Reader for the

18. Interdisziplinary Discussion

Systems, Processes, and their Management

An event at the Institute for Computer Science supported by the
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`http://mint-leipzig.de/2021-07-23.html`

Introduction

The 20th century is the century of development of the industrial mode of production. This development is characterised by

- the development of the means – of the technical principles that can be used in production,
- a huge unfolding of production-organisational interdependencies.

Systemic concepts are applied to cope with the increasing complexity of the processual interweaving of this totality: Processually closely related elements are combined into a *system* whose dynamics is still amenable to description. The "outside" of that system is significant in two ways,

- as source of a throughput that triggers the system's internal structures,
- as target of the system's purpose in the overall context.

In a systemic world, however, that "outside" is nothing else than the totality of all other systems. System formation therefore means to decompose the processual complexity of the totality into, on the one hand, systemic processes *within* a context and, on the other hand, coupling processes *between* such systems. In this sense, the concept of system is central for us to grasp both the descriptive and the real-world structuring processes of modern productive contexts.

Applying practical design on a systemic basis, the systemic thought materialises in reality – in the advancement of a systemically reflected reality, forms of movement emerge and institutionalise, which follow systemic delimitation and control and thus lead to a co-evolution of such forms of reflection and forms of practice. This is not an invention of humans, but the essential core of many "natural" large-scale biological, population-dynamic and social processes, from the "formative" influence of an anthill in the forest on its environment to socio-economic, socio-ecological and socio-cultural processes.

With the unfolding of the industrial mode of production, this systemic structure also unfolds and changes. With the replacement of (old) private procedural skills by the application of (new) technical principles, the focus of the industrial mode of production shifts in a first phase towards increasing importance of systemic production-organisational forms of *description* that can be realised with workers who are easy to "train". The clock rate of the production-organisational description determines the clock rate of this form of cooperative action, particularly impressive with the introduction of the conveyor line.

However, this is only half the story, because the productively effective preparation of technical principles as technical means can in turn be conceived as a systemic process that aims to encapsulate the active principle in a component as a black box whose procedural use is reduced to the operation of a corresponding interface. Thus the carrier of processual knowledge required in the (comprehensively understood) production process is split further: alongside the semi-skilled worker we find the engineer's mastery of the technical principle. The latter skills are required less in production itself than in the design, preparation and maintenance of production, and thus belong to a system in which the system of (immediate) productive labour is embedded. The same applies to the production-organisational work of the manager.

The unfolding of the industrial society is thus also linked to the unfolding and differentiation of *professional profiles.* While Marx in the second half of the 19th century still makes a clear distinction between bourgeois and proletarian, this differentiation leads above all to a differentiation on the side of the proletarians, into *blue collars* and *white collars.*

Systemic approaches are confronted with the dialectical contradiction of unity and diversity. Technical principles are different *unities* obtained from a diversity of sources of experience through a special process of abstraction. The causalities within such a unity of a technical principle are represented in a scientifically based conceptual system that has to be acquainted to develop the required private processual skills of a professional in that technical area. Technical principles can be applied in a variety of real-world situations thus reproducing diversity from unities. The reproduction of this socially available processual knowledge takes place systemically in the training of professionals, the application in practice and the socio-political activity of professional associations of a variety of engineering profiles. Conversely, production-organisational contexts are characterised by the interplay of *several* technical principles. Hence the recovery of diversity from these unities is a difficult process of combination of appropriate principles (available as components) into productive units as "special wholes", i.e. systems.

Such a design of systems from components is driven by many competing aspects. Szyperski shows in chapter 8 of his book *Component Software*[1] how such different analysis concerns influence the practical design of software components and thus directly the real-world processes in which these software components are used. Differently prioritised requirements such as analysability, extensibility, maintainability, fault tolerance, bug containment, combinability, and separate compilability result in differently designed systems and realise differently tailored real-world dynamics, each with its own advantages and disadvantages.

With the unfolding of the industrial society, demands on the *management* of such processes are also changing. In 1911, F. Taylor was still in favour of strengthening the role of production-organisational descriptions that are simply rolled out in the medium of workers. This further develops in the introduction of assembly line systems and the management of largely unskilled and semi-skilled workers in a factory which is imagined to work mechanically like a machine. In most management theories the terms *management*, *leadership* and *personnel management* are largely used synonymously. But management requires process-planning and process-analytical skills as well as skills in personnel management. *Management as a systemic function* is – at least on this theoretical level – tied to the manager as an individual leader. There is little focus on the relationship to top technical personnel and other employees with specific knowledge about the technical principles.

However, with forms of cooperative action in multi-stakeholder contexts relationships are coming into the focus, where more deeply layered processual knowledge from different areas must be brought together and other forms of management as a systemic function are required.

[1] Clemens Szyperski (2002). Component Software. Addison Wesley. 2nd edition.

About the Content of this Readers

In the context of our "Interdisciplinary Discussions", several readers have already been produced. The reader offers a more detailed explanation of the aspects to be addressed in the discussion that cannot be presented in such detail in the invitation to the discussion. Moreover, relevant essays on the theme or even a selection of specific literature on the topic of the discussion were compiled, which is usually rarely considered in this combination.

Our course *Modeling Sustainable Systems and Semantic Web* already for several years addresses questions of modern technology development in digital change. It emphasises at the concepts of technology, co-operate action, common action spaces, and systemic approaches to contradictory requirements. Today, such contradictory requirements not only characterise the everyday technical challenges of the engineer, but are also increasingly appearing as challenges to the management of production-organisational processes.

In the summer term 2021, we used the seminar within this course for a more detailed study of different management approaches to learn more about these problems and solution attempts. Due to the Corona restrictions both the lecture and the seminar were hold in online format.

The main objective of the seminar was to link the findings on systematic innovation methodologies and system concepts from the previous semesters with these approaches and to better understand to what extent systematic and systemic engineering methods also play a role in management today.

The seminar started with two introductory sessions. In the remaining sessions, 11 students presented different management approaches. For each session a handout was distributed in advance and seminar notes on the topic were subsequently published. These materials are compiled in this reader. Slides, notes from the chat and additional material are available from our github repository[2].

As in previous semesters, the seminar was designed as an academic seminar centered around a topic that was new not only to the students but also to the staff. This allows for an academic discussion at eye level with the students. The aim of such a seminar is not to find *the truth*, but to shed light on aspects of a complex context and to make it conceptually more accessible. Hence also this reader cannot count as a *summary* of the seminar but can only highlight some aspects of the discussion.

Hans-Gert Gräbe, July 18, 2021

[2] `https://github.com/wumm-project/Leipzig-Seminar`

Seminar Schedule

13.04. Kick-off Meeting. Introduction to the seminar topic.
Discussion of the seminar plan. (Hans-Gert Gräbe)

20.04. System Management, Organizations, Systems.
General Management Challenges (Hans-Gert Gräbe)

27.04. Business Modelling Basics, ISO 9000 and CMMI (Hans-Gert Gräbe)

04.05. Management by Incentives (Veronika Heuten)

11.05. Russell Ackoff. System Thinking and Management (Jannis de Riz)

18.05. MBO – Management by Objectives (Franziska Görg)

25.05. Business Process Definition Metamodel – BPDM (B.D.)

01.06. The SMART Approach (Axel Schuster)

08.06. Goal-Models and the i* Modelling Method (Marie Windhorst)

15.06. Mintzberg on Management (Felix Walter)

22.06. The Toyota Management System (Toni Pfeiffer)

29.06. Taylor's Principles of Scientific Management (Stefan Grote)

06.07. Russell Ackoff. Interactive Planning (Daniel Werner)

13.07. Anton Kozhemyako. Contradictory Business Processes and Schematization (Lukas Heink)

20.07. Evaluation and lessons learned

System Management, Organizations, Systems. General Management Challenges

Hans-Gert Gräbe

19 April 2021

1 Once more about the goal of the seminar

Systematic innovation methodologies such as TRIZ are essentially based on a better understanding of the development dynamics of corresponding (technical and non-technical) *systems*. The results are rooted in engineering experience from structured processes of planning, implementation and operation of technical systems. Increasingly, cooperative interdisciplinary collaboration matters rather than the one brilliant mind that commands thousand hands. The *socio-technical character* of contradictions is thereby intensified and opens up new dimensions of contradiction management.

Today, managers face similar challenges when it comes to placing decision-making processes on a systematic basis, aligning the processes under control with long term goals, and also achieving the targeted goal corridors. It turns out that many engineering experiences on structured procedures in contradictory requirement situations can be transferred to this area, which has been investigated within the topic "TRIZ and Business" for 20 years.

Nevertheless, experiences and approaches to theories of systematic management are based more broadly and also have much longer historical traditions. *In the seminar*, we want to study this field more closely, with special attention to cooperative approaches in interdisciplinary contexts.

2 Systematic Management Basics

"*Systematic management* is an approach to management that focuses on the management process rather than on the final outcome. The goals to this approach to management were:

- To create specific processes and procedures to be used in job task completion.
- To ensure that organizational operations were economical.
- To ensure that staffing was adequate for the needs of the organization.
- To maintain suitable inventory so that the demands of consumers could be met.
- To establish organizational controls." [3]

These points require a *planned* approach, based on a *conceptual understanding* of the process landscape in an appropriate explicit form of description and *intelligible actions*.

The formulated intelligible actions – the *plan* – is in *contradictory tension* with the processes actually taking place: On the one hand, it has a controlling effect on these practices, on the other hand, those practices partially resist this control.

This difference must be fed back to the planning process as an *evaluation of experienced results* in order to keep also the divergence between plan and reality under control.

Relating planning and experience dimension is only possible on a language level and requires a *system of notions* to accompany the practical real-world development by a discursive process (as *practice of thinking*).

This system of concepts is more stable than the real-world practices, but it is not static – it develops together with the practices.

> **Remember:** *World* is *reality for us* and thus reality in the process of conceptual grasping.

These basic considerations are about *processes* and *procedures* within an *organization.*

3 Organizations

What is an organization? Wikipedia distinguises between formal aud informal organizations.

Formal organizations. "An organization that is established as a *means for achieving defined objectives* has been referred to as a formal organization. Its design specifies how *goals are subdivided and reflected* in subdivisions of the organization. Divisions, departments, sections, positions, jobs, and tasks make up this work structure. Thus, the formal organization is expected to *behave impersonally* in regard to relationships with clients or with its members. [...] A *bureaucratic structure* forms the basis for the appointment of heads or chiefs of administrative subdivisions in the organization and endows them with the authority attached to their position." (Wikipedia, my emphasis)

See about the "impersonality" also the "automaton" in the quote by Marx in my first lecture.

Informal organizations. "[...] The informal organization expresses the personal objectives and goals of the individual membership. Their objectives and goals may or may not coincide with those of the formal organization. [...]" (Wikipedia)

The further explanations in Wikipedia remain weak and contradictory. Structure-building processes and especially shared conceptual systems also develop in informal organizations, with exciting new structuring processes of co-operative action taking place that are of particular interest to us in the seminar. Wikipedia is a reflection of the weakness of the conceptual basis in this field.

Also ORG – the *organization ontology of the W3C* [4] – considers `org:OrganizationalUnit`, `org:FormalOrganization` and `org:OrganizationalCollaboration` as subconcepts of the concept `org:Organization` but does not mention informal organizations. In their definition an organization

> represents a collection of people organized together into a community or other social, commercial or political structure. The group has some common purpose or reason for existence which goes beyond the set of people belonging to it and can act as an Agent. Organizations are often decomposable into hierarchical structures. [4]

`org:Organization` is related to `foaf:Agent`,

> ... the class of agents; things that do stuff. A well known sub-class is
> `foaf:Person`, representing people. Other kinds of agents include
> `foaf:Organization` and `foaf:Group`. [1]

A `foaf:Group`

> ... represents a collection of individual agents (and may itself play the role of a Agent, i.e. something that can perform actions).
>
> This concept is intentionally quite broad, covering informal and ad-hoc groups, long-lived communities, organizational groups within a workplace, etc. ...
>
> While a Group has the characteristics of a Agent, it is also associated with a number of other Agents (typically people) who constitute the Group, its members. ... The basic mechanism for saying that someone is to use the member property of the Group to indicate the agents that are members of the group.

The terms Agent and Group thus introduce self-similar concepts of structures that are *capable of action.* This corresponds to the legal construction of a *juridical subject* in the sense of the Civil Code (BGB) if *responsibility for the consequences of action* is added.

4 Organizations as Socio-Technical Systems

While in the Wikipedia definition positions, jobs and tasks are mentioned, but beyond bureaucracy no people, in this definition an organization is a "community of people". However, it has a goal that does not result from the set of goals of the people involved, but is an emergent function of the organization – the whole is more than the sum of its parts in the sense that relational synergy effects are of special importance in such an organization.

This corresponds closely with the *system concept in TRIZ*:

> A system (lat. greek "system", "composed", a whole consisting of parts; connection) is a set of elements that are interconnected and interact with each other, forming a unified whole that possesses properties that are not already contained in the constituent elements considered individually. [5]
>
> A *system* is a set of elements that are in relationship and connection with each other and that constitute a well defined unity, an integrity. The necessity of the use of the term "system" occurs when it is required to emphasize that something is large, complex, immediately not wholly comprehensible, but at the same time a unified whole. Unlike the notions "set" or "aggregate", the concept of a system emphasizes the ordering, the integrity, the regularity of construction, functioning and development. [7]

Ian Sommerville [6] also starts with the concept of a system and moves from there to the concept of *organization.*

> A system is a meaningful set of interconnected components that work together to achieve a specific goal. [6]

Right after that comes a distinction between technical and socio-technical systems:

Technical computer-based systems are systems that contain hardware and software components, but not procedures and processes. ... Individuals and organizations use technical systems for specific purposes, but knowledge of that purpose is not part of the system. For example, the word processor I use does not know that I am using it to write a book.

Socio-technical systems contain one or more technical systems, but beyond that – and this is crucial – the knowledge of how the system should be used to achieve a broader purpose. This means that these systems have *defined work processes*, *human operators* as integral part of the system, are *governed by organizational policies* and are *affected by external constraints* such as national laws and regulations.

Essential characteristics of socio-technical systems:

1. They have special properties that affect the system as a whole, and are not related to individual parts of the system. These special properties depend on the system components and the relationships between them. Because of this complexity, the system-specific properties can only be evaluated when the system is composed.
2. They are often not deterministic. The behaviour of the system depends on the human operators and on other people who do not always react in the same way. Also, the operation of the system can change the system itself.
3. The extent to which the system supports organizational goals depends not only on the system itself. It also depends on the *stability of the goals*, the relationships and *conflicts between organizational goals*, and how people in the organization *interpret those goals.*

In this context, there is a clear shift

> on the scale of controllability to movement according to intrinsic laws,

which in **socio-economic systems** with a large number of stakeholders or even **socio-ecological systems** shifts further in the direction of movement according to intrinsic laws ("natural processes").

Here, however, the TRIZ principle 25 *Exploit Self-Service Processes* becomes significant, which counts as the mastery of engineering. It claims that the best solution of a task is reached if the aspired goals are realised "by themselves".

However, this means making the "natural" movement in systems according to their own laws accessible to the unified expertise in terms of description.

5 Systems and components

From [2]

Operation and use of technical systems is a central element of today world changing human practices. For this purpose planned and coordinated action along a division of labour is necessary, because exploiting the benefit of a system requires its operation. Conversely, it makes little sense to operate a system that is not being used. Closely related to this distinction between definition and call of a function, well known from computer science, is the distinction between design time and runtime, that is even more important in the real-world use of technical systems based on the division of labour – during design time, the principal cooperative interaction is planned, during the runtime the plan is executed. For technical systems one has to distinguish the descriptive forms, interpersonally communicated as justified expectations, and the enforcement forms, interpersonally communicated as experienced results.

In addition to the description and enforcement dimension, for technical systems the aspect of reuse also plays a major role. This applies, at least on the artifact level, but not to larger technical systems – these are unique specimen, even though assembled using standardized components. Also the majority of computer scientists is concerned with the creation of such unique specimens, because the IT systems that control such plants are also unique. In this work we concentrate especially on such large technical systems and their parallels to design issues of socio-ecological systems.

The special features of a technical system are therefore mainly in the area of interplay of components, where one has also to distinguish between the description form (modeling) and the enforcement form (operation in the context of the various large-scale technical systems). While in the planning and modeling phase there still remains open much freedom for changes, the enforcement form is characterized by significantly higher inflexibility. Although here too the world is more complicated than getting caught up in a dichotomy like this – who dares to change a plan which has already been approved by the high chiefs – we are working with such a concept of „reduction" in the following.

This brings together essential elements to serve as basis for a concept of a technical system, which in a planning and real-world context is four times overloaded:

1. as a real-world unique specimen (e.g. as a product, even if the unique specimen is a service),
2. as a description of this real-world unique specimen (e.g. in the form of a special product configuration)

and for components produced in larger quantities also

3. as description of the design of the system template (product design) and
4. as description and operation of the delivery and operating structures of the real-world unique specimen systems produced from this template (as plans of production, quality assurance, delivery, operation and maintenance).

Technical Systems in such a context are systems whose design and use are influenced by cooperatively acting people on the basis of the division of labour, whereby existing technical systems are normatively characterized at description level by a specification of its interfaces and at enforcement level by their guaranteed specification-compliant operation.

The same applies to the description form of ≪natural≫ systems, which are also modeled in a structured way as systems of systems – as systems consisting of components, which in turn are modeled as systems, whose functioning (both in a functional and operational sense) are presupposed for the currently considered system level.

The (more general) concept of a system in such a concept has the epistemic function of (functional) ≪reduction to the essential≫. This reduction takes place in the following three dimensions

(1) External demarcation of the system against an environment, reduction of these relationships to input/output relations and guaranteed throughput.

(2) Internal demarcation of the system by combining subareas as components, whose functioning is reduced to a ≪behavioral control≫ via input/output relations.

(3) Reduction of the relations in the system itself to ≪causally significant≫ relationships.

It is further stated there that such a reductive description service rests on preexisting (explicit or implicit) description services in three dimensions:

(1) An at least vague idea about the (working) input/output services of the environment.

(2) A clear idea of the inner function of the components (beyond the pure specification).

(3) An at least vague idea about causalities in the system itself, i.e. one that precedes the detailed modeling, an already existing idea of causality in the given context.

(1) and (2) can in turn be developed in systems theory approaches to describe the ≪environment≫ and the components (as subsystems), with which the description of coevolutionary scenarios in turn becomes important for deepening the understanding of (3).

6 Systems and resources

One final thought, not yet elaborated here: the lofty approach at the beginning of these remarks, that it is more about „the management processes rather than the final outcome", is of course only half the truth (a well-known sentence of a former Chancellor). When it comes to *reliability* in collaboration, the specification-compliant outcome of a system (as a black box) is in the foreground, and the way how this was achieved is minor important.

In a network of systems where one relies on the other, this form of reliability plays a major role, since a prerequisite for a system to function in accordance with its specification is not only its internal organisation, but also that the system's operating conditions are met, which manifests itself as structured access to the resources required for the work in the form of a specific throughput of material, energy and information.

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[7] The TRIZ Ontology Project. https://wumm-project.github.io/Ontology.html.

ISO 9000, Business Modelling and Business TRIZ

Hans-Gert Gräbe

19 April 2021

1 Dimensions of a Systemic Approach

The subject of our seminar are aspects of systematic management of planned cooperative action, especially in the form of entrepreneurial organisations.

We had approached the topic in the last seminar and identified as a meaningful starting point the concept of a **system**

- as a *whole* composed of *parts*
- with a *specific purpose* (a *main useful function* – MUF),
- which results from the *interaction* of the functionalities of the parts as an *emergent function.*

Systems thus have a structural, a functional and an operational dimension.

The **structural dimension** (structural organisation) is especially important for understanding the system as a white box (i.e. its implementation).

The **functional dimension** is a specific, complexity-reducing form of both the description and the real-world organisation of complex functional processes (procedural organisation) using the principle of encapsulation, which is also widespread in computer science.

Finally, in the **operational dimension**, the functions are linked with the resources required for their functioning and thus functions are transferred from a pure potentiality into a (potential) reality.

Operationality means that not only the MUF of the system is constituted from the functionalities of the parts in the way described in the procedural organisation, but that the system also creates the operational conditions for the functioning of its parts.

In this sense, the *world of technical systems* (lecture) is itself again a system, although structural and procedural organisation at the system level are largely unknown in terms of description. This system is a "self-moving automaton" in the sense of Marx's statement

> [...] set in motion by an automaton, a moving power that moves itself; this automaton consists of numerous mechanical and intellectual organs, so that the workers themselves are cast merely as its conscious linkages." (MEW 42, ch. 13)

This system functions "by itself" because the parts mutually produce their respective necessary operational throughput conditions. That system has **no external standpoint of planning** for this, but it does draw on external material and energetic resources.

2 Shchedrovitsky [1] on Organisations

What is an organisation? Shchedrovitsky [1, p. 30 ff] distinguishes three dimensions of that notion

- Organisational work
- Organisation as the result and means of organisational work
- Organisation as a form of life of the collective

Organisational work. When we organise we collect something. Let us take a look at design. We need some structural elements, so there is a designer with a set of elements. We must collect these elements in a particular way, and we must establish some kind of connection and relations between them. When we are doing this sort of work we must impose some organisational form on these elements. [...]

And when we have done such work on the integration of the elements and the establishment between them of certain relations and connections, we stop this work, and then the whole, which we have organised, can begin to operate according to its laws. But its action according to its laws no longer belongs to organisational work.

Organisers deal with a particular set of elements, collect elements of a certain type and form in particular quantities, combine them and set certain relations and connections between them. When they have done this and have thus created the structure of the organisation – and the structure is defined by the location of the elements and the type of connections and relations – they recede into the background, and this thing either remains dead or begins to operate according to its laws.

Organisation as the result and means of organisational work. Organisation as the result of organisational work can be regarded as both an **artificial entity** and as **naturally living thing**.

Who takes an artificial view of organisations? Organisers themselves. And those who design and create organisations always looks at them as their own creations. The organiser makes it, and in this sense organisations can be of any kind depending on the goals and objectives of the organiser. The main question is: why does the organiser create a particular organisation? [...]

The organisation acts here as an **artificial entity**. It has a purpose and can be considered, as can any structure, in terms of the functions that it, the organisation, must provide. So we are talking about the functions of the organisation, about the purpose of the organisation. These are all characteristics that are seen from an artificial point of view.

As a tool, as a means, **as an artificial entity, the organisation does not and cannot have goals**. Organisers can have goals. But for their goals, in relation to their goals, the organisations they create are a means, a means for them to achieve their goals.

Organisation as a form of life of the collective. The organisation has been created. And the organiser – a pure organiser, not a manager – has gone. The organisation has been created, and it has begun to live its own life. And then it turns out that, from a natural point of view, other goals may appear in this organisation – the goals of the collective, which was organised. Generally, something quite different begins, inasmuch as this **organisation begins to live its own life**. Then we [...] must seek forms, methods, laws of the life of the groups and the collectives within organisations.

When the organisation is seen from a natural viewpoint, it is not yet the means, but the **form**, the **condition** of the life of the collective (the people) who work in it.

And it is even possible to see the organisation in the same way as we see the sunrise and sunset: the people working in it completely forget that the organisation was created by some other person to resolve particular objectives, achieve particular goals, for a particular purpose. It, this organisation, will be perceived by them like the movement of the heavenly bodies, as a natural condition of life.

3 Shchedrovitsky [1] on Management and Leadership in Organisations

Management. [...] Now a more complex case – a car. Here stands the car, you have not yet pressed the accelerator – can you manage it? You cannot. And when does it become possible to manage the car? When it has started moving.

Management is only possible in relation to objects that have self-propulsion.

Imagine a situation when you can control the flight of a chair. Imagine yourself in a brawl from The Three Musketeers: someone throws a chair, and instead of defending yourself from it, you send it flying the other way. You have performed a one-off, momentary act of management – you changed the direction of the flight of the chair. In this sense, you performed **management of this process**. But what were you managing? You were managing the flight of the chair, but not the chair.

Leadership. Leadership is only possible within an organisation, within the framework of special organisational connections. The essence of leadership is the **setting of goals and objectives for other elements**. But in order for you to set goals and objectives for other elements – in other words, people – they have to reject their own goals and objectives and undertake to accept your goals and objectives. And that is precisely what happens in the framework of the organisation.

The organisation of people always happens like this. The person who **occupies a certain position** gives up their own goals and objectives, their own self-propulsion (by the fact of occupying that position), and is obliged to move only in accordance with this position and with the goals and objectives that will be assigned to them through the channels of the organisation by higher authorities.

But since people are not always aware that they must surrender their own goals and objectives in carrying out their duties, and in addition, because people who have surrendered their own goals and objectives are usually not much useful for anything, the reality is that they only reject them within certain limits. Such is the game. They pretend that they are ready to give up some of their goals and accept other people's goals and objectives, and what they really mean to do is another question. They may temporarily conceal their own goals, but they may use the performance of their official tasks to achieve their own goals.

When self-propulsion begins, leadership either becomes impossible or can only be carried out within a very narrow range, and the need for management appears. Leaders not only lead, but also need to manage, because their subordinates do not always entirely surrender their own goals, their self-propulsion. But when self-propulsion begins, it will not be possible to lead them. We have to use a different technique – the technique of management.

4 Systematic Management in Organisations

The subject of *systematic management* are socio-technical and especially socio-economic systems. The latter consist of economic units (companies, the state, ... – shortly **organisations**) that are interconnected in a market-like manner. The *world of economic units* has a systemic structure similar to the world of technical systems.

In the understanding developed above, **management** therefore means to *control* the processes taking place in the (living) organisation with the *goal* to implement the *purposes* of the organisation in an efficient way.

This is necessary to be operated on several spatio-temporal levels (micro and macro processes), whereby short term goals and long term goals are in contradictory tension. Therefore, management is usually divided into several relatively autonomous levels

- Strategic management
- Middle management
- Operational management
- Infrastructure management and support

which are themselves in systemic system-subsystem interrelations and thus in a co-evolutionary relationship which is best processed via a control loop designed as a feedback loop.

4.1 Systematic Management and ISO 9000

Systematic management requires a descriptive approach to this control loop as part of the organisation's process model, such as given in the modified process model of ISO 9000:2008.

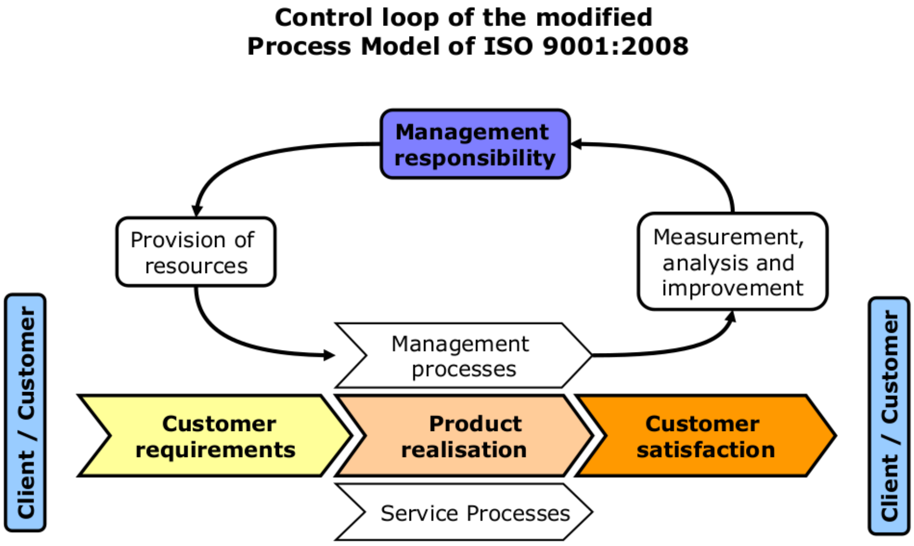

Fig. 1: Control Loop in the Modified Process Model of ISO 9000

ISO 9000 is a set of general quality assurance standards to **assess** the process quality of enterprises. It is a descriptive standard and not directed towards improvement of process quality (although can be used for such an improvement in combination with other tools).

- It is mainly a European standard.
- It is used mainly to assess the process quality of suppliers that demonstrate with a ISO 9000 certificate their ability to produce in a negotiated frame of time, costs and performance.
- Set of standards for the proof of process quality for the creation as of material so also of intangible products and services.
- Framework with a lot of leeway for corporate strategy and concrete management goals. Minimum requirements for a QM system according to ISO 9000: complete, documented, known, verifiable, evolutionary

ISO 9000 contains minimum requirements for the structural and procedural organization, so that quality is not a coincidence, but the result of a controlled process.

Note that the process model shown in fig. 1 is a *standard model* at a higher language level (**meta-model**) than the respective process models of the individual organisations, but unlike the process model of a real-world organisation, it has no real-world instantiation. Such a phenomenon is well known in computer science in connection with abstract classes.

Fig. 2 shows the relation between the ISO norm, quality management documents and real-world process quality at three different levels within a company.

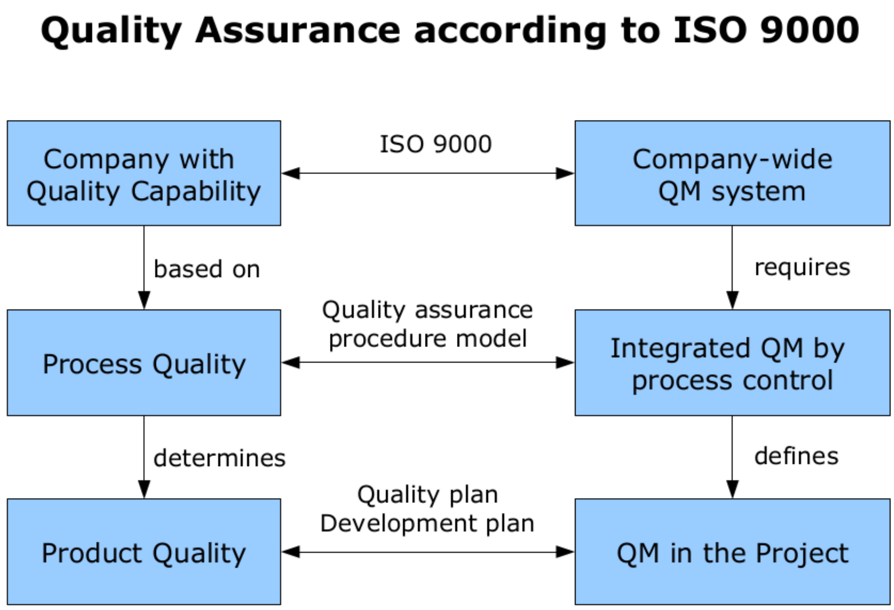

Fig. 2: The relation between model, meta-model and meta-meta-model in quality assurance

4.2 Managing Organisational Development and CMMI

Management is only possible in the context of a clear understanding of the structural and procedural organisation of the organisation. In order to capture this in descriptive terms, a **separation of functions and resources** is necessary. In particular, "human resources" are removed from the description and replaced by the term **role**.

In this way, a *functional decoupling from the resources* is achieved at design time – only at runtime this position must be connected "just in time" with a qualified resource that was produced beyond the horizon of the concrete planning processes.

Only with such a decoupling (and only at the level of such a decoupling) it is possible as management to take an external standpoint on its own activities. Only in this way is **structurally driven organisational development** possible. There are other culturally driven approaches such as TQM, which will be discussed separately (the Toyota model).

Systematic management through structurally driven organisational development means above all the creation and improvement of conditions for the management of well-structured processes.

CMMI (Capability Maturity Model and its predecessor CMM) is such a process model for organisations such as software companies that are project-driven and do not have a continuous production process. The model is a **maturity model** and supports such companies to introduce and improve a company-wide, uniformly structured project management

- from the structuring of individual projects into *process activities and milestones*
- through the definition of *company-wide uniform or specifically adaptable process modules*
- and the *uniform quantitative measurement* of such building blocks
- to the introduction of *qualified error and change management.*

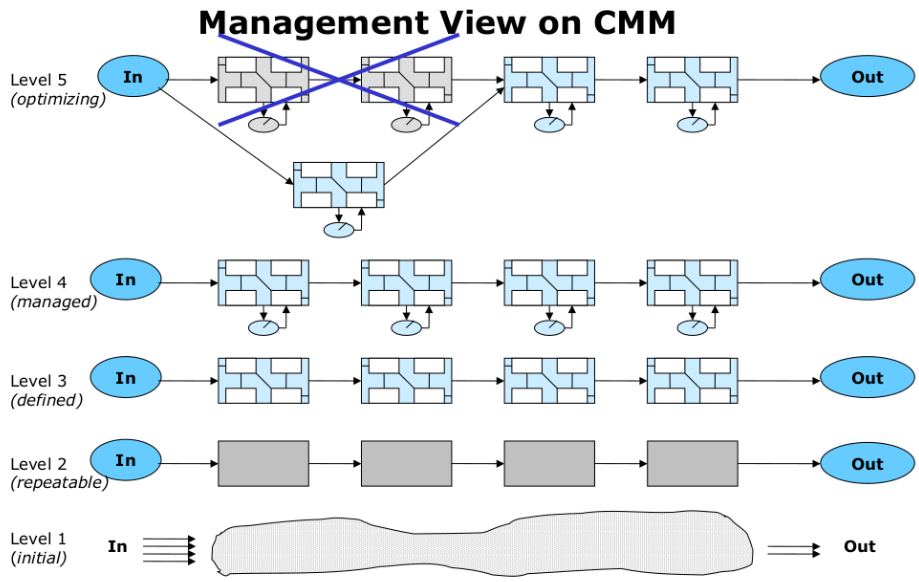

Fig. 3: Increasing maturity of structured project management within CMM(I)

These four transitions are assigned five maturity levels. The transitions are supported by concentrating on predefined *key process areas* and *key practices*.

4.3 Optional: CMMI in more detail

4.3.1 The Maturity Levels

The five maturity levels according to which processes of an organization are evaluated.

Initial Process

- Process exists only informally
- Low adherence to deadlines and costs, high risk
- Chaos, "heroism", fire-fighting operations

Repeatable Process (CMMI: Managed)

- There are defined and structured requirements for the process
- "Learn from similar projects" (requirements management, project management and quality management)

Defined Process

- Procedures and individual process activities are clearly defined
- The organization is in the learning focus
- Process definition, training programs, team coordination

Managed Process (CMMI: Quantitatively Managed)

- Central control that systematically collects process measures
- Process and product development are quantitatively analyzed and rated
- Information is used as support for decision-making

Optimizing Process

- "Self-dynamically optimizing process"
- Process measures are systematically used for dynamic process control and monitoring
- Process change management
- Technology change management

4.3.2 Expectations

The higher the level of maturity,

- the more precisely goals are achieved.
- the less is the difference between the target and actual results.
  - Level 1 companies miss their deadlines at large.
- The fluctuation range of the actual values around the target specifications is lower.
  - Similar projects are completed within a narrower time frame.
- Costs and development time decrease, productivity and quality increase.
  - Higher process efficiency, low rework rate.
- Expectations are more likely fulfilled in standard projects.
- But: New techniques and applications are reducing the process capability due to higher variability.

4.3.3 Determination of the Maturity Level according to CMM

For each stage a number of **Key Process Areas** are defined in which an organization of this level has to reposition itself implementing appropriate given **Key Practices**.

Level 1: Initial Process

- No criteria and specifications
- Project and quality management may or may not exist but are not consistently applied.
- Projects are managed at short notice, adaptively and reactively.

Level 2: Repeatable (CMMI: managed) Process

Goal: Introduction of a basic project monitoring and management, planning and control.

Focus: Leadership principles, structure and management of projects.

Key Process Areas and Key Practices:

- **Requirements management**
  - Establish a common understanding between customer and project team about the requirements.
- **Project planning, tracking and monitoring**
  - Transparent presentation of the development progress in order to be able to initiate correction measures at early stage.
- **Sub-order management**
  - Select, control and monitor qualified sub-suppliers.
- **Quality management** on process and product level, configuration management
  - Ensure integrity of the products throughout their entire life cycle.

Result:

- Processes as a sequence of "black boxes" with milestones as checkpoints.
- Stable project management.
- Processes can be predicted within limits through constant monitoring.
- Cross-project experience can be quantified.

Level 3: Defined Process

Goal: Definition and introduction of an organization-wide valid unified software process; internal structure of the phases is defined and understanding of roles is visible.

Prerequisite: Projects are planned, managed and monitored (level 2) as a sequence of processes according to uniform principles.

Focus: Process descriptions.

Key Process Areas and Key Practices: Focus on process organization

- **Definition** of processes
  - Development and maintenance of a useful set of process values.
- **Training program**
  - An independent unit is responsible for employees' training.
- **Coordination** between project teams (exchange of experience)
- **Integrated SW Management**
  - Development and management are integrated into one over the entire life cycle defined process.
  - Standard processes can be tailored to projects.
- **SW Product engineering**
  - Process integrates all technical activities to ensure to produce correct, consistent products effectively and efficiently.

CMMI further subdivides some of the main process areas

- **Coordination**
  - Integrated team building
  - Integrated sub-order management
  - Decision analysis
  - Integration organization infrastructure
- **Integrated SW Management**
  - Integrated project management
  - Risk management
- **SW Product Engineering**
  - Requirements analysis
  - Technical solution
  - Product integration
  - Verification
  - Validation

Result: Improved, describable quality; institutionalised process prototypes that are maintained and further developed.

Level 4: Managed (CMMI: Quantitatively Managed) Process

Objective: Quantitative measurement of the quality of products and the productivity of processes through an organisation-wide metrics programme as an objective basis for decision making.

Prerequisite: Uniform understanding across the organisation about projects and process models (level 3) and active project management (level 2).

Focus: Process measurement.

Key Process Areas and Key Practices:

- **Quantitative process management**
  - Quantitatively control and monitor process performance.
- **Quantitative quality managament**
  - Develop quantitative understanding of product quality.

CMMI clarifies as follows:

- Quantitative project management
- Performance of organisational processes

Result: Time, cost and quality become fairly predictable.

Level 5: Optimising Process

Objective: Introduction of a continuous and measurable process for improvement of software development.

Prerequisite: Quantitative monitoring information (level 4) and application of innovative ideas and technologies.

Focus: Process alignment.

Key Process Areas and Key Practices:

- **Error avoidance**
  - Identify and eliminate causes of errors.

  Product innovation management
  - Integration of new technological developments at product level.

  Process innovation management
  - Identification of new, useful ideas and their orderly introduction.

CMMI specified:

- Organisation-wide introduction of innovations
- Analysis of causes and elimination of errors

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Management by Incentives

Forschungsseminar "Complex Systems and Co-Operative Action"
Universität Leipzig

Veronika Heuten

May 4, 2021

1 Introduction

Incentives are something that motivates one to do something. In the following text, incentives are defined as something the company gives its employees to motivate them to improve their performance. Due to generation conflicts and questions concerning "fair pay", it is important to take a closer look on different theories and models dealing with incentives.

2 Different Kinds of Incentives

Incentives are differentiated into to kinds – material and immaterial rewards. Immaterial incentives are for example: flexible work time models, a good and inspiring working atmosphere, flexible and generous vacation models, after work activities, and other aspects concerning company culture. Material incentives are valuable considerations beside the fixed salary. This category is splitted in three other categories: fixed payments like additional Christmas and holiday pay, social benefits like health insurance and retirement provisions and variable compensations. These compensations can occur on an individual level as individual performance bonuses or on an organizational level if certain business goals are reached [2].

3 How to quantify work?

How and why is work compensated? Salary is the exchange of money for the time, mental and physical resources the employee offers to the company [2]. Before the employees performance can be improved using incentives a fair and comparable fixed salary is needed. There exist several theories discussing the question how to develop a fair payment in a company. The following paper focuses on the Geneva Scheme and the Hay Guide Points.

3.1 The "Geneva Scheme"

In the 1950s the "Geneva Scheme" was invented to identify and classify different job requirements. The scheme differentiates between fours categories that can be measured in abilities and pressure.

- **Intellectual requirements:** Mental pressured, thinking-processes, professional skills
- **Physical requirements:** Physical pressure and burden of senses
- **Responsibility:** Safety and personnel management
- **Environmental influences:** Temperature, radiation, dust and background noise

This was the first attempt to create a scheme to make jobs and their income comparable to other jobs inside a company and to other companies as well. The scheme is used and developed until today.

3.2 Hay Guide Chart

The Hay Guide Chart is another method to face the complex issue of job evaluation. Using the Hay Standard can help to provide an international standard of job evaluation that brings different benefits to the company and the employees. Employees can check if they get a fair within the company and even in comparison to international competition remuneration [3].

3.3 Manager to Worker Pay Ratio

The manager to worker pay ratio compares two dimensions: the annual compensations of managers (CEOs) compared to the annual total compensation of all employees (excluding the CEOs and part-time workers). For this comparison, the median value is most commonly used. Several HR textbooks recommend to pay the CEOs income depending on the median or even the lowest income [2]. A managers' income 20 or 30 times higher than the income of a normal worker can be tolerated, but super high incomes are hard to justify. Therefore a Swiss referendum in 2013 claimed for a national regulation that the maximum income per month in a company is not allowed to be higher than 12 times the minimum income per month [6]. The initiative was rejected. Regarding the actual manager to worker pay ratios in Germany (57:1) and USA (312:1) might give the referendum a new actuality [4] [5].

4 More Money – More Motivation?

Yes and no. Extra payments for reached goals and bonuses can help to improve the employees performance. But only in a limited way. For so called lower skilled, boring and repetitive jobs a better performance can be reached due to monetary incentives. At the same time, this kind of incentive can harm the employees performance if it comes to more intellectual and creative jobs. Employees could only work until they fulfill the goals for an extra payment, or try to sell as much as they can in order to get the bonus and forget about the customer satisfaction. This might lead to bad image of the company.

It might be a better strategy to focus and itemize intrinsic motivation. This includes a good working atmosphere, a respectful supervisor-employee communication and loyalty to the company and its products [7].

5 Comparing Different Generations

Using incentives to improve the employees motivation to reach a better work performance can be a attempt. But not all incentives work for all employees. Different generations seek for different aims.

	Baby Boomer	Generation X	Generation Y	Generation Z
Geboren	Ab 1950	Ab 1965	Ab 1980	**Ab 1995**
Grundhaltung	Idealismus	Skepizismus	Optimismus	**Realismus**
Hauptmerkmal	Selbsterfüllung	Perpektiven-losigkeit	Leistungs-bereitschaft	**„Flatterhaftigkeit“**
Bezug	(lokale) Gemeinschaft	(lokale) Gemeinschaft	(internationale) Gesellschaft	**(globale) Gesellschaft**
Rolle	Kollektivismus	Individualismus	Kollektivismus	**Individualismus**
Aktivitätsniveau	Mittel	Niedrig	Mittel	**Hoch**
Informiertheit	Mittel	Wenig	Mittel	**Stark**
Qualifikation	Lernen für das Unternehmen	Wenig lernen	Bezahltes Lernen	**Für sich lernen**
Ausrichtung	Nur Beruf	Privat (trotz Beruf)	Beruf, verbunden mit Privat	**Privat (und Beruf getrennt)**

Quelle: Univ.-Prof. Dr. Christian Scholz – Generation Z: Willkommen in der Arbeitswelt

Source: [8]

As shown in the graphic, Generation Z prefers a fixed salary. This matches their individual aims. A high income is not that important. This is completely different for Generation Y. A fixed salary can lead to lack of productivity and motivation. An individual income is seen as appreciation of the own achievements. To satisfy the different needs of different generations, new compensation systems are evolving.

5.1 Cafeteria Systems

The idea of the cafeteria systems is to individualize payments. All employees can choose whether they want more holidays or a higher income. It is also possible to cut down the weekly working time and lower the income. These systems are pretty popular in the US, where health insurance and other social benefits are not obligatory by law. Employees can individualize their compensation model to the maximum corresponding to their private and financial situation. On the other hand are cafeteria systems linked with a high administration effort [2].

5.2 Current Trends in Compensation

New generations insist on new working models and payment ideas. Therefore companies are in need to create new ways to handle these new generations of employees. This lead to the term "new pay". New Pay focuses on more participation of the employees in creating new payment systems, is open for new kinds and alternative ways of incentives, like days off, sabbaticals, trainings and workshops instead of cash [9].

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System Thinking and Management

Russel L. Ackoff

Jannis de Riz

May 10, 2021

1 Introduction

The „System movement“as Schedrovitsky calls it [10] originated for the most part between the 1950s and 1960s with the notion of general systems theory by Ludwig von Bertalanffy and system dynamics (industrial dynamics) by Jay Forrester [11] [7] [8] [6]. Russel Lincoln Ackoff was an american Scientist, Consultant and one of the contributors to the aforementioned movement. He received his Bachelors degree in architecture in 1941. He later went on to teach mathematics and philosophy at the Wayen State University and became a Professor for Operations Research at the Case Institute of Technology. His biggest contribution to the sciences was the socio-systemic approach to organization theory. His works concentrated on systems thinking and its implications for operations research and management [2] [3] [9] [5].
He pointed out that after the second world war, western culture shifted into a systems age where everything had to be taken apart and analyzed. Thinking about purpose was considered unproductive and meaningless [2]. He hypothesized that all failure in management resulted from that purely analytical line of thought and not thinking systemically [1].

2 Systems as understood by Ackoff

Ackoff puts forward the notion that, in contrast to the common view, a system is the product of its parts interactions rather then their sum. He further distinguishes between three types of systems, there being the mechanical, the organismic and the social system [4]. He defines a System as follows:

> *„A System is a whole consisting of two or more parts(1) each of which can affect the performance or properties of the whole,(2) none of which can have an independent effect on the whole, and (3) no subgroup of which can have an independent effect on the whole. In brief, a system is a whole that cannot be divided into independent parts or subgroups of parts. “*

There are several implications that arise from this definition. For example, a system can consist of several subsystems that in themselves form a system. Also, all parts of a System are interdependent which follows from (2). That means changing one part can never be seen in isolation. A change in one, say subsystem, is always accompanied by at least on counteraction. In other words, all parts and their contribution to the system has to be seen in the context of at least one other part. Parts without which a system can not perform its function are called essential. As already mentioned Ackoff discriminated three types of systems.

Mechanical systems are open or closed, as in, they can or cannot interact with their environment. Mechanical systems have no purpose on their own, instead they serve the purpose they where designed for. A car has no purpose on its own but serves the purpose of transportation that it was designed for.

Organismic Systems The organismic system has one goal or purpose that is inherent to it. As humans our body-systems purpose is assuring to survive, or to continue being. Each individual part of our body in contrast has no purpose but a function. Organismic systems are open and therefore react or interact with the environment.

Social Systems Ackoff defines social systems as follows. They *„are open systems that (1) have purpose of their own, (2) at least some of whose essential parts have purpose of their own, and (3) are parts of larger (containing) systems that have purpose of their own. “* [4]

Those three representations of a system are both concept and entity. This enables to think of any system in terms of any of these types [4].

3 Management

Most definitions of management are based on an corporation/business view of Management such as the cambridge dictionary when it sates: management is

> *„the control and organization of something, esp. a business and its employees “ [4]*

The German wikipedia page has a more general definition of the term management which states: Management (lat. manus → hand, lat. agere → guide/direct) :

> *„is every goal oriented human motion thats pursued after economical principles and guides, organizes and plans in all aspects of live. “ [4]*

Ackoff puts forward a chronologically evolving view of enterprises, and thereby direct implications towards their management, from industrial revolution to present(1972) and from mechanistic over organismic to social.

3.1 Enterprise as a Machine

If seen as a machine, the workers are the machines parts. They are interchangeable as most functions did not require some specifically complex skill during the beginning of the industrial revolution. The owner (manager) of the machine was *„all-powerfull“* and could do whatever he or she (in those times mostly he) pleases. If a part broke, it could easily be replaced. And parts did break as there was virtually an unlimited supply of spare parts and therefore there use was reckless.

3.2 Enterprise as an Organism

When the 19s century came to an end the mechanistic view of an enterprise was replaced by a more organismic concept. Due to public companies whos ownership could be bought in parts at the stock market the notion of the owner became an abstraction. The jargon used to describe an enterprise as corporation (lat. body) reflected this abstraction and therefore increase in complexity. Increasing complexity of ownership was accompanied by increasingly difficult work tasks that required more skilled workers. These were not to be found as easily as in the *„enterprise as machine“* age. That positioned them, to varying degree, closer to the essential parts rather then replaceable ones. Managers had to treat them as humans with their own purposes and wishes in order to get good results from the workforce.

3.3 Enterprise as a Social System

The further increasing complexity of the system they managed(corporation) as well as the system they managed their system in(society, state), managers had to adapt a social view on their task. They now had to be concerned with all three aspects of a social system as described in the corresponding paragraph. They (1) had to define a purpose for the company they where leading, (2) take care of the purposes and wishes of the people (systems) that where contributing to those first purposes and (3) lastly place that entire construct within the social system they where part of.

4 Analytical versus Synthetical Management

Ackoff states in 1972 [4] that

> *managers are educated to believe that a social systems's performance can be improved by improving the performance of each of its parts taken separately - that is, if each part is managed well, the whole will be. This is seldom if ever the case, because parts that appear to be well managed when viewed separately seldom fit together well.*

Analysis is taking the whole apart and concentrating on managing every part individually. Understanding a system can not be done by analysis of its parts. The function of each individual part can tho.

Synthesis instead is putting the system together with other systems (parts) and properties of that supersystem are derived in order to understand the function of the initial system of interest.

There is no explanation within the cars that explains why british cars are left driven in contrast to american or other european ones. The explanation lies in the system these cars are part of.

5 Problems and Messes

Ackoff states there are essential treatments (managements) to problems or messes.

Absolution ignores the Problem.

Resolution can be seen as a quick fix. It is an approach that results in a situation that merely satisfice. Its focus is on the very specific problem rather then the general mechanism behind it.

Solution is within the given context the optimum. It is led by a research approach and focuses on the general aspects of the problem.

Dissolution redesigns the entity or the environment where the problem arose. This enables for a future state that is superior to the best possible in the current one. It focuses on generality and uniqueness equally and uses whatever technique seem to be fit.

6 Knowledge versus Understanding

Knowledge comes from analysis. It is knowing HOW something works.

Understanding comes from synthesis. It is to understand WHY something behaves or works as it does.

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MANAGEMENT BY OBJECTIVES

Franziska Görg

May 18, 2021

1 Introduction

On the one hand, management refers to the activity of company management in the functional sense, and on the other hand to the managing body, i.e. the group of leading persons of a company in the institutional sense [1]. If management is viewed as a purposeful activity, the management cycle typically goes through the following phases:

1. Planning: analysis of the target/actual state, problem and task definition, goal setting, alternative planning
2. Realization: Organization and coordination of production factors, such as employees and their motivation
3. Control: feedback, target/actual state comparison for further planning and control

Due to the increasing complexity of markets, structures and processes, some management methods have been developed in the last century. So-called management principles serve to maintain a uniform line in the management of employees. Among these, "management-by" techniques exist, such as the "management by objectives" (MBO) management tool discussed here.

By setting principles for management behavior, it is possible to systematize corporate management and ensure a way of controlling corporate processes while at the same time meeting the expectations of the company and its employees.

In the strategic management model "Management by Objectives" developed by Peter F. Drucker in the 1950s, the focus is on the cooperative development and agreement of objectives by the manager and the employees in order to improve the performance of the organization [2] [3].

According to S.K.Chakravarty, “Management by objectives is result-centered, non-specialist, operational managerial process for the effective utilization of material, physical and human resources of the organization by integrating the individual with the organization and organization with the environment” [11].

2 5-Step-Process

The MBO process consists of five basic steps, as Figure 2 illustrates.

Given an overarching goal, such as increasing the company’s profits, individual goals are derived with the employees, with the measures required to achieve the individual goals, such as the use of advertising, now being left to the respective responsible employees [4].

At this point, the manager takes on a controlling role, whereby the control is accompanied by a performance evaluation of the employees [5]. This performance evaluation can be understood as an incentive system, since it also holds potential for professional development, such as a salary increase. However, the receipt of premiums or bonuses are also conceivable as incentive systems and are distributed as soon as the employee has achieved his or her goal.

As a result, employees are motivated to work on solving problems. Therefore the application of "management by objectives" increases the creativity, motivation and identification of employees with their company. In his controlling role, the manager is thus in constant exchange with his employees and also supports them in finding solutions when problems arise.

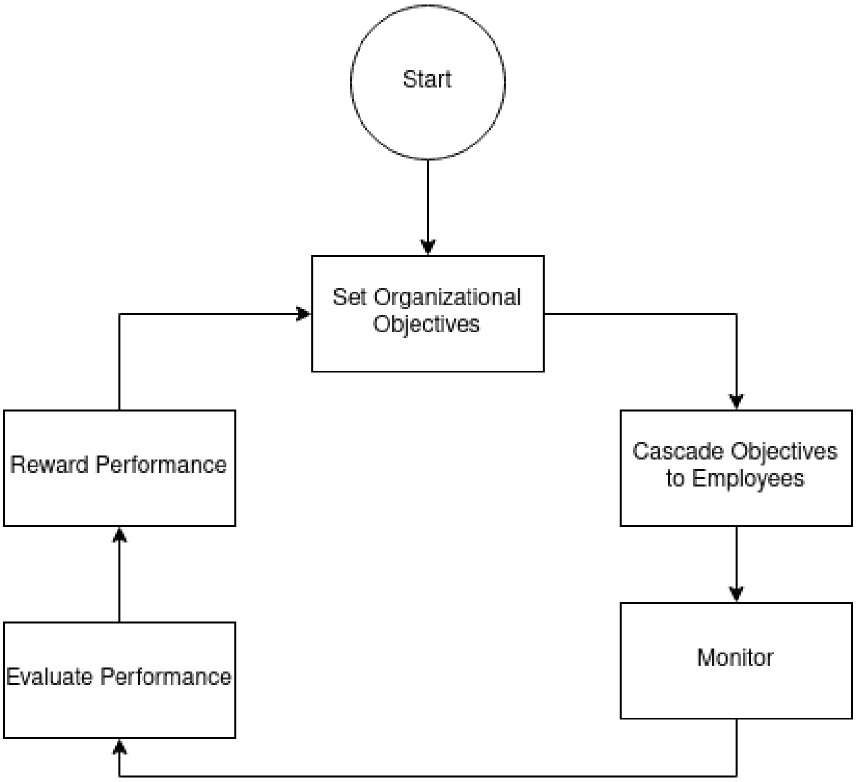

Figure 1: MBO process

Furthermore, management by objectives may be regarded as a flexible model, since control is also related to the objectives themselves. Here, it is checked whether the objectives are still appropriate and relevant for the time or whether they may need to be adjusted.

3 Requirements

According to Bollendorf [5], the successful application of MBO requires leadership, personnel and methodological prerequisites, as well as certain organizational structures.

- **Organizational Requirements**: Tasks and functional areas must be clearly assigned. In terms of target agreement, the framework conditions must be kept constant, allow scope for action and decision-making, and have information structures that permit actual/target state comparisons. In particular, the overarching corporate goals should be clearly communicated, and the goals must also be regularly reviewed, for example, to assess whether they are still up to date and whether adjustments need to be made.
- **Leadership Requirements**: A trusting relationship between management and employees plays a significant role. Here, it is essential that the management supports the management strategy and is convinced of its usefulness. The willingness to adopt a cooperative management style is thus essential, but often lacking in practice according to Dinesh and Palmer [7].
- **Personnel Requirements**: The implementation of the measures by the employees to achieve the goals depends on variable factors on the one hand. On the other hand, it depends on stable personality factors of the employees, based on the personality model published by Watzka [8] called Big Fire with its personality traits called the Big Six.
  - *variable factors*: Qualification, self-efficacy expectations, goal commitment, feedback, task complexity, general conditions.
  - *stable factors*: internal control beliefs, strong achievement motive, strong action orientation, low procrastination tendency, high self-control ability, strong desire for autonomy

- **Methodological requirements**: In addition to a procedure for agreeing on objectives, evaluation criteria for the performance appraisal must be selected. A consensus must also be reached on the evaluation procedure, which should be carried out consistently in practice in order to avoid conflicts.

4 Workflow

A set of action sequences has proven successful in implementing MBO, as Figure 2 illustrates.

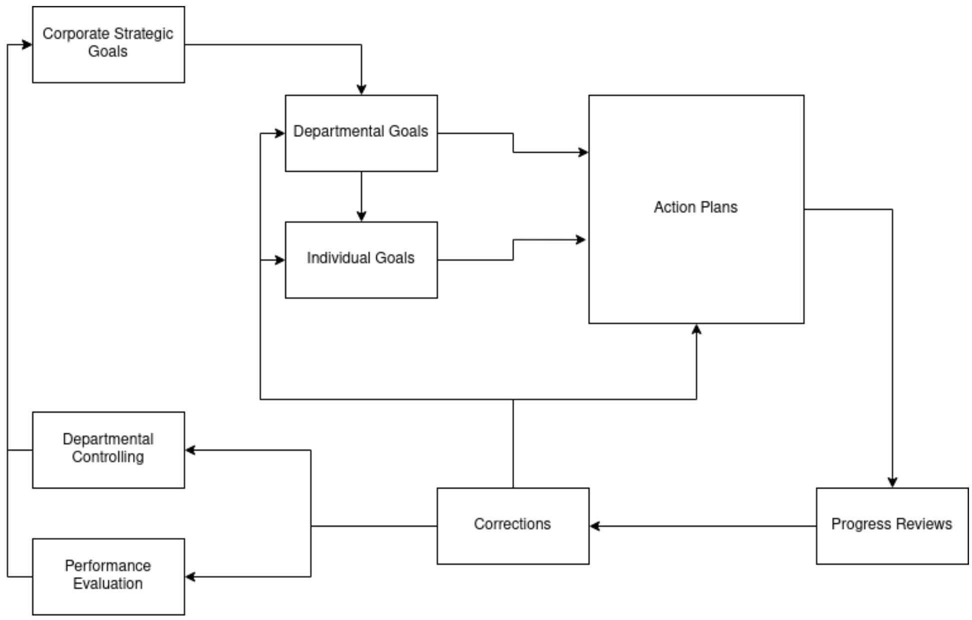

Figure 2: Workflow in MBO

After analyzing the initial situation, which usually shows deficiencies and a need for optimization, objectives must be formulated in order to achieve the desired, improved end state. For effective objective formulation, Doran [6] calls for orientation on the SMART method, which comes from quality management and describes the following criteria for formulating effective objectives:

- **S**: specific (the goal is clearly defined)
- **M**: measurable (the goal is measurable, or contains measurability criteria)
- **A**: activating (the goal is desirable)
- **R**: realistic (the goal is achievable under the given conditions)
- **T**: time-bound (the goal has a fixed time frame)

Ultimately, the concrete formulation of goals takes place in a recorded appraisal interview, in which the manager and the employee discuss the initial situation, reveal their ideas and discuss which goals are to be met in order to achieve the desired end state. Concrete agreements are made and indicators are defined to measure success. It is also important to set priorities and discuss possible bonuses. Through an action plan, that contains interim goals, so-called milestones, it is possible to describe what is to be achieved at what point in time and what the consequences will be if the goals are not achieved.

In interim meetings or milestone meetings, the supervisor can realize his controlling role and, for example, look for solutions together with the employee in the event of deviations in the realization of objectives or, if necessary, make corrections to the objectives.

In an appraisal interview, manager and employee reflect on the overall process from goal agreement to goal achievement, which is accompanied by a performance evaluation. This is measured against the previously defined indicators. If the requirements are successfully met, the employee receives his or her defined bonus.

In case of target failure, the reasons are discussed and, if necessary, leads to adjustments in the framework conditions or, under certain circumstances, to target replacement. At this point it should be noted that the failure to meet the target may also result in the employee's dismissal.

5 Conclusion

The following table 1 presents some advantages and disadvantages that occur when using management by objectives.[4]

Advantages	**Disadvantages**
Improved performance through results orientation	The sense of the goals is often not questioned and goals are no longer adjusted because the preparation of action plans and the conducting of milestone meetings are cost-intensive.
Higher employee motivation through participation and delegation of responsibility. According to Schermerhorn [10], individuals work harder to achieve goals if they are seen as their own goals.	Opportunities are overlooked because they were not part of the goal agreement.,
Clear roles and distribution of tasks, everyone knows what is expected of them.	Increased pressure on employees to perform.
Better results through continuous exchange.	Employees only dedicate themselves to achieving goals and cooperation between employees suffers.
Easier performance and success control through measurable goals.	Control of employees necessary.
Employee identification with company results in stronger commitment to the company.	Increased time required, especially for target agreement in the first cycle [9].
Relief for managers.	Risk that the quantity of goals achieved takes precedence over quality.
Freedom of design for employees.	Excessive demands on employees.
Promotion of employees' own initiative and sense of responsibility.	Communication problems, employee did not understand goals correctly.
Transparent goals	Incentive system must be created so that employees want to achieve the goals.

Table 1: Advantages and Disadvantages of MBO

However, it should be noted that some disadvantages can be eliminated if the system is properly implemented and thoroughly planned. Thus, MBO is suitable for different types of organizations and supports administrators with regard to the management functions of planning, organizing, leading and controlling. On the one hand, the use of MBO is discussed in non-profit organizations such as libraries, universities or governments, and on the other hand, it is applied in profit-oriented organizations, such as Indian companies like Glaxo Limited, Blue Star or Grind Lays Bank [5], [11], [12].

MBO also laid the foundation for other important concepts, such as the OKR management system, which is strongly based on the MBO and SMART methods. Developed by Intel co-founder Andy Grove, it was consequently first used at Intel.

With OPTIMAL MBO, the classic MBO has been superseded and represents a newer approach. Here, optimizations of the existing components were carried out and some additional components relating to business strategy, financial performance and the incentive system were added [13].

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Business Process Definition Metamodel

B. D.

May 24, 2021

1 Abstract

To be able to manage a process within an organization it is necessary to be able to describe the process in an unambiguous way. This enables the comparison of different processes without actually implementing them. This in turn is necessary to distinguish between desirable and undesirable modifications to this process. Different metamodels are applicable like Petri Nets, UML-activity diagrams or event-driven process chain charts. One of the more common metamodels used for this application are BPMN models. To enable automated translation from one metamodel into another and improve cross-organizational communication about business processes the Business Process Definition Metamodel (BPDM) was created. The idea behind BPDM is to define a very extensive set of concepts so that other modeling tools can easily be implemented in a compatible way by providing mappings from their own modeling language to the concepts of BPDM.

2 Metamodel

A metamodel defines the framework for modeling systems on a schematic level. A central part of a metamodel is its language that is used to define models. The modeling language contains the objects used to create models as well as it includes their syntax and semantics. Also part of the metamodel are the representations of the resulting models including graphic-representations and file-format representations. The third component of a metamodel is the modeling procedure used in the creation of models [7].

The choice of the metamodel used for creating a model defines what information is incorporated into the model as well as how this information is understood. Although in the best case no additional information but the metamodel is needed to understand a model in reality almost always additional domain-specific knowledge is necessary.

3 Business Process

"A business process consists of a sequence of coordinated activities. These are either tasks or subprocesses. Tasks are always atomic, i.e. they are not further detailed in the context of a process definition." [2, p. 1]. It is important to distinguish between a process and a process-instance [5]. A business process is the general concept of a sequence of activities

(for example 'appointment scheduling') while an instance of a business process describes an actually occurring event (for example 'Ms. X calls and books an appointment for Friday 1st of January') [7].

4 Business Process Model and Notation (BPMN)

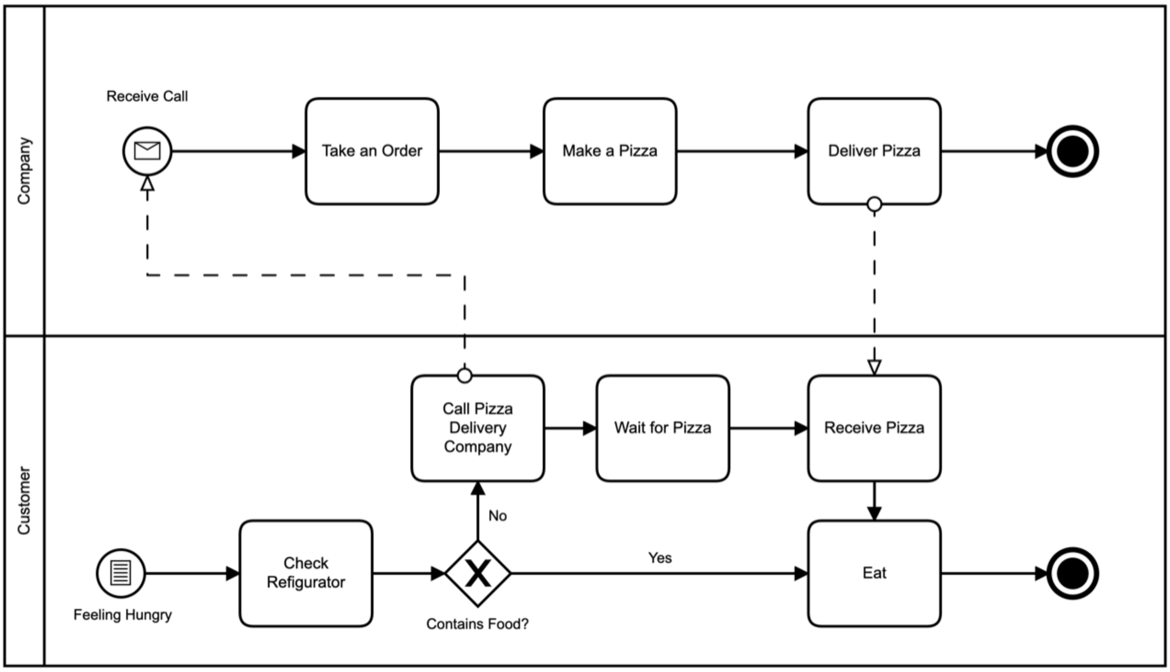

Figure 1: Example BPMN model for the process of ordering a pizza.

BPMN is a metamodel used to describe business processes. In its original version published in 2007 it was only a graphical notation not a full metamodel as the definition was rather informal and focused mainly on the visual elements not on the underlying semantics. These gaps were closed with the release of the BPMN 2.0 specification in 2011 by providing more detailed information on the semantics of model elements as well as standardized data-format for BPMN-models based on the XML format. The BPMN 2.0.1 specification was promoted into an ISO standard in 2013 [3].

5 Business Process Definition Metamodel (BPDM)

The Business Process Metamodel consists of an extensive set of concepts in the form of language elements. Although this concepts can be used to describe business processes BPDM does not provide the modeling language to do so. The fundamental idea is to provide a unified vocabulary for other tools and modeling languages. When implementing such a modeling language one would define a so called 'mapping' between the created model and BPDM. This enables translation between different models without changing the meaning of the portrayed system. Also this would enable platform independence for models as different software vendors could provide a mapping between their data-format and BPDM [6].

BPDM consists of different components that focus on different aspects: the condition model, the composition model and the course model. The *condition model* defines different ways to represent boolean expressions and their relation to the real world. The *composition model* describes concepts that can be used to describe the relation of entities in the real world. The *course model* contains the concepts to incorporate dynamic behavior into the models like events and changes over time [4]. The BPDM definition does not stay completely true to its motivation of being a metamodel independent of modeling languages but does include some references to BPMN.

6 Relevance of BPDM

Both BPDM and BPMN are maintained by the Object Management Group (OMG). OMG does also maintain the UML standard. When the original version of BPMN was published in 2004 it was developed within the Business Process Management Initiative that in 2005 merged with OMG under the OMG name. In 2006 OMG released the official BPMN 1.0 standard which did not include a full metamodel. One year later the vice-president of the OMG organization Jon Siegel stated that OMG was working on BPDM to provide a metamodel not only for BPMN but also for all other business process models although BPMN was specifically considered when designing BPDM. Also BPMN 2.0 was meant to integrate into BPDM by providing a corresponding mapping and using BPDM terminology [6]. The BPDM specification was published in its final form in 2008. Three years later in 2011 BPMN 2.0 was released. But instead of building on BPDM as a metamodel it defines its own metamodel.

In conclusion it is clear that BPDM was mainly created to provide a metamodel to the already existing BPMN while also providing compatibility to other modeling languages [1]. To archive this the metamodel had to be more complex than otherwise necessary if it would only support BPMN and other models had to adopt the BPDM. Today there is no wide variety of modeling languages that adopted BPDM.

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The S.M.A.R.T Approach by George T. Doran

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1 Introduction

The S.M.A.R.T. Approach [8, 9] is an attempt to standardize the writing of effective objectives, to establish a controlled workflow and therefore to ease management in the sense of management by objectives. However one of the main problems of this approach is, that there is no standardized definition of it. The acronym of smart objectives might have occurred the first time in an Publication of George T. Doran [8] who claimed that „most managers still don't know what objectives are and how they can be written" and that "characteristic of management excellence is a climate in which company officers and managers talk in terms of objectives" and therefore makes arguments for a standardized and effective way to write objectives. He argues that the S.M.A.R.T. Approach can fulfill this task and also describes requirements of an organization in form of salary structure and job fit to fully realize the potential of this method. Doran introduced S.M.A.R.T. as the acronym meaning Specific, Measurable, Assignable, Realistic, Time-Related but one of the more common ones is used in the form of Specific, Measurable, Achievable, Relevant, Time-Bound.

Doran's publication being almost 40 years old, this method is widely known and there are many alterations and derivatives of it in use. This work aims to give an overview of the initial intention of the approach by Doran and its most common usage.

2 Goals vs. Objectives

Objectives are seen as an important part of Organization communication by Doran [8]. There exist many different definitions of objectives and goals in which they change its roles eventually. Since for clear communication it is important to clarify vague or variably used. He argues that the definition is not important as long it is used in the same way in one organization, at least on executive level. For this reason two of the more common usages of these terms which also align with the usage of the terms which Doran used in his publication are being presented here.

Goals

"Goals are the specific result or purpose expected from the project. The project goals specify what will be accomplished over the entire project period and should directly relate to the problem statement and vision.The goal is achieved through the project objectives and activities." [3]

Objectives

"Objectives are the specific steps that lead to the successful completion of the project goals. Completion of objectives result in specific, measurable outcomes that directly contribute to the achievement of the project goals.” [3]

3 The S.M.A.R.T. Approach to write effective Objectives

As mentioned before there exist many acronyms based on the term S.M.A.R.T. floating around in publications and the internet. The exact definition can vary and different versions may suit different tasks or organizations. For this reason the most common acronym is being presented here in which S.M.A.R.T. stands for Specific, Measurable, Achievable, Relevant, Time-Bound [6]. The chosen criteria are supposed to be applied on objectives as tightly as possible but as abstract as needed according to Doran [8].

Specific

The objective should be clear and specific so it's tangible and therefore easier to motivate the assigned people to achieve it. The following questions can be useful to determine if the objective is specific enough:

- What do I want to be accomplished?
- Why is this objective important?
- Who is involved?
- Where is it located?
- Which resources or limits are involved?

Measurable

It's important to have measurable objectives, meaning to be able to quantify them or at least suggest an indicator of progress. This helps to stay focused on the intended objective and meet the deadline. It also helps in evaluating the objective and track the progress made on it. A measurable objective should address questions such as:

- How much?
- How many?
- How will I know when it is accomplished?

Achievable

An objective also needs to be realistic and attainable to be successful. In other words, it should stretch the abilities but still remain possible. When setting an achievable objective, it may be possible to identify previously overlooked opportunities or resources. An achievable objective will usually answer questions such as:

- How can the objective be accomplished?
- How realistic is the objective, based on constraints, such as financial factors and other resources?

Relevant

This step is about ensuring that the objective matters, and that it also aligns with other relevant objectives. Its supposed to brings progress for the associated goal this objective is part of. A relevant objective can answer ”yes” to these questions:

- Does this seem worthwhile? Is this the right time?
- Does this match our other efforts/needs?
- Are the assigned people the right ones to reach this objective?
- Is it applicable in the current socio-economic environment?

Time-Bound

An objective needs time frame. In this version it is requested in a form of a target date, so that there is a deadline to focus on when the objective has to be finished. This part of the SMART objective criteria helps to prevent everyday tasks from taking priority over your longer-term goals on the one hand and to make the objective more measurable on the other. A time-bound objective will usually answer these questions:

- When?
- What can I do six months from now?
- What can I do six weeks from now?
- What can I do today?

4 The Right Conditions

According to Doran [8] it is very important to set the right conditions in an organization to be able to establish an environment for effective use of smart objectives to gain maximum productivity. In his opinion the most important part is to find the right job fit for employees so they can bring in their personal strengths where it is most effective. Since job requirements can change quickly over time, job fit evaluation is needed on a regular basis. He argues that therefore ”radical change is needed in the position evaluation and salary structure” so that it is possible to move up or down in positions independent of the salary and reputation. Doran also claims that it is the job of a excellent manger to move people to their job fit and if not possible remove them. He argues that ”if a manager has persons in the wrong job, require him to face up to the reality of it, or be penalized. The immorality lies in failing to tackle the problem, not in beeing soft about it.”

> important: as tight as possible and as abstract as needed
> critics today: performance indicator

5 Critics

Searching for it there is much critic to be found about the S.M.A.R.T. Approach. One of the more common ones is, that dividing goals into smart objectives which fulfill all the criteria is too narrow and doesn't let enough room for flexibility and lacks therefore agility [7, 1, 2]. Another critic is, that dividing every problem or task into objectives could lead to lose the focus on the main goal [1].

Doran states that objectives may be clarified as abstract as needed and may be divided into subobjectives to actually be worked on. So the argument of beeing narrow gets inadequate in the approach described by him.

The problem is, which can also be viewed as the biggest point of criticism, that there is no standard definition of that approach. It's not even certain when the term has been used the first time. Some cite Doran's article [8] as the first occurrence [5, 4]. The way he uses the term in his explanation of smart objectives suggests that the term might has been used and therefore introduced before though. Sometimes also Peter Drucker is named as the creator [4].

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Goal-Models and the i* Modelling Method

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8 June, 2021

1 Introduction to Goal Oriented Requirements Engineering

Requirements engineering is according to the *International Organization for Standardization* defined as following:

> *"interdisciplinary function that mediates between the domains of the acquirer and supplier to establish and maintain the requirements to be met by the system, software or service of interest.*
>
> *NOTE: Requirements engineering is concerned with discovering, eliciting, developing, analyzing, determining verification methods, validating, communicating, documenting, and managing requirements." [4, p.6]*

Requirements engineering is therefore necessary for a successful development of a system, program etc., because it defines the requirements that are needed to meet the intended purpose of the system [8, p.33]. One way to approach requirements engineering is from a goal oriented perspective. Van Lamsweerde defines a goal as *"an objective the system under consideration should achieve."* [9, p.250]. The system in that case can be either referring to the current system or to the system-to-be, and both states of the system are of importance in the requirements engineering process. Van Lamsweerde understands a system as a composition of the environment. The system is made of active components with their own behavior [9]. The active components can be anything from human, software, institutions or devices and are called agents. And to make the loop back to the requirements: *"A goal under responsibility of a single agent in the software-to-be becomes a requirement."* [9, p.250].

It is helpful to use goals as a guideline for requirements engineering process for the following reasons [9, p.250]:

- to achieve requirements completeness,
- to avoid irrelevant requirements,
- to explain requirements to stakeholders,
- to provide a natural mechanism to structure complex requirements,
- to find alternative goal refinements,
- to manage conflicts among multiple viewpoints,
- to separate stable from unstable information,
- to use goals as a driving force.

One problem with goals is, that often they are not expressed directly, but more often indirect or informally. A possible approach to identify goals is to analyze the current system and use it as a source to identify goals. Having a closer look a the current state of the system might end up in a list of problems, and simply turning the problems around can provide in a list of goals to be achieved for the system-to-be [9, p.250f.].

There are several modelling languages that help to analyze, conceptualize and model the requirements of a system to be developed or transformed. Some of the well known goal oriented modelling languages are KAOS and i* [3, 11]. The following introduced modelling language i* (pronounced iStar) was developed by Yu [11]. It is based on the goal modelling approach, but takes it as a starting point for an agent-oriented modelling language.

2 An Agent Oriented Modelling Framework – Introduction to i* Modelling Language

2.1 i* – its idea and intention

The i* modelling language was developed by Yu [11] in his dissertation published in 1995. The framework is designed for the early-phase of the requirements engineering process. It builds upon the goal-oriented framework described above but puts a special emphasis on modelling social relations, in that sense i* is also an agent-oriented modelling framework. It is the understanding that a system should aim at improving the relationship among actors, thus in order for a system to work, the social relations have to be analyzed beforehand [12]. The early-phase of requirements engineering is characterized by understanding the motivation to create a system-to-be, why the current circumstanced do not work and what the different perspectives are on the current situation. This can be analyzed by looking at and rearranging the different social relationships involved.

The benefit of applying a social worldview is to see and understand the different kinds of intentions, dependencies, interests, reasons and many more of the different actors involved the system(-to-be). Especially vague ideas of a system-to-be, or simple desires of an actor can be easily added to such a social worldview. Additionally, applying a social worldview allows to acknowledge the fact that each actor acts (semi-)autonomously in that sense that the actor has a behaviour of himself/herself, but is also dependent on their environment and other actors involved [12].

The i* modelling framework takes upon the two above mentioned benefits of a goal and agent oriented perspective. It uses goals to describe the intentions as attributes of the different actors involved and hence can incorporate the viewpoints from several perspectives. With dependencies created between different actors, the autonomy and vulnerability of actors are also incorporated into the system modelling process. With this combination of goals and agents it is possible to recognize the possible trade-offs and opportunities of different/competing goals from several perspectives [12].

Currently the version i* 2.0 is used. The new standard was published 2016 and is under continuous development [2]. For the i* modelling language several domain specific extensions are available, thus i* can be used for many different modelling tasks in many different domains which shows the intended open nature of i* [5].

2.2 i* Notation – What can i* model?

As mentioned before, the focus of i* are the social relations between different actors involved in a system. A summary of the notation of i* can be seen in table 2.3 as well as some example models in figures 1-3 of a travel reimbursement scenario as described in [2]. Generally i* differentiates between the following model views; *Strategic Rationale, Strategic Dependency, Hybrid SD/SR* (see figures 1–3 for examples).

- *Strategic Rationale (SR):* This view shows all the links, relations, dependencies, resources etc.
- *Strategic Dependency (SD):* This view only focuses on the actors and the associations to others and their dependencies among each other including the intentional elements.
- *Hybrid SD/SR:* The hybrid view is useful, when for example not all the information about all actors is available, or the model is defined from a specific perspective.

From the perspectives of the SR and SD model view, the following section is going to describe what i* can model and for what it can possibly used for.

Strategic Dependency Model (SD): The focus of the SD model is, as its name already states, the dependencies of the different actors, how they are related to each other in terms of their dependencies to each other. The dependency relationship describes a depender, its dependee and the dependum (compare figure 2 and table 1). The focus on the dependencies allows the identification of possible vulnerabilities and opportunities resulting from the different social relations. Taking the example of the travel reimbursement scenario, the student is dependent on the travel agency to provide the booked tickets and the trip being booked, which could create a vulnerability for the student if the travel agency does not do their tasks. But this also offers the student some leisure, not to worry about the trip being booked.

Strategic Rationale Model (SR): The SR model includes all the dependencies described in the SD model and additionally shows the intentions, resources, tasks and the like of the different actors (compare figure 2). One can say that it takes a deeper look into the actors involved and elaborates their position in the system. Different tasks are decomposed into sub tasks, linking different actors together, showing how they interrelate to each other and hierarchically ordered. This could be of special interests to evaluate if there are any alternatives with respect to the interests and intents of the actors. As mentioned in the SD model in figure 1, the student is dependent on the travel agency for them to book the trip. When having a look at the SR model (see figure 2), it is possible to evaluate why involving a travelling agency is of comfort for the student: it is is quicker, it is more comfortable, but also possibly more expensive compared to booking the trip himself/herself.

2.3 Overview of the i* modelling notation as described in [2].

Group	Variations	Description
Actors	Actor	Autonomous entity, that aims at achieving his/her/its goals by exercising their know-how, in collaboration with other actors – used when distinguishing the type of actor is not relevant.
	Agent	Abstract characterization of the behavior of a social actor within some specialized context or domain of endeavor.
	Role	An actor with concrete, physical manifestations, such as human individual, an organization, or a department.
	Actor Boundary	Visualization for the actors intentionality, grouping together their intentional elements together with their relationships
Actor Association Links	Is-a	Represents the concept of generalization/specialization.
	Participates-in	Represents any kind of association, other than generalization/specialization between actors. No restrictions on type of actor linked. Source = agent, then the target is a role - represents the play relationship. Source and Target = same type - represents part-of relationship. Every actor can participate in multiple other actors.
Intentional Elements	Goal	State of affairs that the actor wants to achieve and that has clear-cut criteria of achievement.
	Quality	An attribute for which an actor desires some level of achievement. The level of achievement may be defined precisely or kept vague.
	Task	Represents actions that an actor wants to be executed, usually with the purpose of achieving some goal.
	Resource	A physical informational entity that the actor requires in order to perform a task.

Social Dependencies	Depender	The actor that depends for something (the dependum) to be provided.
	Depender Element	The intentional element within the depender's actor boundary where the dependency starts from, which explains why the dependency exists.
	Dependum	An intentional element that is the object of the dependendy. The type of the dependum specializes the semantics ot the relationship (e.g. dependum = resource - the dependee is expected to make the resource available to the depender; dependum = goal - the dependee is expected to achieve the goal, and is free to choose how).
	Dependee	The actor that should provide the dependum.
	Dependee Element	The intentional element that explains how the dependee intends to provide the dependum.
Intentional Element Links	Refinement	Links goals and tasks hierarchically. Is an n-ary relationship relating to one parent to one or more children. Parent can only be AND or OR refined, not both at the same time.
	AND	The fulfillment of all the n children makes the parent fulfilled.
	OR	Inclusive: the fulfillment of at least one child makes the parent fulfilled. Allows for one single child.
	Needed By	Links a task with a resource and it indicates that the actor needs the resource in order to execute the task.
	Contribution	Represents the effects of intentional elements on qualities, and are essential to assist analysts in the decision-making process among alternative goals or tasks. Defined as relationships from a source intentional element to a target quality.
	Make	The source provides sufficient positive evidence for the satisfaction of the target.
	Help	The source provides weak positive evidence for the satisfaction of the target.
	Hurt	multicolumnThe source provides weak evidence against the satisfaction/denial of the target.
	Break	The source provides sufficient evidence against the satisfaction/denial of the target.
	Qualification	Relates a quality to its subject (task, goal, resource). Expresses a desired quality over the execution of a task, the achievement of the goal or the provision of the resource.

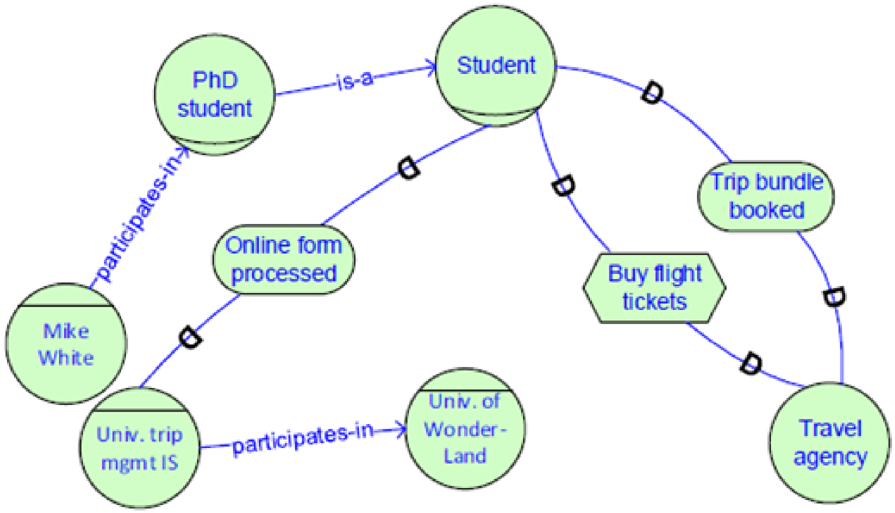

Figure 1: Strategic Dependency Model View of a travel reimbursement scenario [2].

2.4 Short evaluation of the i*

Although i* is widely used in the research field of requirements engineering, some recent studies show that it still has some open issues to be resolved. Yasin and Liu have evaluated a number of studies on i* [10]. Their findings show, that currently open problems dealt with in their evaluated studies of i* are concerning the scalability, clarity and the combined use of i*. Abrahão et al. have compared i* 2.0 to value@GRL concerning several aspects like usability and the achieved model quality (value@GRL is a simplified i* version) [1]. Their results show that the models created with value@GRL are significantly of better quality; the participants in the studie found value@GRL more useful; the ease of use and of value@GRL and i* and productivity of the participant (productivity = quality and time) are comparable; and last modelling time was lower for i*.

These findings show that i* seems not to be the answer to all requirements engineering questions and concerns. But never the less, i* is still very popular with the research field of goal oriented requirements engineering [6, p. 143].

3 Conclusion on goal oriented requirements engineering

Mavin et al. have done a study on the application of goal oriented requirements engineering in practice [7]. They show that though it is quite popular in the academic research field, it finds little application in industry. Most of the publications about goal oriented requirements engineering are coming from the academic field and only in some cases show a connection to the industry and actual application of it. A questionnaire done with practitioners shows that they do work with goal oriented requirements engineering, but mostly in a more general sense of goals. This underlines that there is a gap between the academic field on requirements engineering and its actual application in the field of industry. Therefore in theory goal oriented requirements engineering seems to work, but still needs to find a way into the real world.

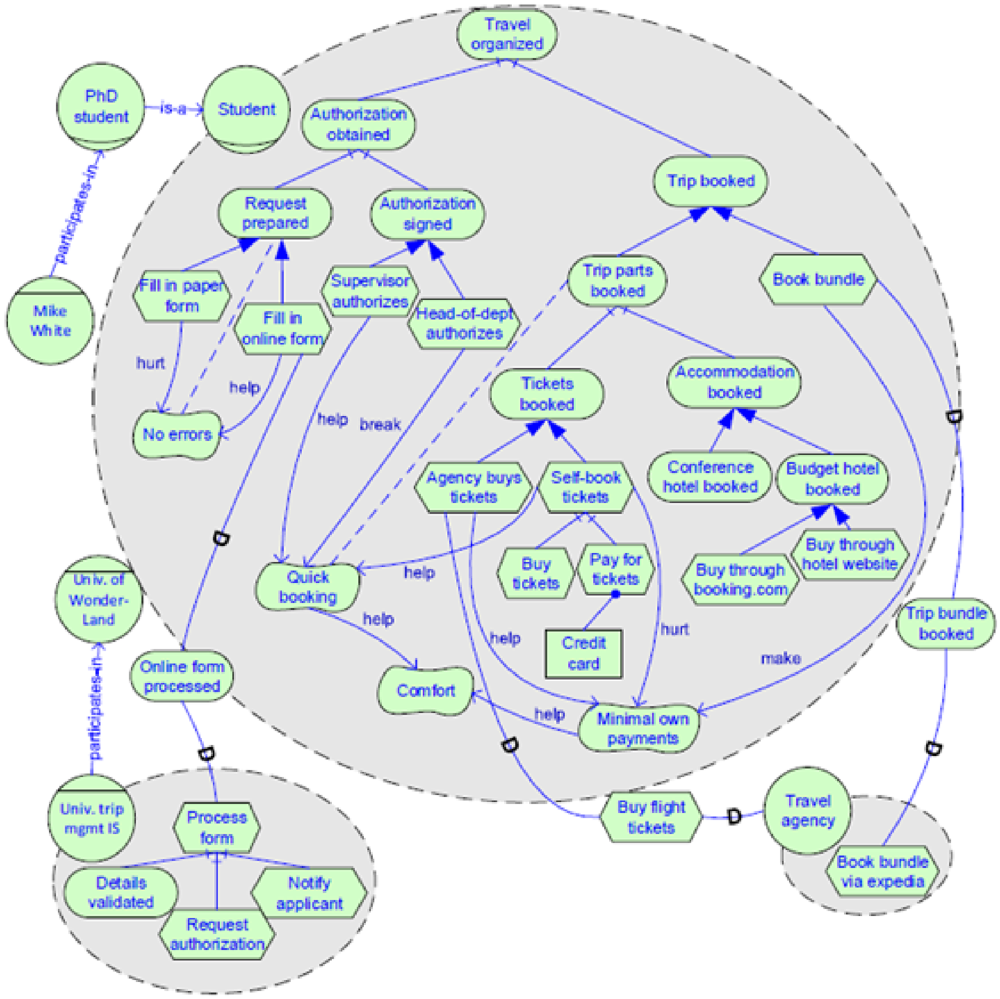

Figure 2: Strategic Relationale Model view of a travel reimbursement scenario [2].

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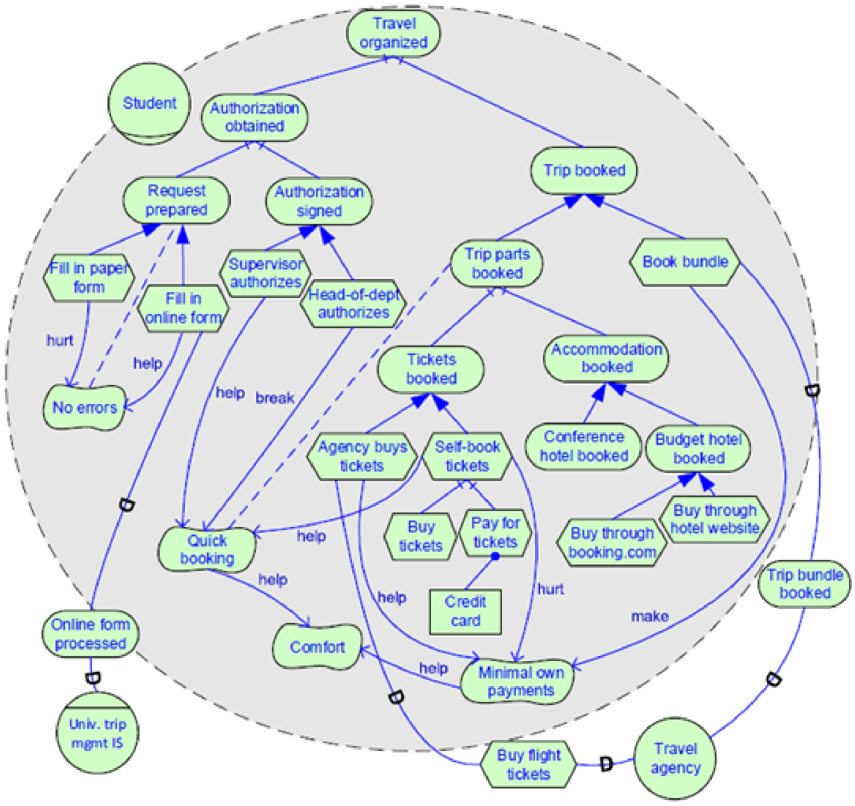

Figure 3: Hybrid SR/SD Model View a travel reimbursement scenario [2].

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Handout: Mintzberg on Management

Leadership and Organizations - Myth and Reality

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June 11, 2021

Abstract

Henry Mintzberg proposes new conceptual relationship to management, organizations and the world constituted by organizations. The subject of management, the manager, is detached from known attributes and receives a theoretical role description in the form of interpersonal, information and decision-oriented roles. Based on this, strategy development in management is highlighted as a craft, which is postulated as a synthesis process of analytical thinking and intuitive action, similar to the consideration of the neurophysical findings of left and right brain hemispheres. In this context, he criticizes the training of managers in MBA programs, which, according to him, rely too much on analytical studies and neglect the "practical" parts. Furthermore, he introduces new classifications of organizations as structural forms and power processes, which can be subdivided into seven types of configurations and described by basic characteristics. Here, organizations are equated with configurations. The differentiation of configurations are presented as entrepreneurial organization, machine organization, organization of professionals, diversified organization, innovative organizations, missionary organizations and political organizations. Furthermore, he supplements the configuration with the concept of form, which can be characterized as a force property in organizations and integrates it into a life cycle model. Finally, he proposes control mechanisms for organizations in society to prevent power concentration and presents a critique towards the formation of society through the construction of organizations and their characteristics.

Keywords: Mintzberg, management, configurations, organizations, society, leadership

Note: "The manager" refers to all genders in the following, with the masculine form used as an abbreviated form.

1 Introduction

In the following, the theses of Henry Mintzberg, a professor of economics and management at McGill University in Canada, from his book "Mintzberg on Management" [1] are presented. Mintzberg refers to three different topics: Management, in terms of looking at the manager, their roles and how they can carry out strategy development. The manager's ways of thinking are related to the concepts of analysis and intuition and put into context with the everyday work process. Advantages and disadvantages of the ways of thinking are compared and new approaches are postulated.

Subsequently, the organization is described as a set of configurations, whereby individual components and participants of the organization are described and the configurations are divided into seven basic forms. The transformation of organizations is illustrated by means of forces, whereby the basic form of organizations carries a dominant force, but at the same time requires a balancing force to maintain itself. With the help of these forces, the transformation process of organizations is presented in a life cycle model, which describes the possible transitions between the basic forms in a diagram.

Finally, Mintzberg summarizes the theses of management and organization and relates them to today's society. He shows who should control organizations (especially in the form of companies) and how this control can be designed. Finally, he puts theses about today's society in the foreground and gives an outlook on how it can come to a positive transformation of our world.

2 Management

At the outset, Mintzberg negates conventional notions about the role of the manager. A manager, he points out, is not a systematic, conscious planner of his work, but performs in short, varying and intermittent activities. The management process is always tied to a form of unreflective activity and is subject to a high pace of work. The freedom of a manager is often restricted by rituals, ceremonies and negotiations. Especially the aggregation of so-called "soft information" via gossip is crucial for the successful manager. The manager spends most of his time in oral communication over the telephone or in face-to-face encounters. Contrary to many theories in the management literature he obtains his most important information not through management information systems, but through direct verbal coordination. The strategic databases remain mostly "in the heads" than in management systems, which is why the managers themselves are of great value to a company. Last but not least, for Mintzberg, management is not a "science" that can be described by analytical processes, but management lives only through the intuition and judgment of the manager.

2.1 Roles of the manager

Further, he describes the manager in terms of *interpersonal*, *informational* and *decision-making roles*, which are manifested through formal authority and status. Thereby the manager commits himself to a responsibility over the organization and its subunits. Access to information characterizes his status and gives him the ability to make decisions and develop strategies.

The interpersonal roles follow directly from the manager's authority: as a *representative figure*, he performs ceremonial duties and routine actions, with no decisive communication in the real sense. However, the *guide* role gives the manager direct guidance over the organization and the hiring of employees. Motivation and encouragement of departments are under his responsibility, therefore he carries a potential power. As a *contact person*, he cultivates contacts to build an information system, which is mostly characterized as informal, private and oral.

Consequently, in the *information roles*, he can manage the information obtained: As a *monitor*, he monitors the environment for further information that can strengthen the organization and make it better assess the market situation. He distributes the information to his employees in the role of *distributor*. To present the information, he has to make speeches and satisfy influential people such as shareholders or shareholders, which is defined as the role of *speaker*.

Finally, in the *decision-based roles*, he gains control over an organization: As an *entrepreneur*, he initiates development projects, which he controls and delegates. As a *crisis manager*, he must respond to external pressures that are beyond his control (strikes, bankruptcies, suppliers). As a *resource allocator*, he decides who gets what in a subgroup and authorizes major business decisions before they are implemented. With access to information and resources, the manager conducts negotiations as a *negotiator*.

These roles cannot be considered anything separate, but are only conceivable in the form of a *holistic gestalt*. For example, a manager cannot conduct negotiations without formal authority, or cannot act as a facilitator without access to information. Therefore, no role can be considered separately or divided among different people.

2.2 Strategy development

The term strategy development is normally understood to mean a form of planning that formulates specific courses of action and presents them clearly and explicitly in a process of analysis. Mintzberg, however, highlights a different image in which strategies are crafted. To this end, he makes a comparison with a potter who puts skill, dedication, and perfection into his work through mastery of details. Mintzberg compares the "serendipity of error" in pottery making to "opportunities" in business and sees the "feel for the clay" as "knowing the industry". The process is characterized more as "calculated chaos" with less thought and reason than involvement, familiarity, and harmony with the material. Many years of experience and commitment are the basic conditions for strategy development.

According to Mintzberg, strategies do not have to be planned, but can also *emerge*. He defines strategy here as plans for the future and patterns from the past, with patterns being defined as "realized strategy." Strategies can be formed and formulated. Companies that rely solely on the image of planning in the literature are often misguided, according to Mintzberg. Managing strategies means putting thinking, acting, controlling, and learning into an artisanal way. Successful leadership requires maintaining the stability of strategies, detecting discontinuities, maintaining a (personal) overview of the market niche and industry and recognizing patterns in itself. Change and continuity of strategies must be adapted to different divergence periods.

2.3 Plan with the left, manage with the right

To clarify what Mintzberg means by his concept of strategy development, he compares the development process of strategies with the functions of the left and right hemispheres of the brain. The left hemisphere functions mainly according to linear patterns of operation, which are generally compared with logic and rationality. Information is processed sequentially and in an orderly sequence. In contrast, the right hemisphere processes information simultaneously and is more focused on the perception of images and gestures.

Mintzberg hypothesizes that important processes of managing organizations depend on the functions of the right hemisphere of the brain. Thus, oral communication, facial expressions, gestures, and linguistic tone tend to be registered by the right hemisphere, with information being perceived as relational and simultaneously than sequential and orderly. Impressions and feelings from hearsay and gossip about other people are of critical importance to the manager. The process is less analytical than "synthetic". Planning may only take place under stable environmental conditions and process-preserving strategies.

3 Organization

An organization is defined as a *configuration*. It is important to note that the success of an organization can only be explained by a combination of different character traits that adapt to a specific task. They strive for consistency in their courses of action in order to create synergies.

3.1 Components and participants

The components and participants of an organization are shown in figure 1. The *strategic top* is led by one or more full-time managers. Below these sit the managers for the operators in *middle line management*. This also includes managers over managers. *Supporting units* are responsible for external communication of the organization as well as maintaining internal processes, e.g., the cafeteria, mail room, or legal department. The *operational core* includes the workers who perform the main work. Often they are instructed by the *technostructure*, which is composed of analysts. Formal planning and control emanates from them. Finally, *ideology* forms a tradition or belief system that delimits the organization.

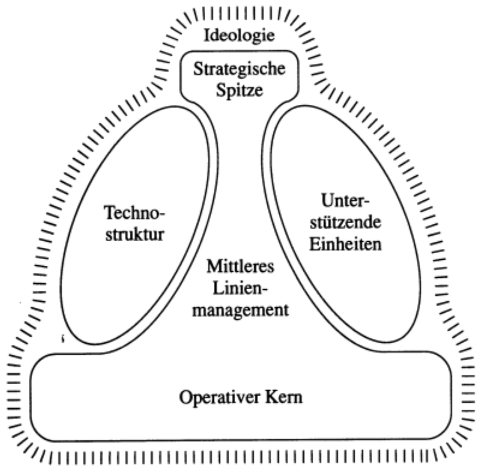

Figure 1: Basic types of organizations: Mintzberg on Management, Henry Mintzberg: 1991 p.110

3.2 Coordination mechanisms

There are six basic structures for coordinating work in an organization. First, there is mutual coordination through informal communication. Through direct control, management issues commands and orders. Standardization of work processes occurs through specification by the technostructure. The same is true for the standardization of outputs, specifying results. Standardization of skills (and knowledge) occurs through employee training. Last, standardization of standards forms a persuasion throughout the organization.

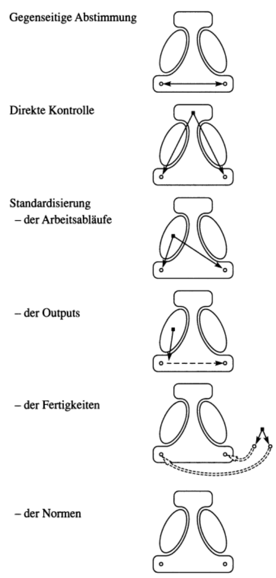

Figure 2: Coordination mechanisms: Mintzberg on Management, Henry Mintzberg: 1991 p.113

3.3 Basic types

Mintzberg characterizes an organization into seven different basic types which are listed in table 1. The *entrepreneurial organization* is defined by a simple, informal structure, with the boss maintaining control. Usually found in simple and dynamic environments, they are characterized by strong leadership and start-up mentality. A visionary process is at the forefront. However, an entrepreneurial organization is most susceptible to external conflict and must balance strategy with profitability.

The *machine organization* is the most common. It is characterized by a centralized bureaucracy and routine, standardized tasks. It lives in a stable and simple environment and is usually large and established. "Rationalized work" in terms of mass production is its main characteristic. Its strategy lies in maintaining stability and is efficient and precise. This strategy can lead to concise control.

The *diversified organization* is an extended form of the machine organization, which is divided into different divisions and has an autonomous management. The market segmentation is founded by its different products and services. It is also increasingly evident in governments and public sectors of society. The individual divisions develop their strategies, which are always under the vision of the main management. Risk is spread across different divisions. Innovation is sometimes difficult to implement and irresponsible behavior can occur.

The *organization of professionals* refers to a high form of complexity and fragmented strategies. Control lies with the professionals and is mostly decentralized. Collective decisions determined strategy development. There can be coordination problems and resistance to innovation.

The *innovative organization* is also based on knowledge, but is characterized by a changing and organic process, distributed among multidisciplinary teams. They are mostly young companies that want to innovate effectively, which can lead to a reduction in economic efficiency.

Additional forms indicated are *missionary*, which is defined by an ideology, and *political*, which is usually an internal power play. Missionary means "pulling in the same direction," whereas political means a form of conflict toward a needed goal.

Configuration	Primary coordination mechanism	Key part of the organization	Type of dezentralization
Entrepreneurial	Direct control	Strategic top	Vertical and horizontal centralization
The machine organization	Standardization of work processes	Technostructure	Limited horizontal decentralization
Professionals	Standardization of skills	Operational core	Horizontal decentralization
Diversified	Standardization of outputs	Middle line management	Limited vertical decentralization
Innovative organization	Mutual coordination	Supporting units	Selective decentralization
Missionary organization	Standardization of standards	Ideology	Decentralization
Political organization	None	None	Various

Table 1: Basic types: Mintzberg on Management, Henry Mintzberg: 1991 p.120

3.4 Forces

Further, Mintzberg describes configurations as manifestations of *forces* in an organization. Thereby each configuration tends to a dominating force which are shown in figure 3. Forces must always be counteracted by compensation so that the organization can maintain itself, otherwise it will get out of control. Entrepreneurial organizations tend to have a *directional force*, usually given by the leader. Machine organizations tend to be more *efficient*; everything must go according to plan. Professionals want to prove their *skills* and avoid relinquishing control. Diversified organizations tend to increase the *concentration* of power and finally the innovative organization especially wants to promote change and adaptation by *learning*.

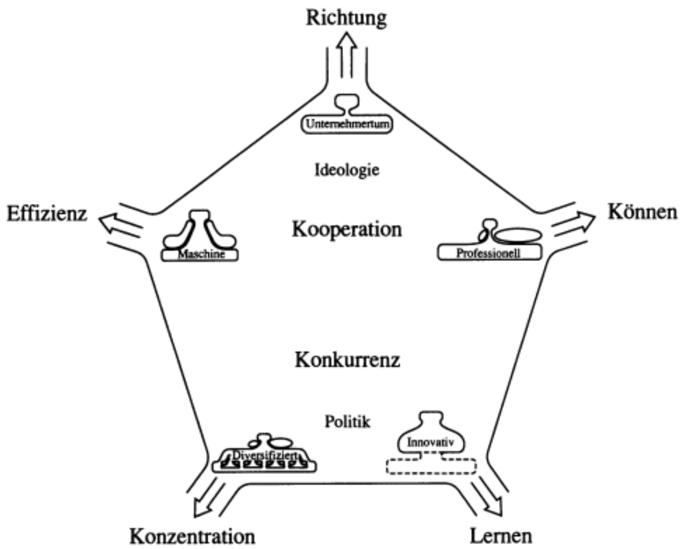

Figure 3: Coordination mechanisms: Mintzberg on Management, Henry Mintzberg: 1991 p.264

3.5 Life cycle model

The change of organizations is subsequently explained in more detail in the form of transitions between the basic forms presented above. For this purpose, a life cycle model is introduced, which divides the stages of an organization into *formation stage*, *development stage*, *maturity stage* and *decline stage*. The transitions are usually of a political nature or end in the demise of the organization.

Organizations usually begin in an entrepreneurial variant with a specific mission. This is maintained until the leader remains in his role or the organizations ceases to exist. An outside control mechanism is rarely present. A transition to the missional configuration is most common, where the leader's vision is institutionalized. A belief system is established and interwoven into the mangament. In contrast, entrepreneurial organizations tend toward the innovative form on the one hand, with a creative mission, and toward the professionalized form on the other, with the expansion of standardized capabilities. In addition, starting from the entrepreneurial configuration, there can be a change to the machine organization. In the case of takeovers, first to the instrumental machine, where the power lies with external influencers, or directly to the closed machine, if the power with internal management is great enough. Missionary organizations tend toward the closed machine because its inherent ideology can create isolation and destroy it from within. Closed machines can evolve into the diversified configuration as it grows larger and gains increased influence. A bureaucratic structure is established. Lastly, political organization can lead to the demise of the organization because it cannot exist effectively for long, or a new turnaround occurs.

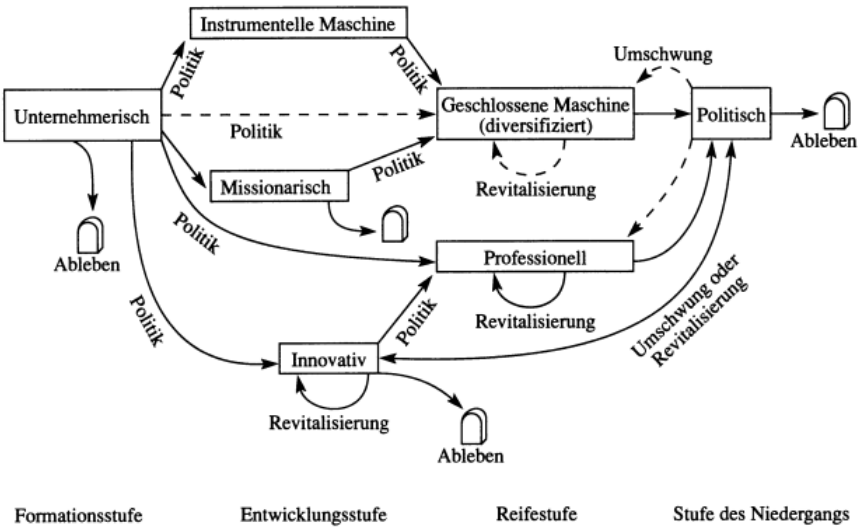

Figure 4: Life cycle model: Mintzberg on Management, Henry Mintzberg: 1991 p.288

4 Our World: A society of organizations

> “We create organizations, so that they serve us. But somehow they also force us to serve them.” - Henry Mintzberg

In the last part, Mintzberg puts the above hypotheses in relation to "our world today", which he calls "society of organizations". In order to give an answer to the control question of organizations, he presents different mechanisms shown in figure 5. *Nationalize* means to put the organizations in a government management, recognizing the task society as important, but it is not covered by the private sector. The organization should be run as a direct arm of the state. Further, he refers to *democratize* as intervening by facilitating the expansion of corporate governance. Power should be constitutionally decentralized in the process. *Regulating* means that certain activities are committed to a higher authority. Limits are imposed from "outside," leaving internal control with managers. In addition, *pressure* can be applied, usually in the form of campaigns calling for social action. *Trust* means that business leaders are trusted to want to pursue social goals themselves because "it’s a good thing to do." In contrast, *ignore* is trust in business success, with social needs included. *Incentives* may also be provided in the form of subsidies. Regulation and incentives may not be at odds with each other, or as Mintzberg clarifies: *"Financial incentives do not belong where a company has caused a problem, but rather has the ability to solve a problem caused by others."* Lastly, by *restoring* is meant a decline to a strictly managed system, where profit alone counts and freedom is equated with free enterprise.

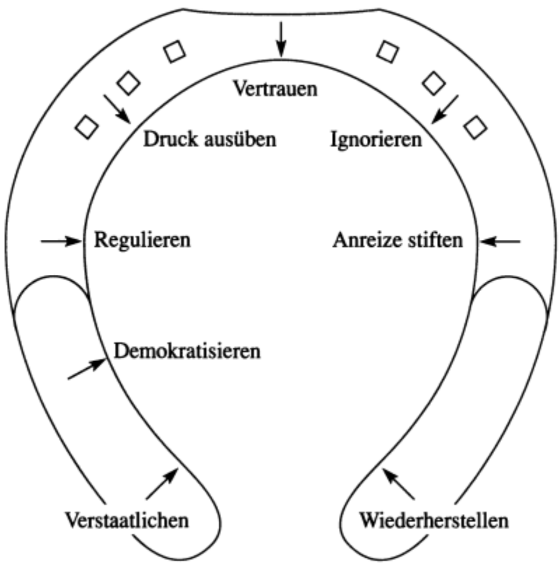

Figure 5: The conceptual horseshoe: Mintzberg on Management, Henry Mintzberg: 1991 p.312

In conclusion, Mintzberg points out that the organizational structures in society have led to a decline in intuition. According to him, society has become uncontrollable due to the current understanding of management. So far, no systematic approach to strategy formation has been shown, which is why he criticizes the theoretical managerial programs. Our society is a society of organizations, where everything can only be done within the framework of organizations. Our world, he argues, is dominated by large organizations. An understanding of society is therefore better described by organization theory than by established social sciences. The machine bureaucracy dominates thinking and dictates the nature of social structure. Control is the central driving force here. An organization can only persist if it dominates others. The loss for the value of spontaneity is the reason for the overrated need for planning. Thinking, orientation, and even goals must be provided from "outside and above" as a result. According to Mintzberg, intuition is no less rational than the current understanding of "rationality". Strategy formation is a process of synthesis rather than analysis. The right hemisphere of the brain is neglected and the holistic view is displaced. Professional management is the reason for the destruction of effectiveness of an organization. Theory about management became more important than management itself. The driving out of understanding, intuition, conviction and commitment resulted in the alienation of the population from the private and public sectors. People were degraded to impersonal shells. In the process, each organization carries with it the power for its own destruction, which can only be stopped by a countermovement. Large corporations have become political entities that can sustain themselves through power influence, for example, through mutual agreements, advertising campaigns, bribery, or lobbying. Even governments can positively influence the retention of power. Therefore, Mintzberg calls for a balance between intuition and analysis, concluding:

> "Only in this way will we find a way out of the unreal land of a strange world of organizations."

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The Toyota Management System. Guiding Principles and Main Tools

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Seminar Complex Systems and Co-operative Action

June 22, 2021

1 Introduction

This handout refers to the book "The Toyota Way – 14 Management Principles of the World's Most Successful Automotive Company" by Jeffrey K. Liker [1]. Jeffrey Liker has followed the company for 20 years and summarized his knowledge about it in the book. He analyzed Toyota's success and discovered 14 methods that enabled Toyota to become the most successful automotive company in the world. In order to understand the success of Toyota, it is necessary to look at the history of the company.This will be described in more detail in the next chapter. The Toyota Production System, another component of success, will be described only briefly. Here we will focus on the management methods that describe Toyota's holistic approach. The individual principles were divided by Liker into 4 categories, also called the 4 P's. Philosophy, Processes, People/Partners and Problem Solving. These categories can be thought of as a pyramid to be seen in Figure 2. Problem solving is the top of the pyramid. The most important is the foundation, the philosophy of the company. This philosophy runs through all management levels and eras. Starting with the founding Toyoda family, which is described in more detail below.

2 History of Toyota

Toyota's history began with Sakichi Toyoda. He started to build looms in 1894. Soon he bought a used steam engine and experimented with it to build a power loom. Together with his son Kiichiro Toyoda, he succeeded. He sold the patent for his automatic loom in Great Britain and got the start-up capital to found Toyoda Automatic Loom Inc. In 1936, the first car model was launched. The company was then renamed Toyota Motor Corporation. Fortunately, the company was able to survive the 2nd World War unscathed. Nevertheless, difficulties arose due to inflation. Kiichiro had to lay off staff. He also left the company and made room for his cousin Eiji Toyoda. Eiji Toyoda made several trips to automobile manufacturers in the USA and returned with the task of outperforming them. He shared this task with Taiichi Ohno, the plant manager, who then developed the Toyota Production System. This system is illustrated in Figure 1. The cornerstones of success are based on this system. Stable and standardized processes, visual management, and Toyota's philosophy form the foundation. The pillars are the Just-In-Time principle, Jidoka, people and the elimination of non-value elements. This system leads to the best quality, lowest cost, highest safety and high morale. All steps and processes must be seen as a whole. For example, just-in-time deliveries may lead to performance improvements, but may not be beneficial in the long run. It is necessary to constantly analyze and improve the processes. This is what the upcoming managers of Toyota did. They improved processes and introduced principles that increased Toyota's success. All driven by the philosophy and the 14 principles explained below.

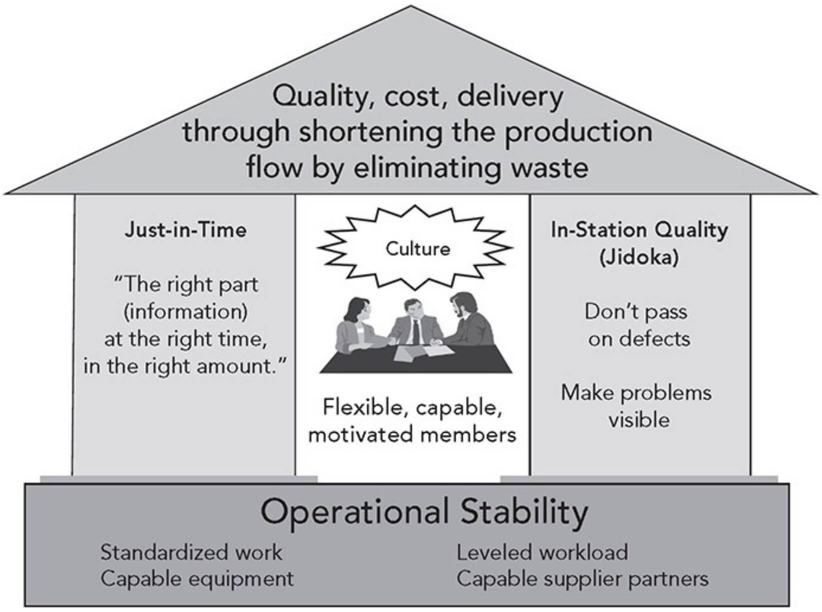

Figure 1: The Toyota Production System

3 Principles

Jeffrey K. Liker divides the principles into four categories – Philosophy, Processes, People and Partners, and Problem Solving. These four categories contain the principles that made Toyota successful. In Figure 2 you can see the pyramid that Liker describes. The foundation is the philosophy which is now described first.

3.1 Philosophy

1. **Principle: Long-term thinking**

   Base your management decisions on a long-term philosophy, even if it is at the expense of short-term profit targets. Toyota's major goals are to generate value for the customer, society and the economy.

   Toyota's philosophy is summarized by Liker in 7 points.

   - Honor the language and spirit of the law of every nation and undertake open and fair corporate activities to be a good corporate citizen of the world.

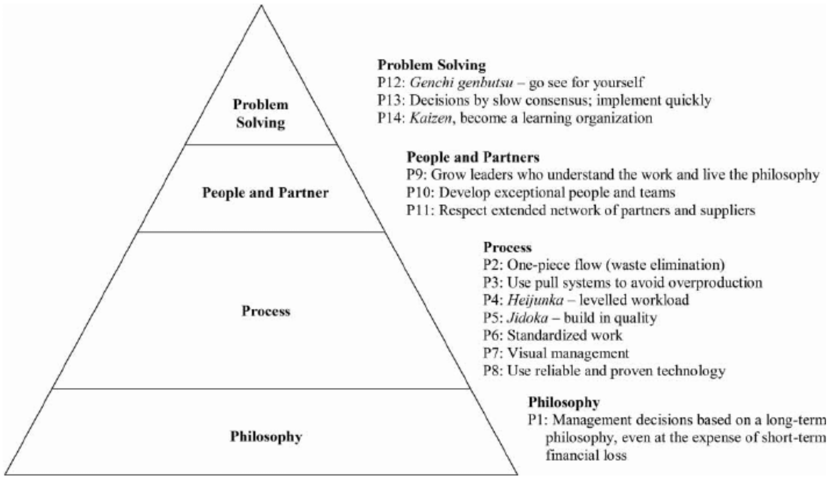

Figure 2: The Toyota Way Model

- Respect the culture and customs of every nation and contribute to economic and social development through corporate activities in the communities.
- Dedicate ourselves to providing clean and safe products and to enhancing the qualitiy of life everywhere through all our activities.
- Create and develop advanced technologies and provide outstanding products and services that fulfill the need of customers worldwide.
- Foster a corporate culture that enhances indiviual creativity and teamwork value, while honoring mutual trust and respect between labor and management.
- Pursue growth in harmony with the global community through innovative management.
- Work with business partners in research and creation to achieve stable, long-term growth and mutual benefits, while keeping ourselves open to new partnerships.

3.2 Process

2. **Principle: One-Piece Flow**

   The main goal here is the elimination of superfluous things, also called muda. These muda, according to Liker, can be the following things:

   - Overproduction
   - Waiting
   - Unnecessary transport
   - Overprocessing
   - Excess inventory
   - Unnecessary movement
   - Defects
   - Unused employee creativity

   In Figure 3 you can see the wastes in a value system. If you eliminate them, you can get the following advantages:

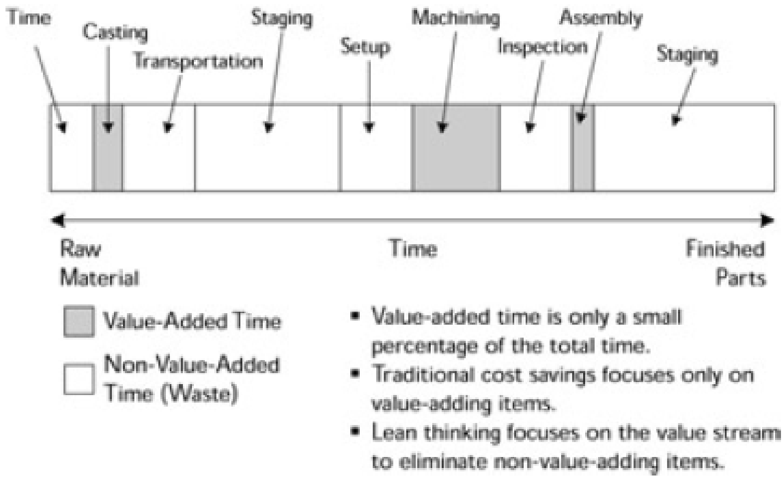

Figure 3: Waste in a value system

- Build-in quality
- Creates real flexibility
- Creates higher productivity
- Frees up floor space
- Improves safety
- Improves moral
- Reduces cost of inventory

3. **Principle: Pull-System**

   The main goal of the pull system is to make what's needed when it is needed. So you can get advantage of small storage costs.

4. **Principle: Heijunka: Balanced Workload**

   Heijunka tools attempt to balance workload and production volume. Yamazumi balances workload within a production process. A balance in both areas leads to a continuous flow of work and materials, from transport to the customer at the end of the chain, to material deliveries from suppliers at the beginning of the chain.

5. **Principle: Jidoka: Build-in quality**

   Create a culture that produces quality right away, rather than a culture of perpetual rework. Providing customers with quality drives your value proposition. Use all available modern quality assurance methods. Equip your machines to be able to identify problems and shut down automatically. Develop a visual system that notifies a team or project manager when a machine or process needs help. Jidoka (self-directed error detection) is the foundation of "in-process" quality. Establish support systems in your organization for rapid problem resolution, and take resolution action. Incorporate into your culture a philosophy of deceleration or interruption of production to get quality right the first time, thus increasing productivity in the long run.

6. **Principle: Standardized work**

   Standardized work steps are the foundation for continuous improvement and the transfer of responsibility to employees. Use stable, repeatable methods everywhere to ensure predictability, regular timing, and regular results from your processes. This is the basis for fluid processes and pull effects. Capture cumulative learning about a process by making best practices the standard. Give room for creative, individual expression to further improve the standard, and incorporate that improvement into the new standard. This way, you can transfer the learning to a successor when an employee leaves the company.

7. **Principle: Visual Management**

   Use visual controls to ensure that no problems remain hidden. Use simple visual signaling devices to help your workers decide if it's a standard situation or an anomaly. Eliminate computer screens if they distract your workers' attention from their workstations. Develop simple visual systems at individual workstations to support fluid processes and pull effects. Wherever possible, reduce your reports to one page, even for your most important financial decisions.

8. **Principle: Use only reliable technology**

   Use only reliable, thoroughly tested technologies that serve people and processes. Use technology to support people, not replace them. It is often best to execute a process manually before adding technological support. New technologies are often unreliable and difficult to standardize. Therefore, they put the "flow" at risk. A proven process that works reliably is far preferable to a new untested technology. Conduct testing before introducing new technologies into business processes, manufacturing systems, or products. Eliminate or modify technologies that conflict with your culture or that threaten the stability, reliability or predictability of the system. Nonetheless, encourage your employees to engage with new technologies as they seek new approaches. Deploy a thoroughly tested technology quickly if it has been proven in testing to improve your process flow.

3.3 People

9. **Principle: Leaders**

   Grow leaders who thoroughly understand the work, live the philosophy and teach it to others. Develop leaders from within your own ranks instead of buying in external leaders. Don't think of the leadership role as simply performing certain tasks and being able to deal well with people. Leaders must serve as role models for a lived corporate philosophy and for the way the company does business. A good business leader must be intimately familiar with the details of day-to-day business. Only then he can be the best teacher of the corporate philosophy.

10. **Principle: People and Teams**

    Develop exceptional people and teams who follow your company's philosophy. Create a strong and stable culture where corporate values and beliefs are shared by all and actively lived for many years. Train above-average employees and teams to work in line with the corporate philosophy to achieve exceptional results. Work hard to continually strengthen the culture. Use interdisciplinary teams to improve quality and productivity and increase process flow by solving difficult technical problems. Ownership happens when employees use the tools of the business to improve the business. Work tirelessly to show individual employees how to work as a team toward a common goal. Teamwork is something that must be learned.

11. **Principle: Network**

    Respect your extended network. Respect your business partners and suppliers, and treat them like an extension of your company. Challenge your external business partners to grow and develop. This shows your appreciation. Set challenging goals and support your partners in achieving them.

3.4 Problem solving

12. **Principle: Genchi Genbutsu**

    Solve problems and improve processes by getting to the root of the problem and personally verifying information, rather than writing theoretical papers based on second-hand information or computer data. Everything you say and think should be based on data you have personally verified. Even high-ranking managers and executives should personally see things for themselves so that they fully understand the situation.

13. **Principle: Nemawashi – make decision**

    Make decisions wisely and according to the consensus principle. Weigh all alternatives carefully, but implement the decision made expeditiously. Do not become rigid about a direction and take that course before you have thoroughly considered the alternatives. Once you have decided on an alternative, follow that course briskly but carefully. Nemawashi is the process of discussing the problems and their potential solutions with all stakeholders to gather their ideas and gain agreement on a solution. This consensus-based process is time-consuming, but opens up more avenues for solutions. And once the decision is made, the conditions are in place for rapid implementation.

14. **Principle: Kaizen – continuous improvements**

    Become a truly learning organization through relentless reflection (hansei) and continuous improvement (kaizen). Once you have a robust process in place, use continuous improvement tools to identify the root causes of inefficiencies and implement effective countermeasures. Develop processes that require virtually no inventory. This will make wasted time and wasted resources visible to all. When waste becomes visible, get your staff to continuously improve processes (kaizen) to eliminate the waste. Protect institutional knowledge by ensuring a stable workforce, slow promotion, and very careful succession systems. Use hansei (reflection) when you reach certain milestones and after a project is completed to reveal any shortcomings of the project. Develop countermeasures to avoid repeating the same mistakes. Learn by making best practices the standard, rather than reinventing the wheel with each new project and each new manager.

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The Principles of Scientific Management

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1 Abstract

In the late 19th century, Frederick Winslow Taylor was a foreman at a steel plant in Pennsylvania, US. While observing his workmen, he identified multiple reasons why workers would, sometimes even deliberately, stay behind Taylors expectations of how fast a set of tasks could be completed. Believing that major improvements in productivity were possible, Taylor started to develop a new type of management, which aims to perfect and optimize how every task is done. He formalized this new "Scientific Management", sometimes also referred to as "Taylorism", in his book *The Principles of Scientific Management*, which was published in 1911. Even though Scientific Management received a lot of criticism over the years, the positive effects on productivity and effectiveness were undeniable, resulting in aspects of the management still being visible in today's production routines.

2 Historical context

In 1880, at age 25, Frederick Winslow Taylor became foreman at the Midvale Steel plant in Pennsylvania, US. He was impressed by how much his workmen would stay behind his expectations of how much should be possible in a single day [3]. While investigating, he identified several reasons for that:

- Each worker was responsible for a complete production routine, and there was no specification of how to do it exactly.
- Employers were looking for "the perfect man" for the job, instead of telling workers how do to it.
- Responsibility of how the work was done lay with the worker.
- Workers would choose the easiest way or the way of least resistance.

Taylor was convinced that he could minimize losses due to these reasons by applying scientific methods to manufacturing.

3 The Principles of Scientific Management

3.1 Fundamentals

The Fundamentals of Scientific Management is the first chapter in [1] after the introduction. Here, Taylor prepares the basis for his principles by showing how both the task of the management and why workers work less than they could.
According to Taylor, the main task of management is to make maximum prosperity possible for both the employer and the employee. This can be achieved by a simple chain of events: By increasing the productivity of workers, the company makes more profit. More profit then results in higher wages. This is only possible, if both sides do their absolute best. Therefore, the views of employers and employees are not necessarily contradictory.
On the other hand, Taylor identified three reasons, why employees would deliberately work less than they could ("to soldier"):

1. Belief, that an increase in output of a single worker or machine would result in the dismissal of then obsolete other workers.

2. Workers are paid for work they done. Not showing, how fast it can actually be done, results in higher wages for less work.

3. "Rule-of-thumb" methods still had more importance than scientific approaches to solving a problem.

3.2 Principles

The Principles of Scientific Management is the next and last chapter of [1]. Before presenting his principles, Taylor gives an overview about a different and widely used type of management: "Initiative and Incentive". The initiative of a worker describes "his best endeavors, his hardest work, all his traditional knowledge, his skill, his ingenuity, and his good-will" [1], and it's the task of the management to make workers use their whole initiative. The management accomplishes this by giving incentive, for examples promotions, raising wages and similar aspects.
In Taylors new Scientific Management, incentive is only given in an indirect way: Only by sticking to his principles, an increase in productivity and therefore wages can be achieved. Taylors four principles of scientific management are:

1. They develop a science for each element of a man's work, which replaces the old rule-of-thumb method.

2. They scientifically select and then train, teach, and develop the workman, whereas in the past he chose his own work and trained himself as best he could.

3. They heartily cooperate with the men so as to insure all of the work being done in accordance with the principles of the science which has been developed.

4. There is an almost equal division of the work and the responsibility between the management and the workmen. The management take over all work for which they are

> better fitted than the workmen, while in the past almost all of the work and the greater part of the responsibility were thrown upon the men.

According to Taylor, the advantage of Scientific Management over Initiative and Incentive lies in combining the initiative of the worker and the new tasks of the management. This results in an even higher productivity and effectiveness.

4 Scientific Management

When put into practice, Scientific Management actually yielded good results. After finding the "one-best-way" to do something (principle 1), workers would be trained to do that exact method over and over again (principle 2). Workers would also be supervised and checked using different methods (principle 3). For example, stopwatches were used to measure a workers performance, until they were forbidden in 1916 due to the Hoxie-report [2]. By selecting the methods, the management automatically took on more responsibility, because if those methods were not good, it's now the managements fault and no longer the workers (principle 4).
But even though productivity increased, Scientific Management received criticism for multiple core aspects. After strikes in weapon factories, a special committee, which commissioned the Hoxie-report [2], was formed to examine Scientific Management and its methods [4]. Criticism regarding Scientific Management includes, but is not limited to, the results of the Hoxie-report and the following bullet points:

- Measuring time and fatigue is too inaccurate, and destroys the solidariy between workers.
- Work is now split up in physical and mental work, which results in few highly qualified and many under qualified workers.
- Physical work is split up in to many small parts, resulting in monotonous repetition.
- Scientific management itself results in outsourcing and lower wages, because now even unskilled workers can complete more complex tasks by simply following instructions.

In spite of this, the ideas of Scientific Management spread internationally and influenced others to implement or extend them.

5 Scientific Management today

While Scientific Management in it's original form is not used today anymore (because of the aforementioned criticism), some aspects are still visible in today's industry. An example for this is the production line for new cars: the same steps have to performed on every car, and while some can be completed by machines, workers are still needed. Delays caused by mistakes or not following the best procedure slow down the whole process and can potentially result in losses.

Even though it was initially developed for the secondary sector of the economy, sometimes it can be found in the tertiary sector as well: Fast food production and templates for documents or other objects are just two examples for how in the beginning, the best way to do something was found, and then reused over and over again by the employees.

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Interactive Planning

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1 Introduction

Interactive Planning is a methodology derived by Russel L. Ackoff, in his book „Creating the Corporate Future: Plan or Be Planned for"[1]. It is build upon the basic concept that the future of a company depends on what actions and events it realizes in the present, aiming towards an ideal future. Interactive Planning (*IP*), and trough its execution their planner, wants to design a desirable present which it then tries to approximate as good as possible [1]. The approach clearly sees the interdependence of problems and incorporates this into its planning.

Ackoff based this idea on the ideal of his so called „Interactivist" , who wants to actively shape the future of the organization. The „Interactivist" accepts that the future cannot be predicted and planned for in an all-encompassing way.

2 The three principles of Interactive Planning

Three principles are constantly influencing Interactive Planning [3]:

- The participative principle:
  Involvement of as many different stakeholders in the process as possible. All planning members should learn to understand the organization as a whole.

- The principle of continuity:
  Since *IP* is not based on future predictions, the plans that have been developed must always be monitored, evaluated and possibly modified.

- The holistic principle:
  Relevance of simultaneous and interdependent planning across all levels of the organization. Coordination (all parts across the same organization level) and Integration (one part of the system across all levels of organization) always have to be kept in mind while planning.

3 The Phases of Interactive Planning

Interactive Planning consists of two parts, Idealization and Realization, which each consist of planning phases. Idealization has two phases, Formulating the Mess and Ends Planning, whereas Realization has the remaining four phases, Means Planning, Resource Planning, Design of Implementation and Design of Controls.

3.1 Idealization

Formulating the Mess This first phase can be viewed as a situational analysis. The term "mess" describes the multiple, interacting threats the organization will face in the future (unless it changes). The goal is to find the reasons for the organization's potential decline if it does not adapt to its environment. It consists of four sub-activities:

- System Analysis:
  A detailed description of how the system (organization + environment) functions and operates, the organizational structure, policies, strategies, and practices.

- Obstruction Analysis:
  Identification of attributes and characteristics that impede the organization's development and identification of conflicts within the entire system itself.

- Reference Projections:
  Extrapolation of current organizational data and performance characteristics into the future, assuming no changes are happening in the organization or its environment.

- Reference Scenario:
  A detailed, procative, and possibly even shocking description of how the organization would end itself (self-destruct) on its current path, assuming the previous analysis is to be true [4]. Systematically, it is the synthesis of the previous three steps that yields the "mess", the disorder in which the organization finds itself. The objectives of this reference scenario are to highlight implications of current behavior and draw attention to relevant problems. Also its aim is to motivate all stakeholders to change and improve the organization.

Ends Planning This second phase is probably the most complex and important one. The planners define what the organization would like to be at the present time. It then aims at identifying the discrepancies between the developed Reference Scenario and the designed desired present. The "Ends" are then the goals to be achieved, the formulation of the ideal of the organization. For this purpose, Ackoff describes the methodology of "Idealized Design".

Idealized Design The basic assumption of the approach is, that the organization to be planned was destroyed last night, but its environment in which it was embedded remains intact. On this base the planners should design an organization to replace the current (destroyed) one **right now**. Every possible organization is conceivable, except for two constrains and one prerequisite [1]:

- Technological Feasibility: The design should only use technologies that are usable at the current time.
- Operational Viability: The system, should it begin to exist, is able to survive in its current environment.
- Learning and Adaptation: The organization should have the ability to continuously adapt to internal and external changes that could potentially affect it. This also implies the requirement for adaptability of internal and external stakeholders.

Idealized Design consists of three phases:

1. Formulation of a mission statement,

2. Specification of the characteristics that the organization to be designed should possess,

3. Design of an organization with these characteristics.

The goal of "Idealized Design" is **not** an ideal organization, but a possible, best result at the time of development.

> *„It is neither perfect nor utopian. The design produced should be that of the best ideal-seeking system of which its designers can currently conceive. (They may, and probably will, be able to conceive of a better one later.) " [1]*

3.2 Realization

Means Planning This phase is the first of the realization step. It aims at the development of means/opportunities to close or at least reduce these discrepancies or "gaps" identified in Ends Planning. Therefore, it can be seen as the correlation of the reference scenario and idealized design [4]. Here, the planners elaborate and select courses of action, projects, programs, and new policies that drive the organization closer to the ideal. The planned ideal present should be approximated as best as possible for the near future.

Problems in the Reference Scenario can be handled by either "resolving, solving or absolving" [2]. Absolving (justifying) should rarely be chosen and should be done only under certain circumstances. It is better to find a solution to the problem (solve) or at least to eliminate it (resolve). For each problem, several alternative solutions can be discussed, which are then prioritized and selected by means of questioning, experiments, models or simulations [2].

Resource Planning The means and possibilities developed are now considered in the context of economic and business aspects, specifically under the following questions:

- What and how many resources are needed to implement the Means? Where are they needed?
- When will the resources be needed and how much will be available?
- What should happen in the event of a shortage or surplus of resources?

Ackoff identifies five relevant categories of resources for planning: inputs (e.g. materials, supplies, energy and services), facilities and equipment, personnel, money and data (information, knowledge, understanding and wisdom).[1]

Design of Implementation This phase aims at planning and executing the previously developed means (in the context of resources). Decisions made in the previous phases are translated into a set of instructions and schedules. Those responsible for planning should fully and holistically coordinate this process, and be available as contact persons. This phase was briefly and simply summarized by Ackoff as „determining who is to do what, when and where."[1]

Design of Control This final phase runs in parallel with the previous one as a control and monitoring instance. Criteria are identified and selected that allow evaluation of the success of planning decisions. Using these developed metrics, the instructions and flowcharts are then to be monitored, checked for effectiveness, and adjusted if necessary in the event of errors.

3.3 Execution of Interactive Planning

According to Ackoff, these six phases should be initialized in this order, but need not be explicitly performed in the presented order. Due to their strong dependence on each other, they often take place simultaneously and interactively. Interactive planning is therefore also continuous planning, in which no phase is ever completed.

> *„All outputs are subject to subsequent revision. Plans are treated as, at best, still photographs taken from a motion picture." [1]*

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Anton Kozhemyako. Contradictory Business Processes and Schematization

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July 13, 2021

1 Introduction

In his thesis "Special Features of the Use of TRIZ for Solving Organisational-Managerial Tasks (OMT): Schematization of an Inventive Situation and Work with Contradictions" [1] Anton Kozhemyako proposes a way to use schematization on business tasks to TRIZ tools which can be successfully applied. Further he develops a method for determining the operational zone in OMTs.

2 Organisation and Management

According to Kozhemyako [1] there are three forms of activities that build the basis of management:

- **Organisation** is the process of forming supersystems and/or subsystems of various level in business systems: associations, organisations, departments and workplaces. Organisation is the formation of the structure, i.e. of the elements and their interconnections.
- **Leadership** is the setting of tasks to performers and monitoring their implementation.
- **Management** is a change in the activities of performers, i.e. when the structure is organised and all tasks are distributed (including tasks for feedback), but the efficiency of the performers is not satisfactory. The Manager tries to change their activity in the direction of improvement, that is, he/she begins to manage their activity.

All of these are activities in business systems and can be called "organisational-managerial" tasks or OMTs for short.

Most of such problems do not cause difficulties to managers since they encounter similar situations regularly. However, some OMTs cannot be solved in the usual way. For this reason, many attempts have been made to use TRIZ tools to solve OMTs but to analyse the OMT it turned out to be difficult or unreliable since most of the TRIZ methods are ill equipped to incorporate human elements [1]. When solving OMT, it is impossible to consider people in organised social systems as "objects", since they are essential (and often the most important) elements of the system.

3 Schematization

Schematization is a method developed within the Moscow Methodological Circle lead by G.P. Schedrovitsky as a means to solve problematic situations in the field of organization and management [1].

Schematization tries to look at the business system from a bird's eye view. The use of schematization prevents the narrowing of the task during the analysis stage [3].

Components of schematization: [3]

- System Framework or model of a working system (MWS). This is the system to be analysed.
- Elements. There are two types of elements: Objects and Subjects.
- Levels. The levels describe which element is managing and which element is managed. The element of the higher level is the managing one.
- Connections. There are three types of connections:
  - A direct line – A relation. There is a connection between two elements but it is of no interest.
  - A one-directional arrow – A function. A function is defined similar to TRIZ.
  - A two-directional arrow – A process. A process is the development of a phenomenon in time.
- Generalized objects. A generalized object is a shell that serves a role within a system. It specifies the requirement of that element.
- Filling (content). A filling or content of a generalized object specifies the requirement of a specific entity. For example, a person with relevant competences or a computer program with special characteristics.

Using a generalized object without a filling result in a repetitive solution that can be used in a variety of situations and it can be easier to anticipate outcomes.

Using a filling on the other hand allows for the usage of its characteristics to get a more specific (taylored) solution for the problem but risks not being reusable.

Schematization should be considered only as a tool for the primary analysis of a business system and should be combined with the analytical tools of TRIZ [1].

4 Inherent Contradictions of Goals Regarding the Remodelling of Business Processes

When remodelling business processes the main technical contradiction has to be found. The technical contradiction is a pair of two opposing goals both demanding the same resource. This pair is called the operational zone and is the location of the conflict.

Within the operational zone you can find a tool, which is the object that performs a negative impact, and a product which receives the impact as well as the environment surrounding this conflicting pair.

Using those it is possible to find the resources used by these elements and prioritise them if necessary. Resources can be prioritised by e.g. the available quantity, how useful or harmful it is, how high the cost of the resource is or to which element it correlates.

Each resource should be used in the most optimal way possible in order to get the best solution [1].

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Seminar Notes

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Summer Term 2021

Contents

1 Management by Incentive

In the presentation and discussion, it became clear that incentives offer a very comprehensive toolbox to improve the fit and performance of "human resources" (HR) in an organisation, but that this requires a very precise understanding of the *places* in the organisation where these HR are "docking" with the organisation. We identified these places earlier as *roles* and *role descriptions* in the context of the organisation's structure and process description. If role-specific effects are to be achieved through incentives, both the specificity of the role and the specificity of the person to take that role must be considered. Accordingly, for incentives with emergent effects, the strategic goals of the organisation are a determining component. Somewhat underexposed remained the question that incentives presuppose the *availability* of the corresponding resources in the company, i.e., they presuppose an (ultimately financial) *throughput* through the company (as a system) in order to be able to influence the efficiency of the use of resources with this management instrument. In this sense, management by incentives is a management instrument "of abundance".

2 Russell Ackoff. System Thinking and Management

Ackoff's systems theoretical approaches to management theory date back to the 1970s and are strongly influenced by the developments at that time, especially in cybernetics. With the availability of the first computers at that time, questions of *control theory* were newly discussed, which in the pre-computer age could often only be solved by filigree mechanical constructions such as the pressure regulator on steam engines, the clock pendulum, etc. The computer opened up completely new dimensions of management and control through data collected and processed at the right time, even though technology at that time was still far from being able to realise the mature theoretical concepts that had already been conceived. The roots also reach far back into the first decades of the 20th century to the beginnings of *assembly line* production, the associated standardisation of operating procedures and the possibilities and realisation of *automation technology* emerging in parallel. In the cybernetics wave of the 1960s, practical applications of control circuits in various domains played an important role, right up to the "BMSR technology professional" as a newly emerging profession in the GDR economy. So much about the background of Ackoff's theoretical approaches. See also [14], [15] or [11].

It is interesting to note the convergence of Ackoff's concept of system with those introduced earlier in the lecture and the seminar, but also their differences. Ackoff, too, sees the constitutive property of a system in the interaction of its components and the emergent functionality resulting from it. This phenomenon, which is also called *synergy*, leads from concurrency and, in the worst case, opposition of the components to cooperation. In contrast to TRIZ, where the creation of such a cooperation is a constructive engineering achievement, Ackoff takes up the idea with the concepts of organismic and social systems that such *synergetic* or *symbiotic* (as a higher form of synergy) structuring phenomena also occur "spontaneously" and without "constructive" intention under natural-biological (organismic) or socio-cultural conditions of humans' co-operative actions. In the field of management, especially systematic management, the idea then arises to influence such "natural" processes also in *socio-economic systems*, namely in *organisations*, in order to push them in a certain direction through active management action (ultimately in a technical understanding of "social engineering" and management as a kind of engineering profession).

An essential contradiction arose from the attempt to gain influence on systemic processes with such individual management action, the emergent character of which had just been postulated, i.e. which precisely does *not* develop from the influence of one component alone, even if it is at the top of a management hierarchy and concentrates great decision-making powers in its hands.

2.1 "A whole cannot be divided into independent parts." (Ackoff)

However, this is exactly what is done in system's analysis – first *structural analysis* and then *procedural analysis* are performed, the analysis of the interaction of the parts. These contradictory views are present both in the system concept of the lecture and in Shchedrovitsky's argumentation [8, p. 61 cont.]. Shchedrovitsky further asks (p. 58) what is the significance of a "human component" in such a system (i.e. in an organisation), which on the one hand is a "cog in the system" (ibid.) when it is about functioning of the system as a whole, while on the other hand the (formal) organisation as a "living organisation" has an "informal structure" (ibid.). Shchedrovitsky goes on to ask what it means for a "manager component" to be an element of two subsystems of the organisation and thus of the system as a whole, on the one hand in the management circle of the company and on the other hand as the head of his own department (p. 61). Is this manager then not rather the *link*, the "transmission rod" (ibid.) between these two subsystems?

Is Ackoff's thesis therefore self-contradictory? Is the answer to the question "Can a system be broken down into parts?" therefore perhaps "No, but we have no choice but to try it if we want better to understand the system"?

In particular, what does this mean for another thesis of Ackoff "if each part is managed well, the whole will be"? For M. Rubin, not only analysis and synthesis play a role here. Both have to be complemented by *evaluation*, in which the *justified expectations* that have grown up from a system description are compared with the *experienced results*, which closes the circle of system descriptions to an evolving dynamic that relates it with reality that is evolving, too.

2.2 Mechanical, Organismic and Social Systems

We already analysed this subdivision in more detail a year ago in the seminar, see [5], and exposed the roots of such a subdivision in the history of ideas. Briefly speaking, they consist in the fact that 400 years ago, with the gradual transition from scholasticism to an experimentally based understanding of science, the success of an initially mechanical technology became the basis of generalised scientific world views. Attempts to explain biological phenomena mechanistically quickly came to their limits. The first major critique of such a kind of explanation is certainly Offray's "Man a Machine" [9], even though such explanatory approaches are still widely used today, not least in certain explanatory approaches in the Human Brain Project or in the field of AI, when their mechanical constructs are now finally supposed to obtain a "divine spark" of intelligence breathed into them thanks to advances in computer technology.

Criticism led as early as in the 18th century to the demarcation of (technologically accessible) *mechanical* systems from (technologically inaccessible at those times) *organismic* ones. With the further development of chemistry (from phlogiston to modern analytical methods, which would not have been possible without the developments of physics and precision mechanical technologies based on it) and biology (from a theory of the development of species according to Darwin and Haeckel to modern molecular genetic methods, which in turn would not have been possible without those scientific and technological developments in chemistry), lines of tradition have shifted here, but the qualitative picture has not changed.

The concept of *social systems* in its diversity as socio-technical, socio-economic, socio-cultural and socio-ecological systems is, however, new and relatively recent in this phalanx of broader reflection, although already clearly articulated and developed in a relatively strong materialist reading in Hegel, Feuerbach and Marx/Engels. Its breakthrough is also linked to the cybernetics debate of the 1960s and more complex approaches to control circuits, which have since been investigated in greater mathematical detail. The properties of systems discovered in that research process (up to the "strange attractors" discussed in the lecture) revealed extremely complicated forms of progression of systems, which can be described deterministically by simple differential equations. This showed that classical mechanistic approaches can only be exploited to adequately describe a very small section of reality. These argumentations and insights influenced even political writings such as the Club of Rome's "Limits to Growth" (1972) or Gorbachev's demand for a "new political thinking" [4], but resulted also in the demand for a new thinking in science as a transition "from the materialistic-mechanistic worldview to a mental-vital cosmos" in the Potsdam Manifesto 2005 [10], there also the demand "We have to learn to think in a new way.“ The latter goes back to the politically motivated Einstein-Russell Manifesto 1955) up to practical approaches of an Open Culture (open source, software ecosystems, energy ecosystems, models of distributed autonomous agents, etc.). It remains to be explored which qualitatively new approaches are hidden behind such thought figures.

3 MBO – Management by Objectives

In contrast to Management by Incentives (MBI), which is primarily oriented towards the activation of forces of self-control, Management by Objectives (MBO) focuses on controlling the implementation of objectives in the combination of planning and monitoring.

The unit of implementation is again thought systemically as a delimitable and delimited management unit with an externally given objective (target), i.e. it can be interpreted in the context of our system concept. However, this system concept requires for such a unit to work not only *objectives* but also a corresponding *throughput of resources*, without which a real world system is not viable, no matter how hard one tries in managing objectives. This aspect remained underexposed in the presented MBO concept.

In contrast to MBI, which (implicitly) assumes a comfortable throughput and asks which incentive systems can be used to stimulate the system's internal self-organisation and self-structuring forces, MBO takes a much more structured approach. The *objective* as an external, unquestioned requirement is detailed in and by the systemic structural unit into an *action plan*, which consists of individual *activities* that are linked to each other via *work products* as output and subsequent input, which must be produced on time and in quality and are subjected to quality assurance (QA) at milestones. This QA is carried out against quality measures that can be product- or process-related and form the basis for progress control.

This remains also within the framework of our system concept, which provides precisely such a white box analysis of structural and process organisation of the system. In addition to the flow of substance and energy between the activities, the instrumentation with quality measures also initiates an *flow of information* in the system, which, however, remained unspecified – beyond the SMART requirement – and was only addressed as management instrument. This corresponds quite well with the TRIZ systematics, when flows of substance and energy as well as actions of tools on objects (in the activities) are described in more detail, but the control structure as another component of the system still remain hidden.

The systemic self-similarity structure of the approach remained underexposed, but immediately emerges when the systemic "white box" – "black box" principle developed in the lecture is applied to the action plans as a component-container pattern. The *action plan* as a systemic "white box" contains activities as systemic "black box" components that enter the planning solely through their IO characteristics. For the overall process, the components must work at runtime in accordance with their specification assuming the required throughput is guaranteed. However, this throughput is guaranteed by the scheduled provision of the required work products by other components (through their activities). This organisational principle can be repeated at the activity level, but also at the level of the strategic interaction of the different action plans at the enterprise level. Multi-level hierarchical management systems can be built according to this principle of action planning, which will mainly differ in the eigentimes of the built-in evaluation cycles. Action planning at different levels does not necessarily have to follow the same rules.

Problems in such a system, which can be recognised via the reports on process parameters informally passed on to the (human) control component (a TRIZ system concept), are transformed in this control component into a process modification output, insofar it remains within the limits and tolerances of the system (more precisely: in the system description). Hence such problems can be compensated within the system itself. If the problems exceed the self-regulation capacity of the system, they must be propagated to the supersystem. Such regulation processes are bound to managers and responsibilities. The abilities, competencies, skills and formal requirements for occupying such a position are fixed in the corresponding *role definition.* At runtime of the system, the *role-adequate staffing* of this post is part of the "throughput" required for the system to function.

The *control component* of the system – in the simplest case given by the responsible manager – is thus at the same time its "brain", which holds a description (a picture) of the system and regularly updates it via the incoming information (the "sensors" of the system), which forms the basis of the control (the "management") of the system. It is necessary to distinguish the dynamics of the real system and the dynamics of this image of the system.

In this understanding, management means *exerting influence on the self-movement of the system* (Shchedrovitsky: "You can only manage something that is in motion.") Therefore, not only a metabolism of substance and energy must be organised in the system, but also a metabolism of information. This information turnover is the core ingredient to process the difference between description and reality of the system dynamics.

What remains problematic for the whole approach is the basically sacrosanct *objective*, which leads to a rigid hierarchical management structure. Such a structure has the advantage of exploiting the local compensation potentials to the maximum in order to limit necessary system adjustments to the lowest possible components. Also, cumbersome feedback structures lead to inadequate objectives being recognised late and wrongly assigned to responsibilities. Comprehensive systemic reorganisations require a significant deviation from regular operations and thus a considerable use of resources. In companies organised in this way, they can usually only be implemented with massive support from strategic management that can override the usual rules.

Further flexibility is achieved above all from action plans which are built up from parameterised company-wide mandatory process modules that can be adapted (taylored) to special application scenarios, thus systematising company-wide project experience (CMMI maturity level 3 "defined"). Uniformly instrumented process modules of this kind also allow to establish a company-wide "brain" for such management experiences (CMMI maturity level 4 "quantitatively managed"). For both approaches, however, a "system of systems" is required that integrates the action planning systems into a company-wide systemic framework at a higher level of abstraction.

4 Business Process Definition Metamodel – BPDM

4.1 Current Trends in Business Process Language Standardisations

Presentation and discussion focused on a closer look at concepts, tools and models for the description of Business Processes (BP). This field has been massively evolving over the last 20 years. This evolution is characterised by a theory-practice cycle between development of appropriate concepts and testing their practical suitability in applications in a co-operative process of practice. This clearly goes beyond the sometimes speculative conceptualisations of Russell Ackoff or Peter Drucker.

The result is a process of development and consolidation of the terminology itself, which was illustrated in the presentation by means of the historical development of various BP language systems (in addition to BPMN, 3LGM and EPK were considered). The need of cross-concept coordination processes for *practical* interoperability led to cooperate structures between the various groups around the different emerging standards in a *Business Process Management Initiative* (BPMI, until 2005) and a *Business Modeling and Integration Domain Task Force* (BMI DTF, until 2008). Since 2008 the standardisation was coordinated by the *Object Management Group* (OMG). In this course, BPMN consolidated and is nowadays widely accepted as leading standard, while the other alternatives lost significance.

BPDM emerged as the product (in TRIZ terms) of the process of formally fixing the meaning of terms that had previously been used in the different standards with a wider range of variation.

In this process, the cross-company infrastructural significance of such descriptive systems becomes evident. Only on the basis of clearly agreed models with a sufficient number of degrees of freedom (parameters) cross-company workflows can be effectively coordinated. Only in such a cross-company infrastructure digitally executable "smart contracts" will be available for recurring and clearly defined business transactions. A similar development is well known from computer science with the formalisation of repeating functional sequences in function definitions.

The development path of the potential of the modelling language covers several levels of maturity – from simple communication in concrete cooperations (model) to the development of structured communication on the basis of emerging common concepts (meta-model) to the (currently still informal) development of the expressive capacity of that language itself at the level of a meta-meta-model. This evolution illustrates once more the dynamic character of the thesis "the meaning of terms *is* their use" developed in the lecture.

Ralf Laue additionally explained the meanwhile dominant position of BPMN 2.0 with the fact that it is the only standard that also defines a *process semantics*. This aspect remains to be explored further, especially the significance and position of such a process- and workflow-oriented *process semantics* compared to a taxonomically oriented concept formation process of a *structural semantics* within the language development process. Process semantics presuppose structural semantics, but the modelling focus is shifted from static to dynamic models. It remains to be clarified to what extent the required conceptual system can be understood as a simple extension of the structural model or whether more fundamental qualitative changes in the modelling itself are present here (Shchedrovitsky once more: "You can only manage systems that are in motion").

BPDM is part of that taxonomically oriented component of BPMN. This raises the question whether it is really out of date as claimed in the presentation or it is nowadays already an integral part of the established taxonomic-structural component of that language universe containing notational systems such as BPMN, CMMN or DMN. In any case, Ralf Laue is aware of such a shift of the frontier of current BP concept formation processes in the direction of variabilities of dynamic process description schemes.

4.2 The Relation to a Systemic Approach

Let's discuss the relation of the presented BP concepts to our systemic context.

The definition "A business process consists of a sequence of coordinated activities. These are either tasks or subprocesses" clearly shows that we are in the continuity of the concepts presented in the last seminar on MBO (action and activity) and that the self-similarity of the approach still assumed there (action as activity in a more comprehensive action) is clearly presupposed.

This allows to interpret the concepts of BP modelling in our systemic context. The main problem from the last seminar – a clear distinction between design time and runtime of the respective systemic description – was addressed rudimentarily in the presentation with the distinction between BP and BP instance, but not developed consistently. The (simple) distinction between class and instance (or object) from OO programming takes place on another level, between *template* and *specific expression*, both of which are still forms of description.

This is already clear from the position of compiler and interpreter as tools – as it is well known, that both are translators from a high-level language into a machine language, hence input and output are in language form. Only the *execution* of that detailed programme *on a robot infrastructure*, for example, has real-world consequences. The relationship of BP and BP instances as a high-level and detailed description form of (potential) business transactions to the *real* business transactions themselves is similar. The essential link between both is the *solution of the resource question*, without which the potentiality of the form of description cannot be transformed into the reality of the form of execution. This fundamental question remained unilluminated once more.

5 The S.M.A.R.T. Approach

One of the central questions of the discussion was once again the relationship between description and execution forms in the context of management action. SMART comes with the claim to support managers in formulating effective objectives. Like comparable approaches, it is a *methodological handout* that has to be tailored to the domain-specific context of management planning in order to produce context-specific management tools and documents for management action (description level), which then have to prove themselves efficient in the concrete practice of management action.

Of these three levels, the lowest one of special management action is ultimately decisive for practical performance. The other two levels – that of a special management strategy and that of the methodological foundation of such a strategy – clearly move on at two more comprehensive spatio-temporal scales. This suggests that three system levels are intertwined here.

The first system level is that of the manager with its assigned area of responsibility and in which he or she represents an essential element of the control component of that system. In addition to a primarily output-oriented view of "objectives", such a system also needs an *external throughput* to function, which must be guaranteed by the system environment. In this sense, the manager in that system has not only an inwardly directed *control function*, but also an outwardly directed *security function*. The effect that a system itself exerts an active influence on securing its conditions of existence is under-illuminated in the management approaches considered so far.

This influence must be exerted and negotiated in the supersystem, in which the management strategies are coordinated company-wide among the managers. This supersystem has not only a processual but also a structural dimension, concerning available tools and institutionalisation. On the first system level cooperative action appears primarily in a form based on the division of labour as cooperation between the manager as individual leader and the domain experts (to be understood here in a very broad interpretation) of the respective area of application under secured resource throughput. On the second system level it is about securing precisely this throughput of resources. The throughput, which appears as a *contextual prerequisite* on the first level, is the object of management action on the second level in the sense of an overarching primary "objective" to "keep the business running" as the first prerequisite for any further strategic objective. These aspects link directly to the debates a year ago [5], [7], [3] about resilience or systematic transformations of corporate contexts in which this resilience has been exhausted. This goes far beyond SMART approaches and thus marks an area of sufficiently "resilient" systems in which SMART management action is even possible.

While at the lowest system level, management activities are primarily directed towards operationally producing the expected output, at higher management levels it is primarily a matter of reproducing the *ability* to produce output in the necessary quantity and quality.

ISO 9000 and CCMI are structured in such a way: They are not primarily about *product quality* of an operational output, but about *process quality* in the respective companies with the proviso that process quality is a necessary, but not sufficient, prerequisite for product quality. Process quality, however, includes appropriate management measures for product quality and thus builds up a *feedback loop* of quality experiences (positive and negative) on production conditions, which in turn has an impact on process quality.

This raises the question how the SMART approach fits into more complex strategies of corporate development and the prerequisites that must be in place for a fruitful implementation of the approach. At the same time, this question relativises a context-free bashing of the methodology. Above we identified the system of corporate development as the supersystem of the system of operative control of the production. In this hierarchy the system of cross-company methodologies, to which the SMART approach belongs, is a super-supersystem. It has in turn an effect primarily through feedback loops in the system of corporate development. SMART is therefore not only and not so much a methodological tool for individual managers to reflect on their own management experience, but part of the organisation of a company-wide process of applying the methodology. However, this presupposes that the activities in the company are structured in such a way that SMART principles can be applied at all. In CMMI, for example, this is only the case from level 2 onwards. In addition to a cooperative feedback loop at system level 2 of the company-wide management experiences, there is therefore another loop between the systematic implementation of structural requirements and the increasing possibility of effective use of the SMART principles themselves.

6 Goal-Models and the i* Modelling Method

6.1 Systemic Structuring Processes. Theory and Practice

Systemic concepts have proven useful in engineering applications and are the basis of the design of technical systems from components. Systemic concepts are thus the core of systematic innovation methodologies such as TRIZ. They allow to delimit different levels of analysis and synthesis on the one hand and on the other to connect them alternating black box and white box modes. The dialectical conceptual pair of *system* and *context* plays a central role here.

The mental systemic structure of analysis and synthesis as forms of description has a clear influence also on the *practical* structuring of the world as "reality for us". Systemically based forms of reflection are transferred to real-world structures in the course of action, even if in this process "the material" more or less "resists" based on own laws of motion. Thus the establishing form of relationship in this process is to be understood as a dialectically shaped co-evolutionary relationship. Such co-evolutionary relationships between real-world and reflexive processes of formation of structure are in no way a privilege of anthropomorphic action, but are typical for coupled flow equilibria in other developed, metabolising biological systems as well.

6.2 Structural, Functional and Processual Systemic Forms of Description

Engineering approaches in general and TRIZ in particular have difficulties to switch from structural and functional to processual forms of description. For example, TRIZ knows a larger selection of function-oriented methods and tools, but flow-oriented approaches are weakly developed. This has much to do with the fact that systemic composition methods can exploit functional specifications of interfaces, but in rare cases processual performance parameters are specified as interfaces. Such imbalances are also widespread in computer science – functional tests start early in integration scenarios in software testing, including the use of test drivers and mock objects, which are *functionally* designed, whereas load, stress and performance tests usually start only at the system test level.

6.3 Systemic Approaches in Engineering and Management

As central goal of our seminar we try to identify systemic approaches in different management theories and to investigate parallels and differences between engineering and management action. We found that the context of management action can be well captured with self-similar systemic methods, but the associated hierarchical scaling remains underexposed in most management theories.

The major management theories we have looked at so far focus on *practical* management action. Descriptive forms and theoretical approaches are considered merely as support and tools for this main focus. The context for such management actions are systemically structured "living organisations" (Shchedrovitsky) in the mode of operation. Thus the context of management action differs fundamentally from engineering action, which – at least in the horizon of the experience of most TRIZ practitioners – refers to systems in *maintenance* or even *design mode*. This is, however, only a provisional demarcation, because the majority of engineers are *production engineers* and thus are concerned with the *mode of operation* of large-scale technical systems. Moreover, the maintenance mode of a technical system is part of the operating mode of the (socio-technical) supersystem.

Embedding management action in an already *well developed systemically structured real-world context* and thus in an advanced structured "living organisation" also makes sense under another aspect. We consider objectives, rules and frameworks – including the authorisation of the managers themselves – as *given* existing conditions of the management action and consequently fade out the analysis of their historical genesis as part of a "reduction to essentials".

From a TRIZ perspective, management in this sense is a *function* of the control component of the corresponding system. It remains open to what extent this function can still be personalised under modern technical conditions as in classical management theories, if methodological knowledge (of the manager) and deep domain-specific special knowledge (of the production engineer) are both required for appropriate management. It is also open to what extent management action under modern technical conditions can be primarily directed at the inside of the system. It may well be that division of management as in SCRUM (between product owner, SCRUM master and team) are methodologically more appropriate.

6.4 i* Models and Business Process (BP) Modelling

The long introduction served primarily once again to mark the place of the explanations on i* models in the overall theoretical building of management theories. The repeated comment that various of the discussed management approaches are of academic interest only without significant practical impact indicates above all the multi-layered nature of the corresponding (interpersonal) reflection structures of production, selection and self-regulating dissemination of the corresponding explanatory patterns.

With an actor-centered view, i* models consistently implement the approach of "areas of responsibility" (lane, performer role and actor in BPDM) built into other BP models. It is implemented in a more strict way as it points in the direction of a systemic closure by a feedback loop between expectations and experiences (not yet included in the i* concept). The areas of action of the individual actors highlighted in grey in the i* diagrams have many parallels to the concept of action spaces in the lecture. Compared to classical management approaches, this requires a concept of interaction *between* such management areas and thus opens the door to self-similar system concepts. It was not further addressed in the presentation to what extent this is already realised in the current i* concept, i.e. if system-supersystem structures are conceptualised. However, it must be taken into account that the approach does not claim to be a complete BP modelling, but focuses on requirements engineering and thus on a first phase of a detailed modelling.

i* modelling consists of two essentially different dimensions – the design of *dependency relations* between areas of action and the modelling of internals of the "grey areas". From a systemic point of view, the former is comparable to the black box specification of dependencies. On the one hand import and export interfaces can be distinguished by specifying such couplings and directions. On the other hand it preserves not only the functional "what?" but also the causal "for whom?". In modern component concepts in computer science, such as the *CORBA Component Model* CCM [2], these import and export interfaces play a central role as receptacles and facets, and the couplings are dropped under the aspect of (broader) reuse in favour of a formal specification of the interface.

Inside the "grey areas", process structures are modelled as directed graphs from predefined building blocks. This models a white box approach. It remains unclear to what extent structural, functional and process-related aspects are differentiated. In the examples given, the structuring of *goals* – the central notion in an i* model – is used in all three ways. It is also clear that the notions *task* and *resource* conceal further requirements (a task must be implemented, a resource must be provided), which are not further developed in the diagram. The distinction between these two types of (masked) requirement was not touched in the presentation and discussion.

It remains to note that the approach goes beyond those considered so far in one special direction. It considers the interaction of independent third parties (the actors) in a service area and thus *contractually bound management structures* without a "central manager" with correspondingly authorised possibilities of intervention. It remains open to what extent such modelling approaches are typical for a service-oriented industry and whether we are or since when we really arrived in a "service society" in which such economic relationships are dominant.

7 Mintzberg on Management

The goal of our seminar is to gain insights into different approaches of management theories and to interpret them in a system-theoretical context. This was outlined in more detail in the first seminar. Management in this understanding is always directed towards *managing an organisational context*, even if this is not explicitly present in some management approaches.

This refers especially to approaches that identify management largely with management of people, such as "management by incentive". Also the concept of "systematic management" [6] mentioned in the first seminar, which focuses on management as process, points in the direction of such an understanding of management that is primarily oriented towards tactical concerns. Shchedrovitsky [8, p. 66] states that management must not be reduced to such a perspective: "Programme design is what management is all about. Someone who cannot design development programmes cannot manage people".

In the sense of our notion of technology with its three levels

- socially available processual knowledge,
- institutionalised practical procedures and
- private procedural skills

such approaches in fact neglect the second level of targeted organisational development. In the first seminar the interplay of personal development possibilities and organisational structuring was addressed above all by a reference to Ian Sommerville [12, ch. 19] with his version of the concept of a socio-technical system. Shchedrovitsky points out that designed structuring processes within organisations, however, have their limits and, especially in the case of changing framework conditions, easily come into contradiction with self-movement structures of a "living organisation". The distinction between formal and informal organisations according to the gradual expression of such a designed structuring component takes up this idea. It can be assumed that such informal organisations, which are typical for multi-stakeholder contexts, are to be managed by different principles than formal organisations with their clear structures of authorisation and responsibility.

The general connection between practical activity and conceptual reflection described by Shchedrovitsky in [8, p. 70 cont.] unfolds for management and in management theories on three levels:

- The practical activity of a manager in the conceptual context of his or her own experience and of a concrete organisation with little separation of the concrete and the abstract.
- The practical reflection of this action in groups of such managers in the conceptual context of generalised own experience and typified organisational structures with little separation of domain-specific and methodological aspects (the term "group" is used here in the sense of Shchedrovitsky).
- The academic reflection of these reflections across domain boundaries in order to advance to general methodological insights.

Each of these three levels is associated with a specific spatio-temporal dimension of a feedback loop between justified expectations and experienced results. This feedback is objective insofar as the evaluation of the experienced results is not solely individual-subjective, but – in the sense of Berger/Luckmann's "legitimate interpretation of meaning" [1] – broken by the social behaviour of others. In this sense, managers and management theories are themselves "managed".

Managers on the first level are evaluated by the extent to which their actions have been "successful". Managing at this level is a private procedural skill that can only be improved in practice. However, since "success" is evaluated on the conceptual standards of the second level, these conceptual standards must be acquired in a learning process, for which there are a large number of educational offers and certification structures for "management professionals".

In this process, strange structures emerge, as described in "Mintzberg on Management" – an orientation structure in language form which the management novices have to follow and to adopt, while those rules do not seem mandatory to be applied by the same management gurus that teach the novices. In any case, (not only) Mintzberg repeatedly points out that management rules are made to disregard them. Good managers know above all which rules in which contexts are better not applied (and are allowed not to apply them).

This strange evaluative relationship of development forms between level 1 (of practical management) and level 2 (of systematisation of practical management experience) does repeat itself in the relationship of levels 2 and 3 when it is emphasised that most academic approaches in management theories have little practical relevance. The alleged ineffectiveness of level 2 and 3 approaches for the respective upstream level is opposed by the dense institutional structures in which new generations of managers are growing on just these rules. This is in sharp contrast to Mintzberg's insistence on the purported lack of usefulness of advice from these training structures.

8 The Toyota Management System

The Toyota Management System, like other management approaches, has its roots at the turn of the 20th century. Management thus appears as a specific aspect of further differentiation of an industrial production process whose beginnings lie in the second half of the 19th century. The essential prerequisites for this were

- the production-technical provision of energy sources, which in their power went far beyond the previously available human and animal energy sources,
- the mass production of standardised intermediate products and semi-finished goods on the basis of advanced scientific and technical knowledge (e.g. iron processing and steel production in the second half of the 19th century),
- the inventive use of these new principles of action and materials in new, standardised products suitable for the mass market.

This unfolding industrial mode of production was shaped in many places by new entrepreneurial personalities who were distinguished by both technical expertise and entrepreneurial skill and thus combined two essential components of economic success – access to generally available processual knowledge as private processual skills and a feeling for market demands – which later diverged in the professions of engineer and manager. However, in the biographical literature, engineering requirements and their scientific foundations are in the foreground; there is no mention of special management techniques developed and generalised at that time.

This was also the case with Toyoda senior and Henry Ford around 1900. However, there were the scientific methods so successfully applied in the technical field and the challenge to apply them also to business organisation. The vision was to organise a factory to run as well and smoothly as a machine.

The system-theoretically founded design principles of hierarchical composition of a whole organising the functional interaction of viable technical artefacts as components were transferred to the organisation of production. However, in that situation the principles must not to be applied in a constructive way as in the design of a machine, but as reorganisation of an already viable business system, a "living organisation". Among all components of such a business system the "human" component turned out to be the most unwieldy and least accessible to "specification-compliant functioning".

Major transitions in this direction took place in the first quarter of the 20th century. They are primarily associated with the names Frederick Taylor and Henry Ford. Ford introduced assembly lines with his car factory as early as 1913 and thus switched to a highly disaggregated form of organisation of production. Interestingly (according to Wikipedia), the initiative for this reorganisation did not originate from Ford himself, but from leading employees of the Ford Motor Company.

Fordism is also usually associated with a second insight, that the entire economic cycle requires not only supply but also demand with purchasing power in order to close the product cycle and thus also the cycle of capital. This requires an appropriate wage policy. In this way, labour turnover can also be dampened and thus important private processual skills can be kept in the company. Of course, this is only possible if corresponding profits are generated in the company, i.e. if the systemic context ensures not only the throughput of energy and material, but also of capital (that can be converted into social energy).

We studied such management approaches several times in the seminar. The repetition here is mainly to highlight similarities and contrasts with the Toyota system. The Toyota Motor Corporation, which started car production in 1936, was not only in competition with General Motors and the Ford Motor Company, which dominated the American car market of that time, but also in tension with the first emerging American management theories based mostly on *structural* production-organisational approaches. Toyota, on the other hand, relies on a *process-oriented* model of *networking* systemic approaches. This is particularly visible in the principle of "just in time". The throughput of a *resource* to be guaranteed in a system as a contextual condition is coupled to the *resource provision process* ("the right part at the right time in the right amount") of another system. In this approach, the focus is on the networked structure of flows of interweaving processes and thus the coordination of cycles and rhythms instead of static structures and a stronger orientation towards quantities. The Toyota Management System and the closely related Total Quality Management (TQM) approach differ significantly in their model-theoretical approaches to process modelling, which is reflected, for example, in the different guidelines ISO 9001 (for classical process models) and ISO 9004 (for TQM-based process models).

It remains open how such a process oriented coordination works beyond the boundaries of the company. For example, the expansion of a worldwide digital shipment tracking system comes with completely new networking possibilities in the area of Supply Chain Management (SCM) for just-in-time production. It is currently confronted with increasing real-world logistical problems due to disruptions in connection with the Corona pandemic. Forms of description and execution forms are in tension. However, major problems do not arise *within* the individual systems of logistics or production, but *at their interface*. Short-term real-world disruptions in the logistics chain can be communicated, but they influence real-world execution of longer-term planning in production, which in turn has impact on the chain of distribution. Such problems at the interface of two systems – the resource demand of production and the resource provision by logistics – the disruption of coordinated rhythms – must be intercepted by corresponding robustness of the production organisation of the target system to avoid further propagation to other systems. The Toyota system of exhausting all productive reserves has therefore its limits.

All relies on the stabilisation of existing systemic processes *and* the stabilisation of their interaction. Gradual changes are possible above all in stable environments and thus in a context that is today much associated with the term *resilience*. One question remains: How does the Toyota System handle such more disruptive change management, e.g. caused by deep technological changes as the Digital Change?

9 Taylor's Principles of Scientific Management

Taylor's approach throws a spotlight on practical production-organisational developments and their reflection in the early phase of the 20th century.

We are faced with a beginning production-organisational differentiation, which in the further course leads to the formation of the professions of *engineer* and *manager*. Both professions are (well-paid) wage labourers in the sense that they are usually don't own the companies for which they work.

The emergence of the *Principles of Scientific Management* is embedded in the technological upheavals of that time, which led to the devaluation of previous private processual skills (the "rules of thumb"). New processual skills are to be built up. In that context the "scientific" methods that have been successfully applied in the technical field are also to be applied to the organisation of production. In contrast to the scientific background knowledge, on which engineering solutions were formed and based at that time, such a background did not exist in the production-organisational context. Taylor therefore generalised above all his own production-organisational experiences within the context of an increasing algorithmisation of production.

This strenghtens the production-organisational description form. Weights shift from the workers' private processual skills to institutionalised procedural methods. When such methods are applied it is assumed that only a small amount of conditioning for workers is required, i.e. a short training is sufficient in order to make them to function within the "living organisation".

This marginalises the essential feedback loop between justified expectations and experienced results at the base of the individual worker and shifts it to the cooperative space of action of the enterprise as a whole. There, the two professions – engineer and manager – take over the coordination of this feedback at the technical and production-organisational level.

It is also noteworthy that these differentiations have their roots in the differentiation within wage labour itself in the second half of the 19th century. Taylor begins as a foreman in a steel plant, knows very well the motives and methods of his colleagues to resist too much work pressure and ultimately acts against them with his methodical approach. The differentiation of professions thus leads to contradictions and tensions in the workforce itself, which later experience a conceptual consolidation in the distinction between *blue collar* and *white collar*.

Taylor's principles are to be considered on the plane of the further development of the organisation of production. With the emerging "assembly line society", the further division of the production-organisational process continues and the processual skills of a largely unskilled workforce are less and less important. In addition to the *profession* for the few, there is now also the *job* for the many.

With the invention of the computer, this "trivialisation of production" is pushed even further on the one hand and culminates today in the image of the automatic "Factory 4.0", in which the "renitent human element" can apparently be completely eliminated. On the other hand, the increasing technisation of production leads to a revitalisation of suitable non-trivial "processual skills". As simple tasks are more and more carried out by automated systems, this aspect is gaining increasing importance again.

10 Russell Ackoff. Interactive Planning

Ackoff's Interactive Planning has a high affinity to TRIZ concepts and methods. The relation to Business TRIZ need to be explored further, but this is a topic for future seminars.

In my remarks I concentrate once more on a question that played a subordinate role in the analysis of management tasks so far: The relationship between *resource use* and *resource provision.*

Let me start first with a relation of this problem to the context of the conceptual system developed in the lecture. A central question was "What does it mean to change a world that is itself also constantly changing?" This can only mean to *get influence* on the development of the world. But why get influence on the development of the world? Because the way as the world developments "by itself" is problematic. Management therefore means to solve problems. "Where there are no problems, there is no need for management". The solution of problems is preceded by their delimitation and analysis. In a systemic context, this is done by internal demarcation of elements, external demarcation of the system against an environment and reduction of the relationships between the elements to essential ones.

A systemic approach thus assumes that a contextually delimited area is accessible to description as a white box and thus to management. Management in this understanding is an *internal function* of the system, which in the TRIZ context is assigned to the control component of the system. In this context, the interaction of the various systemic resources must be organised. Resources appear conceptually in TRIZ under various names – as components, tools, processed objects, etc. All these resources have in common that they appear in the system with a functionally (components and tools) or structurally (processed object as preliminary product) significant role, but the *reproduction* of these resources takes place in neighbouring systems.

In this sense, components are also neighbouring systems rather than subsystems, because the emergent properties of a system result from the *interaction* of the component properties. Since only the *interfaces* of the components are accessed here, components thus appear as a black box just like the services of neighbouring systems in the environment. An immersive system approach makes a clear distinction between "inside" and "outside". This looks different in a submersive system approach – a component appears in the system as a *reference* to the implementation of its functionality. The same for services from neighbouring systems. A similar conceptual arrangement is known from the theory of Component Software.

Thus in a systemic context *resource use* and *resource reproduction* are in a contradictory relationship, since both occur in different systems. For resource utilisation, the interface to which the resource couples must be described in more detail. Since a system description is always a reduction to essentials, this interface description can and must work with a *fiction*[1] – an abbreviated way of speaking about a social normality. In a world of labour division, this "production of normality" as reproduction of resources is outsourced to another systemic context.

The central resource in cross-system socio-technical processes is the human being. Resource description and resource reproduction for "human resources" use the concepts of *role description* and *role occupation.* A problem (even a contradiction) arises when no suitable

[1]The notion *fiction* is used in this place in the meaning developed in the lecture.

candidates are found to fill a role. Approaches such as Management by Incentive or Management by Objective completely ignore these questions and assume that sufficient qualified personnel is available. F. Taylor's Scientific Management includes a qualification programme for appropriate role appointments, which is still significant today in the concept of trainee programmes. However, even then this approach only workes for unskilled and semi-skilled workers, but not for high qualified technical personnel.

What has been explained here for human resources also applies to other resources. A system that consumes a certain resource depends on the provision and thus reproduction of this resource, which corresponds to a coupling of two systems. The contradictory nature of the description form results from the fact that in each of the two perspectives the other system is seen as a black box. This leads to inconsistencies in the coupling of justified expectations and experienced results in the common execution form.

Although in the Toyota system such interfaces are considered in more detail, the question remains open how exactly the contradictions of a "just in time" coupling are processed. The approach to provide "the right thing at the right time in the right quality" propagates a *push concept* and externalises the responsibility for solving the mentioned contradiction to the (other) system of resource reproduction. However, this system is dependent on a certain external throughput in order to function adequately. The question how the resource-consuming system affects this systemic existence condition of the resource-producing system remains open in the Toyota system approach. The overarching principle of the coordination of cooperative action is the push principle, according to which everything happens "by itself".

Ackoff's approach of Interactive Planning moves a step further and formulates the coordination problem at least as a planning problem. From a systemic point of view, the contradiction of resource mediation can only be solved in a further system whose emergent function is to secure precisely this resource mediation. In an immersive system approach, such a system would be called an supersystem. In a submersive systems approach, however, this system stands alongside the systems it connects, because it has to fulfill a specific task that has to do with the *functioning* of the subsystems and to a less extend with their *function*.

Management in this sense therefore does not only mean leadership as a personal characteristic or control as a functional component of a system, but is a central element of system development itself.

11 Anton Kozhemyako. Contradictory Business Processes and Schematization

During our seminar we observed that the term "management", especially as a profession in its own right, emerged only in the course of the 20th century. Moreover, we established a close connection to the growing penetration of production processes by technology thus deepening the division of labour. Like the technical development in the 20th century, these production-organisational innovations did not form a linear process, but were characterised by at least two upheavals – the *transition to assembly line production* and a largely increasing degree of dissection of work processes since the 1930s, and *digitally based measurement and control processes* since the 1960s. The latter are gaining a new dimension of significance in the digital transformation where they are widespread introduced as SCM and CRM in production-organisational processes *between companies.* This also influences the structure of management processes. Moreover, this requires the development of common conceptual systems, at least in areas that are linked by such common supply chains.

Accordingly, management theories in the 20th century focused on different focal points. Taylor's *Scientific Management* (1911) is still entirely under the impression of the principal possibilities of large-scale machine production on a "scientific" basis and focuses above all on the preparation of the worker for such an industrial process, which is driven in its descriptive form by "one clever head" but (still) requires "a thousand hands" for practical realisation.

Even in such an algorithmisation of production, as is well known, the devil is in the detail. In computer science, the difference between abstract high-level language programs (up to generative programming) and their implementation in machine code is well known and has been the subject of a lengthy process of development. Everything remains relatively simple as long as the computer program does not leave the computer as runtime environment and produces at most figures on the screen. The story gets more difficult when the algorithm is designed to control and manage real-world processes.

The story also becomes more difficult when the algorithm leaves the single-user computer built according to von Neumann principles and starts to make programs interact in a distributed environment. Ackoff's *Interactive Planning* addresses the algorithmisation of production processes in such distributed structures.

However, the dependencies and interaction of actors in *multi-stakeholder contexts* can no longer be captured in a mechanical-algorithmic concept. *Agent-based programming* in complex authorisation and mediation structures are developed, in which the individual "agents" operate as actors, each with its own *fictions*, i.e. abbreviated ways of speaking about "social normality" that is produced by others of the involved actors. In addition to the goals and interests of the actors, the *mastery of means* moves further into the foreground. It is more and more a limiting factor and at the same time a trigger for further systemic differentiation.

Ackoff's self-similar approach of *Systemic Thinking* should not be misunderstood as conceptualising a "system of systems" as "supersystem". The "system of systems" is reduced in its descriptive dimension, also in Ackoff's case, to the interaction of the subsystems as *working units*, while in the descriptions of the subsystems their *functioning* in the sense of a means perspective is in the foreground. The forms of description themselves use different conceptual systems on both levels and thus ultimately also different languages. Both forms of description meet only in the *interaction of a real-world practice*, which, however, also *structures itself systemically* under the influence of systemic planning – proven thoughts solidify in systemic structures that can be reused as templates. This is part of the feedback loop between justified expectations and experienced results. Ackoff's proposal is therefore to concentrate the development of new systemic boundaries in the description form along the narrower contexts ("cohesion") of practical cooperation of already established systemic structures that *emerge in practice* in this process of experience. In this way emerging along those boundaries systemic "superstructures" are additionally strengthened in terms of description. But this "superstructure" is by no means a "supersystem", since it operates with other "fictions" as abbreviated ways of speaking than each of the subsystems.

Management as problem solving enters precisely this field of *system formation* by transforming problems into solutions and thus developing systems further – from the "system as it is" to the "system as it should be" and finally to the "system as it has become". Management theories claim to provide conceptual and methodological tools for this. **Ackoff** sees a systemically based methodology as an important general approach to such a task. **Shchedrovitsky** develops a conceptual system specifically oriented towards the manager's field of activity. **Mintzberg** probably assumes that such a uniform methodological approach is not possible due to the structural diversity of his *basic types*. He claims that at best a toolbox of basic procedures can be given to be applied based on experience and situation.

Business Process Modelling, whether as SMART approach, as Goal Model, in MBO or in Business TRIZ, however, assumes that a *process-oriented* conceptual system is well suited for modelling business processes and thus supporting real-world management processes. The focus, however, has always been on *inner-system interrelationships*. The throughput of material, energy (including the social energy of real employees) and information *driving* the inner system structuring appears in these methodologies in the term *resource* as an interface. This seems to be a difficult issue because in the *BPDM glossary* the term "resource" is used in many places but not defined. V. Souchkov summarises the term in his glossary [13] as "Any type of tangible or intangible matter that can be used to solve an inventive problem: time, space, substances, fields, their properties and parameters, etc." The *TDS-100 glossary* [16] defines only the term "SuField resource", but writes about it in more detail "These are fields, substances, time, space, neutral or harmful functions and relationships that are available in the system, supersystem, subsystem and can be used to realise useful functions. For the realisation of useful functions, derived resources can be used that are formed by transformation or combination of original resources. Universal resources are emptiness and periods (pauses) in time. ...". In any of these definitions, *resources are given as things ready for use*. Resource production and provision is not addressed.

However, we have already seen that in the term *resource* two processes of different systems are coupled – the *use* of the provided resource and the *process of its production or reproduction*. In the case of "human resources", the concept of "role" is used, which breaks down into the sub-processes of "role definition" and "role occupation" as two complex forms of description with a clearly different focus. Anton Kozhemyako takes up this question in his text with the terms "generalised object" and "filling" and follows approaches proposed by Shchedrovitsky. However, the exact modelling in the case under consideration remains controversial ...

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