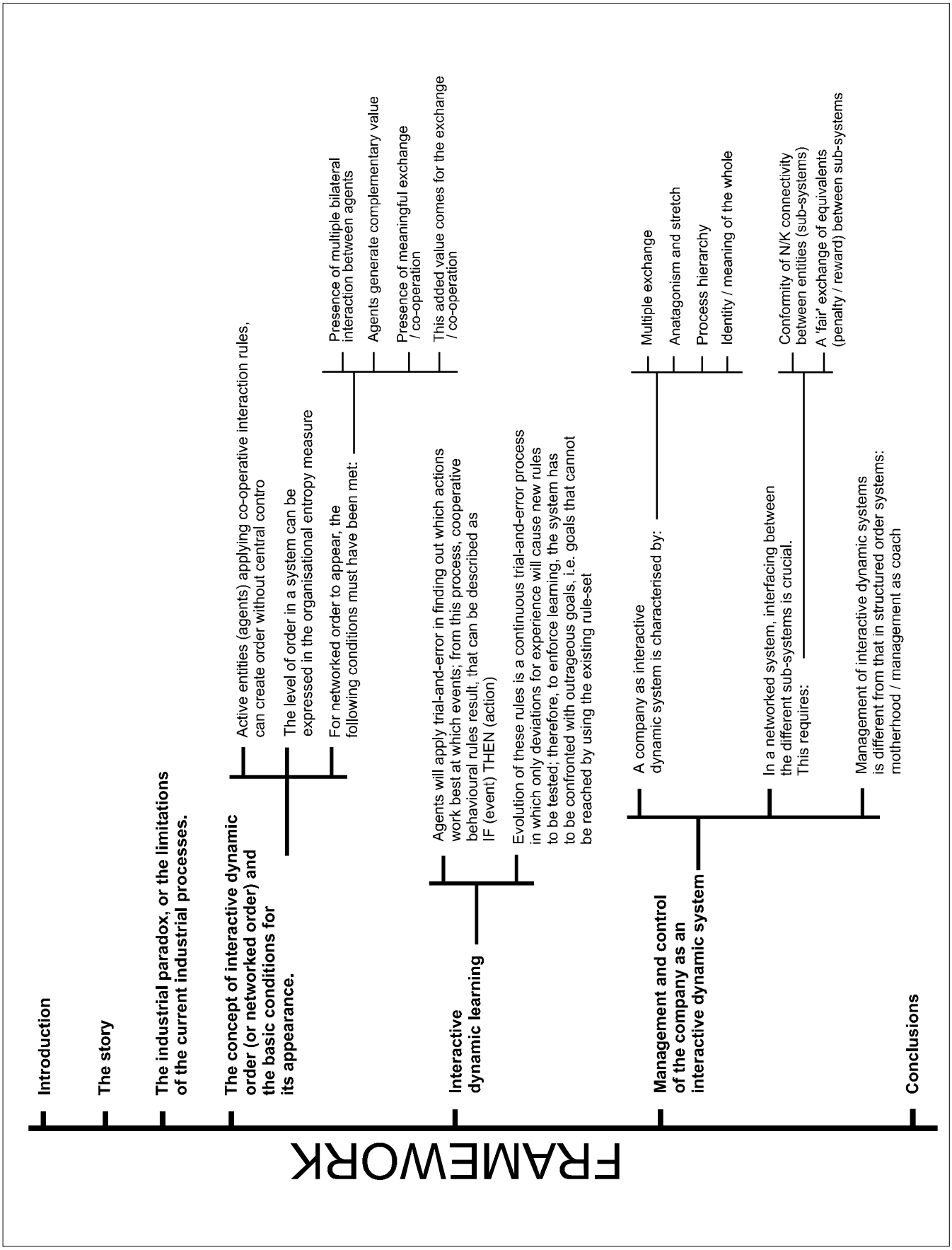
8.1.3 In the next paragraph we will present the framework on which all case illustrations are based. According to this framework, five separate cases will be treated:

- An experiment at a supermarket organisation in the Netherlands,
- A case on copier repairs at Xerox Corp.;
- A description of an innovation trajectory educational institution in the Netherlands;
- A case study on the development of Microsoft's Windows NT;
- A description of the free market economy as an interactive dynamic system.

The chapter will be finished with cross-case conclusions.

8.2 Framework

8.2.1 This framework consists of the propositions as derived from Chapters 5 through 7. Besides introduction and conclusions, every case will be described along the lines of this framework [i] as stated below.


FRAMEWORK
Introduction
The story
The industrial paradox, or the limitations of the current industrial processes.
The concept of interactive dynamic order (or networked order) and the basic conditions for its appearance.
Active entities (agents) applying co-operative interaction rules, can create order without central contro
The level of order in a system can be expressed in the organisational entropy measure
For networked order to appear, the following conditions must have been met:
Presence of multiple bilateral interaction between agents
Agents generate complementary value
Presence of meaningful exchange / co-operation
This added value comes for the exchange / co-operation
Interactive dynamic learning
Agents will apply trial-and-error in finding out which actions work best at which events; from this process, cooperative behavioural rules result, that can be described as IF (event) THEN (action)
Evolution of these rules is a continuous trial-and-error process in which only deviations for experience will cause new rules to be tested; therefore, to enforce learning, the system has to be confronted with outrageous goals, i.e. goals that cannot be reached by using the existing rule-set
Management and control of the company as an interactive dynamic system
A company as interactive dynamic system is characterised by:
Multiple exchange
Anatagonism and stretch
Process hierarchy
Identity / meaning of the whole
In a networked system, interfacing between the different sub-systems is crucial. This requires:
Conformity of N/K connectivity between entities (sub-systems)
A 'fair' exchange of equivalents (penalty / reward) between sub-systems
Management of interactive dynamic systems is different from that in structured order systems: motherhood / management as coach
Conclusions

8.3 Supermarket organisation in the Netherlands

Introduction

8.3.1 This is the report of an experiment that was conducted in one of the shops of a large supermarket organisation in the Netherlands. It contains the story as reported by the shop manager a few months after the experiment had started. The comments on the story, representing the connections between the experimental situation and the principles as presented in Chapters 5 through 7, are derived form an interview with the shop manager and the assistant manager, held about four years after the start of the experiment.

8.3.2 This experiment illustrates the organisational materialisation of networked order, under which conditions this order can emerge, how it develops and adapts to its environment, and how it can be managed.

The story

8.3.3 As part of a large strategic transformation programme the logistics processes of a supermarket company in The Netherlands were changed from a push-driven predictive system to a demand-driven pull system, while increasing the frequency of delivery from twice a week to once a day. It is conceivable that this fundamental change in supply methods would have a knock-on effect on the labour organisation in the shops, but this change did not come about all by itself. In the best tradition of the bureaucratic organisation, a task force was asked to design a new organisational structure, which would capitalise on the benefits of the so-called 'Vandaag Voor Morgen' project. After a considerable time, the group came up with something only marginally different from the previous structure and where the benefits of the change in logistics set-up fell far short of the ambitions to which the company aspired.

8.3.4 It must be said, that at that time, the new logistics system was by no means working perfectly, and that the actual situation was difficult to judge because of the system's daily failure to achieve a 100% reliability. In order to create a breakthrough, it was decided to experiment with a single shop. It was felt that, in terms of current quality and processing, the experiment required a state-of-the-art shop with a team of people who were proud enough of their position in the market to protect that position at any cost. In order to prevent disruption by the imperfect logistics system, the logistical performance of the new system would be mimicked by special precautions that in fact created a separate supply chain for this single shop for the period of the experiment. Unfounded estimates made us to expect that probably only half of the management content of the shop would be required in the future, whereas the operational labour content would only slightly reduce.

8.3.5 Rather than gradually depleting the number of staff, it was decided to take the supposed excess (management) staff out in one blow. In order to prevent a negative effect on motivation of the crew, those people were guaranteed employment in neighbouring outlets of the same supermarket where vacancies existed. Incidentally, the existence of vacancies in the neighbourhood was another criterion for the selection of this particular shop [ii]. The team was told it was an experiment, and briefed with respect to the goal.

8.3.6 The aim was to achieve the same performance as previously, but with 20% less labour cost in the shop, a reduction largely achieved by halving the management content of the particular supermarket. No instructions were given as to how to reach this goal nor were any limitations put on change to administrative and operational work processes. The explicit aims was to find ways, with this reduced labour force, to sustain the current performance as seen by the clients of the shop and reinvent the work processes accordingly.

8.3.7 The team embarked enthusiastically on this task, deducing after a week that the only way in which they could sustain the quality of performance was to work very long hours. During that period, most of the staff worked 30-40% more than their contracted time; a situation, due to family resentment, which could not be sustained. When, as a result of these external pressures, the working hours were brought back to normal, inevitably the performance of the shop deteriorated to the level, described by some of the employees, of a Russian shop.

8.3.8 Then, confronted with the outrageous combination between sustaining performance and returning to normal working hours, past work practices were pushed aside and step-by-step new ways of conducting the work materialised. They emerged by doing and experimenting and passing on successes to others, not by means of reports, formal meetings or any other management structure, but just by lateral communication within the shop. The manager describes most of his activity during that time as that of encouraging people, helping them create facilities to support new ideas and promoting the proliferation of successes from one part of the store to another. After approximately four weeks the shop was back to its normal level of performance, and was capable of achieving this with roughly normal working hours.

8.3.9 Interestingly, when the manager of the shop was debriefed after the experiment, the hypothesis was suggested that the supermarket would return back to the old situation, which existed before the experiment. The manager, without any hesitation, stated that if that were the case we would probably lose most of the staff, because they now experienced a more rewarding work situation through better relationships with colleagues and a closer contact with clients. On the contrary, he saw absolutely no necessity to return to the old practices, and in fact the crew was asking for the next challenge to be picked up.

8.3.10 Although this experiment could not be duplicated throughout the company, as there was no way to resolve the social problem caused by halving the management, it has given us a very interesting insight into the mechanisms which govern self-organisation and learning processes in the shop environment.

Limitations of current practice

8.3.11 One of the most important reasons for starting the experiment was the clear failure of the existing structured order system, to adapt shop floor work practises to a fairly radical change in supply-chain systems structure

8.3.12 Another problem that had long been recognised by the shop manager, was the enormous management intensity as imposed by the overarching system. The manager:

> *"You simply had to have a certain number of department managers and sub-department managers, regardless of whether they were needed."*

This management intensity was thought completely unnecessary, as it only induced extra cost and co-ordination problems. In the old situation, management merely kept itself busy through meetings, analysis, planning, co-ordinating, etc., in fact adding little or no value to the operational processes.

8.3.13 At the start of the experiment, August 1993, the organisation scheme was as in Figure 8-1, reflecting the functional bureaucracy, which was typical for the organisation as a whole.

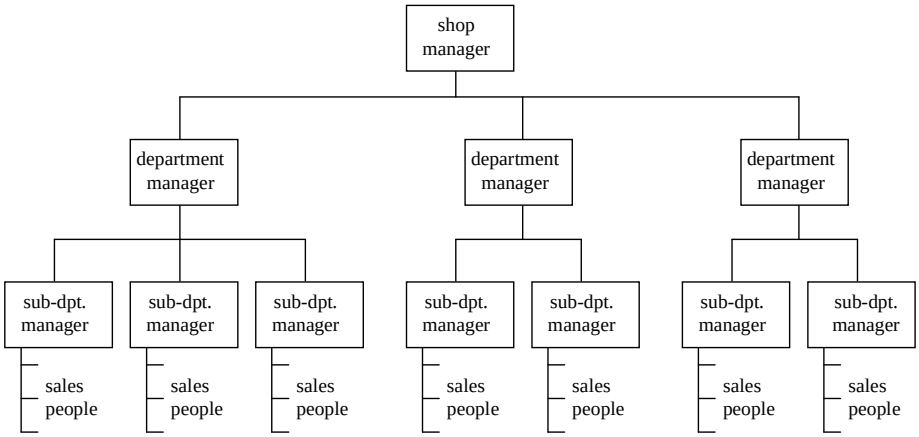


Figure 8-1: Organisation of the shop before the experiment (August 1993)

8.3.14 The entire formal communication structure had a number of disadvantages: it costed valuable time and money, was mostly ineffective as it addressed the wrong issues, and it created a power distance between management and employees, resulting in employees holding back information because they were not encouraged to speak freely. This principle of hierarchical order based on formal power instead of capabilities worked all the way down to the shop floor. The higher an employee's formal status, the further away from the customer. This resulted among others in very strong feelings of envy among the employees, making the movement and promotion/demotion of personnel to a very complicated and politically tricky process.

Interactive dynamic order

• Order without central control

8.3.15 This experiment is a beautiful example of how interactive dynamic order originates. Clearly visible in this experiment is the increased emphasis on horizontal interaction, if only by taking out half of the management intensity and thereby diminishing a lot of vertical, formalised communication.

> *"We had everything: management team meetings, department meetings, meetings with personnel, formalised individual conversations, on all of which reports had to be made, etc. We dropped it all, and started to concentrate on the shop floor. There is where it happens. Instead of all the meetings, we organised informal, voluntary after-work sessions to keep people informed. Without any obligation, most of the personnel attended."*

8.3.16 One of the first things management made clear was that it had no clear-cut answers itself to the arising situation. Therefore, the initiative should come primarily from the shop personnel. In fact, they should find out together. They would be backed by management, but management would not steer the transition process.

8.3.17 Through the whole process, interpersonal communication and management attention turned out to be of critical importance. Not through formal meetings, but continuously over the day. Not only about the successes, but also about the doubts and the problems. Management showing its own emotions and sharing experiences with people created a sense of openness and mutual trust, required to keep the process going. This informality and openness in communication resulted in employees becoming more open and more willing to give their opinion and to deploy their own initiatives. In other words, it provides a feeling of liberation and freedom that encourages people to take initiatives:

> *"Now I can finally do my work as I always though it should be done, but was never allowed to in the past."*

8.3.18 Informality also implies that it is no longer possible to draw a formal organisation scheme. Instead of the traditional line-and-box hierarchy, the organisation is now best represented as in Figure 8-2. This is the organisation structure approximately one year after the start of the experiment, September 1994. Today, the shop still works according to this concept.

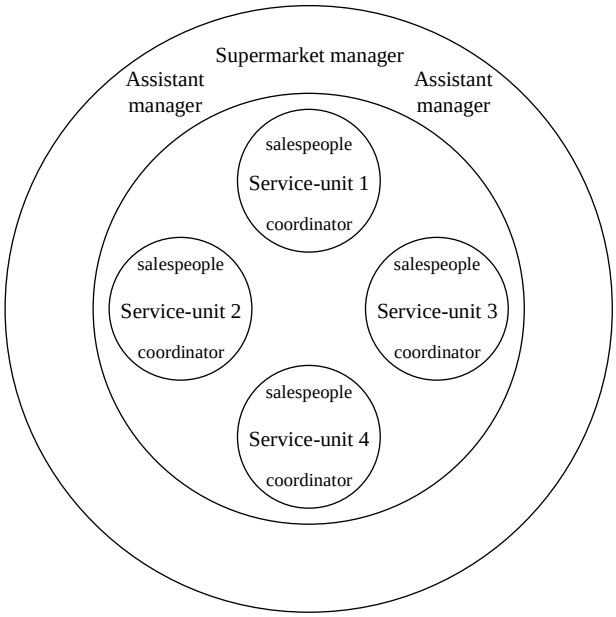


Figure 8-2: Organisation scheme of the shop one year after the beginning of the experiment (September 1994)

8.3.19 On balance, replacing formal communication in the form of unproductive meetings, with informal communications in the form of interaction between the people on the shop floor and between management and personnel, a lot of time is saved. Also, in this way proliferation of new knowledge became a much more effective process, as it is heavily based on communicating while working together, rather than on formal meetings and reports.

8.3.20 A related process can be viewed on a higher level in the interaction between the different departments as subsystems and between the departments and management. The premise is always the self co-ordination among departments. In principle, the departments address management when they encounter problems, not the other way round. When department teams have a capacity problem, they can borrow people from other departments. In the morning, often people form the pay-desk assist at shop logistics, at other times people from other departments assist at the pay-desk. This all happens on a voluntary basis. In other words: the department do not act as separate boxes solving their own problems, but rather they are loosely inter-linked just as the people within the department are inter-linked.

- **Organisational entropy**

8.3.21 The evolution of organisational entropy from the rigid, unsustainable hierarchical order through near chaos (Russian shop), and back to a more-or-less stable situation between these two extremes has been clearly discernible in this experiment. Though this sequence was to be expected, the Russian shop surely rang an alarm bell. The manager:

> *"My boss from headquarters came by and he was really terrified; the area manager, who is in the office next to mine and walks regularly through the shop kept criticising me: 'you can't do this'. I told them that this was what we chose to happen and that it was part of the development phase we were in."*

8.3.22 An interesting observation is that there is no way back from this discovery trip. It is as if it were an irreversible process. The employees, now used to the freedom, do not want to return more formal and/or less demanding structures. In fact, it appears that a number of employees that switched jobs to another supermarket later returned to this branch.

- **Conditions**

8.3.23 As for multiple bilateral interaction, this is clearly present in the new situation as indicated by the informal communication lines.

8.3.24 Also, the conditions of complementary value and meaningful exchange between agents are clearly discernible, e.g in the process of distribution of work among the employees. In the old situation, a (sub)-department manager used to co-ordinate this along the needs of the shop system. Nowadays, the teams on the shop floor co-ordinate themselves[iii] for the optimal match between the employees' needs and the shop requirements. Employees that like to be at the pay-desk are not forced into more responsible functions if they don't want (which does not mean that they are not encouraged to improve), employees that want responsibility now have the opportunity to be responsible for their own shop floor space. In other words, employees generate complementary values, and meaningful exchange or co-operation can take place.

8.3.25 These differences as mentioned above are one of the conditions to get interaction going at all. Accepting the differences between people is an important instrument in using the dynamics of the whole. The manager:

> *"Last year we tried to make people more all-round, the idea of 'everyone must be able to work in any department'. It turned out that this does not work. A lot of people just feel attached to and responsible for their specialism of department. It is fantastic to be able to reach this in a shop, so why would I try to tell these people to relocate?"*

A problem related to this is that the overarching organisation is trying to formalise this in standard work descriptions, thereby risk destroying the interactive process.

8.3.26 Recognising the importance of the differences between people also means that the process is people-dependent. With other people, be it in management or on the shop floor, an entirely different process might be necessary. It is impossible to devise a manual of how to reach this new way of working. Rather, it has to grow like a tree, keeping in mind that every tree grows in a different way and at a different pace.

8.3.27 One of the most important starting conditions mentioned by the shop manager is that the shop personnel should have the ambition to want something more than the existing situation, i.e. the exchange or co-operation should generate added value. Also, this added value must offset the energy invested, or the benefits of co-operating must be bigger than of not co-operating. In other words, there must be a goal people cannot reach individually. Repairing the image of a 'Russian shop' was such a goal. This really got them going. The manager:

> *"We called the people together, and asked them what we should do. This was the phase in which people said 'we're going to fix it now' and 'we'll never accept this'."*

8.3.28 An important test to the success of the experiment, then, is whether it leads to better performance compared to other shops confronted with roughly the same external circumstances. In the experimental shop this is clearly the case. With less investment, the experimental shop makes better profits than other shops in the same cluster by operating at a margin which is 50-100% higher, year after year[iv]. Further, unlike the 20% labour cost cut realised as an enduring effect, the experimental shop has been able to raise its turnover by 7.5% annually, which is way above average. Another indication of the effectiveness of the new order is the reduction in sick leave from 21% to 2.5% in the past few years.

8.3.29 A noticeable exception to this performance superiority is reflected in the customer satisfaction survey scale. This performance is generally not better (nor worse either) than in similar shops. Possible explanations for this are that a number of external factors (e.g. lack of parking place) seriously dissatisfy customers or that other shops are able to keep customer service at an equally high level, albeit at larger cost. The exception to this trend is the 'personnel' variable in the survey, on which the shop scores considerably better than similar shops.

Interactive dynamic learning

- ### Trial-and-error / emergent rules

8.3.30 In the three weeks after the 'blow', gradually a chaotic situation emerged, which best be described as a 'Russian' shop [v]. This situation was on the one hand very alarming to higher management and lead to the 'I told you so'-effect with other shop managers. On the other hand, it proved to be a great help in making visible the problem at full scale to the shop personnel, and a great encouragement to take action.

8.3.31 The manager:

> *"My colleagues (managers from other shops) came by and laughed at me 'is this it?'. I kept explaining them that this was just a part of the discovery process. To improve you have to search, and this searching creates chaos. By picking out the valuable things from this chaos, and by doing this together with the people on the shop floor, you gradually improve and eventually arrive at a better solution."*

8.3.32 What is visible, at least by the people most closely involved, is that when the situation gets out of hand in a department and the employees cannot solve it on their own, they will jointly decide to take action. Some of these actions turn out to be successful and will hence be retained. After a while, people in other departments see that this particular department has created a successful solution and start to try it out themselves. When it does not work as planned, they start to communicate with the first department ('why does it work with you and not with us?') and adapt the measures to their own situation. In a sense, it is a kind of voyage of discovery, in which people and departments learn from each other.

8.3.33 The discovery process for new rules or work practices proceeds at a different pace in different departments. As is to be expected from Kauffman's N/K-theory, large departments where people have little interaction are relatively slow in discovering new rules, whereas small units, where people have more interaction, are relatively fast. In practice this is clearly visible: the fresh foods department is relatively small, with a lot of full-time staff working close together. People know each other well, communicate easily and, also very important, can continually see what the others are doing. New practices easily spread, improve, and proliferate. By contrast, the groceries, covering a large shop floor area and involving a large number of part-time employees, proves very slow in the discovery and proliferation of rules. As in the past pieces of this department have become more self-standing, their self-steering capacities have risen considerably. Due to logistics problems, however, it is not possible to further split up the department while maintaining current efficiency levels [vi].

8.3.34 Besides deciding on how their particular task was to be done most effectively, employees also get the opportunity to discover for themselves what functions are fit for them. Experimentation is encouraged under the condition that customer performance does not suffer. Management acts as a coach, offering help and support to employees as they need it. Some employees turn out to have more capabilities than everyone, including themselves, thought beforehand. Employees discovering they don't have the capabilities for a certain task usually decide themselves to stop doing it. This shows a large difference with the old situation, especially in relation to the promotion/demotion process. In the new situation this is a much more natural process that avoids feelings of

shame and jealousy. This eventually leads, more than in the old situation, to 'the right person in the right place'. As this radiates off on customers, it is a win-win situation.

- **Evolution of rules**

8.3.35 What is clearly visible at the start of the rule discovery process is the idea of 'critical mass'. In the beginning, moreover, as management made clear it could not provide the answers, there was considerable anxiety as to 'what to do when everything is allowed but all certainty has gone?' In the beginning, people start trying out different things, but they only become convinced once it starts bringing results. The same effect is visible between shops in the same area. While the colleagues lacked confidence in the beginning, the success of this approach encouraged them to start changing things themselves. As for now, most of them are trying to implement some form of self-steering in their shops [vii].

8.3.36 The outrageousness of the two goals (50% reduction of management intensity while retaining market performance) is very visible and has been designed very explicitly into the experiment. Evidently the old rules, originating from the industrially organised set-up of the shops in this company, were not adequate for the situation. It took them a quite considerable effort to find out that the mental model of reality was not adequate and new rules had to be invented to actually achieve both antagonist objectives.

8.3.37 Despite the fact that recombination and coding is not so explicitly visible, in the way the situation improved in small steps by communicating bits and pieces of working recipes to colleagues, it is fairly evident part of the success of this experiment has been the ability to distil successful rules and proliferate them to other colleagues.

8.3.38 An illustration of this success is that the new way of working clearly led to a better adaptive power to external changes. In the old days, and still in many other shops, environmental changes had to be detected by management, then the best possible reaction had to be calculated, which then had to be 'sold to' or imposed on the employees. Some examples of how this now works in the new situation:

- The shop manager decided not to go along with an overall investment plan for the entire supermarket chain. Instead, he went by the teams on the shop floor, and asked them for investment ideas. The result is that, instead of a large forced investment, now five or six smaller investments have been done, directly benefiting the customer, according to the suggestions of the employees (who, we suppose, will best know what the customer wants);
- Shortly after the transformation process as described above took place, the chain wide decision was taken to extend opening times considerably. While this was still a management-imposed decision, a lot less management steering and persuasion was needed compared to other shops. The process was characterised by a balance between management and employee action;
- More recently, however, the idea to keep the shop open until 22.00 h. originated with the employees. While they are very aware of the social problems and consequences of this change, they also see the advantages for the customer and the business. Measures to resolve the tension between these problems and advantages do not have to be

imposed by management but come from the employees themselves. The shop manager:

"The result is nobody complaining, and the feeling among the people that a good performance has been delivered."

The company as an interactive dynamic system

• Characteristics

8.3.39 The characteristics of multiple exchange, antagonism and stretch and identity and meaning of the whole are clearly present in this experiment. The concept of process hierarchy was not a subject of this case study and will therefore not be treated here. The ideas of multiple exchange and interaction and of stretch (outrageousness) have been described above.

8.3.40 The effect of antagonism is present in the constant tension between sound business opportunities and the social stress this creates (e.g. staying open until 22.00h). This tension in fact induces to a large part the outrageousness of the goals. It is this constant tension that keeps knocking the system slightly out of balance, thereby creating change and keeping it alive.

8.3.41 The sense of identity is very recognisable in the loyalty of - especially full-time - employees. It proved to be one of the most important elements in keeping the transition process going. When this sense of identity is present as a basic starting condition, it will probably not be possible to start up, let alone complete such a transition process. The manager:

"If this sense of identity and pride for the organisation is not present, people will be likely to only look for signs confirming their ideas that 'it will not work'."

8.3.42 To illustrate identity, the following example is striking: one day the power supply failed in the entire neighbourhood. On the other side of the street, the employees of a competing supermarket immediately stopped working, because all equipment had come to a halt. At our supermarket store, employees immediately started to improvise, using pocket calculators and price lists, etc. In short, doing the best they could to ensure continuation of the service to the customer. This reflects the difference in company motivation and loyalty.

8.3.43 In terms of identity, the people that relied most on the old structure - among whom a number of the superfluous layer of management - were the first to leave the organisation. These people did not have the capacity nor the motivation to make any real contribution to the new organisation or, in other words, they were not a part of the organisation's identity.

• Interfacing

8.3.44 As to the conformity of N/K-connectivity between the shop system and the customer demand, it was clear that the old situation of industrial order was inadequate to meet expected customer service levels. By increasing the connectivity of the shop system, it proved possible to balance the connectivity of the customer demand and the shop system.

8.3.45 To get interaction started, an important condition is preventing the threat of negative pay-offs. In the experiment this equals taking care of the social consequences for the superfluous part of management in order prevent feelings of anxiety with the remaining personnel.

8.3.46 In terms of equivalencies, management played heavily on the pride employees would feel by maintaining performance towards clients with less management. Stimulating people's own initiative instead of imposing a solution really gave employees the impression of having achieved this goal together, thereby reinforcing the feelings of pride.

8.3.47 To maintain the attained situation of interactive dynamic order, it proves important to adjust reward structures. Existing rewards reinforce the idea of obeying orders and management instructions, whereas in the new situation it is individual initiative and customer focus you want to stimulate. Adjusting payment and reward structures proves to be very difficult however, as the organisation as a whole still strives for uniformity among all shops.

- **Management**

8.3.48 In the opinion of the shop manager this kind of order will not emerge all by itself. It is needed to set clear overall targets, not interfering with the way people do their job, but making sure that there is some sense of stretch. The manager:

> *"I tell them 'this is our end goal, you can decide for yourself how it is to be reached, but this is where we are going to'. As a principle the goals itself are not disputed. When you start doing that, you will only cause a compromise, a 'worst-of-both-worlds'. I always tell people we had those large problems in the past, and we managed solving them, so we will succeed this time. "*

On top of that, the manager's role is to selectively stimulate or slow down certain developments (i.e., in order to prevent the organisation or the departments from stranding on a local optimum). Above all, the manager's task is to facilitate the free flow of people's energy. Management facilitates the inflow of energy, in order to prevent organisational entropy from going to infinite, but management is not itself the main source of energy.

8.3.49 In other words, the role of management has been more like the 'mothering' as defined by Stacy, than the traditional hierarchical 'fathering' role. Managing connectivity makes sure the equivalence balance, for both staff and the company, was maintained and together with controlling anxiety has been a prime ingredient.

8.3.50 An important issue in managing the early stages of the transition process was how to foster people's motivation. As it is impossible to force people to be motivated, and as threatening consequences will only increase anxiety, another mechanism has to be found to create motivation. As explained before, an outrageous goal was formulated, playing heavily on the pride of the shop personnel to preserve shop performance. This emotional equivalent turned out to be a powerful motivator, whereas traditional equivalents used in past (e.g. the promotion-demotion trajectory) merely gave rise to jealousy.

8.3.51 After the initial shock of creating anxiety, through sketching an image of what happens to companies that do not take measures in time [viii], management started taking away anxiety and resistance from the personnel by open and

informal communication. In other words: anxiety (or continuous dis-equilibrium) is needed to create awareness and to start the change process.

8.3.52 Compared to the old situation, daily management behaviour now means spending much less time in the office, much less time in meetings, much less time reading and answering mail, much less time in detailed numbers-analysis. Instead much more time is spent on the shop floor, providing instant attention and coaching. In the words of the shop manager the shop floor has become the major if not the only relevant source of management information. With regard to performance tracking, the manager states:

> *"We get large amounts of data-garbage, of which I use almost nothing. I closely follow a small number of key indicators. By far the largest source of guiding information comes from the shop floor, being the only source of relevant information."*

8.3.53 In the words of the shop manager, facilitating self-steering and interactivity is a kind of game. On the one hand it is necessary to have total confidence in the employees, and hence provide no steering, on the other hand some employees clearly need management attention and encouragement, although not in an instructive manner. In other words, the manager should become a coach, rather than an instructor, but this does not play down the importance of management. This new role of management appeared gradually. Especially in the beginning management had a feeling of 'we have to keep it going, otherwise it will slide back'. Gradually, however, management became convinced that the new form of order, provided it is well coached, can sustain itself.

8.3.54 While a number of conditions have to be fulfilled to create interactive dynamic behaviour, and while it takes considerable time to build a strong self-bearing interactive dynamic order, it proves rather easy to destroy this order by re-imposing the old structures. This is viewed by the shop manager as a very real danger, as a successor, albeit with the best possible meaning, may have quite different ideas of managing a shop and may easily undo one or more of the basic conditions, thereby converting the shop back to the old command and control structure. An example is communications: the informal on-the-floor interaction proves very stimulating to the process of knowledge proliferation. Re-institutionalising communication, by holding special sessions and on separate locations, will (and does) result in top-down instruction, because people will not as easily communicate their problems.

- **Conclusions**

8.3.55 Concluding, the story of this experiment provides a good insight in a number of the principles as treated in Chapters 5 through 7. Especially the concepts of interactive dynamic order, the conditions under which it appears, the organisational entropy level, the principle of rule finding, and the issues of the interfacing and the management of interactive dynamic systems appear in an almost one-to-one ratio with our propositions. Less clear in this case study are the concepts of rule recombination and coding and the process hierarchy principle.

8.4 Copy repairs at Xerox Corp

Introduction

8.4.1 This story describes an experiment as conducted by anthropologists of Xerox's Palo Alto Research Centre (PARC), regarding interactive dynamic order and learning with Xerox copier repairmen. It is based on an oral account by John Seely Brown (director of PARC and corporate vice-president at Xerox), though it is also part of a larger body of literature on organisation learning and 'communities of practice' as published by among others Brown (1992; 1994), Brown and Duguid (1991; 1992; 1996), and Orr (1990). In Chapter 12, an example is given on organisational work, learning and innovation at Xerox, elaborating on the subject of 'communities of practice'.

The story

8.4.2 Having joined Xerox in San Diego, an anthropologist, as part of his training period, was seconded to the service & repair department. In discussions with the local service manager, he was confronted with the problem of Xerox equipment showing intermittent failures; the sort of failures which show up if the repairman is not present, but that disappear miraculously as soon as he arrives. This is very cumbersome as the faults are hard to diagnose, and consequently difficult to repair. In an urge to be helpful in finding a solution, the anthropologist introduced into the central service manual a procedure for attacking this kind of problem in a copy machine. He stated that, by making 3,000 copies, statistically the chance of them being faulty is almost 100 %. Therefore, by running 3,000 copies and sorting them out, the repairman would most probably find the problem.

8.4.3 On hearing this, the service manager explained how they were already dealing with it in San Diego. He mentioned the fact that almost certainly there would be a waste paper basket beside each copier. By simply emptying the waste paper basket on a table and examining the contents, there was as near as 100% chance that the faulty copies would be in there. In other words, users have already made thousands of copies and pre-selected the mistakes. The anthropologist was fascinated by the fact that servicemen in the field were capable of identifying such simple but effective procedures. From discussion with the service manager he became aware of the fact that the problem was not in finding solutions but in making them available to, and compatible with the particular circumstances of a distributed service crew. Conveying all of this information to servicemen, either in the form of lessons or by writing handbooks, would cause huge costs, and at the time of the repair it would probably not be easy for them to find the relevant information.

8.4.4 They both decided to run an experiment, and provided each serviceman with a portable two-way radio, which enabled them to communicate freely one to another. Although most of the time the apparatus was used for socialising and gossip etc., occasionally, someone would encounter a copy machine that displayed problems he had never encountered before, and ask for help over the radio system. Mostly someone amongst the servicemen would either have the solution, or at least have an amount of information that could help find the solution. Not only were repairs carried out more effectively, but such information was memorised much more effectively, within the service group, than through any other form of programmed learning.

8.4.5 It is interesting to note that, when duplicating the system in another service location, the attempt failed with no immediately obvious reason as to why it worked in San Diego and it did not work in the new location. However, after some time, it appeared that the local manager had a habit of passing on social information that had been communicated through the radio system in conversations by the servicemen. The servicemen felt they were being overheard so they discontinued socialising on the radios, and finally stopped listening at all. This resulted in them no longer being able to respond to requests by colleagues for information on repair problems.

Limitations of current practice

8.4.6 Limitations of current practice become clearly visible in both examples. In the first example, while the manual provides the solution to the problem, it only does so after a very long searching time (as consulting the manuals is a very cumbersome process). Moreover, the solution it provides is typically the technical/statistical solution, which proves to be unworkable in practice (who would run 3000 copies just to discover what is wrong).

Interactive dynamic order

- ### Order without central control

8.4.7 This case links in with the aforementioned principles of interactive dynamic order. Firstly, by introducing radio communication, horizontal interaction was created, where previously only vertical connections existed in such a decentralised organisation. Secondly, the reason why duplication of the experiment failed in another location indicates decisively that the company's goal in using this system was quite different from that of the servicemen. Whereas the company was looking for a more effective service process, the servicemen predominantly saw the value of the communications system as a means of maintaining social contact with colleagues in remote locations, and as such made them listen more attentively for possible problems and respond accordingly.

- ### Organisational entropy

8.4.8 In the example, interactivity between the repairmen rose sharply, causing organisational entropy to rise. For an outsider to listen the repairmen talk on the radios would be complete disorder. Strictly taken, one could say that organisational entropy should not be so high, as only a small part of the time was used for discussing problems. However, in this example it proves that this level of organisational entropy is needed for the system to be effective, as it is not possible to undo the system of the social talk.

- ### Conditions

8.4.9 In the example, most conditions for interactive dynamic order are present. There is multiple bilateral interaction between the repairmen over the radios. They also generate complementary values, as each of them has his own specific knowledge of or story at what goes wrong in a particular situation. In case of a problem with a repair, the repairman can contact his colleagues, who can present him with alternative solutions or information on where to find the

solution. I.e., the exchange is meaningful and provides added value. As each of the repairmen encounters unusual problems sometimes, the interaction is mutually beneficial, the added value offsetting the invested energy. Besides, the social function of the radio network helps to enlarge the pay-off.

8.4.10 Particularly in this example the exchange of value between the sub-systems (employees, clients and shareholders) becomes visible. Whereas the prime equivalency for the employees was the social contact, the utility for the shareholders was a higher service-productivity, and for the client a faster repair.

Interactive dynamic learning

- **Trial-and-error / emergent rules**

8.4.11 By nature rules in repair situations have an IF/THEN character and can be easily coded in those terms and transmitted. Mostly these rules are proliferated in the form of stories:

"When I was at location x and we had problem y under conditions a, b, and c, we did z".

The idea of trial-and-error also plays an important role as repairmen encounter defects they had not seen before. Strictly taken, almost all of the 'recipes' for solving these problems would be in the service manual or in some technical manual at the head office. As these are not readily accessible, however, repairmen favour the trial-and-error approach in combination with the interaction with their colleagues.

- **Evolution of rules**

8.4.12 As the stories on particular situations get told and re-told, as knowledge on the specific problem gets added through new stories and experiences, gradually a base of 'shared knowledge' grows, equivalent with a complex set of IF (...) THEN (...) rules, connecting more and more possible events to more and more meaningful actions to resolve these problems.

8.4.13 Also the critical-mass- and trust-arguments as well as Axelrod's prisoner's dilemmas show up. While the management left the communication untouched the benefits in social communication terms for the servicemen secured sufficient critical mass. However, as soon as the second manager interfered, the negative impact e.g. punishment element reduced the critical mass to virtually zero and switched off the communications.

8.4.14 With respect to the exploration/exploitation dilemma it is clear that whereas originally the exploitation angle dominated exploration, and in fact the discovery of new rules did not have a basis for proliferation throughout the service organisation, they evidently only emerged if situations were met which, for the particular serviceman, were outside the area of his current knowledge and capabilities. So, in fact, discrepancy between his incomplete picture of the world and the real phenomena drove the request for help. The company as an interactive dynamic system

- **Characteristics**

8.4.15 In this example the characteristics of multiple exchange and antagonism and stretch are clearly present. Multiple exchange is present in the exchange of knowledge and stories between the repairmen. Antagonism can be spotted between the goals of the company, wanting to increase the effectiveness of its repair force and the repairmen themselves, appreciating the radio system primarily for its social function. As long as these goals are not mutually exclusive, both can be served simultaneously. The characteristics of process hierarchy and identity are not subject of this example.

- **Interfacing**

8.4.16 In the old situation, the company is typically trying to encounter a very complex demand topology (displaying an enormous variety of possible defects) with the too limited solution topology of the standard manuals. In the new situation, the solution topology is much larger because of the higher connectivity, and what's more, the solution topology automatically adapts to the demand topology as the repairmen gain experience and encounter new problems.

8.4.17 In terms of pay-off matrices and equivalents, it becomes clear that the system stops working when the element of trust is violated, since the service manager on the new location destroys the equivalencies by unjustly interfering in the privacy of his employees' conversations

- **Management**

8.4.18 At the first location, management did not interfere with the network, other than providing the repairmen with the means to communicate (i.e. the radios). The example of the second location shows that it is not possible to 'control' the network in a conventional way, as this would require e.g. using the communication system for management instructions and/or for recording the messages exchanged and redistributing the knowledge.

Conclusions

8.4.19 Concluding this example, we can say that a number of our propositions have been confirmed. Particularly the conditions under which interactive dynamic order appears or disappears and the notions of emergence, recombination and proliferation of rules are supported by this case. Less evident are the notions of organisational entropy and of the management of interactive dynamic systems, apart from the disturbance of the equivalence system. Also, the issue of hierarchy of processes is not involved in this example.

8.5 Educational institution in the Netherlands

Introduction

8.5.1 This story is based on a report of an organisational transition process at one of the faculties of an educational institution in the Netherlands (Andriesse, 1997).

The story

8.5.2 The beginning of the 1990s had been a turbulent time for the educational institution, as it arose out of two merger processes that took shape around this time. While any of the formerly independent faculties had previously implemented educational improvement programs, joint performance was not satisfactory. The largest problems seemed to lie in missing connections between pieces of the different educational programs, students' difficulties in actually doing these programmes and rather passive student behaviour.

8.5.3 These problems, combined with societal developments inducing changes in student behaviour, professional practice and educational institutions, created a growing feeling among an increasing number of people that educational processes needed change. After the merged faculties had been working together for about a year, the bomb burst: in a stormy meeting a large number of organisational problems were identified. At that time, no one had a clue of how to solve these problems.

8.5.4 Management felt the educational system had to be shaped in accordance with these societal developments, and that the existing quality problems had to be tackled simultaneously. The price-performance ratio of the 'product' education had to considerably improved upon. What was needed was a fundamental restructuring of the way education is normally shaped: from transmitting factual knowledge in a standard fashion to a situation in which the student increasingly steers his own educational process. In other words, students should not only learn, but primarily 'learn to learn', learn how to acquire knowledge and skills and adequately keep up to date.

8.5.5 Management decided on doing a pilot project in one of the faculties and offered the means to implement and support the project. To guide the process, educational and organisational frameworks were drawn up, providing employees with the general principles (or goals) according to which the processes were to be shaped.

8.5.6 Implementing the project would be a combination of top-down steering and bottom-up implementation. This means that while management determined overall goals and framework, the employees themselves had to shape the processes and had to find ways of resolving problems through cooperation. Starting this process was facilitated by organising a 'search conference', at which employees, management, students and external experts were present. The conference was meant to find ways of realising the ambitions that had been set for the new situation.

8.5.7 During the preparation phase, a number of conferences were being held, meant to extricate employees' thinking power in finding possible solutions and to

create a broad platform of support for the actual implementation. In this way, the educational practitioners were actively involved in the project's design.

8.5.8 While the preparation had been extensive, the actual implementation of the new plans still caused a shock: *"We knew the water would be cold, but we didn't expect is to be that cold..."*. In fact, implementing the project meant that all existing routines had been dropped for the first year of study. This caused considerable strain among the employees as their activities and priorities had dramatically shifted (i.e. from a teacher transmitting facts to a coach facilitating students own learning processes), and among students as they didn't know how to act and what to expect from their teachers

8.5.9 It proved necessary to solve all kinds of larger and smaller ad hoc problems. To preserve focus on the eventual goals, a lot of communication and interaction between management and employees proved necessary. This helped facilitating the gradual emergence of new ways of working and studying.

8.5.10 As the year proceeded it turned out that students gradually grew into the new way of studying through 'learning to learn' projects. Among the employees also new ways of working gradually appear, although they have to cope with the additional problem of maintaining education for the students not yet involved in the new programmes. Moreover, during the practical implementation, a lot of imperfections surfaced that are gradually being resolved. On the other hand, the teamwork, enabling employees to interact in a more meaningful way with their colleagues and with the students, proves to be a very motivating factor to most employees.

8.5.11 The project will be fully implemented only when the last students form the old programmes will have left the institution. However, the most important results of the new way of working are already discernible: managers and employees now thinking in terms of educational processes, being more supportive of individual student needs more inclined in resolving emerging problems together.

Limitations of current practice

8.5.12 The most important limitations of current practice are connection problems between the different educational programs supplied and between the educational programs and professional working practices with which future student will be confronted. While these are very real problems, the case study does not really provide insight in the 'industrial order' character of the old situation other than that it was based on conventional transfer of knowledge.

Interactive dynamic order

• Order without central control

8.5.13 A lot of things in the transition process cannot be predicted or designed in advance. This means that the process is heavily dependent on the improvisation talents of the individual employees and their ability to solve problems through mutual interaction. It was stimulated that employees develop their own problem-solving abilities, and no longer depend on instructions by management.

8.5.14 This meant that increasingly the actual implementation had to take place within the development teams. This notion of employees working together in teams was also to become the basis for the newly emerging organisation. This notion of working in teams, which was clearly something employees were not used to, combined with the outrageousness of the goals to be reached, stressed the importance of interactivity and mutual support.

8.5.15 In order to achieve this, communication became of crucial importance, both between management and employees and among employees themselves.

8.5.16 Summarising, the process contains a number of self-steering, interactive dynamic characteristics. Project planning, however, was quite tight, relying on a predictable, planned trajectory rather than on solutions gradually emerging out of improvisation.

- **Organisational entropy**

8.5.17 Also in this case study, the development of organisational entropy is very visible. Starting at a reasonably high level due to the implementation of the merger processes, organisational entropy reaches a first peak as the 'learning to learn' project is announced. Gradually, as the preparation evolves, the image of the 'situation to be' emerges, equivalent to a decrease in organisational entropy, creating confidence among the participants. Project implementation then causes a second peak in organisational entropy, as reality is more prosaic than plans. From this state of chaos, gradually a new order appears.

- **Conditions**

8.5.18 Firstly, through working in project teams and stimulating communication, multiple exchange and interaction was ensured. Secondly, the professionals manning an educational institution are complementary by the nature of their speculums. Aside from this complementarity, which is very useful on the operational level of educational process design, complementarity on other field is tapped through the 'search conferences'. Thirdly, the case report describes as one of the most important conditions *that "everyone should have the idea that it is only possible to reach the desired goals by actively co-operating".* Fourthly, people should be willing to invest in this co-operation; i.e. they should be enthusiastic and be willing to give up the certainty of the old situation. This only works if improvements, not just for the institute or the student, but also for the staff involved, arise from the project, which in the end proves to be the case.

Interactive dynamic learning

- **Trial-and-error / emergent rules**

8.5.19 While the case study report goes deeply into the preparation, design and implementation of the project, it says relatively little about how these processes operationally took shape. It is therefore that the notions of rule emergence and evolution are hardly touched.

- **Evolution of rules**

8.5.20 The mechanisms of rule coding and proliferation are not part of this case. What is supported, is the outrageousness of the goals, the ways management selectively stimulates or restrains certain developments and the idea of double-loop learning.

8.5.21 In the first phases of the project people's most import problems involve 'why us?'. Gradually, this shifts to the question 'how the hell can we make this work?', indicating the outrageous goal. As there were clearly enormous problems to solve, as the old educational programs proved more and more inadequate, everyone had a common interest in turning the change into a success. People clearly had something to fight for.

8.5.22 To create sufficient critical mass for new initiatives to become accepted a critical role of management laid in supporting the organisation's pioneers. Another way of ensuring critical mass for new ideas was to present actual positive experiences to employees to show them that it really worked.

8.5.23 The bottom-up implementation of the frames as set by management involved double-loop learning expected from employees. Once employees started to solve problems on their own they would find out that the frameworks and project plans as set by management were in some cases inadequate, In these cases, it was encouraged to suggest changes.

The company as an interactive dynamic system

- **Characteristics**

8.5.24 In this case study, most of the characteristics of interactive dynamic order seem to be present. Multiple exchange primarily between employees (teachers) in finding solutions, but also in the implementation phase between teachers and students. Antagonism can be viewed in the knowledge transmitting practices of educational institutions versus requirements of student's future working practice. Related to this, the stretch goal is really to try and find ways of providing education that fits future work practices while ensuring educational quality levels.

8.5.25 Further, the hierarchy of processes principle is clearly present. This hierarchy was necessary to guard the integration of the project on different levels. At the basis, teams of employees (teachers) performed the operational work. On a higher level, a subproject group ensured that the results of these operational projects fitted within the educational program. On the level above this a project group concentrated on the connectivity between the different educational programs. Finally, the highest level, consisting of a steering group ensured that overall project goals were reached in accordance with the overall vision of the institution.

8.5.26 The principle of identity / meaning of the whole is not treated as such in the case study description. It is neither confirmed nor contradicted.

- **Interfacing**

8.5.27 Clearly visible in this case study is the notion of gradually increasing N/k-connectivity in order to prevent chaos. In the beginning, the process was guarded against an overkill of communication and information. Rather, communication intensity was gradually increased. Much the same was true for management steering. At the start of the process top-down steering was thought necessary to get the process started. In the later stages, management steering gradually decreased, leaving more room for employee initiative. In this way, N/K-connectivity was gradually increased to better adapt to the demands of the environment.

8.5.28 While equivalencies are not explicitly treated in this case study, there are a number of indications that most important equivalencies for the employees lay in improvement in the relations with colleagues and students, and the room for self-expression and personal development. Their feelings of pride of providing good education also play an important role. The most important equivalencies for students are described in terms of ease of studying the program (which is quite different from easy courses or exams) and the presence of basic student facilities. For management and the institution as a whole, the judgements of the visitation committee and the number of students the most important equivalencies.

- **Management**

8.5.29 The task of management was primarily to support and stimulate employees in shaping the key processes. Another important role was that of 'champion' behaviour by managers that were highly respected by the employees for their leadership, their enthusiasm and their efforts.

8.5.30 The most important means of management control was steering on the process goals and the frameworks. Management would control the process by guarding process end goals and in-between milestone results, The frameworks and project plans only provided the general principles, offering employees lots of free space for implementation. The outer borders of project plans and frameworks were imperative, however. Management was only willing to make changes, when employees provided valid arguments on why the frameworks was inadequate and when they made suggestions for improvement. Moreover, the decision on whether or not to change the framework or the project plan would always lay with management.

Conclusions

8.5.31 Concluding, this case study illustrates a number of principles of interactive dynamic order, though not all to the same extent. From the case study description, the principles of interactive dynamic learning and identity / meaning of the whole do not become quite clear. Besides, in this example central control and planning is much stronger than in the other case studies presented in this chapter. In other words, the principles of interactive dynamic order have not been applied as rigorously as in e.g. the supermarket case of the Xerox case. The case study, however, amply illustrates the principles of organisational entropy, conditions of networked order, antagonism and stretch, and hierarchy of processes.

8.6 The development of Microsoft's Windows NT

Introduction

8.6.1 This story is based on the well-documented ways Microsoft Corp. develops software. It is based on Zachary's (1994) book 'Showstopper: the breakneck race to create Windows NT and the next generation at Microsoft' and on articles about the software development at Microsoft by Cusumano and Selby (1996; 1997).

• The story

8.6.2 Microsoft started the development of the Windows NT operating system after it had been working, together with IBM, on the development of OS/2 for a long time. In fact, in the same way as the original MS Dos had been, OS/2 was intended to be a combined Microsoft/IBM project. At the time, however, Bill Gates came to the conclusion that IBM rather than co-operating with, was more interested in getting rid of Microsoft. Thus, Microsoft decided to develop its own operating system under the name Windows NT, which would be a head-on competitor with OS/2. Because of the late start, IBM well under way in the development of OS/2, the programme had to be put under extreme pressure while yielding a product directly competitive in quality and performance with the IBM OS/2 product.

8.6.3 In order to achieve this objective, the Microsoft project leader took a very brave step. Whereas the original framework of Windows NT was developed using the OS/2 pre-release as an operating platform, after the first rough version of Windows NT was ready, he replaced OS/2 in all the development systems. The engineers found that they now had to develop Windows NT while using Windows NT itself as an operating system. This principle became known as 'eating your own dog-food'. The basic idea behind it was that, in order to create speed, the balance of effort in software development had to shift from co-ordination and planning to its writing code.

8.6.4 By putting in Windows NT as a development platform, the team would be instantly been confronted with the shortcomings of that same product. There would be immense pressure to repair crucial faults and thereby prevent software being coded which would destroy the function of other parts of the very complicated programme. This, in fact, is what happened. The development programme caused enormous stress within the team, particularly to people who either failed to deliver or caused problems in the development that forced other people to stop working. An example, given in the book, is of someone who, by a coding mistake, stopped the whole printing on the network, and was literally surrounded by a large number of programmers pressing him to resolve the problem 'pretty damn quick!'.

8.6.5 A few months before the release of the programme at a popular trade show, the project manager issued to the team a list of 'must be fixed bugs'. The most prominent of these bugs, that should get most of the effort, he classified as 'showstoppers'. A showstopper bug was serious enough to stop the show performed by the operating system, and thus was grounds for holding back the release, which might cause serious embarrassment to Microsoft.

8.6.6 Not only did Microsoft succeed in bringing the product to the market in a time which was very much shorter than the OS/2 development time of IBM product, but it was also considerably cheaper, in terms of investment, than the development of OS/2.

8.6.7 As Zachary comments:

> *"The saga of NT is a compelling instance of how one organisations balances order and chaos, rules and serendipity, innovation and tradition. This task is messy, irrational and often painful. Born of conflict, innovation is dangerous because it hastens change, which is the main source of an organisation's instability in the fist place. The making of NT is at once a primer on software, a portrait of a community of programmers and a gritty melodrama about the perilous task of managing complexity in an age of information."*

Limitations of current practice

8.6.8 The Microsoft way of product development is an example of a modern way of organising product development in multiple parallel processes. Microsoft had clear advantage when it began developing NT: a monopoly position in operating systems, vast wealth, and proven expertise. Yet other organisations in possession of such assets have failed time and again at big challenges. In periods of rapid change, power wealth and expertise often bind big organisations to the past.

8.6.9 The most important characteristics and disadvantages of more traditional, sequential product development projects are the following:

- Complete 'frozen' specification and detailed design before building the product, which complicates flexible adaptation to market changes;
- One late and large integration and system test phase at the project's end, delaying all possible problems and hence a large workload to the end;
- Aiming for feature and product perfection in each project phase, often leading to phase sub-optimisation;
- Feedback only after development as input for future projects, which means that customer feedback will not benefit the project itself;
- Working as a large group of individuals in separate functional departments, leading to functional sub-optimisation and 'not invented here syndromes';
- Excessive management and co-ordination energy compared with the direct labour involved in getting the task completed.

8.6.10 As computer programmes become more complex and become more essential to the functioning of society, writing good code for these programs is increasingly the work of large teams. Yet such teams often sink into mediocracy because their size alone can breed bureaucracy and sterility. To protect themselves against incorrect decisions, they form committees to weigh important matters. These committees spawn subcommittees, and before long a straightforward proposal is subject to a lengthy review by people who aren't actually doing the work.

Interactive dynamic order

- **Order without central control**

8.6.11 Microsoft culture is often referred to as a 'hackers culture', centring around fervently anti-bureaucratic PC programmers, who do not like a lot of rules, structure, or planning. This requires an alternative way of organising. While management is surely present, it does not attempt, however, to determine everything programmers do in advance. This leaves (groups of) programmers' room for innovation or adaptation to unforeseen developments.

8.6.12 The way in which individual programmers and teams of programmer's structure their mutual co-ordination is largely up to themselves. They have to find a balance between the flexibility to change their specific parts of the product and the reliability of the connections between the different parts. In other words, finding a balance between synchronising development and form time to time stabilising the product-to-date in a new release.

8.6.13 Microsoft's approach to product development allows these many small teams to work together as a large team, while still retaining considerable freedom to work in parallel. In order to achieve this, frequent co-ordination and communication are of crucial importance. To facilitate communication and co-ordination, the teams work at a single site, and use the same programming tools, so that people understand each other and can resolve problems in a face-to-face manner.

8.6.14 Besides interaction between programmers and teams of programmers, there is also interaction between the product development team as a whole and the customers. During development, the product is continually tested by customers and refined accordingly. As hardware improvements and customer desires are constantly and quickly evolving [ix], it becomes impossible to determine product design on beforehand. Instead, the product evolves, continually iterating between the parallel activities of designing, code writing, building and testing.

8.6.15 Besides the importance of communication throughout the entire development team, the most striking feature of the Windows NT case is the continuous feedback of the developing product's performance to everyone involved in the development. Rather than thinking through the consequences of a particular change in the product for all other areas of the software, success or failure became immediately clear and gradually, in continuous interaction between the different streams of programmers, the project was not engineered but literally grew from its original basic version.

8.6.16 In practice, it went as follows: every week a new 'build' became available, i.e. the new version of the programme, consisting of the latest versions of all various pieces sewn together. Each build was a snapshot of NT at a given moment in time. On completion, the build was distributed to testers and programmers, who quickly decided whether the latest build was an improvement over the last one. It was strongly recommended that programmers use the most recent build, even if it did not appear to be decidedly better on first glance. The philosophy being that the only way to really evaluate code was to run it's latest version, because only in this way it would be possible to gradually improve the build.

8.6.17 This principle of 'eating your own dog food', being a cornerstone of the project manager's philosophy, greatly helped in creating awareness of the programme's quality with the team members. By running the new code on the programme as built so far, there would be no escape from its flaws and imperfections. Moreover, only by eating dog food could programmers find the bugs that stemmed strictly from the interplay of the pieces of system software. If at first NT tasted no better than dog food, all the better. Code writers would feel an urgent need to raise the dietary level by quickly fixing the errant code and writing more durable code in the first place.

8.6.18 As more programmers ate dog food, they were astonished by NT's crudeness.

> *"I was totally flabbergasted by the difficulty of getting things done with NT",* said one*. "It seemed that every time you typed a command NT didn't work and you had to go off and find out why."*

8.6.19 This meant questioning team-mates, thus sharply rising the number of daily interruptions and making it hard to write any new code. While almost no one liked the interruptions, the project manager considered them unavoidable.

- **Organisational entropy**

8.6.20 The evolution of the organisational entropy level is clearly present in this case study. At the outset, the project was fraught with difficulties, the organisational entropy growing with every new addition to be made to the programme and every group of programmers to be added to the development team. After the shock of 'eating dog food' the programme fell to a state of complete chaos, as all the pieces of software that had seemed to be quite orderly on themselves now had to interact and function as a true operating system. As the structure of the product (i.e. the programme) is mirrored in the structure of the development project, the organisational entropy level of the development team mirrors that of the programme. Out of this state of disorder gradually a new emergent order developed.

- **Conditions**

8.6.21 This case study provides ample insight in agents generating complementary values and the meaning of exchange. The issues of added value as coming from exchange are not dominantly present in the description of this case.

8.6.22 It was discovered in the 1980's that relying on the multi-functionality of programmers was not the right strategy. Instead, as programmes became ever more complex, it turned out to be necessary to stimulate (groups of) programmers to specialise in distinct skills. The tension between co-operation and specialisation was resolved by creating overlaps at the boundaries of these skills, thereby making it possible for programmers to co-operate in small multifunctional teams, while maintaining their specialism.

8.6.23 The NT team included many different people, bringing their own beliefs and opinions. Without violating the mores of the team, the broke old rules and made new ones in response to shifting circumstances. They felt free to criticise their managers or seek advice form people who had no formal responsibility for their work. They rarely asked permission before taking important initiatives that they believed would improve NT.

8.6.24 The project manager saw the benefit of allowing personal differences over technology to play themselves out. He rarely stifled conflicts, under the slogan that 'conflict introduces life in the laboratory, when there's no conflict, no lab is good'.

8.6.25 As the development trajectory proceeded, conflicts between programmers and between programmers and testers abounded. Coming out as conflicts over small bug in pieces of code, they were the reflection of conflicts over ideals and programming style looming beneath the surface. However, these conflicts while in itself unproductive were also the lifeblood of innovation.

> *"Because code writers rely on logic and mathematics in their designs, they often downplay the role of personality in their technical decisions. But this sense of logical inevitability is an illusion, as there are invariably many ways to achieve roughly the same technical ends. Technical choices are often highly personal."*

8.6.26 Implicitly, the connectivity in the team was an emergent property of the software product as people were doing things in programming code which would bring them into contact or conflict with selective other people in the project, without any required management co-ordination. Links would establish themselves and people would find each other in cases where problems arose.

8.6.27 In fact, the Microsoft philosophy is that individualism is only of value in interaction with others. Teamwork was an important factor in the project's eventual success. Not teamwork that precludes individual expression, for in the creative process the uniqueness of each individual is badly needed. In technical communities, however, the team gives an individual's work its bedrock value as the complexity of the system is such that a single piece holds little meaning outside the whole.

Interactive dynamic learning

• Trial-and-error / emergent rules

8.6.28 The issues of trial-and-error and emergence of rules are not deeply discussed in this case study. A few clues are given, however, to learning adherence to rules.

8.6.29 At Microsoft, programmers mostly learn by doing, i.e. by discovering how to handle a problem or by learning from more experienced programmers. There are no formal training programmes or rules and regulations, as these become too easily outdated in the fast-changing software industry.

8.6.30 For teams and individual programmers to be able to work in parallel, they have to adhere to a few interaction rules. Examples are: programmers have to synchronise designs and resolve (programme code) conflicts with other programmers on a frequent basis; when programmers deliver their pieces of code they have to do so at a particular time in order to make it possible to create a 'build' (i.e. the putting together of the pieces of code); if a programmer delivers code that breaks the build, he must fix the defect immediately. Or, as the example in Zachary's book goes:

"When completed, the build had to be 'propagated' across the team. Once in use, the build might die unexpectedly due to faulty code. When the person whose code broke the build was identified, there was hell to pay."

- **Evolution of rules**

8.6.31 Clearly discernible in the case study description are the outrageous goals that were set to get rule discovery started and the ways in which knowledge is propagated through the population.

8.6.32 Clearly the goal was outrageous at the beginning, given best practice in software development, it was inconceivable that such a complex product at a desired quality level could be developed in the time span which was thought to be necessary. This became more clear as the project went further ahead, gaining even more complexity, e.g. compatibility demands for DOS, OS/2 and Unix programmes, the building of a complete graphics interface around the programme core, and the continual addition of new features as desired by the customers. The project manager, wishing to limit commitments in order to speed up the completion of the programme, felt that his superiors and the programme managers [x] 'always wanted more than we could deliver'.

8.6.33 The development team was understaffed by ordinary measures, even counting the dozens of contractors hired by the team for handling specific jobs. Everyone had more work to do than was possible in a forty-hour week. At Microsoft, resources were deliberately limited, the policy being 'if it takes two people to do a job, hire one'. This approach forced team managers, finding themselves short-handed and busy, to let their people find out solutions by themselves. This prevents too much management control and stimulates new initiatives by individual employees. It also helped bottom-line results, by greatly increasing efficiency in this extremely labour-intensive business.

8.6.34 The outrageousness became even clearer as all the bugs, primarily the 'showstoppers' had to be fixed for an intermediate release. Every time the team thought the programme was ready for shipment, another showstopper appeared. Fearing the release would be late, the project manager used the metaphor of 'extrusion', or how molten steel can be shaped into a finished piece of metal by pushing it through a small hole with enormous pressure.

8.6.35 As to proliferation of knowledge, teams retain and spread technical wisdom in much the same way that preliterate people preserve the folklore of a tribe. In both cases, the wisdom is kept in people's heads. It is therefore, that NT project management created some sort of 'tribalism' in shaping the interaction between people. Technical advance is no so rapid that printed matter is outdated in a stunningly short time. Field of knowledge are so specialised and change so fast today that no manuals or text books can reliably describe central practices. Code writers thus must depend heavily on team-mates for know-how and measures of progress.

8.6.36 In rule evolution, the role of project management was to selectively amplify or restrain the developments started by the programmers. A stimulating sign for a programmer was when project management decided to accept as 'dog food' the build containing this programmer's new piece of code. An example of restrain is given with reference to a discussion among programmers on the grammatical use of the words 'who' and 'whom'. As this discussion was clearly unproductive

in the final stage of the project, it was immediately put to a stop by the project manager.

The company as an interactive dynamic system

• Characteristics

8.6.37 As to the characteristics of interactive dynamic order, the issue of multiple exchange was extensively described above. The 'antagonism and stretch' argument, is extensively described by Zachary. In his book, the concept of process hierarchy is not recognised as such, but still latently present. The identity/meaning argument is not a subject of this case study.

8.6.38 The stretch situation and the personal goal - business goal antagonism are very poignantly described in Zachary's book, as it also provides descriptions of employees' private situations. At times during the project, the pressure got extremely high, forcing people to make long work hours, causing intense social strain. Due to this, the drive for the preliminary release for applications writers became known as 'death march'. The reason for the pressure was that the date for the conference on which the release was to be presented, and at which the world's most important software developing companies had been invited, had been set. Delay or cancellation was simply impossible.

8.6.39 The same principle went for the final release deadline, as Bill Gates had publicly announced the release date. At the same time, the preliminary release showed that the programme was still far from reaching its initial goals: it guzzled computer memory, was too slow and still contained lots of bugs. The strain was raised even further when an influential computer journal set off serious doubts about programme performance and the making of the project deadline. With bugs keeping to appear, blurring into one another, team motivation was slipping fast. It was clear that the programme needed a final 'performance push', to prevent the risk of it never getting finished.

8.6.40 Project management issued an urgent plea:

"We're almost there, we can't give up now."

In this phase, motivation was badly needed as people's temptation to quit was growing. The project manager's message was:

"Everybody has to finish what they have started; if you drop out now, you're basically shitting on everyone else",

thereby greatly reinforcing group pressure. The final goal, then, was having fixed the most important bugs before the 'beta' (test version) release. Again, there were classes of bugs: 'showstoppers' were worst, as they forced delay in the release; next came 'priority one' bugs, of which the sample version still contained several hundreds; less important were the 'priority two' bugs, that still numbered in thousands. Then, every morning, project management would perform a 'bug count'. At the planned day of the beta release, the team was still saddled with 45 showstoppers. It took a week to reduce these to zero, enough for the beta release. In the ensuing weeks, however, the number of discovered bugs again rose sharply.

8.6.41 Management decided to make 'zero-bugs' in a programmer's code into something to be proud of, creating motivation for the other programmers to fix all their bugs. The symbol representing 'zero-bug' was a blue polo shirt with the

text 'zero-bug club' given to those who made it, in fact creating organisational heroes.

> *"The shirts stood as a badge of distinction; those who wore them were and elite; their celebrity was meant not only to prod people into correcting their coding errors but to shame the laggards too."*

On the other hand, the checking in of an incorrect bug fix cost the responsible programmer a symbolic $5 penalty.

8.6.42 We recognise the concept of process hierarchy in the relation between the process levels of programming or testing code and the level of bringing together these pieces of code into a 'build'. Also the idea of the higher time constant of the process higher in the hierarchy is confirmed as programmers are writing code all the time while a new build is only made once a day (or once a week in the beginning of the project).

- **Interfacing**

8.6.43 As becomes clear from descriptions above, a densely connected development team consisting of specialist programmers is necessary to cope with the increasingly unpredictable demand for new software products in the market. It is in this notion that we recognise the concept of N/K-connectivity. Zachary's description pays a lot of attention to the 'equivalencies and pay-off' argument.

8.6.44 In terms of equivalencies the importance of speed and success for Microsoft was evident, but it was synchronous with the revaluation of programming staff, as the core of the project, whereas in the IBM development managers and co-ordinators had become dominant. The role of code writers and programmers in the Windows NT project with their emotional attachment and motivation to actively beat IBM, is very prominently described in the book.

8.6.45 The development of Windows NT clearly meant a revaluation of the code-writing programmers. The importance of code writing had been downplayed for years, particularly as the computer industry had long focused on hardware developments. In the past, most hardware developments made obsolete the operating programmes and applications for the previous hardware generation. This made the craft of code writing an activity second in rank to the engineering of hardware. Windows NT was intended to be different. It was to be a 'portable' operating system, designed to work on most current computer systems and on future generations of hardware. This development made software the core of computing, thereby greatly raising the status of the software developers and code-writing programmers. Of course, this kind of role to play in such a development process greatly enhanced feelings of pride among the code writers.

8.6.46 Every time the team had to deliver a huge performance, e.g. for an intermediate release or a trade show, the project manager played heavily on people's pride to achieve something great. As the pressure rose as the project advanced, this feeling of 'not letting go' and 'pride of finishing the job' was reinforced.

8.6.47 Another element of motivation was peer pressure.

> *"The most successful people at Microsoft worked long hours. Those who didn't risked being banned and cut off from the team."*

This strained relations with families and other parts of social life, motivating people to 'get it over with' as fast as possible.

8.6.48 Admittedly, besides playing on the emotional equivalents, Microsoft rewarded its programmers richly through stock options on the company's shares. With Microsoft's skyrocketing share prices of that time, the team members could make a fortune. Besides the emotional equivalents, this greatly helped in reducing the pain of the long work hours and the huge efforts. As in this way money became overly abundant for some people, it stopped having a motivating effect, and proved to be only a relief for the tension in the end.

- **Management**

8.6.49 In a company like Microsoft, involving a lot of creative people, it is important to direct these people's creativity. Without management, software developers may never ship anything to the market, because there is always the latest feature to be added or improved on. In fact, management prevents the organisation of stranding at a local optimum.

8.6.50 Management does this by a) setting vision statements and project milestones (i.e. the overall project goals), and b) deliberately limiting resources, e.g. the number of people working on a project and the amount of time allocated to the project, in order to create an outrageous goal. Programmers and teams then have to commit to the final goal.

8.6.51 Most clearly described by Zachary, are the symbolic and example functions of management. E.g., the project manager's action in the final stages was to put up his desk in the room where the build was made. This provided the right focus as it delivered the programmers two clear messages: 1*) "If he's in the build lab, I better not check in badly written pieces of code"*, and 2*) "If he's willing to sit in the build lab, this guy really wants NT built well"*. The manager's philosophy was that power in the group comes from what you accomplish, not from a title or a large office.

- **Conclusions**

8.6.52 Concluding we may state that the Windows NT case illustrates or confirms a number of the propositions. Particularly supported are the concept of interactive dynamic order, the conditions of complementary values and meaningful exchange, the concept of organisational entropy, the outrageousness needed to induce try-out of new rules, and the antagonism and stretch argument. Less clear, but latently present are the concepts of process hierarchy and N/K-connectivity.

8.6.53 More difficult to distil, but implicitly present in this case is the concept of trial and error and rule finding and the concepts of recombination and coding of rules as well as the concept of identity and meaning. Especially during the software development stage, the description in the book about the team finding a way to work together, and learn the do's and don'ts with respect to the way they work together towards completion of the software, is an example of continuous trial and error as well as the transmission of both punishment and reward throughout the group. Be it, because the whole of the team is standing around your table because you faulted up printing routines, and hence stopped all of them working, or at a positive side by being recognised as a member of the 'zero-bugs' club.

8.6.54 Throughout the whole description of the team and team interaction, the notion of being Microsoft and not IBM, and therefore being different and determined to

beat IBM is a clear expression of identity and meaning in the context of this project.

8.6.55 The description on equivalencies and management of interactive dynamic systems are not in all cases very clear. As to equivalencies, throughout the book continuous references made to the importance of the financial reward both in terms of income as well as the value of stock options. On the other hand the way Zachary describes these financial rewards, they sound more like compensation for the dissatisfiers of this way of working, whereas the real motivation on a day today basis arises from the work itself, the progress which is being made by the team and once respective position within the team. Maybe, though the book is never being written to demonstrate the principles of these thesis, one could conclude that an adequate share in the ultimate rewards in financial sense or has being a prerequisite for the satisfier's system to work.

8.6.56 The management as described by Zachary is at times very directive, especially with respect to goals, limitations, and utility exchange, which often are very strongly shaped by the project management. On the other hand, with respect to how the work is actually conducted during the development stage, the way things are working together and interact collectively and individually, there is hardly any interference from the project management. The project management seems to be more concerned about creating and maintaining the interaction mechanisms and pay-off structures in the utility exchange, as well as helping teams out which get stuck in the process, rather than describing the way they ought to do the work. To this extend at least in the development stage, the motherhood dimension (be it a though mother) is probably stronger present than the fatherhood dimension. This however might not be true in the design stage, nor in the stage where the bugs had to be resolved, which resembles a more conventional way of running software-development programs.

8.7 Free market economy as an interactive dynamic system

Introduction

8.7.1 This description of the free market economy illustrates a number of aspects of interactive dynamic order. It is primarily based on Schotter's (1990) book 'Free Market Economics', amplified by the dynamics of the economy as can be perceived in the world today. With this illustration, we do not take a moral stand as to the righteousness of the free market system, nor will we treat the (theoretical) criticisms the classical free market model has received in the social sciences. In this case study two additional examples have been inserted. The first is from the fashion business, the second is based on a case study of the Italian Prato industrial network structure by Kumar, Van Dissel and Bielli (1996).

- **The story**

8.7.2 In Chapter 2 assumed that the different groups of stakeholders increasingly have a free choice of joining or leaving the company, the company becoming a (temporary) coalition between these stakeholders' interests. The underlying assumption is that of a free market economy. Though clearly not present in its purest form, advanced economies (e.g. North-America, Western Europe,

Japan) show large similarities with such an image of free market economy and also with the image of interactive dynamic systems.

8.7.3 As traditional boundaries [xi] disappear and global interactivity increases, similarities become even more apparent. Murpty, in 1996, identified a view of the present societal scenario:

- This is an age of change and speed;
- This is an age of global civilisation;
- Ideas are moving far ahead of behaviour, every action is therefore finding a philosophical justification almost to the level of licence;
- Size and technology are development exponentially, impacting society without corresponding adjustments in social behaviour;
- Environments are becoming increasingly turbulent;
- This is an age of masses and democracy;
- Every system is exhibiting severe complexity;
- Money has acquired an enormous mobility around the globe;
- The age of information has arrived;
- There are conflicts of different kinds at several levels;
- It is becoming difficult to identify clearly conflicts, and parties to conflicts, but violence is becoming pervasive;
- Small product basis are causing micro-level disturbances ;
- Confrontation, confusion and complexity seem to characterise the individual's environment;
- Shifting alliances between nations, fast-changing trade relations, religious, communal and ethic alignment, cutting across boundaries of nations are very common occurrences;
- Society has become generally a buyers-market than a sellers-market.

• Limitations of current practice

8.7.4 First, in a free market economy, there is no central power that can instruct the players what to do. Legislation and governmental interference merely define the boundaries of the playing field, but do not define the play itself, let alone instruct the players how to act. Where governments have tried to create an economy based on central command and control, as in the Eastern European economies, this has bitterly failed.

8.7.5 Free market theory states that it is even worse than this: not only will central planning fail, it will also damage the self-regulating mechanism of the market. If society uses or starts using a non-individualistic social ethic, i.e. if a 'planner' would maximise some goal that is not emergent form individual's choices, the efficiency of the market mechanism itself (i.e. the optimisation of the outcome as emerges from individual's choices) will suffer.

Interactive dynamic order

• Order without central control

8.7.6 The free market economy has many elements of a self-organising system. All social action must be sanctioned by the will of the rational individuals composing society. Under this view, society is the aggregate of the individuals composing it. This also means that a free market ethic - if it comes to exist at all

- will be an emergent property of the interaction between individuals, it cannot be imposed by a government or a social planner.

8.7.7 Individualism as viewed e.g. by Hayek[xii] explains the nature, evolution and function of institutions in terms of the unplanned and unintended action of free individual agents. This contrasts with the idea of creation or design of institutions by some centrally controlled planner. Or, in Hayek's words:

> *"It is the contention that, by tracing the combined effects of individual actions, we discover that many of the institutions on which human achievements rest have arisen and are functioning without a designing and directing mind; that, as Adam Ferguson expressed it, 'nations stumble upon establishments which are indeed the result of human action but not the result of human design';"*

and

> *"that the spontaneous collaboration of free men often creates things which are greater than their individual minds can fully comprehend."*

8.7.8 This is closely connected with the invisible hand - laissez faire assumption. It focuses on individuals, saying that the ability to create social institutions spontaneously and unconsciously furthers society's aims better than institutions consciously designed by the same people. It is in the generation of what Hayek call 'spontaneous order', superior in terms of social welfare to any planned social order, that the free individual is in its place.

8.7.9 To clarify this, we consider the example of the competitive free market is an extremely efficient information processing device that allows individually scattered bits of local information to be exchanged at minimal cost in order to co-ordinate social activity efficiently.

8.7.10 Consider the example of the organisation of a tennis tournament with, say, 20 players. Some are better than others, and each knows roughly how good the others are. In the first round, each would play three matches, the outcome of these to determine whether the player would go on to the second round. For the organiser, to plan an optimal playing scheme for this first round, assuring among others that no players play each other twice, that there is spectator interest in the games (i.e. not a very weak versus a very strong player), and that all players play the same number of rounds, means to solve an enormously complicated mathematical problem. There is, however, another possibility: doing no planning at all and instead just announcing that each player must find his own three first-round matches. Each player would try to find the easiest three matches, no player would agree to a match if there was a lesser player who would agree to play him, and players could refuse to play opponents who were obviously better than they. Since the matches are arranged voluntarily, players could not argue they were assigned matches that are too hard, no mismatches will result, and the spectator interest will be maximised.

8.7.11 By trusting the selfish, utility-maximising aims of the players, the organiser could have resolved the problem relatively effortlessly. Planning would involve the centralisation of all available information on player qualities at the organiser. This would involve lots of information extraction and processing. Allowing participant to make their own matches places decision-making power in the hands of those who have the best information at their disposal. Hence, a better decision is guaranteed to result at considerably lower cost of planning and organising.

8.7.12 These mechanisms can also be applied to economic and organisational questions as 'which goods and services should be produced', 'in what quantities should they be produced', 'how should labour and capital be allocated to produce these various goods', etc. Similarly, planning these allocations problems would require huge amounts of information collecting and processing (e.g. by interviewing all agents on their preferences, and aggregating these) and would most likely lead to sub-optimal outcomes (as there is no one consistent way of aggregating preferences).

8.7.13 Another good example of these kinds of processes is the fashion business. The fashion business, especially its expression in clothing, does appear to have a number of characteristics suggesting it to be an interactive dynamic system. Again here, as with the free market economy as a whole, there is no central authority which issues commands as to what should, or should not, become fashion. In fact, in fashion, the taste of next year's clothing seems much more an emerging collective phenomenon where microscopic events appear to emerge from incidents in a network of interacting players. The speed at which such phenomenon emerges can only originate from non-linear propagation, in fact, increasing returns probably driven by group and identity motivations of participants. Also the fashion business displays continuous imbalances and for most players has a large degree of unpredictability, at least, in the short term, with respect to sort and quantities of goods to be sold.

8.7.14 Nevertheless, the fashion business itself is highly interconnected with many aspects of society. Richardson, 1996, in his article on rapid response in fashion apparel describes the industry as follows:

> *"While such industries as personal computers and consumer electronics are prominent examples, the fashion apparel industry provides an interesting case of hyper-competitive behaviour (D'Aveni, 1994). Fashion apparel makers are continually jockeying for position with new products and marketing efforts in an attempt to capture the imagination of customers with styling and image. They create short-lived differentiation advantages that are easily and rapidly eroded through imitation and innovative new styles. The fashion apparel business is characterised by a very short product life, fickle consumer preferences, numerous competitors, relatively easy entry and exit, and a myriad of manufacturing, marketing, and retailing alternatives. In such an environment, competitive advantage is difficult to create and nearly impossible to sustain."*

8.7.15 The example shows that in this arena the competition is shifting due to process innovations known as 'quick response'. By use of information technology, leading quick response competitors have replaced traditional competencies in design and fashion by new capabilities in rapid learning, communication, and co-ordination. Rather than bet on a few new designs from the most savvy designers, as used to be the case in fashion, they try out many, quickly imitate others, and continue to produce only what sells.

8.7.16 A more apt example of parallel processing, rapid proliferation and continuous quest for change and adaptation is difficult to find. The question is whether this behaviour is driven by consumers, or whether it is driven by a number of central forces with a distinction between the two aspects. Where does demand emerge? And what happens the moment it has emerged? We don't know a lot about how demand emerges, but the moment it emerges, it causes non-linear propagation. The emergence of such avalanches implies that such trends are not against the wishes of the consumer, because otherwise the acceleration would be dampened by those very consumers.

8.7.17 Fashion designers are probably predominantly those who pick up the weak signals of new trends, very rapidly proliferate these them and convert them into real products into the market. Whichever way, fashion business has something. There are no people who force trends upon the market. Designers, in fact, are only the amplifiers of the movement. Fashion writer Helmut Gaus (1992) has indicated that fashion has predictable elements but on the very long term (50 years or more). This may be true, but short-term, in the cycle of seasons when non-linear propagation and unpredictability prevail, it does not help.

- **Organisational entropy**

8.7.18 While the free market economy is certainly dynamic and interactive, few people would consider it as truly chaotic, at least when looking at the more sophisticated markets in the world. It is erratic and unpredictable, but is not chaotic in the sense that no meaningful coherence between different parts of the network is maintained. In fact, especially where companies tend to be more selective in the supply structure and go for more intense co-operation and strategic alliances, it is maybe even becoming less chaotic than it was in the past, achieving a higher level of order or a better-balanced level of organisational entropy.

- **Conditions**

8.7.19 If the individual is to be the sanctified atom of social life from which all social molecules are constructed, then it becomes necessary to create some calculus that will measure when society is made better or worse off by a certain policy. In Bentham's words:

> *"The happiness of the individuals of whom a community is composed, that is, their pleasure and their security, is the end and the sole end which the legislator ought to have in view [...]"*

8.7.20 If individualism dictates that only the preferences of individuals are allowed to count in social decisions, then these preferences must be aggregated. E.g., when a decision has to be taken whether to invest in project A or B. In the classic utilitarian view, individual preference intensities for the alternatives are simply added up and the largest chosen (i.e. 'the greatest good', but not necessarily for the 'greatest number'). In the Paretian view, the social choice will be unanimous of the entire society. E.g., when the total aggregated preference for alternative A is larger than the total aggregated preference for alternative B, there will be some 'bribe' the voters for alternative A will be prepared to pay to the voters for alternative B, thereby re-balancing the utilities. Notice that this calculation only uses information of individual preferences, and that no external ethic or external planning is involved.

Interactive dynamic learning

- **Trial-and-error / emergent rules**

8.7.21 In the free market economy, preferences of the economic agents are expressed by their individual biddings for goods and services, for labour and for capital: prices reflect the preferences of consumers, wages reflect the abilities of employees, profits reflect the capital risk of the entrepreneurs. The mechanism perfectly regulates type and quantity of goods and services produced, and the

allocation of labour of capital to these. It will automatically shift if allocation is not in equilibrium.

8.7.22 Entrepreneurs simply guess what people want, produce these good and put them on the market, adjusting prices to fit actual demand. If they choose to produce a product no one wants, or if they produce too many products, their price will be low. As a result, their incomes and profits will be low, their satisfaction will be low, and some will switch to production of goods with higher expected profits. Until they do so, the economy will not be in equilibrium.

- **Evolution of rules**

8.7.23 Since prices simply reflect the preferences of consumers, we find the competitive process moving resources from low profit (low demand, high supply) industries to higher profit (low supply, high demand) industries, which is exactly what is needed to satisfy preferences of consumers.

The free market as an interactive dynamic system

- **Characteristics**

8.7.24 The characteristics of multiple exchange and antagonism and stretch are clearly present in the free market system. For process hierarchy and identity this is much less the case.

8.7.25 The free market qualifies as a networked system, with a number of antagonist performance goals which simultaneously have to be met, and which, in combination, have a truly outrageous character. Capital suppliers are looking for returns, citizens are looking for quality of life, clients for value for money in products and services, and employees for perspective and employment. There is an implicit tension between all of these goals to be achieved simultaneously, but, apart from incidents where things truly go wrong, on balance we seem to be capable collectively of achieving an ever higher performance in all of these aspects. The system is characterised by continual balancing between fighting and co-operation. Companies are always trying to cope with matters, which both negatively and positively affect them. Any relationship between two companies is never completely symbiotic. There are coherence, as well as divergent, forces; the fact that they are both present keeps the system involved and lively. In cases where some of these forces are removed through reduction of competition, cartels etc., in the long run it tends to destroy rather than sustain the success and competitiveness of that part of the economy, as is shown, for example, in Michael Porter's book, 'The Competitive Advantage of Nations' (1990).

8.7.26 A good example of a networked organisation or supply chain conglomerate is the small textile firm industry structure around Prato, Italy. As this structure is extensively described in a case study by Kumar, Van Dissel and Bielli (1996), we will not go into it in detail. However, a few highlights of the organisational structure might clarify our points.

8.7.27 The Prato industrial conglomerate exists of approximately 8500 small firms, half of which employ fewer than 10 people. This conglomerate has proven highly successful, and has been extensively studied in the 1980s. It has the capability

of providing quick response to the rapidly changing fashion market, turning out more than 70.000 different materials each year, usually in small production runs, and showing great flexibility in design and production.

8.7.28 The structure that gives form to these firms' relationships is one of a value chain, made up entirely of independent firms. This means de-verticalisation and decentralisation of all the major functions of the organisation, from purchasing to individual production steps, to marketing, each of which is performed by independent firms. Moreover, the units of production are further specialised in only one or two of the different phases of production, e.g. sorting, spinning, dyeing, weaving, finishing, etc. This value chain is not at all static: it has meaning and existence only for the duration of the fulfilment of a specific order. The primary catalyst of this network is the unique and traditional role of the typical Pratesian entrepreneur. This is mostly an entrepreneur without a firm: all he does is obtain orders and distribute work to the firms in the production process. He does not have formal contractual power, and thus is not able to exercise formal control over firms that constitute this dynamic value chain.

8.7.29 The co-ordination of the chain is primarily achieved by horizontal communication between the adjacent parts of the chain and through a much lesser extent by the flow of information to and from the entrepreneur who 'owns' the order. Thus, the dynamic value chain is almost a self-organising one, in which production materials and information flow directly from one firm to the next with only minimal interference or control by the entrepreneur. It is very common for the entrepreneur to communicate only with the first and last actor in the chain, and to communicate with others only to track order progress and in case of problems or exceptions. From a straight economic or functional perspective, this organisation provides economies of scale, the flexibility to meet highly specialised and variable market demand, and an ability to maximise capacity utilisation of the system as a whole.

8.7.30 Normally, under pure market regulation this structure will involve enormous transaction costs due to uncertainty, specificity of investments and asymmetries of information. Instead of market regulation, the Prato conglomerate relies on interactive network mechanisms. According to Kumar, Van Dissel and Bielli, networks are formed by relationships that are cumulative over time, stable, and long term in nature. These relationships provide the context in which interaction (i.e. exchange and adaptation) can take place. These relationships depend primarily on trust, as an informal mode of control governing mutually identified partners. Trust reduces uncertainty regarding mutual behaviour through a process of self-control, in other words: it reduces transaction costs.

8.7.31 Concluding, they state that transaction cost theory, depending on the assumption of opportunism and lack of trust, is insufficient to describe the Pratesian dynamic network, as in the Prato context transaction cost are much lower than would be predicted from its diffuse and complex structure. Besides the 'power and politics' of the opportunistic perspective, and besides the (naive) system rationalist assumption that all actors will automatically ascribe to the same economic goal of maximising organisational economic efficiency, there is a third perspective. In this perspective, trust and co-operation exist alongside power and politics and naive rationalism, and collaboration and co-operation are the key interaction processes.

8.7.32 It is assumed that economic and social agent are rational in that they are fully aware of their own preferences and capable of making all the calculations to efficiently pursue their own self-interest. This argument has two components: utility maximisation and selfishness. The first component states that social and economic agents make decisions that bring them the greatest satisfaction. The second states that it does not matte to them whether other agents receive less or more than they do. The selfishness assumption does not deny the possibility of socially minded behaviour, if only because this behaviour could add to the satisfaction or utility an agent perceives by acting socially.

8.7.33 This selfishness is supposed to lead to optimal social outcomes. This assumption holds that if individuals are left alone and allowed to contract voluntarily, the welfare of society will be enhanced. Any intervention in this process is bound to make things worse. Quoting Adam Smith's famous lines:

> *"It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but form their regard to their own interest. We address ourselves not to their humanity but to their self-love, and never talk to them of our own necessities but of their advantages."*

Hence, the freedom of individuals to maximise their own interests leads 'as if by an invisible hand' to an end which was no part of their intention.

- **Interfacing**

8.7.34 The notion of N/K-connectivity is not explicitly present in the free market system. We could reason, however, that the connectivity balance between e.g. production and consumption is automatically optimised through the price mechanism

8.7.35 We know no systematic research of the characteristic of interaction between production and consumption, apart from the McKelvey's example for the portable computer industry, which has been mentioned in Chapter 7.6. This does indeed suggest that a continuum of complexity be maintained over the interface between the production and consumption subsystems in this case between a network of suppliers and a network of distributors. This notion of interacting landscapes, creating a search towards the global maximum in the solutions pays for the actual moment specific needs is underlying the model which describes buying decisions based on perceived utility in Chapter 9.4.

8.7.36 What is explicitly present, however, is the whole concept of equivalent exchange. As economic agents exchange utilities, these are by default equivalencies (otherwise there would be no exchange). While money is the currency for these equivalencies, it is not only money that provides utility. An important distinction is between process and end-state orientation. End-state orientation only considers the outcomes of the economic process in terms of money. Process orientation also considers the economic processes in which this money is exchanged for other types of utility. In this view, unequal income distribution (an end state) is not a sign of injustice per se. If the outcome was arrived at voluntarily by the mutual consent of all involved, it can be justified, since noting individuals enter into voluntarily can be bad for them.

8.7.37 As an example, consider a world in which there are three people, person A, Joe Frazier and Muhammed Ali. Each person receives $100. Frazier and Ali agree to box each other, charge person A $50 to attend the fight, and decide to split the proceeds at $30 for Ali and $20 for Frazier. Person A, who is an avid boxing

fan, agrees happily and hands over $50. So, at the end of the fight, the income distribution is $130 for Ali, $120 for Frazier, and $50 for person A. An advocate of end-state principles might say this state is unfair, because income is not distributed equally. However, since the agents voluntarily traded away from the equal income distribution, each has the right to keep what he earned. The process justifies the outcome. This leaves government in the position that it should not design societal outcome (which would be against the choices of the individuals), but rather to establish and keep fair rules of interaction (guiding the process, and thereby ensuring fair outcome).

8.7.38 In terms of pay-off matrices, Schotter states a number of basic criteria for the well-functioning of the free market system in a real economy:

- The incentives existing in the system should be consistent with the nature of the social agents functioning in the economy. The system should not rely on agents behaving in ways or responding to incentives that are unnatural for them. The free market can be looked upon as a set of rules, specifying allowable and unallowable actions (e.g. laws against stealing someone else's goods, antitrust laws, etc.). These rules set up an incentive system, rewarding people for certain types of actions, and punishing them for others. To be effective, this reward-punishment system should be consistent with the nature of the agents;
- The system should conform to the cultural history of the society it is being imposed on;
- The economic system must lead to results that agents feel are fair, otherwise social unrest is bound to exist;
- The system should be efficient to be considered truly successful (i.e. pay-off from co-operation should be larger than pay-off from defection).

- **Management**

8.7.39 A number of aspects in the emergence and evolution of interactive dynamic order are hence present. Only the aspect of management control over the network is difficult. We assume that governments as well as economies play an important role in defining the boundaries and adjusting the distribution of wealth, and hence manage the equivalencies exchange between the various parties. Although they do not tend to do so in a co-ordinated central-command way, there is a fair amount of co-ordination of economic policies, for example within the European Union, as well as, on a global level, within the G7 on essential points. As management in complex dynamic systems is not an instructive type of management, but merely one, which controls anxiety, guards evolution, and promotes connectivity and proliferation, it resembles closely the activities, in national and international economic policies, of modern governments. It might, therefore, well be that this role is fulfilled by governments. This thought is supported by the fact, that in cases where there is a complete absence of government e.g. in Yugoslavia, some parts of Russia or in Africa, market mechanisms do still develop, but in a way which is much closer to our concept of chaos than the situation we experience in highly developed Western markets.

8.7.40 The difference with our propositions is that government is considered an emergent property of the system itself. This assumes that the system itself will sprout orderly behaviour, even as management/government is still absent. This is contrary to our proposition that order will not emerge by itself. When management (in the form of a government) is present, however, it is supposed to assume a facilitating role, concordant with our propositions.

8.7.41 The way government and society emerge from these processes closely connects with John Locke's famous analysis of how the political state (and law) emerges form a 'state of nature'. It is created at he will of the individuals existing in this state of nature solely to maintain their rights and property. Hence, the state has no rights of its own, but rather must be the servant of the individuals that create it.

Conclusions

8.7.42 Concluding, a true free market system can be considered as a near perfect example of interactive dynamic order. Also the conditions for networked order to appear become very clear from the free market example, as does the characteristic of antagonism and stretch and the notion of equivalencies. Less clear are the notions of organisational entropy, interactive dynamic learning, process hierarchy, identity and N/K-connectivity. Finally the notion of management in some respects contradicts our propositions, unless governments could be seen (partly) in such a role.

8.8 Cross-case conclusions

8.8.1 The case studies as presented above offer a rich base for embedding the principles as described in Chapters 5 through 7 in an organisational and societal context. While it is not our aim to provide extensive empirical validation, we think the presented case studies provide ample illustration as to the occurrence of interactive dynamic order within different contexts. Furthermore, the case studies illustrate that the conditions under which interactive dynamic order occurs can indeed be created and maintained and that organisations applying principles of interactive dynamic order can do so successfully.

8.8.2 The extent, to which the principles as described in Chapters 5 through 7 are confirmed or illustrated by the case studies, is summarised in the following table:

Framework	Super-market	Xerox Corp.	Educ. Institute	Windows NT	Free market
Limitations of current practice	+	+	O	+	O
Interactive dynamic order					
Order without central control	+	+	-/+	+	+
Organisational entropy	+	O	+	+	O
Conditions	+	+	+	O/+	+
Interactive dynamic learning					
Trial-and-error / emergent rules	+	+	O	O	O
Evolution of rules	O/+	+	O	O/+	O
The company as an interactive dynamic system					
Characteristics					
* Multiple exchange	+	+	+	+	+
* Antagonism and stretch	+	+	+	+	+
* Hierarchy of processes	O	O	+	O/+	O
* Identity / meaning	+	O	O	O/+	O
Interfacing:					
* N/K-connectivity	+	O/+	O/+	O/+	O
* Equivalencies	+	O/+	O/+	O/+	+
Management	+	O	+	O/+	-/+

Legenda to table:

- + clear positive relation between the proposition and the case study description;
- o proposition is not subject of this case study;
- o/+ proposition is not explicit subject of this case study, but a positive relation may readily be assumed;
- -/+ both positive and negative relations between the proposition and the case study description.

[i] As to the validity of these case studies: construct validity is ensured (where possible) by using multiple sources of evidence and reviewing of the draft report by key informants; internal validity is achieved by matching the pattern as emerges from Chapters 5 through 7 with the patterns emerging from each individual case study; external validity is provided by use of a replication logic in the case study design (in each case study it is the same set of propositions that is being tested); finally, reliability is ensured by the availability of a case study database.

[ii] This condition limits the possibilities of generalising the process to other shops in the same supermarket, because of the problems that would occur in guaranteeing the social equivalents of existing management.

[iii] Required is, of course, that they possess a sense of responsibility for the well-being of their department and the shop as a whole.

[iv] While external circumstances can never be totally excluded, this shop is certainly not in a more profitable area than others.

[v] That is to say, form the perspective of the shop personnel and the higher management of the supermarket chain. From a customer point of view it was not a disaster scenario. Still, one of the goals was that the change process should not bring any inconvenience to the customer. A customer survey indicated that the customers showed no significant dissatisfaction during those weeks. In the opinion of the shop management the customers must have experienced some inconvenience, but this was acceptable because of the enthusiasm and customer orientation of the employees.

[vi] This is largely due to the overarching logistics system of the supermarket chain. In this case the overarching technical system limits possibilities at a lower level (this links up with the 'technical system' criterion Mintzberg (1983) uses in his organisation typology).

[vii] It was the same effect of critical mass that in the old situation prevented the manager form changing the interaction processes, as he had not been able to gain critical mass for his ideas with higher management.

[viii] While some anxiety is needed, it is important to recognise that in this case anxiety did not come in the form of an immediate threat to the continuity of the business, as is often used to legitimate far-reaching restructuring measures.

[ix] In the case of Microsoft, the problem is not as much in product variety, but rather in unpredictability of markets and customer behaviour.

[x] Programme managers are described by Zachary as a kind of 'messengers from the market', in fact looking at the programme form the customer's point of view, and giving advice about which features to put in or keep out. While they had no formal power to force the programmers into doing something, their informal power was considerable.

[xi] E.g. disappearing national boundaries through European Unity, disappearing physical boundaries through growth of electronic connectivity by means of e.g. internet.

[xii] Quoted by Schotter, 1990.