Inaugural Lecture of Dr. Jac Christis Professor Work Organization and Labour Productivity in the Centre of Applied Labour Market Research and Innovation at Hanze University Groningen

# 'Organization and job design: what is smart organizing?'

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## 1. Smart organizing

*Organizing defined: the work organization of the organization*[1]

To organize your household, paper or lecture means to give it a structure, as in a well organized, that is, well structured household, paper or lecture. Applied to organizations, organizing refers to the process of division (differentiation) and coordination (integration) of work (Thompson 1967; Mintzberg 1984). The product of organizing is not an organization, but the work organization of an organization: the way its work is organized. In that sense Philips *is* an organization in the institutional meaning of the word 'organization' and *has* a (work) organization in its instrumental meaning. Because the work organization is an instrument or tool for reaching organizational goals, organizing in the wrong way will cause difficulties for reaching those goals.

*The definition of smart organizing*

We define smart organizing as organizing in such a way that everyone (including the shop floor worker) is involved in the control, improvement and innovation of the organization. This not only results in the creation of more challenging work for employees with more learning opportunities and less stress risks (Karasek 1979). It also increases organizational adaptability by a more efficient and flexible organization of its work. So, smart organizing increases the quality of both work and organization.

*The problem and redefinition of smart organizing*

Involving everyone with everything is possible in a small group (as in a start up firm). It becomes more difficult when an organization has twenty employees, and impossible when this number grows to fifty or more. In that case, an organization needs an organizational structure which, according to Simon (1997: 112), ensures that not everyone has

- to cooperate with everyone on everything (horizontal division of labour)
- to co-decide with everyone on everything (vertical division of labour)
- to talk with everyone on everything (lines of communication) and
- to constantly re-invent the wheel (routines and standard operating procedures).

Since it is possible to involve everyone with everything only in a small group, we redefine smart organizing as organizing in such a way that everyone can cooperate, co-decide, communicate and innovate with everyone at the level of the group or team. To reach this goal of local, conditionally autonomous groups (Thompson 1967) at the lowest level of the organisation, structural adjustments are needed at the level of the work organization as a whole. This raises the question: what are these adjustments?

*Answers from science and practice*

To answer this question, we can look at the scientific literature on organization design and job design in which theoretically derived and empirically tested solutions to practical design problems are proposed. Modern socio-technical system theory as developed in the Netherlands by Ulbo de Sitter is an example of such an endeavour. It is also possible to look, not at science but at organizational practices and search there for smart solutions. In that case, we derive the principles of smart organizing inductively from existing practical examples. In this lecture, I will adopt the second route. I will discuss organizational practice as a source, not of problems to be solved by science, but of solutions. In that case, it is the task of science (1) to appraise the merits of those solutions, (2) to generalize these solutions by embedding them in a more general language and (3) to re-specify them for different circumstances.

In the second part of this paper, I will compare the insights gained in this inductive way to those of modern socio-technical theory which are deduced from a small number of system-theoretical principles. Any agreement between the two will increase our confidence that the proposed solution is a robust one. Because the approached defended in this paper is a structural one, I will conclude this paper with some remarks on the concept of a structure.

## 2. High Reliability Organizations

*High Reliability Organizations as high-risk systems*

The first practical example we will look at involves the so-called "High Reliability Organizations" or HROs as described by Weick and Sutcliffe (2007). Examples of HROs are nuclear power stations, chemical plants, aircraft carriers and operating rooms. These organizations have complex primary processes. As a result, they often have to deal with unexpected events and malfunctions. It is a further characteristic of these organizations that any inadequate responses to such events and malfunctions lead to disaster causing substantial human suffering (recall the chemical-leak disaster in Bhopal) or damage to the environment (such as the Exxon Valdez oil disaster). That is why they are called high-risk systems by Perrow. In his book *Normal Accidents* (1984), Perrow argues that in these types of organizations disasters are unavoidable and in that sense 'normal' occurrences. Consider by way of example an aircraft carrier. The deck of such a ship has been identified as the most dangerous 4,5 acres in the world:

> So you want to understand an aircraft carrier? Well, just imagine that it's a busy day, and you shrink San Francisco Airport to only one short runway and one ramp and gate. Make planes take off and land at the same time, at half the present time interval, rock the runway from side to side, and require that everyone who leaves in the morning returns that same day. Make sure the equipment is so close to the edge of the envelope that it's fragile. Then turn off the radar to avoid detection, impose strict controls on radios, fuel the aircraft in place with their engines running, put an enemy in the air, and scatter live bombs and rockets around. Now wet the whole thing down with salt water and oil, and man it with 20-year-olds, half of whom have never seen an airplane

> close-up. Oh, and by the way, try not to kill anyone (Senior officer, Air Division, quoted in Weick and Sutcliffe 2007: 24).

Remaining disaster-free under such circumstance is the mark of a true HRO.

*HROs as reliable high-risk systems*

HROs are therefore defined, in a first step, as a subset of high risk systems, that is, as high risk systems in which disasters do not occur or at least less frequently than "normal". Such safety records are, in turn, caused by a number of principles that Weick and Sutcliffe label "mindful" principles which inform "mindful" practices. The discovery of these practices enables the transformation of a symptom-based definition into a cause-based one: HROs are now defined not in terms of safety records (symptoms), but in terms of the mindful practices that cause these high safety levels.[2]

Compare this to driving a car. Just as drivers of unsafe vehicles, aware of the risks they are running, drive in an attentive manner, so HROs develop in a similar way attentive or mindful practices in response to the constant threat of disaster.

*Mindful practices*

The first three techniques are anticipatory and make HROs aware of their vulnerability. They know that both their experience and knowledge are incomplete. They acknowledge that events might occur which fit neither previous experience nor existing knowledge. They are therefore constantly alert to unexpected deviations, a state allowing them to react with strong responses to weak signals. The last two techniques are reactive and enable HROs to remain operational despite breakdowns and to recover quickly from malfunctioning. HROs are not error-free, but errors do not disable them.

*The function of routines*

HROs are obsessively preoccupied with (1) what might go wrong and (2) what they might do wrong. They feel threatened by the first and unsure about the second. In response to these concerns, they have developed standard procedures and routines for everything. However, their attitude to these routines is ambivalent: they need routines (routines enable quick detection of and response to deviations), but they do not trust them (routines could be wrong). Because of this distrust, HROs are continuously critically examining, revising and updating all those routines. HROs are therefore characterized by both a high degree of standardization and formalization and a continuous revision of those same standards and rules. They can, in this manner, be compared to performing musicians. These musicians have practiced their routines extremely hard in order to be able, when perfoming, to direct their attention to the music they are playing. Routines do not only free attention but also enable small deviations to be immediately perceptible, responses then to occur promptly and flexibly during execution, and changes to be made after critical review of the performance. Only by developing routines and simultaneously critically examining them, are musicians able to improve and further develop in a continuous way.

In 'normal' organizations, this combination of developing routines and simultaneously submitting them to critical review and revision is unusual. Instead, one group (Mintzberg's technostructure) develops the standard procedures and routines that another group (Mintzberg's operating core) must implement. In HROs, this separation between thinking and doing, conception and execution, is broken down. The individuals who execute the routines are also involved in the critical examination, adjustment and improvement of them. In addition, HROs use a cognitive in stead of a normative approach to standards and routines. The question is not: Who makes a mistake and must be disciplined, but what goes wrong and what can we learn from it? They treat reliable performance [as] a system issue (a "what"), and not an individual issue (a "who") (Weick, Sutcliffe 2007: 51).

*HROs: learning organizations*
HROs can therefore truly be called organizations that use mindful practices to organize work as a continuous improvement process, that is, as a permanent process of learning, development and discovery. Weick and Sutcliffe emphasize that the practices concerned are counter-intuitive. After all, we prefer to focus on successes rather than failures. We like simplicity and dislike making things complex. We would rather deal with large strategic views than with their operational implementation. The primary process is therefore regarded as a cost item from which all 'slack' and resilience must be eliminated, and we consider it safer to obey the person in charge than those with the required expertise. HROs do precisely the opposite: they think and value things differently and because of that they organize differently. They do so because of a strong motive: to avoid disasters at all costs.

## 3. The problem: Can normal organizations learn from HROs?

*HROs and normal organizations*
Without question, unreliable high risk organizations could learn from HROs. However, to improve the transfer of mindful practices to unreliable high risk organizations, High Reliability Theory needs to explain why some but not all high risk organizations develop those practices.[3] Things are different when we ask whether normal organizations could learn from HRO's. This question presupposes a different contrast space: we now need to compare HRO's, not with unreliable high risk systems, but with normal organizations.[4]
Our question therefore is: Can mindful practices be transferred to normal organizations? Not so according to Roberts. Normal organizations have no catastrophic potential and so lack the motive to invest in mindful practices:

> It does not make sense for organizations to adopt expensive ways to manage themselves if they do not need to (Roberts 1990: 173; see also Rochlin 1993: 19).

Weick and Sutcliffe disagree. They have written their book for normal organizations with the assumption that these can learn from the practices employed by HROs:

> [HRO's] use techniques that you can copy - techniques that are worth copying because they ensure faster learning, more alert sensing, and better relationships with customers. ... It takes mindful variety to ensure stable high performance. HRO's have learned that the hard way. We hope to make it easier for you to learn the same lessons they learned the hard way (Weick, Sutcliff 2007: x)

Weick and Sutcliffe's thinking rests on two questionable arguments. First, they relativize the notion of catastrophic potential. The unexpected shutdown of an assembly line is a minor thing for the organization but can be a catastrophic event for the line supervisor. Whether something is a crisis depends on scale and context. This is correct, but does not solve our problem. It is the organization that has to introduce the mindful practices and it will still not do so as a reaction to what for the organization are minor things.
Second, when trying to solve the transfer problem, Weick and Sutcliffe stress the similarities between HROs and normal organizations. In fact, they do two contradictory things. When they wish to explain why HROs and not normal organizations have developed these mindful techniques, they emphasize their differences (recall the above description of an aircraft carrier as the most dangerous 4,5 acres of the world). However, when existing HROs are taken as examples to be followed by normal organizations, they emphasize their similarities. An aircraft carrier now is suddenly nothing more than a transformation process with an input and output which, of course, characterizes all organizations:

> We want to emphasize that the problems of a carrier are similar to the problems you face. At the most basic level, the task of people on a carrier is to move aircraft off the pointed end of the ship and back into the blunt end of the ship. And at the most basic level, your task is to move products or services out the front door and raw materials in the back door (36)

This seems to be a form of "unmindful" thinking. Raising your abstraction level and eliminating enough context will enable you to treat everything as similar "at the most basic level". After all "at the most basic level we are all human beings." However, doing so sins against the second technique of mindfulness: you can not resist the reluctance to simplify and consequently your thinking does not incorporate sufficient complexity. In this case, it means that the fact that normal organizations lack a motive (in the form of catastrophic potential) remains hidden.

*The problem of transfer*

Our problem is this. If we treat HROs and normal organizations as different (as Roberts and Rochlin do), we can explain why HROs do have and normal organizations do not have a motive to introduce mindful practices. Catastrophic potential is the explaining variable. But we then have a transfer problem: it is difficult to see why normal organizations should follow the example set by HROs. HROs have been compared above to drivers of unsafe cars who therefore drive with particular care. Normal organizations can similarly be compared to the drivers of safe vehicles. As is well known, such drivers often do the opposite; because their vehicles are safe, they tend to drive inattentively or unsafely.

If, however, we treat HROs and normal organizations as the same (as Weick and Sutcliff do), the transfer problem disappears. But now we have the problem of explaining why HROs did and normal organizations did not develop these practices in the first place.

*A strategy for solving the problem*

So, we still have the question: can ordinary organizations develop mindful practices despite their not being high-risk systems? We will answer this question in the following way. To do something, for example to drive safely, we need both the required motives and skills. Traffic experts know that special measures are needed to get drivers of safe cars to drive in an attentive way. The same holds true for organizations. The five mindful practices are organizational practices that need both the required organizational motives and organizational skills, capacities or capabilities. So, what we need are examples of organizations that, without being high-risk systems, employ the mindful practices of HROs. If we can find such organizations, we can subsequently examine the extra measures that these organizations have taken in order to enable implementation of these practices. We can look for both the motive and structural capacities for such an implementation.

*Sabel's discussion of the "pragmatist" organization*

In a paper entitled "A real time revolution in routines", Charles Sabel (2005) describes three types of organizations that share both the need for and distrust of routines and the way they handle this ambivalence. In that paper Sabel shows that, when organizations follow principles based on the Toyota system of lean manufacturing, they work in the same manner as HROs. Here we have the example we need of normal organizations that are characterized by the same combination of standardization (we need routines) and continuous critical review (but we cannot trust them). In supporting his view, Sabel focuses on the method of the "five why's". Whenever a malfunction occurs in these organizations, an effort is immediately made by shop floor workers to discover its "root causes". These are only discovered when the question "why" is asked at least five times. Not satisfied with a first or proximate cause, they look for the (distal) causes of causes. The basic idea is that the further upstream the discovered cause, the greater the area downstream no longer affected by the error. Furthermore, the higher the system level where the cause is located, the greater the system scope of the solution.

Sabel labels these types of organizations "pragmatist organizations". They use John Dewey's idea that we do not just need goals to search for the means to reach these goals but that, in searching for the means, we reformulate our goals. Situated in volatile environments, these organizations are constantly preoccupied with and involve everyone in a critical investigation of both means and ends. A lack of time precludes the separation of goal formulation from goal realization, conception from execution. These organizations consequently owe their success to exposing their habits and routines to continuous critical review:

> [They] routinely question the suitability of current routines for defining and solving problems... They systematically provoke doubt, in the characteristically pragmatist sense of the urgent suspicion that our routines - our habits gone hard, into dogma - are poor guides to current problems. Or we can think of ...[the] disciplines grouped under the heading of "continuous improvement" as institutionalizing, and so making more practically accessible, the deep pragmatist intuition that we only get at the truth of a thing by trying to change it (Sabel 2005:121).

Sable astutely observes that these organizations must not be confused with the well-known organic and informal structures identified by Burns and Stalker (or the adhocracy discussed by Mintzberg). Their level of formalization and standardization is just too high to allow any such equation with organized informality. In effect, they are distinguished by the capacity to develop routines while, simultaneously, subjecting these routines to continuous critical examination. Sabel also suggests the motive why such practices are undertaken:

> [T]he near misses ... are the urgent analog in the HRO to the line stoppages in a just-in-time system. Both trigger root-cause analysis meant not only to uncover the proximate cause of the incident, but to eliminate, through redesign of the organization if necessary, the background conditions which generated the immediate sources of dangers (Sabel 2005: 122).

A closer analysis of the Toyota system of lean production can therefore help to resolve the transfer problem. We will show that by replacing a functional structure with a flow structure, these organizations create both the motive and the structural preconditions for the introduction of mindful practices. Creating a flow makes these organizations vulnerable to disruptions and so creates an 'internal catastrophic potential.' At the same time, organizing in a flow enables the creation of cross functional shop floor teams that participate in the continuous control, improvement and renewal of the primary process (recall our redefinition of smart organizing as organizing in such a way that at the level of the group or team everyone is involved with everything).

## 4. The secret of lean production

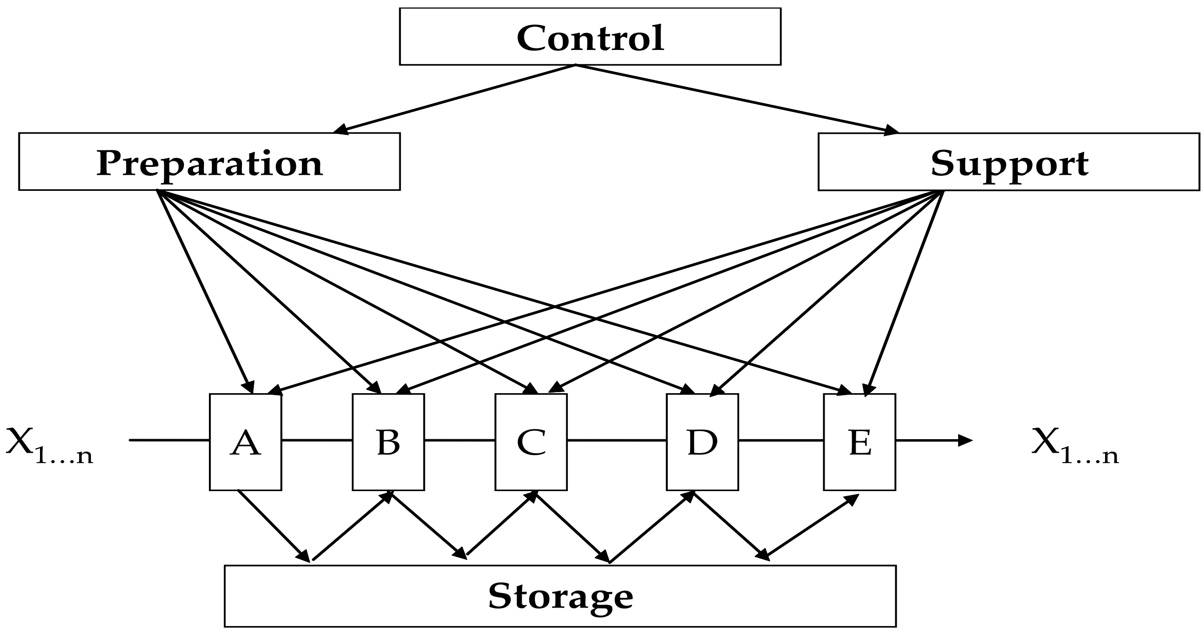
*The bicycle factory: economies of scale*

To understand the secret of lean production, we will first examine what Japanese consultants or *sensei* do when they come to the aid of, in this case, an American company in danger of going bankrupt.[5] The firm in question manufactures various types of bicycles in a variety of sizes and colours using a number of materials, including steel, aluminium and titanium. These materials must among other things be cut, bent, welded, painted and washed, after which the entire bicycle can be assembled. The factory has a functional structure in which similar machines are grouped together in departments specialized according to similarity of operations or process. A functional structure is characterized by batch and queue production. Production in large batches enables the amortization of set-up times over many parts. And functional grouping makes it possible to maximize capacity utilization of both machines and workers and to increase efficiency at the level of workstations and functional departments. Organizations with a functional structure aim at the maximization of efficiency (at the work station and departmental level) by exploiting economies of scale.

*Hidden diseconomies of scale*

The same functional structure produces a lot of diseconomies of scale. The production of large batches in functional departments creates excessive micro inventories at work stations and macro inventories between departments. This has negative effects on costs, quality, flexibility and cycle times. Excess micro and macro inventories of work in progress (WIP) ties up a lot of capital and so diminishes the cash flow of a firm. Besides, excess inventory requires storage space and material handling such as stacking, moving, staging, counting, and re-packing. Because of the time lag between operations, material is subject to damage, obsolence and loss and defects may not be detected until after a long time. This makes it difficult to discover root causes and necessitates a lot of rework and scrap. At the same time batch and queue production disrupts the smooth and continuous flow of parts through the factory. Large batches and long waiting times reduce flexibility (the capacity to produce a mix of different product variants in varying quantities) and increase mean cycle time (cycle time being processing time plus waiting time). Because a batch contains parts for different orders, the variability of cycle times will also be high. In addition, the departments will be processing many different orders at the same time. Whenever disruptions occur, the various orders will begin to interfere with each other, causing backlogs to occur and delivery dates to be unreliable.

Workers in such an organization perform one specialized operation (for example cutting) on potentially all orders. At the level of the organization as a whole, everything is connected with everything else, as all operations are coupled to all orders. At the level of the job however, no one has much to do with anyone else. Persons may stand next to each other and perform the same operation, but they are working on different orders. In a functional structure, all preparatory work (such as product development, production planning and work preparation) and support functions (such as quality control, maintenance and internal logistics) are centralized. Decentralization of these functions to the shop floor is both impossible (workers lack the required overview of the interconnections between different operations) and uneconomical (it would destroy the only advantage of a functional structure: maximizing capacity utilization of machines and workers. In sociotechnical terms, such an organization is called a complex organization with simple jobs (De Sitter et al 1997). To illustrate in a diagram:




*Functional structures*

In the diagram, $X_{1...n}$ represents the number of orders that have to be processed and A … E represent the departments in which specialized operations are performed on all orders. An order is a customer with a wish; in this case a customer who wants a bicycle. In a hospital, that would be a patient with symptoms. In homecare, the orders are persons that need care. And in schools, the orders are students who need some form of education. Functional structures are therefore not only found in factories but also in offices, hospitals, homecare agencies and schools. In all these cases, the functional structure permits the full use of economies of scale. But in all cases the diseconomies of scale tend to overshadow the supposed efficiency gains. Functional batch and queue production, whether applied in industry, health care or education, produces high inventories and long waiting times and so has dramatic negative effects on costs, quality, flexibility and cycle and lead times. In addition, the complexity or deep division of labour in the primary process necessitates a centralization of preparatory, support and control functions.

*What did the Japanese sensei do?*

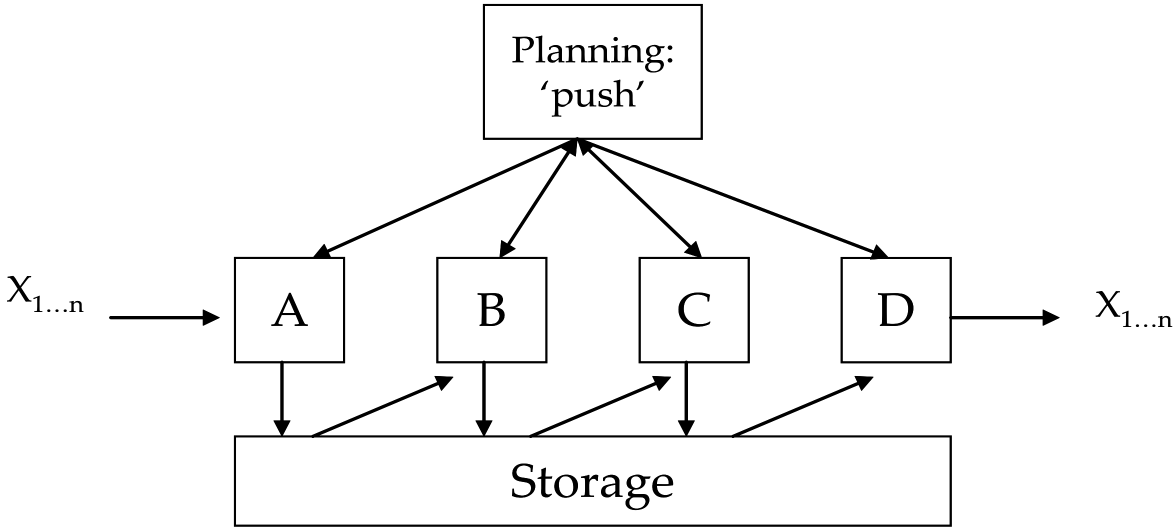
Let's go back to the bicycle factory. After a long period of fruitless urging, the Japanese consultants were finally persuaded to visit the facility in order to provide assistance. At first, the *sensei* assembled all the employees, including managers, on the shop floor. The General Manager was given the task of sawing in half all the racks for storing inventories of work in progress. The Japanese definitely do not like inventory; they consider that to be a form of waste. Next, they selected one order (a customer wanting a bike), identified the machines required to manufacture that kind of bike, unfastened them from the floor and moved them into a production unit sequenced in the order necessary for the production of that type of bike. In this way, they replaced a functional structure with a "flow" structure. The results were immediately perceivable. Since parts were immediately passed along to the next station after completing an operation, waiting times were minimized. This not only meant that inventories of work in progress vanished like snow in spring (large storage areas were no longer required) but also that cycle times were drastically reduced.

Of course, the bicycle factory could not create such production units for each individual order, as such a practice would require too many machine and work force capacities. For this reason, a second step was undertaken in which all orders were examined and subdivided into families of similar orders. Japanese experts call such a family or group of similar orders a "value stream". These different value streams of similar orders were then each provided with the necessary machine and work force capacities. In the case of the bicycle manufacturer, three streams were created: one each for steel, aluminium and titanium bikes. Grouping similar orders is based on similarity of routings and/or required operations.

A flow structure is the mirror image of a functional structure. Interdependencies at the organizational level are cut by the creation of three independent value streams with their own capacities. This allows the decentralization of preparatory, support and control functions to the three independent streams. And independent work stations in functional departments are now replaced by teams in which workers perform different, interdependent operations on a restricted number of similar orders. Operational preparatory, support and control functions can now be delegated to those teams. This enables the teams to participate in structural (improvement) and strategic (renewal) control.

*The problem of smart organizing solved*

Recall that we redefined smart organizing as organizing in such a way that on the level of groups or teams everyone is involved with everything. We now know that in order to reach this goal functional structures need to be replaced by flow structures. What is required is, in socio-technical terms, the transformation of a complex organization with simple jobs into a simple organization with complex jobs.

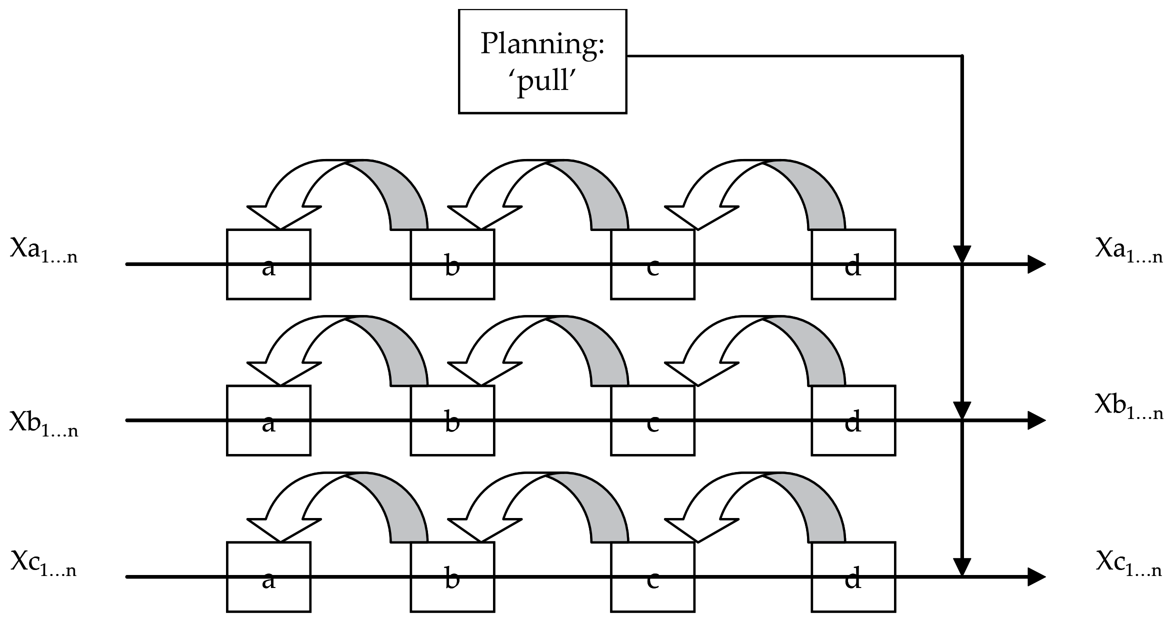



In a functional structure, all orders ($X_{1\ n}$) pass through departments specialized in terms of processes, and planning "pushes" work into the departments in a way that ensures maximum use of machine capacity. Organizing in such a way means organizing across the process: functional silos prevent orders from flowing smoothly through the process. In such a structure, planning tries to control throughput (what goes out) by regulating input, that is, by pushing shop orders into the functional departments. A push system works on forecasts of the future and so is an anticipatory system. However, since the future is unknown (machines might break down, employees fall ill, material be lacking and customers change orders in the interim), plans must be constantly adjusted by shifting orders ahead or delaying them. The result is a hectic production process and unreliable delivery times.

In a flow structure, the starting point is not division of work into similar activities, but division of orders into similar orders (Xa, Xb and Xc). Organizing in such a way means organizing, not across the process, but around similar order processes, order flows or value streams. In a next step:

- each value stream of similar orders is provided with the required machine and workforce capacities,
- preparatory and support functions are decentralized to the different value streams and
- the "push" system is replaced by a "pull" system.

In this way, economies of scale are replaced by economies of flow. The reduction of inventories and waiting times results in shorter cycle times, lower cost, better quality and more flexibility.

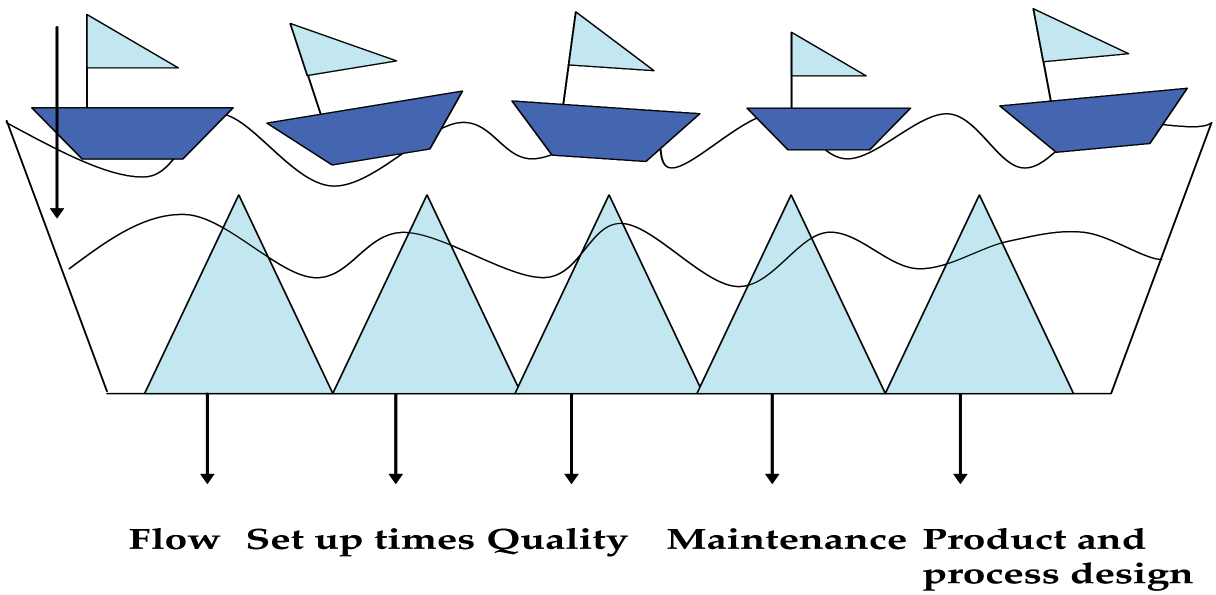



In this new structure, complex planning systems such as MRP II and ERP can be replaced by simple "pull" systems such as KANBAN. In a pull system WIP is controlled and output regulated. In its simplest form, this means that an order can only be entered as input when another order is discharged as output. Such a model is also known as the "Constant Work in Progress" system or CONWIP. In a more complex form, each station pulls orders from the preceding station. A well-known example is the so-called "two bin system". Each station has two bins or containers of parts to be processed. If one is empty, the preceding station then knows that a delivery needs to be made (JIT or "just in time" production is consequently only production without inventories under exceptional circumstances such as single piece flow). In both cases the accumulation of WIP is prevented. The principle is known from supermarkets. Filling shelves in response to anticipated customer demand ("push" system) will result in some shelves being overfull while others are empty. In a "pull" system, the state of the inventory on the shelves determines when they are filled, which means that it only occurs when customers remove items from the shelves.

*Flow structures*
The same structural change is applied when hospitals are organized around similar patient flows, when homecare providers such as District Care Holland are organized around autonomous district teams and when "team teaching" is used in schools and universities, for example in semester teams. A teacher is then a member of a team of teachers offering different courses to a limited number of similar students.

*The dangers of JIT: the creation of an internal catastrophic potential*
JIT means manufacturing products with as little inventory of work in progress as possible. In a functional structure inventories function as a safety device. Removing those buffers in a flow structure makes the process extremely vulnerable to disruptions and so

creates an internal catastrophic potential. Since you have less inventory, every disruption means that the next station and, ultimately, the customer has to wait. On-time delivery is then no longer possible. What occurs in such cases can be illustrated by comparing the primary process to a river. The boats sailing on the river are the orders (customers with wishes). The water level in the river represents the level of inventory of work in progress. The river has a number of rocks at the bottom. In a functional structure, the rocks are kept out of sight by the high water level. Offsetting this advantage are the afore mentioned diseconomies of scale: high costs, low quality and flexibility, long cycle times and unreliable delivery times.




JIT production as an idea means: lowering the water level. Doing so could produce the afore-mentioned economies of flow. The rocks at the bottom, however, prevent the realization of those economies of flow. So, lowering the water level not only makes problems more evident but also increases the urgency of removing them. Failure to address these problems would have catastrophic consequence for the organization as a whole. Reducing inventory without making other changes leads to a decrease in throughput, revenue and profitability. That means that in a JIT system with reduced inventory, the primary process of an organization is transformed into a high-risk system.

To avoid disasters that go with lowering the water level:

- The functional structure involving large runs must be replaced by a flow structure with small runs; failure to make this change will prevent elimination of micro and macro inventories.
- The "push" systems developed for planning can now be replaced by simple "pull" systems.
- Due to the small runs, re-setting times must be shortened. In a functional structure, large runs are employed to avoid the need to frequently re-set

machines.

- The flow is interrupted when defective products are passed along or machines breakdown; after all, there are no inventories to absorb the disruption. Quality must be produced at the point of production rather than inspected at a control station (Total Quality Control) and maintenance procedures re-organized (Total Productive Maintenance).
- Product and process design must consider the manufacturability of products. Neglect of precisely this consideration is the source of many root causes for disruptions during production.

The Japanese approach resembles HRO practices in its constant concern with reducing set-up times, improving quality and maintenance, and the consequences of product and process design for production. It is forced to have these concerns because of the other vales and goals that it promotes. Its primary aim is to reduce inventories of work in progress as well as cycle times. For this reason, it requires the structure of production to be changed from function to flow. Since the process then becomes extremely vulnerable to failure, it is necessary to develop mindful techniques. The same structural change makes these mindful techniques possible. Building blocks of the organization are now teams comprised of members who have insight into the coherence of the various activities that they perform on a limited number of similar orders. The teams are now made fully responsible for the operational preparation, execution and support of the process. Partly on this basis, they can be involved in the continuous improvement and renewal of processes and products.

**5. Science and practice: sociotechnical theory and lean production**

*The best of both worlds.*
Lean Thinking is based on a clear conception of what is a wrong and a right or smart way of organizing. Wrong is a functional, batch and queue organization. In that case, you organize *across the process*. Smart is a flow structure, in which case you organize around similar orders, that is, *around similar order processes*. Because an order is a customer with a wish, a flow structure can assume three forms. Organizing occurs

- around similar products or services (similar wishes of different customers) in a product-based structure;
- around similar customers (with different wishes) in a customer-based structure;[6]
- around similar projects (for customers with unique wishes) in a project-based structure.

My socio-technical friends would now state that this is nothing new, and they are of course right. What the Japanese have empirically derived from practice agrees with what Ulbo de Sitter (1981, 1994) previously theoretically deduced from a restricted number of systems-theoretical principles. I take this overlap to be evidence for the robustness of the proposed solutions.

Lean Thinking is an approach in search for a scientific foundation. For that, we can turn to Operations Management and especially to the science of factory physics as developed by Hopp and Spearman (2006). Duenyas (1989) even calls factory physics the science of lean manufacturing (see also Standard and Davies 1999, chapter 5). In this paper, I turn to modern sociotechnical theory as a complementary scientific foundation. Lean is primarily aimed at a reduction of inventories and cycle time. Factory physics shows that the success of this strategy is explained by a reduction of process variability. Modern socio-technical system theory explains the nature of the structural changes that are needed for such a reduction of variability.

*Modern sociotechnical theory*[7]

In the Japanese approach the same two-step design strategy is followed as in modern socio-technical theory (MST). In a first step, the production structure is simplified by replacing a functional by a flow structure. This constitutes the necessary condition for the decentralization of the control structure in the second step. In Lean Thinking, this strategy is derived from the practical goal of reducing cycle time (by reducing inventory and waiting time). In factory physics, the success of this strategy is explained by a reduction of process variability, because variability in a production system will be buffered by a combination of excess inventory, capacity and (cycle and lead) time. In MST, the strategy and its success is derived from the system-theoretical insights of Ashby (and its further development by Beer), Simon and Thompson. Briefly stated, they encompass the following. According to Ashby, systems need requisite variety to handle disturbances. In order reach the goal of requisite variety, systems combine a strategy of attenuating the variety of disturbances and of amplifying the variety of the regulator (Beer). According to Simon, systems attenuate or reduce variety by introducing a modular structure. In such a structure, the system is decomposed in subsystems in such a way that interactions within subsystems are high and interactions between subsystems are low. These correspond to the value streams or independent flows. This not only reduces internal complexity (no longer every element is connected to every other element of the system), but also external complexity (each subsystem "takes care" of its own part of the environment). According to Thompson, and applied to organizations, such a modular structure can only be achieved when reciprocal and sequential dependent positions are placed in the same organizational unit. This enables the replacement of costly inter-unit coordination (by planning and mutual adjustment) by intraunit coordination. By decentralizing coordination (or control), self-regulating modules are created, that possess the requisite variety to adequately deal with a reduced number of internal and external disturbances. Simplifying the production structure by creating relatively independent modules reduces the variety of disturbances and decentralizing the control structure amplifies the regulatory potential of the modules.

*Ashby on "requisite variety"*

From Ashby, we learned that a system must possess requisite variety and so has to attenuate or reduce the variety of disturbances and to amplify or increase the variety of the regulator. De Sitter applies this lesson to organizational design in the following way. The primary process or 'core technology' (Thompson) of an organization is defined as a network of functional interdependencies with individual jobs or workplaces as the nodes of the network. If in this network disturbances (control problems) occur, two things are possible. Either the disturbances are absorbed at the workplace, which requires control opportunities at the job level. If, however, such is not the case, the disturbances are passed along to the next station and so spread over the entire network. Applying Ashby's law at the level of the individual job explains quality of work: lack of required control opportunities increases stress risks and decreases learning opportunities (as in Karasek's demand-control model). Applying Ashby's law to the organization as a whole explains the quality of the organization. Lack of requisite variety at the level of the organization decreases organizational performance in terms of cost, quality, flexibility and time.

If lack of requisite variety explains both quality of work and quality of the organization, the next question is: what explains lack of requisite variety? To answer that question we have to look again to the primary process, defined as a network of functional interdependencies. More specifically, we now have to look at the structure of the network. The primary process has a performance aspect (the execution of performance functions) and a control aspect (the selection of performance functions). So, a primary process has a production structure (the grouping and coupling of performance functions) and a control structure (the grouping and coupling of control functions). It is the complexity of the production structure of the network that explains the probability of disturbances or control problems: the higher its complexity, the higher the probability of disturbances. Complexity of the production structure also explains the centralization of the control structure: the higher the complexity of the production structure, the higher the level of centralization of the control structure of the network, which explains the lack of control opportunities at the job level.

The redesign strategy follows logically from these insights. A reduction of the complexity of the production structure at the same time decreases the probability of disturbances (the attenuation strategy) and creates the precondition for the decentralization of control opportunities (the amplification strategy). In system-theoretical terms, effective and efficient control requires unity of place, time and action, that is, decentralized control.

*Simon on "the architecture of complexity"*

From Simon (1996) we learned that the complexity of systems is determined by the number of elements and relationships between the elements: the higher this numbers the greater the number of possible system states. In complex (physical, chemical and biological) systems this complexity is reduced by a hierarchical or modular structure. Such a system is decomposed into subsystems with high internal and low external interactions. This process of decomposition can be repeated on the level of subsystems until the level of system elements is reached. In this way a hierarchy of system levels, levels of recursion or levels of aggregation are produced. Simon calls this a "nearly decomposable system" because, at each system level, interdependencies within subsystems are high and between subsystems low.[8]

Applied to organizations, this means that all complex organizations are organized hierarchically, that is, decomposed into subsystems. However, in a functional decomposition near decomposability will be logically impossible. For, in that case, interdependencies between subsystems are high and within subsystems are low. Only decomposing in a market oriented way around similar orders (products, customers or projects) creates nearly-decomposable organizations. In such a structure, on the level of the organization as a whole, every activity is no longer connected to all other activities. And at the level of the subsystems everyone can participate in everything. A modular production structure is a precondition for making the modules self-regulating. Because the system is not fully, but nearly decomposable, a distinction is made between three levels of control. Teams are responsible for the operational control of the process on all aspects (integral control) and participate in structural and strategic control.

*Thompson on the design of work-organization structures*

Thompson defines organizations as open (or "indeterminate") systems that seek closure (or "determinateness").[9] As open, natural systems, organizations are confronted with both internal and external uncertainties and contingencies. The primary process or core technology of an organization is the source of its internal uncertainties.[10] External uncertainties stem from the environment of the organization. As rational, goal-directed systems, organizations try to reduce internal and external uncertainties. If successful, they resemble closed or "determinate" systems. In such systems, environmental adaptation takes place in a planned and controlled way

Since uncertainty has two sources, Thompson discusses the topic of the design of organizational structures in two different chapters. In Chapter 5 "Technology and structure", Thompson argues from inside out (by looking at internal interdependencies) and bottom up (by building up a modular, hierarchical structure from below). In Chapter 6 "Organizational rationality and structure", Thompson argues from outside in (by looking at external dependencies) and top down (by building a modular, hierarchical structure from above). In a last step, both perspectives are combined in a number of propositions.

*Organization design: inside out and bottom up*

In chapter 5 Thompson introduces his three well-known forms of internal dependence and co-ordination. He distinguishes three increasingly more complex forms of dependence between organizational positions: "pooled interdependence" in which contributions to the whole organization are provided by independent units, "sequential interdependence" characterized by one-sided input-output relationships of dependence, and "reciprocal interdependence" characterized by two sided input-output relations of dependence. To those increasing levels of dependency (which means increasing levels of 'openness' and complexity) correspond increasingly complex forms of coordination:

rules for pooled interdependence, planning for sequential interdependence and mutual adjustment for reciprocal interdependence.
Thompson then formulates his first general rule for the design of organizational structures: "Under norms of rationality, organizations group positions to minimize coordination costs" (Thompson 1967/2003: 57). From this general rule, a number of more specified design rules are deduced. First, to avoid costly inter-unit coordination by mutual adjustment (and planning), reciprocally (and sequentially) dependent positions should be grouped together in the same organizational unit:

> Organizations seek to place reciprocally interdependent positions tangent to one another, in a common group which is (a) locally and (b) conditionally autonomous [that is] autonomous within the constraints established by plans and standardization (Thompson 1967/2003: 58).

This is what the Japanese consultants did in the bicycle factory, when they repositioned machines and operators in a flow. They placed interdependent machines and operations for the same order in a common group or production unit. The workers operating the machines form a "local and conditionally autonomous team". The way of working is inside out ("where are the internal interdependencies located?") and in the next step, a modular hierarchy is build bottom up:

> When reciprocal interdependencies cannot be confined to intragroup activities, organizations subject to rationality norms seek to link the groups involved into a second-order group, as localized and conditionally autonomous as possible...We have now introduced the first step in a hierarchy ... Each level ... is a more inclusive clustering, or combination of interdependent groups, to handle those aspects of coordination which are beyond the scope of any of its components (59).

This multi-level modular structure is clearly intended to contain coordination within the hierarchy. Failure to construct such a hierarchy produces a proliferation of lateral relationships between subsystems, such as those existing in functional structures. Establishing lateral linkages is consequently not something that should be promoted as a design objective, as it is in Galbraith's discussion of the 'lateral organization' (1994) or in the 'shared service centres' and 'multidimensional organization' of Strikwerda (2005, 2008). On the contrary, the primary design objective is to avoid lateral linkages as much as possible. Put differently, the presence of many lateral linkages is a sure symptom of a wrong design.
As we saw in the bicycle factory, the Japanese consultants subsequently used a top down approach. They decomposed the heterogeneous set of orders into subsets of homogeneous, similar orders. These subsets of homogeneous orders are then coupled tot independent subsystems, that are provided with the necessary capacities. In this way, independent value streams are created at the macro level of the organization. If the

streams are too substantial, they are decomposed into segments that are as autonomous as possible. De Sitter (1981: 122) accordingly reverses Thompson's sequence rule. In order to reach the goal of teams with reciprocally interdependent team members at the micro level, designers start at the macro level with independent, homogeneous value streams:

| | Macro | Meso | Micro |
|---|---|---|---|
| Pooled | Independent streams | Segments within streams | |
| Sequential | | Segments within streams | |
| Reciprocal | | | Teams |

*Organization design; outside in and top down*

This agrees with the procedure that Thompson develops in Chapter 6, where he looks at the problem of organizational design from the outside in and top down. In Chapter 6, Thompson classifies environments along two dimensions. The environment of an organization can be static or dynamic. It may also be either homogeneous or heterogeneous. A heterogeneous environment occurs, for example, when a company manufactures several products and therefore has to deal with a number of different customers. Dealing with different unions or with different suppliers would be other examples. According to Thompson, a dynamic environment requires decentralization. Otherwise, the organization reacts too slowly to environmental changes. Furthermore, in a heterogeneous environment, organizations should look for homogeneous segments within that heterogeneous environment and couple those segments to independent organizational subsystems. This obviously corresponds to the top down approach that is used both in Lean Thinking and in MST:

> Under norms of rationality, organizations facing heterogeneous task environments seek to identify homogeneous segments and establish structural units to deal with each (70).

Combining the internal and external perspectives, Thompson arrives at the following conclusions. In a stable and homogeneous environment, boundary spanning units (purchasing, sales and marketing, production design) can be separated from the primary process or core technology and the primary process can be shielded from environmental influences by a strategy of buffering, that is, by placing inventories on the front and back-end of the process. In this case, a centralized structure with a functional organization for preparation, execution and support is to be expected.

> When technical-core and boundary-spanning activities can be isolated from one another except for scheduling, organizations under norms of rationality will be centralized with an overarching layer composed of functional divisions (75).

Note that environmental stability and homogeneity explain the possibility of isolating and buffering the primary process and the feasibility of a centralized functional structure.

*Ford: The functional unitary form (U-form)*

The classic example of this is undoubtedly the Ford Motor Company during its years of success. Henry Ford saw his mission to be one of providing the entire American population with ever better and cheaper cars. His market strategy was directed at customers who were thinking "if X dollars cheaper, I would have bought this car". To increase market share, Ford introduced better and less expensive Model Ts on the market at regular intervals. Under these stable (a constantly increasing demand) and homogeneous conditions ("it doesn't matter which car they buy as long as it is a black, model T"), Ford followed a three-pronged strategy: (1) vertical integration by extensive forward and backward integration, (2) permanent but abrupt product and process innovation enabling better and cheaper cars to be intermittently introduced on the market, and (3) a functional organization of the production process, based on a high level of standardization of operations, machines and tools. To reduce extremely high levels of labour turnover, Ford introduced the "5 dollar day" (a 100% percent wage raise) and a drastic reduction of daily and weekly work hours.

Ford became so rich by using this strategy that he could buy out all his shareholders. In this way, he no longer had any trouble with what he regarded as lazy and meddlesome investors who only complained about low dividends and endangered the fulfilment of his mission: providing every American with a cheap high quality car. At the same time, being in full control brought about his downfall in the competition with General Motors (GM).

*GM: the multi-division structure (M-form)*

Under the leadership of Du Pont and Sloan, GM developed a different market strategy, directed at customers who thought "if I could have this car in another colour, with a more luxurious interior and with other accessories, I would pay X dollars more". The GM strategy was therefore based on product differentiation for three market segments (low, middle and high) and on various types of cars within each segment. Because the complexity of producing and marketing so many different types of cars surpasses the capacities of a centralized functional structure, Sloan introduced the multi-product division structure or M-form. In such a structure formerly centralized functions such as purchasing, planning, marketing and sales are decentralized to the independent product divisions.[11] Sloan needed to do so, for every introduction of a new type of car would lead to an exponential growth of interdependencies between centralized functions and decentralized manufacturing. In Thompson's words:

> Under conditions of complexity, when the major components of an organization are reciprocally interdependent, these components will be segmented and arranged in self-sufficient clusters, each cluster having its own domain i.e. product and customer range (76).

The M-form amounts to the introduction of a modular or flow structure at the macro level of divisions. It is important to note that decentralization did not extend beyond the division level. At the next lower levels the structure remained functional.
Because Ford stubbornly kept to his own strategy he lost evermore market share to GM. In fact, Ford was initially saved by anti-trust legislation, which prevented a takeover by GM, and subsequently by WW II, which compelled all carmakers to switch to war-time production. After WW II, the Ford Motor Company followed the example of GM and introduced the M-form.

*Toyota: flow structure "all the way down"*
At this moment the leading position in the car industry has been taken over by Toyota, and we know why: Toyota organizes according to a flow structure that extends "all the way down". Toyota's strategy is focused on: (1) vertical disintegration, which is to say that integration is replaced by intensive cooperation with a limited number of carefully selected main suppliers; (2) a flow structures "all the way down" in which routines are simultaneously developed and critically reviewed, resulting in (3) a reduction of the distance between incremental improvements and abrupt innovation.
The Toyota system was developed in the fifties in reaction to the specific characteristics of the Japanese sales and capital markets. In comparison to America, the Japanese sales market is small and varied (private cars, delivery vans, light and heavy freight vehicles, ambulances and fire engines). This forced Toyota to design factories that were able to produce a varied mix of cars in varying quantities (qualitative and quantitative flexibility), in an effective and efficient manner:

> The American automotive market was virtually unlimited, and each assembly plant specialized in its own specific product family. For example, in 1950 the Ford Rouge plant was pumping out 7000 similar vehicles each day. This contrasted sharply with Toyota, which was producing many different vehicles in small volume. Toyota did not have the resources or the market to support many plants, and the product mix was too eclectic to justify dedicated plants (Standard, Davis 1999: 60).

Moreover, the lack of capital forced Toyota to work with low inventories (to reduce the amount of capital tied up in inventories) and with short cycle and lead times (to fasten the process of earning money and improve the cash flow). The Toyota System is the result of finding ways to reach those goals of flexibility and cycle time and inventory reduction.

The Toyota way of thinking and doing is radically different from the functionally organized mass production of Ford and GM. What has first priority in the Toyota system (lowering inventories, lowering lot sizes, shortening cycle times, and involving workers in operational planning, quality control and maintenance) is unthinkable in a functional structure. This consistently and almost brazenly implemented structural approach is what it shares with MST (see insert). Both use a structural approach in the diagnostic step of the intervention cycle ('are problems structure related?') and in the design step ('how should we design independent value streams or flows and segments within those flows?'). There are a number of misunderstandings about such an approach that I, in conclusion, would like to clear up.

*Modern socio-technical theory*

**Design object**: the primary process consisting of operations with performance and control aspects. The primary process is a means for achieving many different, potentially conflicting and changing organizational goals.

**Design objective**: requisite variety and controllability as a generic structural capacity, which is to say as a structural feature that enables organizations to simultaneously achieve many different goals and modify goals at the appropriate time.

**Design strategy**: simplification of production structure as a condition for the decentralization of the control structure.

**Design criteria** or functional requisites: pertaining to three areas, namely the quality of the organization (flexibility, controllability and innovation), of the work (stress risks and learning opportunities) and of the labour relations (cooperation instead of conflict).

**Design parameters** (the 'knobs' a designer can turn): parameters relate to the production structure (functional concentration, specialization and division) and to the control structure (separation of performance and control, control level, control domain, control range and control function).

**Design sequence rules**:

1. PCI model, which is to say first production structure, then control structure and finally information structure.
2. Production structure top-down: parallel flows, segments within flows and conditionally autonomous teams.
3. Within the production structure: first the 'make' process and then the preparation and support functions for the make process
4. Control structure: bottom-up and hierarchical, with teams responsible for integral control on the operational level and involved in improvement at the structural level and renewal on the strategic level.

## 6. Misunderstandings about the notion of structure

*Standard objections*

Standard objections against a structural work-organisation approach always take the following form. It is claimed that not structure but something else is important. In this case, "something else" means that processes (and not structures), people (and not structures) or culture (and not structure) are important.

*Structure and process*

"Not structures but processes are important." This is a remarkable statement; after all, a process is a non-arbitrary, that is, structured sequence of events. A melody, for example, is a non-arbitrary sequence of sounds. In a primary process, these events are operations with performance and control aspects. What ensures that the sequence of operations is non-arbitrary is the structure of the process. There are consequently no processes without structures. The contrast is therefore not between structure and process but between organizing across all order processes (functional structure) and organizing around similar order processes (flow structure). Of course, a flow structure enables more attention to be spent on the control, improvement and renewal of processes. That is why structural changes are so important.

System theorists define a social system and therefore also an organization as a process with a structure. A structure is an enabling constraint: by constraining the behaviour of the elements it enables the system to function in a certain way. The general idea can be explained in a simple way with the help of the example of a traffic light (the example is from Ashby). A traffic light is a system with three elements (N=3); it consists of a red, yellow and green light. The number of relations between the elements is N(N-1)/2 when relations are symmetrical (exchange, communication) and N(N-1) when relations are a-symmetrical (buying and selling, asking and answering). Note that the number of possible relations between elements grows exponentially with the number of elements. A system with four elements already has 4 x 3 = 12 potential asymmetric relationships. In the simplest case, elements and relationships can assume two states: they are on or off. The number of possible system states is the $2^N$ or 8 (calculated in terms of elements) and $2^{N(N-1)}$ or 64 (calculated in terms of a-symmetrical relationships). We know however that only three of the eight or 64 possible system states actually occur; each of the three elements is turned on in a fixed sequence. What ensures that from the eight or 64 possible system states only three are realized is the structure of the system. So, the structure functions as an "enabling constraint". Because the structure constrains the behaviour of the elements, it enables the system as a whole to function as a traffic light. Simon has shown us that the same applies to organizations. Organizational structures ensure that not everyone has to be involved with everyone and everything. Hierarchical or modular structures make it, on the other hand, possible for everyone to participate in everything at the team level.

*Structure and people*

"Not structures but people are important." Of course, people are important. But it is precisely for this reason that so much attention must be devoted to the structure of the work organization within which they work. After all, this structure determines which skills are required, with which control problems people are confronted and which possible control opportunities are available to them. In the words of De Sitter, human resources, talents or skills must first be *mobilized* (a matter of work organizational policy) before they can be *managed* (a matter of personnel policy). Some organizations organize in a way that maximum use is made of the talents of employees, others in a way that minimizes their dependence of employees. Obviously, this has consequences for the way these resources are to be managed.

In general, what people do, think and feel can be explained by referring to the persons that act, think and feel in a certain way and by referring to the situation in which their acting, thinking and feeling takes place. Designers of work organizational structures find people so important that they apply a priority or sequence rule. This rule reads as follows: before you blame people for improper actions (they make errors), improper thinking (they are mistaken) and improper feelings (they feel stressed), you first have to ask yourself if this is not caused by the situation in which they act, think and feel. In this way you prevent blaming the victim, that is, blaming someone for what is actually caused by structural flaws in the system in which they work.[12]

*Structure and culture*

"Not structure but culture is important." Such a statement presupposes that we know the difference between structure and culture is. This is a notoriously difficult question. First, there are several definitions of culture in circulation. Second, culture interventions are, in practice, most of the time coupled to structural interventions. For example, Shell required a cultural transformation to make an end to the fraudulent practices being perpetrated there. Many of the measures taken were, however, structural measures: the two head offices were merged, while responsibilities and authorities were re-defined (organizational structure). Furthermore, some people were dismissed, while others were promoted (personnel structure). Evidently, structural measures are necessary to facilitate a cultural transformation. I will demonstrate that, no matter the definition of culture used, cultural interventions are and must always be associated with structural interventions.

*Human actions in social contexts*

The social or behavioural sciences deal with what people do, think and feel in social contexts or environments. To explain what we do, think and feel, we may refer to the persons that act, think and feel in a certain way (the psychologist's area of expertise). We may also, however, refer to the environment or social context in which these persons find themselves. Structures and culture both belong to our environment. In this sense, it is misleading to define culture as a person's "mindset" or mental models. Instead, an understanding of culture should be used to explain why a person has a certain mindset; for example, by pointing out that that person grew up in a Dutch culture. But, of course, the Dutch culture does not has a mindset nor is it composed of a number of mental models.

*Institutions*

Let us call our social environment or context our institutional environment. Institutions function to reduce complexity. As instinct poor beings, humans have to find out everything for themselves. However, the world is too complex in this respect. As limitedly rational beings, we need institutions that reduce a part of the complexity of the world for us. Without these institutions we would not survive and in that sense "we are necessarily institutional beings" (Simon). Institutions reduce complexity for us in the form of behaviour expectations. These behavior expectations are called decision premises by Simon and include both fact and value premises. Simon distinguishes between institutional premises (that come 'from the outside') and personal premises (that come ‘from the inside’). In a decision, we synthesize institutional with personal premises. So, as teachers, students, parents and car drivers, we know what is expected of us. We know the rules of the game, and decide within these rules if and how we will follow them.

Institutions can be found at the macro level (such as politics, law and science), at the meso level (such as organizations) and at the micro level (such as immediate “face-to-face” relationships). Institutions can be informal and develop into formal institutions. The latter case involves both a separation of rule makers and rule followers or takers, and the appointment of third parties for monitoring the behaviour of rule takers. The distinction between informal and formal institutions can be used in a diachronic and synchronic way. Used diachronically, we refer to the process of formalization (from street football to football in the context of the Dutch Professional Football Association competition). Used synchronically, we refer to the fact that formal institutions always have informal aspects. After all, the informal organization is defined as that which (1) is left open by and/or (2) deviates from the formal organization. So, the formal organization has both epistemic and practical priority. If you don’t know the formal organization, you cannot now what is left open by or deviates from the formal organization. And in a bureaucratic structure little is left open which produces deviations of the rules.

*A broad anthropological notion of culture*

With this conception of institution in place, we can make a distinction between a broad anthropological and a limited sociological conception of culture. Anthropologists originally mapped out the institutions of far away, foreign countries: for example the political, religious and family institutions in these far-off places. As a result, they discovered that what is taken for granted in these foreign countries is considered strange and exotic by us Western people and vice versa. So, we labelled them exotic, non-western cultures and discovered through our confrontation with them that we also belong to a culture. We discovered, in other words, that we in the West have more in common than we originally thought.

Nowadays, many anthropologists stay at home and apply their ethnographic methods of fieldwork research to the cultures of neighbourhoods, the shop floor and the office. In this way, we discover cultural diversity at home.

To be recognized as a separate discipline, anthropology had to be first differentiated from psychology, and for that, anthropologists used the work of such writers as Durkheim, one of the founding fathers of sociology.[13] At least since anthropologists stay at home there have been differentiation problems between anthropology and sociology.

One possible distinction between these disciplines can be stated as follows: anthropologists use a broad definition of institutions. Institutions include the rules of the game as well as the values and ideas on which the rules are based. Values, ideas and rules together structure what we do, think and feel. Anthropologists are different from sociologists insofar as they study the cultural (i.e. the self-evident, taken for granted and/or symbolic) aspect of these values, ideas, rules and practices. They therefore study the same thing as sociologists but focus on the unquestioned aspect of it.

Luhmann (2000) plays with this notion of culture in his book *Organisation und Entscheidung.* Institutions provide us with behaviour expectations. Following Simon and applied to organizations, Luhmann calls these expectations the value and fact premises supplied by the organization. Those organizational premises are the object of formal decision-making. The culture of an organization then refers to the subset of fact and value premises that are taken for granted and therefore not the object of formal decision-making.

*Cultural and structural interventions*

When use is made of this conception of culture, a cultural intervention is, by definition, a structural intervention. After all, an attempt is made to change the self-evident part of the structure, which is to say the values, ideas, rules and practices that are taken for granted. Furthermore, in this conception, it is immediately clear why cultural interventions are so difficult: you don't give up easily what is self-evident for you.

For this reason, what the Japanese experts did in the bicycle factory amounted to a culture shock. They introduced values, ideas, rules and practices that were, for the Japanese, self-evident, but counter-intuitive for those working in the bicycle factory. This has nothing to do with something inherent to Japanese culture. Apart from the fact that lean production largely agrees with the socio-technical theory developed in the Netherlands, the Japanese experts largely adopted it from America (Ford used manufacturing cells in an early period of its existence). Moreover, the principle of group technology (organization around families of similar parts) originated in Russia and was further developed by Burbridge in England. And KANBAN was inspired by American supermarkets.

*A limited sociological notion of culture*

In a limited sociological view of culture, the concept of structure is reserved for the rules of the game and the concept of culture applies to the values and ideas on which these rules are based. In this conception, anthropologists do not study a sub-set of what sociologists investigate (the self-evident part of the values, ideas and rules), but a different set of things (values and ideas as against the rules of the game). In this manner, the relationship between structural and cultural changes can be investigated such as is done in the work of Weber and Archer (1996), as well as in the semantic, sociology-of-knowledge studies by Luhmann. In institutional theory, we encounter this distinction in the conflict between "the structuralists and culturalists". Structuralists such as Streeck and Theelen (2005) place the emphasis on the interest and power positions created by the rules of the game and on the conflicts about the rules themselves. Culturalists such as Meyer and Rowan (1983) or DiMaggio and Powell (1983) place the emphasis on the self-evident, shared and taken for granted values and ideas on which the rules are based. This conflict has been or should now be settled. Culturalists should know that ideas can also be reasons for fighting and, especially in the form of ideologies, can also be put to strategic uses in defending or attacking interest positions. And structuralists should know that existing structures may be based on self-evident, taken for granted values and ideas and that we need new, creative ideas for the design of new rules.

*Cultural and structural interventions*

In this limited, sociological perspective of culture, the term culture does not refer to the self-evident aspects of social structures but to something that is different from social structures. Applied to the problem of cultural interventions, this means that focus is placed on the changing of values and ideas. Still we all know that cultural interventions without structural interventions remain nothing more than political symbolism. It is easy to announce a commitment to small inventories and short lead times, an opposition to fraud or a position in favour of "profit, planet and people," but when such announcements are not translated into appropriate structural measures, they lose their credibility. In this sense, we can say in a Kantian manner that we are blind without ideas and powerless without structures. That is why we need people who are able to develop clever ideas about smart organizing and the structures it requires, no matter if such people have their roots in science or in organizational practice.

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(Endnotes)

1. As in Luhmann (2000: 302); "Die Organisation der Organisation" (the organization of the organization).

2. Both Natural Accident Theory or NAT and High Reliability Theory or HRT start with symptom-based and end up with cause-based definitions. Such a redefinition requires clearing up the symptom-based data base: some organizations don't fit the causal criteria.

3. HRT would then meet the macro level power structures that are stressed in NAT.

4. On the technique of why questions with contrast spaces, see Garfinkel 1981).

5. The following account is taken from Womack and Jones (2003). Standard and Davis (1999) and Nicholas and Soni (2006) are also used.

6. Note that a situation in which the same kind of customers have similar wishes (so-called product-market combinations) will be the exception.

7. For the fundamentals of system theory, see Achterbergh and Vriens (2009).

8. For recent applications of the idea, see Garud, Kumaraswami, Langlois (eds.) (2003).

9. Closed or rational systems are determinate systems (Ashby), that is, systems that know and control all relevant internal and external variables. Open or natural systems are indeterminate. So, Thompson does not introduce a third, open systems approach (as in Scott), but combines the closed and open approach. In this he follows Simon's notion of bounded rationality: organizations are rational systems by intention, but only in a bounded way.

10. Note that technology and levels of technical rationality refer to the primary process (long-linked, mediating or intensive) and not to the level of technological development of the means used in those processes (you handle tools, steer machines or control automated machines).

11. This history is described by Chandler (1962; 1997) and revised by Freeland (2001).

12. For more details, see Christis (1998).

13. This development of the discipline is nicely described in the biography of William Rivers (Slobodin 1978), one of the founding fathers of English anthropology and one of the main characters in Pat Barker's novel trilogy *Regeneration*.