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Seminar Notes

Hans-Gert Gräbe

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1 About the Course

The course consists of

- the lecture "Modelling Sustainable Systems and Semantic Web",
- the Research Seminar "Sustainability, Environment, Management" and
- optionally a practical online lab "Introduction to TRIZ".

In this course, the focus is on the prerequisites and conditions associated with sharpening the meaning of notions in concrete contexts. Technical issues of the Semantic Web[1] will be addressed only marginally, as we assume that sufficient materials exist on the web to learn more about such concepts to the extent required for practical purposes.

The course is designed as an **interdisciplinary academic course**.

Interdisciplinary means that colleagues from different areas are involved – Sabine Lautenschläger (IIRM), Ken Pierre Kleemann (philosophy), Ralf Laue, Kristin Kutzler and Hans-Gert Gräbe (computer science).

Academic means that we want to work with each other and with the students – especially in the seminar – at equal level. It is about rational argumentation on a scientific level, i.e. we count for *arguments* and not apodictic truths.

All materials and seminar reports that can be made publicly available, are be published in the github repository

`https://github.com/wumm-project/Seminar-W21`.

1.1 Modelling Sustainable Systems and Semantic Web

The Semantic Web extends the Web in order to make data easier to exchange between computers and make it easier to use; for example, the term "Bremen" in a web document can be supplemented with information as to whether it refers to a ship with that name, a family name or the town "Bremen". This additional information makes information explicit in otherwise unstructured data. To add such information in a formalised way Semantic Web standards for the publication and use of machine-readable data (especially RDF) are applied.

This is a *very technical view* that does not take into account, *why* these distinctions are relevant at all. In this more general sense **Semantic Web Technologies are concerned with the sharpening of the meaning of concepts in particular contexts**.

These challenges are part of another core informatics competence – the ability to elicit corresponding requirement complexes within the framework of *Requirements Engineering*, to structure and finally to model them.

The **focus of the lecture** is on the connection of these two complexes of competences, whereby it is assumed that students in computer science already have a basic knowledge of both areas. A special focus is on the *resolution of contradictory requirement situations* as the core of systematic innovation methodologies such as TRIZ.

[1] See `https://www.semantic-web-grundlagen.de`.

1.2 Aim and Methodology of the Seminar

The concept of a *system* plays a prominent role in computer science when it comes to database systems, software systems, hardware systems, accounting systems, access systems, etc. In general, computer science is regarded by a majority as the "science of the *systematic* representation, storage, processing and transmission of information, especially their automatic processing using digital computers" (German Wikipedia). Also certain relevant professions such as the *system architect* are in high esteem by IT users.

However, the significance of the concept of system extends far beyond the field of computer science – it is fundamental for all engineering sciences and as *Systems Engineering* with the ISO/IEC/IEEE-15288 standard "Systems and Software Engineering", it is also the subject of international standardisation processes. Even more, the concept of systems also plays an important role in the description of complex natural and cultural processes – for instance in the concept of an *ecosystem.*

While classical TRIZ focuses strongly on instrumentally feasible engineering solutions, Systems Engineering "is an interdisciplinary field of engineering and engineering management that focuses on how to design, integrate, and manage complex systems over their life cycles. At its core, systems engineering utilizes systems thinking principles to organize this body of knowledge. The individual outcome of such efforts, an engineered system, can be defined as a combination of components that work in synergy to collectively perform a useful function." (English Wikipedia).

Earlier in this seminar, we had already studied more intensively different system concepts and, in particular, examined their application in complex socio-ecological, socio-economic and socio-technical contexts, see [14]. We observed that the central concepts of *transition management* and *activity management* addressed two different perspectives on structural change processes. In the transition management approach, the structural-transitional challenges are in the foreground, the activity management approach studies the implementation of structural changes via the actions and co-actions of actors and stakeholders.

In both approaches, however, the focus was on a holistic-structural and analytical view of a *decision preparation* rather than on practical procedural management approaches of *decision-making* and decision implementation in complex and contradictory real-world situations.

The WUMM project[2] aims at a better understanding of such management processes. Our starting point is TRIZ as a systematic innovation methodology derived from engineering experience in contradictory requirement situations. With the field of "Business TRIZ", which has been unfolding for about 20 years, a transfer of experience is being actively promoted, embedded in older management cultures and theories. A better understanding of such approaches to management issues and their connection to systemic concepts and approaches was in the focus of our seminar last semester.

In the seminar, we want to learn more about such modern management appoaches in which *common conceptualisations* and *consensus-oriented decision-making processes* are central and of crucial importance for the success and ways of formation and consolidation of new systemic structures. We are particularly interested in the connection between the dialectical resolution of contradictory requirement situations in the sense of TRIZ methodology and the emergence

[2] See `www.leipzig-netz.de/index.php/WUMM`. WUMM stands in German for *Widersprüche und Managementmethoden* (Contradictions and Management Methods).

of common conceptual and notational worlds as a result of the application of suitable semantic web technologies. A special emphasis will be put on the work of the *Methodological School of Management* around G.P. Shchedrovitsky [13].

The seminar is a research seminar in which we jointly explore different aspects of co-operative action in different management concepts. With this seminar, we are approaching a topic that is new to us, which offers the opportunity to participate in a joint academic explorative process on a basis of equals.

2 On the Notion of a System

2.1 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 systemic concepts are based more broadly and also have much longer historical traditions. *In the seminar*, we want to study such concepts more closely, with special emphasis on cooperative approaches in interdisciplinary contexts.

2.2 What is a System?

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 – during design time, the principal cooperative interaction is planned, during the runtime the plan is executed. For technical systems one has to distinguish the description, interpersonally communicated as justified expectations, and the results of operation, interpersonally communicated as practical experience.

Most definitions grasp the term *system* as a delimited set of interacting components, whereby the interaction of the components gives rise to a unified whole, which realises an emergent function and is thus more than the sum of its parts.

> 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. [11]
>
> 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. [23]
>
> Systems Engineering "is an interdisciplinary field of engineering and engineering management that focuses on how to design, integrate, and manage complex systems over their life cycles. At its core, systems engineering utilizes systems thinking principles to organize this body of knowledge. The individual outcome of such efforts, an engineered system, can be defined as a combination of components that work in synergy to collectively perform a useful function." (English Wikipedia).

The second definition also points to the purpose of systemic delimitations – it is about making complex relationships accessible to description by reducing them to essentials.

In all these definitions, the *structuredness* and thus *decomposability* of the system in the analytic dimension is emphasised on the one hand, and the *interdependence* and thus *indecomposability* in the execution dimension on the other. This corresponds to the practical experience of the engineer when she assembles a system from individual components – the system is only viable when it is assembled. In the assembled system in addition to the components, the *connecting elements* also play an important role. They mediate the *flow of energy, material and information* that is required for the operation of each component. In component software [22], with *deployment*, *installation* and *configuration* three stages of preparing components for their operation in a systemic context are distinguished, and this preparation for operation is often considered as a separate state – for example, as *maintenance mode* different from the *operation mode.*

The aspect of operating a system did not play a role in the first two definitions. Only here, however, the dialectical interrelationship between decomposability and indecomposability comes to light: Viable components deliver processual services in *guaranteed* quantity and quality during operation, if the *external operational conditions* are guaranteed. These processual services of the components in combination form the emergent function of the overall system. The self-similarity of the concept is obvious: components themselves have an inner life that can be described systemically, but which is largely abstracted from at the level of the overall system. The component enters the description of the dynamics of the overall system only as Black Box with a precise specification. This specification is divided into input and output interfaces. The former describe the necessary operating conditions, the latter the performance parameters of the respective component.

In [6] the system concept is identified as descriptional focusing to make real-world phenomena accessible for a description by reduction to the essentials. Such a reduction focuses on the following three dimensions:

(1) Outer demarcation of the system against an *environment*, reduction of these relationships to input/output relationships and guaranteed throughput.
(2) Inner demarcation of the system by combining subareas to *components*, whose functioning is reduced to "behavioural control" via input/output relations.
(3) Reduction of the relations in the system itself to "causally essential" relationships.

Further, it is stated that such a reductive description (explicitly or implicitly) exploits output from prior life:

(1) An at least vague idea about the (working) input/output services of the environment.
(2) A clear idea of the inner workings of the components (beyond the pure specification).
(3) An at least vague idea about causalities in the system itself, that precedes the detailed modelling.

2.3 Systems, Components and Reuse

One important aspect, especially of technical systems, has not yet been taken into account in the considerations so far: the aspect of reuse. Reuse plays a central role in computer science – copy/paste of code, outsourcing of repetitive pieces of code in function definitions, grouping of related function definitions in pre-compiled libraries, etc. This in no way exhausts possible forms of reuse, not to mention higher forms of reuse such as design, patterns or frameworks. Szyperski discusses in [22, ch. 8] aspects of the relationship between goals and forms of reuse.

Hence in addition to the description and operation, for technical systems the aspect of reuse plays an important role. However, this does not apply, at least on the artifact level, to larger technical systems – these are unique specimen, even though assembled using standardised 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.

Computer science has long struggled with a form of reuse that is widespread in developed engineering sciences and ultimately turned the manufacturing of tools and products from an art first to a craft and later to an industrial process – the *use of components produced by third parties* (components off the shelf).

Thus, after the analytical and operational dimension of systems and components, the *production by independent third parties* and hence the technical-economic interrelationships of an industrial mode of production based on the division of labour move into the focus of attention.

In such a context, the concept of a technical system is fourfold overloaded. A technical systems can be considered

1. as a real-world unique specimen (e.g. as a product or 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 specimens of this system produced according to this template (as production, quality assurance, delivery, operational and maintenance plans).

The concept of a technical system thus has also in this context a clearly epistemic function of (functional) “reduction to the essential”. To Einstein the recommendation is attributed “to make things as simple as possible but not simpler”. The TRIZ *law of completeness of a system* expresses exactly this thought, however, not as a *law*, but as an engineering *modeling directive*. The apparent “law” of the observed dynamics therefore essentially addresses *reasonable human action*.

In an approach of “reduction to the essential” and “guaranteed specification-compliant operation” human practices are inherently built in, since only in such a context the terms “essential”, “guarantee” and “operation” can be filled with sense in a meaningful way. These essential terms from the socially determined practical relationship of people are deeply rooted in the concept generation processes of descriptions of special technical systems and find their “natural” continuation in the special social settings of a legally constituted societal system.

2.4 Socio-technical Systems

The last considerations already embed the concept of system in social practices of cooperatively acting people. This embedding is also present in TRIZ system definitions, when the emergent function realised by the system is considered as *main useful function* MUF and linked to a *purpose*, why this (technical) system exists or was designed or redesigned in this way. This *aspect of purposefulness* (Zweckmäßigkeit) plays only a subordinate role for "natural" systems, namely for socio-ecological systems, since in this context in most cases the "purposefulness" comes up against hard limits or causes massive problems or has even already caused them. Nevertheless, this *orientation on purposes* is another throughput parameter (e.g. as monetary throughput) from a social environment relevant for the inner dynamics of a system. It can ultimately be subsumed under the *throughput of information* if a sufficiently viable concept of information is taken as a basis.

This purposefulness transforms the totality of technical systems into an interconnected *world of techical systems* full of preconditions and conditionalities, which opens up a fourth dimension of the concept of system, to secure stable operating conditions of the systems themselves.

The self-similarity of the systems concept provides a solution for this challenge – consider systems as components and the relations of purposefulness as interdependencies, delineate larger socio-technical systemic units, develop appropriate forms of description and operation. The transformation towards a sustainable mode of production and living that is on the agenda just requires a big step forward in this direction. This is one of the objectives of management and hence in the primary focus of our seminar. However, socio-technical systems are, in addition to technical restrictions, charged with the contradictory expectations and interests of concrete people and groups of people.

Ian Sommerville [16] elaborates a number of challenges in this regard. He also starts with the concept of a goal-centered system.

> A *system* is a meaningful set of interconnected components that work together to achieve a specific goal. [16]

Right after he develops 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 organisations 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 organisational 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 organisational goals depends not only on the system itself. It also depends on the *stability of the goals*, the relationships and *conflicts between organisational goals*, and how people in the organisation *interpret those goals*.

In this context, there is a clear shift on the scale of controllability from direct control by external human operators to indirect control and movement according to intrinsic laws, which is even more prevalent in **socio-economic systems** with a large number of stakeholders or even **socio-ecological systems**.

2.5 Shchedrovitsky on Systems Analysis

The system concept thus serves to delimit a part of the complex, all-connected world (hereafter *reality*) in order to make this part accessible for description. However, this human activity, which Georgi Shchedrovitsky (a Russian Philosopher and the head of the *Methodological School of Management*) refers to as *mental activity* [13, p. 47], is itself part of that reality and thus also of practical relevance. Real-world processes are thereby charged with description forms. Thus in systems these two dimensions – description and operation – must therefore be distinguished. Charging a system with a description form is what Engels' calls, in reference to Kant's *thing in itself*, the transformation of the *thing in itself* into a *thing for us*.

Shchedrovitsky [13, p. 80 ff.] conceptualises this process in two different concepts of system [13, pp. 89 and 98] as process of breaking down the system into parts (components), charging the components with description forms and then reassembling the components thus charged into a whole. The result is a *new* system in the sense that it is the old one but charged with a description form. In this way, the *structural organisation* of a system can be grasped.

The real world and thus also systems develop and change over time. In order to understand the *development of a system*, its *processual organisation* must be examined. Shchedrovitsky emphasises that the development of a system can *never* be described in its disassembled form, since disassembly destroys the systemic coherence. An aeroplane disassembled into its individual parts cannot fly, only an assembled one. We are dealing here with a fundamental epistemic contradiction.

For details we refer to [13].

2.6 Theory of Dynamical Systems

The Approach

The processual dimension of systems can be investigated with the mathematical tools of the Theory of Dynamical Systems if the processes can be modelled as equations of motion in phase space.

The Theory of Dynamical Systems as a branch of mathematics investigates the dynamics of structurally defined and modelled systems. Attributes which are essential for the description of the system are combined into a *phase space* and the changes in the attribute values are described as *equations of motion* by differential equations. If only temporal changes are considered, this leads to systems of *Ordinary Differential Equations* (ODE), complex spatio-temporal changes lead to Partial Differential Equations. We restrict ourselves to the first case, i.e. purely temporal structural changes.

In the simplest case, such as the pendulum or the movement of two bodies in a homogeneous gravitaional field, a *trajectory* can be calculated from the equations of motion.

Examples:

- Pendulum: `https://en.wikipedia.org/wiki/Pendulum_(mechanics)`
- Two body problem: `https://en.wikipedia.org/wiki/Two-body_problem`

Model and Reality

However, the solution of this equations only describes the motion $m(t)$ in the model. Good modelling is characterised by the fact that the real movement $f(t)$ and the movement $m(t)$ according to the model differ only insignificantly $r(t) = f(t) - m(t)$ in practically relevant parameter ranges (the *context of observation*). This can only be verified empirically through experiments that are to be planned more or less precisely, since reality is only accessible empirically.

Particularly interesting are modellings in which the residual $r(t)$ decreases "by itself". Such systems strive towards an equilibrium, which structure can be derived from the model.

How Chaotic can Trajectories be?

Examples:

- Double Pendulum, `https://en.wikipedia.org/wiki/Double_pendulum`
- Magnetic pendulum with three attracting magnets,
- 3-body model: `https://en.wikipedia.org/wiki/Three-body_problem`

We see that there is apparent stability for a long time, but in phase space there are certain *areas of instability* in which (exactly calculable!) trajectories passing through points in phase space that are close to each other strongly diverge. Such locations are called *bifurcations*. Often there is a single phase parameter that makes this bifurcation particularly clear. Such a bifurcation on a one-dimensional scale is also called a *tipping point*.

Not everything that looks like chaos has to be chaotic:
`https://i.redd.it/zr7tet9mdfl01.gif`

Attractors

How complicated can an equilibrium position be?

Examples:

- Pendulum,
- pendulum with three attracting magnets,
- pendulum with one repelling magnet.

Limit cycles: `https://en.wikipedia.org/wiki/Limit_cycle`

When the body is on the limit cycle, it remains there, i.e. the limit cycle is a *stable solution* of the equations of motion of the system, called **steady-state equilibrium**.

In many cases the real movement $f(t)$ in time is *attracted* by that limit cycle, i.e. $f(t)$ can be decomposed into $f(t) = l(t) + r(t)$ with $l(t)$ the projection on the limit cycle and $r(t)$ a (small) orthogonal deviation. In this way, it is often possible to simplify complicated models.

An attractor is a specific steady-state equilibrium with just this attracting property.

More precisely: Let $f(t, a)$ be a function which specifies the dynamics of the system with starting point $f(0, a) = a$. An **attractor** is a subset A of the phase space characterized by the following three conditions:

- A is forward invariant under f: if a is an element of A then so is $f(t, a)$, for all $t > 0$.
- There exists a neighborhood of A, called the basin of attraction for A and denoted $B(A)$, which consists of all points b that "enter A in the limit $t \to \infty$".
- There is no proper (non-empty) subset of A having the first two properties.

Attractor as stable solution of the corresponding system of ODE
`https://en.wikipedia.org/wiki/Attractor`

On the importance of "stable" cyclical processes in nature

We are able to perceive such *approximately* repeating patterns in natural processes (i.e. attractors), i.e. perform such a reduction also independently of mathematical abilities.

For given (deterministic) equations of motion one can compute the geometry of such an attractor as *global deterministic* invariant of the equations of motion.

How Complicated can an Attractor be?

- https://en.wikipedia.org/wiki/Attractor
- https://en.wikipedia.org/wiki/Lorenz_system
- https://de.wikipedia.org/wiki/Lorenz-Attraktor
- Attention, with the numerical methods used there for visualisation it is difficult to distinguish whether they are calculating a chaotic trajectory or really the attractor, which is a *global* artefact.
- "Almost all initial points will tend to an invariant set – the Lorenz attractor – a strange attractor, a fractal, and a self-excited attractor" (Wikipedia)

Dissipative Systems

Closed and Open Systems. Previous investigations were directed towards the inner dynamics of an autonomous, i.e. closed system.

Importance of a (stable) throughput of energy, matter and information for the inner structure formation in systems.

- Self-organisation in dissipative structures
  - https://en.wikipedia.org/wiki/Rayleigh-Bnard_convection
  - https://en.wikipedia.org/wiki/Belousov-Zhabotinsky_reaction
- Dissipative systems https://en.wikipedia.org/wiki/Dissipative_system
- Life on Earth as a dissipative system.

3 Systems, Organisations, Management (Gräbe)

3.1 Organisations as Systems

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 and managerial experience from structured processes of planning, implementation and operation of such 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.

This seminar topic aims to shed more light on the connection between the concepts of system and (social) organisation. **Social organisations** such as companies, associations, projects, unions, parties, governments, states ... are undoubtedly theoretically delimitable and practically delimited parts of reality with outwardly (and inwardly) directed goals and purposes whose internal structure and dynamics are driven by an external throughput of energy, material and information, and which can therefore be studied from a systemic perspective.

The external throughput of energy, material and information is usually not in the focus of consideration, as these throughputs are already mentally charged in language form in a **more complex social context** and in the form of interests, needs, monetary flows and power relations. Nevertheless, a systemic structure is clearly recognisable, which is to be worked out in various theoretical approaches that we will look at in more detail. In particular, the concepts of *action space* and *cooperative action* in such spaces will be conceptualised in more detail.

3.2 Leadership and Management

Management is an essential form of influencing the dynamics and development of organisations. Shchedrovitsky emphasises that one can only manage something that is in motion[3] and that there is no need for management if there are no problems.

In the previous semester, we had already considered the topic by studying different theoretical approaches to management. Most of them assumed a manager as a single leader and developed approaches and patterns of how persons in such a *role* can develop leadership in achieving given goals. If we project such approaches onto a systemic concept of development in contradictions, there seems to be a recurring central contradiction between the goals of the organisation and the goals and interests of the people involved in realising them.

However, such leadership principles have been under massive pressure for at least 20 years, as they have only limited effect in modern contexts of action in interdisciplinary teams. Even more, they presuppose the authorised individual leader who combines management and leadership in one person. In multi-stakeholder contexts such as socio-cultural or socio-ecological systems, even this prerequisite is not given.

In this context, Shchedrovitsky clearly distinguishes between the notions of *management* and *leadership* [13, p. 27-30] and shows to what extent a new principal is confronted with contradictory challenges of both concepts.

3.3 Systemic Management Basics

In the further course of the seminar we want to discuss the systemic development of social organisations in the unity and difference of *planned action* and *experienced results* in the light of different theoretical approaches.

This requires a concept of *action planning*, based on a *conceptual understanding* of the process landscape within and around the organisation in an appropriate explicit form of description and *intelligible operational 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* in the unity and difference of *pure thought* and *mental activity* as explained in [13, p. 33-51]).

[3]"Management is only possible if the object we manage is in motion, self-propulsion. Management is the use of this self-propulsion by managers for their own purposes." [13, p. 28]

This system of concepts is more stable than the real-world practices, but it is not static – it develops together with the practices. ***World* is *reality for us* and thus reality in the process of conceptual grasping.**

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

3.4 Organisations

What is an organisation? Wikipedia distinguises between formal aud informal organisations.

Formal organisations.

> An organisation that is established as a *means for achieving defined objectives* has been referred to as a formal organisation. Its design specifies how *goals are subdivided and reflected* in subdivisions of the organisation. Divisions, departments, sections, positions, jobs, and tasks make up this work structure. Thus, the formal organisation 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 organisation and endows them with the authority attached to their position. (Wikipedia, my emphasis)

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

Informal organisations.

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

The further explanations in Wikipedia remain weak and contradictory. Structure-building processes and especially shared conceptual systems also develop in informal organisations, 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 *organisation ontology of the W3C* [10] – considers `org:OrganisationalUnit`, `org:FormalOrganization` and `org:OrganizationalCollaboration` as subconcepts of the concept `org:Organization` but does not mention informal organisations. In their definition an organisation

> 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. Organisations are often decomposable into hierarchical structures. [10]

`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`. [4]

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, organisational 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* (juristisches Subjekt) in the sense of the Civil Code (BGB) if *responsibility for the consequences of action* is added.

3.5 Organisations as Socio-Technical Systems

While in the Wikipedia definition positions, jobs and tasks are mentioned, but beyond bureaucracy no people, in this definition an organisation 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 organisation – the whole is more than the sum of its parts in the sense that relational synergy effects are of special importance in such an organisation.

This corresponds closely with the *system concept* developed so far:

> A *system* is a *delimited set of elements* (components, objects, resources) that are interconnected and interact with each other. Their interaction realises a *qualitatively new function* (emergent function) and thus constitutes a *new unified whole.*
>
> A system has a *structural* and an *operational* dimension which are in contradictory dialectical relation of decomposability and indecomposability.
>
> The *operation of a system* requires a qualitatively and quantitatively defined throughput of energy, material and information.

Ian Sommerville [16] also starts with the concept of a system and moves from there to the concept of *organisation.*

> A system is a meaningful set of interconnected components that work together to achieve a specific goal. [16]

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 organisations 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 organisational 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 organisational goals depends not only on the system itself. It also depends on the *stability of the goals*, the relationships and *conflicts between organisational goals*, and how people in the organisation *interpret those goals*.

In this context, there is a clear shift on the scale of controllability from direct control (technical systems) to indirect control (socio-technical systems), 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").

This relates to TRIZ principle 25 *Exploit Self-Service Processes*, 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".

Ultimately, this means to resolve the contradiction between plan and realisation and to develop a form of description that brings the "natural" movement in a system according to its own laws in coherence with the human goals and needs.

3.6 Shchedrovitsky on Organisations

What is an organisation for Shchedrovitsky? In [13, p. 30 ff] he 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. [13, p. 26] 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. [13, p. 29] 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 look 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 (Zweck) 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** (Ziele). 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. [13, p. 30] 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, 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.

3.7 Systematic Management in Organisations

The subject of *systematic management* are socio-technical and especially socio-economic systems. The latter consist of economic units (companies, government, state, ...) 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.

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.

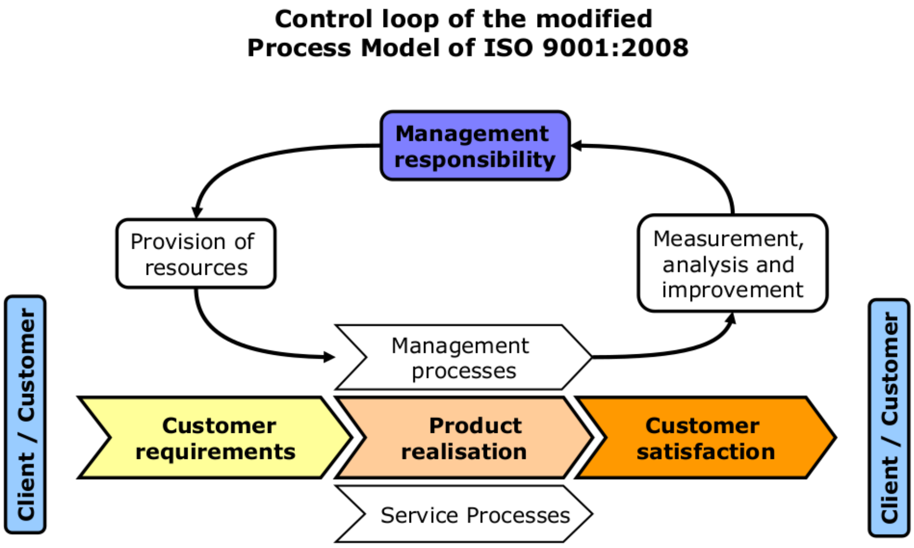


Fig. 1: Control Loop in the Modified Process Model of ISO 9000

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.

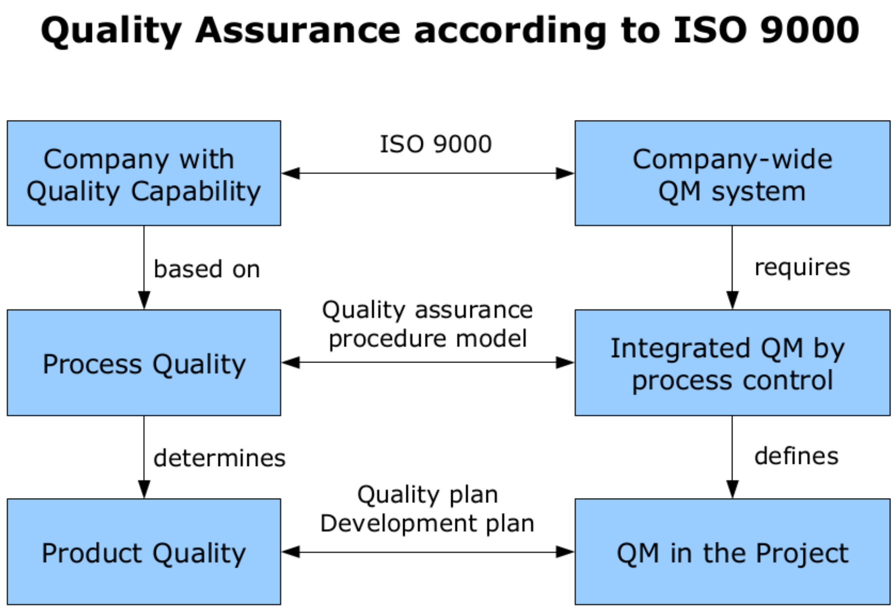


Fig. 2: The relation between model, meta-model and meta-meta-model in quality assurance

Managing Organisational Development and Capability-Maturity Models

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.*

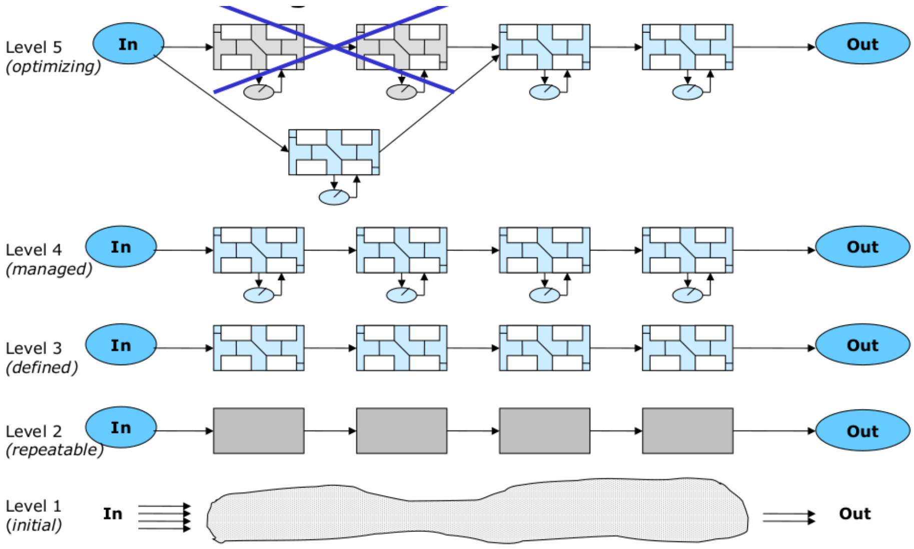


Fig. 3: Increasing maturity of structured project management within CMM(I)

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

4 PCF – The APQC Process Classification Framework

With more than 550 member organizations worldwide, APQC (American Productivity & Quality Center) counts as "the world's foremost authority in benchmarking, best practices, process and performance improvement, and knowledge management (KM)".

In the presentation, PCF [2] was introduced as a system of concepts that is very important in the US in describing the structure of business processes. In a five-level hierarchy, corporate decision-making structures can be described in an increasingly refined approach.

Processes are first assigned to *Categories* that can be used to describe and plan essential strategic corporate aspects both for Operating Processes (from 1.0 "Vision and Strategy" to 6.0 "Manage Customer Service" in [2]) and for the Management of Resources and Support Processes (from 7.0 "Develop and Manage Human Capital" to 13.0 "Develop and Manage Business Capabilities"). The categories describe *strategic planning fields* of corporate development and are in a mutual tension as components in an overall corporate strategy as the first systemic level of description.

For each such component, *Process Groups* are defined as refinements of the strategic planning fields, whose interaction on a smaller-scale operational time scale implements the process-related challenges of the strategic planning field. This corresponds to a hierarchical structural model as it is also known from TRIZ.

While a largely uniform system structure is postulated on the first two levels of PCF, the third level, *Processes*, in addition to core elements provides for variants and reworks. This takes into account the character of the framework as a *Meta-Model*, because it must be able to be broken down to many *specific* business process model instances of different companies with very specific and heterogeneous requirements. These specific business process model instances are in turn in tension with the *real* business processes that they describe, plan and model.

The performance of a framework is also determined by the extent to which it is able to map this three-stage instantiation process in a result-oriented manner. The three stages – the meta-model of the framework, the special business process model of a company and its business practice – are associated with the two feedback loops between the business process model of the company and reality on the one hand and between the variety of such "real" business process models and the meta-model on the other. This important connection remained underexposed in the presentation and discussion.

It also remained open which *implicit prerequisites* the PCF assumes for its basic structuring of business processes, i.e. on which *meta-meta concepts* it builds. In the discussion it turned out that APQC is a largely American standard, tailored to American legal and contractual structures and therefore hardly used in Europe. A comparison with relevant European or German standards, such as the **V-Modell XT** or **ISO 15504** "Software Process Improvement and Capability Dtermination", would therefore be interesting in order to better understand this meta-meta level. The latter standard in particular comes with a reference model that can be adapted to *different* process and process assessment models. The standard presupposes already in its first development stage "performed" that a basic project-like production or service structure has been introduced in the company, which allows *activities* to be defined in terms of *time* and *resource* bounds and *key events* (APQC) or *KPI – key performance indicators* (SPICE). Especially in agile environments this is not self-evident. "No formal process management within the organisation" counts as one of the main reasons why organisations don't adopt a framework.

Finally, the difference to classical business process modelling should be addressed, in which process flows, sequences, branches and variants in various logical combinations (BPMN) or questions of the execution conditions of such processes (BPEL) play a role. This corresponds to our general observation that systems always have to process the dialectical contradiction between decomposability and indecomposability. This contradiction is articulated in the field of tension between *function* and *process*. In the context of an analysis of the organisational structure, *functions* can be very finely decomposed into sub- and sub-sub-functions. In the *process view*, however, these functions must then prove their ability to interact by transforming sequentially *work products* (resources) into suitable forms. Only an assembled system can be operated.

In this sense, APQC is directed at the organisational structure of a company and thus also at management, but understood in the sense of Shchedrovitsky [13], who clearly distinguishes management from leadership by focusing on the planning quality of management. With the two dimensions *benchmarking* and *content management*, two further planning dimensions are addressed in the corporate context – the planning of the evaluation (assessment) of activities and the planning of planning and access structures.

5 Business TRIZ

Business TRIZ [17, 18, 19, 20] is a development direction within systematic innovation methodologies in which contradictory requirements and problematic situations in the area of management in companies are considered and the classical tools of TRIZ are examined for their applicability and need for modification in this non-technical area. In these developments it becomes clear on the one hand to what extent engineering methods have already found their way into modern management. On the other hand, the necessary modifications of classical TRIZ tools required in these applications lead to a better understanding of overarching systemic phenomena.

The aim of the presentation was to put the approaches pursued in Business TRIZ and its tools and methods in the larger context of description and analysis possibilities of business processes and models discussed in our seminar.

In the comments on the last seminar I referred to three levels – practice, model, meta-model – which are to be distinguished in different management theories. While APQC PCF focused on the structure-building meta-level, it was noted in the discussion that the Business TRIZ toolbox is mainly applied at the modelling level of real-world business activities.

The question of the conceptual basis and associated structural prerequisites on which the effect of these tools can unfold – for the PCF this was a five-level structure with the largely fixed levels of *category* and *process group* and possibilities for variance at the levels of *process*, *activity* and *task* – remained largely open, but is marked more precisely in [17] with the definition of the notion *business model* and the four *component groups* of *value proposition*, *profit formula*, *key activities* and *key resources*. This structuring is broken down further into *business model building blocks* and *bulding block patterns*. Here, a comparison with the categorical approaches of PCF remains interesting.

In [20], the conceptual network is further differentiated and a *business innovation roadmap* is proposed, which is oriented towards a general further development of business models.

In the presentation itself, Business TRIZ was mainly presented as a large toolbox of instruments for various not specified more precisely purposes. The contradiction in TRIZ itself between the variety of tools and the claim of a systemically driven general framework as a uniform process model was addressed in rudiments on slide 24, in which three abstraction levels of entrepreneurial transformation demand were assigned to the three levels of a Business TRIZ certification. The connection is deeper, however, and only becomes clear when the multitude of tools are placed in a uniform development cycle of analysis, synthesis and evaluation, which embeds corporate development in a field of tension between justified expectations and experienced results, as is discussed in [1], for example.

6 Conceptual Systems and Coordination Processes in Agent-based Business Systems

The consideration of agent-based business systems was actually intended to take a multi-stakeholder perspective in order to expand the view of business processes gained in the past seminars in the context of a single company and to examine more closely the design and implementation of business processes in cooperative contexts without a central decision-making authority. We did already consider similar approaches in the previous semester with the i* model [15].

This was not achieved since the presentation and discussion addressed agent based systems and not agent based business systems and thus focused on a rather technical dimension of the theme. Agent-based systems in such a technical sense are a topic of programming distributed middleware in computer science. We discussed the question which characteristics distinguish such systems in the spectrum of general (distributed) component-based software architectures. If one analyses such software architectures in more detail, specifics exist above all in the design of the communication concepts as well as the specific form of the persistence layer and thus in the management of decentralised states. With regard to the system concept developed in the seminar, there is a central challenge. Systems are *indecomposable* in their process dimension, which means that in most cases optimising the behaviour of the individual agents does not lead to an optimal overall system. Optimisation of the overall system requires corresponding system-global description forms and thus also a suitable *global state management* in the distributed system. There are enough conceptual approaches for this in computer science, how far they may be applied in each individual cases. This elementary insight of systemic modelling did not play a role in the presentation and discussion.

Agent-based systems model a basic assumption of the free market concept – the contract-based action of economic subjects as homines oeconomici optimising private benefits leads to an optimal overall economic system. The "blind hand of the market" and thus the "naturally" developing economic processes (TRIZ Principle 25: By itself) lead "behind the market participants" in most cases to better results and are superior to regulatory interventions in these processes. This belief is in blatant contradiction not only to the importance of institutionalised procedures as pillar 2 in the 3-pillar concept of technology developed in the lecture, but also to all *practical* efforts to standardise business processes, which were addressed in the previous seminar presentations (APQC PCF and Business TRIZ).

Such market-like mechanisms are of very restricted value for technical interaction scenarios in distributed systems, each with local memories, to simulate agent-based business systems. Such simulations use a very specific understanding of market contexts, in which competition, mutual observation and local inference systems are in the foreground, while aspects of cooperative action and in particular the formation of common conceptual systems in such action are in the background compared to the "inner goals" of the agents. Such an approach emphasises the processual elements of these interactions and largely ignores the formation of structures through institutionalisation.

Agent-based approaches nevertheless represent an important field of gaining experience for precisely such institutionalisation processes, if the corresponding systems are regarded as developing systems that are still in an early phase of interaction networking. Digital agent-based systems are a particularly interesting field of experimentation in view of their easy modifiability, where gaming approaches have recently enjoyed particular popularity.

However, these experiences only become interesting when they are (or can be) transferred to real-world multi-stakeholder systems. At the centre of corresponding institutionalisation processes is the genesis and consolidation of system-global conceptual worlds to articulate and codify global system states, which transcend local beliefs as new, emergent systemic qualities. This process, which can still be controlled in the classical way within a company in the direction of a corporate identity under tight strategic management, cannot be implemented in such a way in multi-stakeholder contexts. The identification of suitable concepts how such forms of cooperative action can be conceptually accompanied is the main concern of our seminar.

7 Supply Chains and SCOR – the Supply Chain Operations Reference Model

The following notes once again present the basic structure of the line of argumentation followed in the seminar. It starts from "classical" company modelling on the basis of the APQC-PCF, whereby a distinction is also made between a strategic and an operative management level as independent systemic contexts with their own "reductions to essentials" and conceptual systems corresponding to the respective reduction.

Classical management theories focus on supporting an appropriately authorised individual leader in the operational area to develop leadership (in Shchedrovistky's understanding) in order to implement the given goals (as a specification) in his or her area of responsibility with the allocated resources (personnel, material, time). Classical business process modelling is more oriented towards management (in Shchedrovistky's understanding), i.e. the modelling and thus the description of the (technical) processing in such a context.

Classical operational management is strongly oriented towards instruments of direct control. In contrast to this are agent-based approaches with instruments of indirect control, even though these aspects were not further illuminated in the last seminar, which dealt with agent-based approaches. Such instruments of indirect control also play a role at the level of strategic management, where decision-making processes have to take into account complex conditions arising from both external corporate goals and the internal reproduction requirements of production conditions. The similarity of relationships between different corporate divisions at the strategic level to agent-based approaches was illuminated in more detail.

This also bridged the gap to supply chain management and the structures of business relationships between independent third parties, for which SCOR is developing a reference model. With [21] our text refers to a paper from 1997 and develops the problem from a principial point of view. Due to time constraints, more recent developments could not be taken into account.

7.1 On the Systemic Structure of (Enterprise) Organisations

The systemic understanding of an (entreprise) organisation, which can be read off from the normative documents (APQC-PCF) and practically relevant enterprise modelling (Business TRIZ) examined so far, assumes two systemic levels to be distinguished – operational and strategic management.

From the *perspective of strategic management*, the system is the whole enterprise, divided into strategic business units as components (APQC-PCF levels *category* and *process group*). Reduction to essentials at this level means organising the relationships both between these components and with the company's environment to achieve the *strategic goals*[4]. It is therefore a matter of organising the throughput of energy, material (in the broadest sense, including "human resources" which play a central role here) and information in the qualities, quantities and rhythms required within a specific intrinsically defined time horizon (the "rhythm" of the overall system). This kind of organisation assumes that short-wave temporal fluctuations of the throughput can be intercepted and compensated within the components. Such *resilience* of the components is, of course, a property that in turn must be reproduced at the level of the overall system. APQC-PCF provides here for a company-wide division into 13 *categories* as strategic business areas. These do not have to be formally established or separated within the company, but if a company wants to participate in the cross-company exchange of experience that APQC organises, then these areas must be at least virtually delimitable in the business model of the company.

The focus of *operational management* is on the concrete design and development of these individual business areas at the operational and thus at an intrinsically shorter time horizon. APQC postulates at that level clearly more centralised management structures with corresponding authorisations and rights of intervention, but also responsibilities. On the other hand, it also provides for differently designed intra-company structures through *variants of the standard* at the level of modelling processes, activities and tasks. The standardisation efforts are thus directed at the *strategic structural level* and a certain standardisation of *operational processes in their methodological meta-model* rather than structural model dimension. The latter makes it possible, despite structurally different modelling at the operational level, to organise the comparison between process planning and real-world process execution as a contradiction between *justified expectations* and *experienced results* in a comparable way by regularly recording *Key Perfomance Indices* (KPI) (see 13.6 *Measure and Benchmark* in APQC-PCF).

This information, collected *globally* at the subsystem level as a component of the overall system, is then used for controlling processes at the subsystem level by operational management. This information is thus part of a *global conceptualisation* for this subsystem level, of a *cooperative world view* as an emergent phenomenon, which is inseparably linked to the development and strenghtening of the structure at this subsystem level. Both individual steering impulses for individual employees (management by objective, management by incentive, ...)

[4]According to previous discussions, I use the term *goal* for longer-term and *objective* for shorter-term targets.

and cooperative steering tools (such as the relationships between *Product Owner*, *Team* and *Scrum Master* in Scrum) are used.

Even if the KPIs are modelled and collected globally throughout the company, the possible uses of these instruments remain the same at the operational level, because the authorisation of the operational management is limited accordingly and thus *judgement practices* can be executed only within the subsystem. On the other hand, the KPIs of a globally collected system are not very useful in this level of detail at the strategic management level and must be *aggregated into strategic KPIs* to enable similar judgement practices at the strategic level. Such judgement practices at the strategic level thus strenghten a *strategic worldview* of the company that differs from the worldview at the operational level in the sense of the tension between the general and the special. It should be further noted that operational management enters as control component *subject* (in the sense of TRIZ terminology) at the subsystem level, but is predominantly the *object of control* at the strategic level.

Particularly in agile contexts, in which instruments of indirect control are also used at the operational level, there are often more than two such system levels to distinguish, which can be read off from clearly differing time horizons. In Scrum, for example, the structuring units *Daily Scrum*, *Sprint* and *Product Backlog* or *Project* mark four systemic contexts – the *Project* as a whole as a component of strategic corporate development, the individual *Sprints* as components of the system *Project*, the contents of which are negotiated between the project owner as control component in the *system Project* and the team, and the agile implementation structures in the *system Sprint* by the individual team members as components (or resources?) with, e.g., their progress reports in the *Daily Scrum*. Here, too, the structural design of the *system Sprint* is in the hands of the team; Scrum provides only methodological advice and tools that – if they are used appropriately – enable progress to be monitored "from outside" at the level of the *supersystem Project*, on the basis of which decisions can be made about interventions in the team's self-organisation processes by the control component of the supersystem.

7.2 Systemic Structures and Agent-based Systems

Most management theories focus on developing methodological tools with which appropriately authorised individual leaders can *implement* externally specified objectives (as a *specification* of a justified expectation) so that the experienced result comes as close as possible to the expectations. Both (specification and result) can be found in descriptions based, e.g., on APQC-PCF as *activity* and *work product*. In this context, management and leadership overlap, as both the employees involved in the process as "human resources" are to be guided in order to fulfil the operational tasks appropriately, and the emergent systemic resources as *infrastructure*, in particular these "human resources" and the "cooperative world view", are to be maintained and further developed.

Management theories do not say much about how to address the same issues at the strategic level of the company. One of the (non-explicit) preconditions at that level seems to be a certain collective decision-making, since the managers involved represent different operational areas that are all important by their own and thus, in addition to *goals* as justified expectations that can be bundled, the various intrinsic logics of the operational areas enter into the decision-making process as partly contradictory restrictions and thus the reproduction conditions of the components appear as a multitude of (additional) requirements.

A radical answer to this problem is the transition to agent-based systems as presented in the previous week's seminar [8]. A system is built from agents as components whose internal reproduction conditions ("belief, knowledge, desire, obligation, commitment, state, thinking about past actions, learning, (internal) goals" – [8, slide 9]) are decisive for what kind of systems can be assembled from them at all. If one believes the explanations in [8], goals or objectives of an overall system no longer seem to drive the development, but (solely?) the coordination achieved by "communication, negotiation, information sharing" [8, slide 34] among the agents as system components. However, later [8, slide 35] a CEO with "guidance" appears.

Essential "advantages of an agent-based approach in business environments" are summarised on [8, slide 37]:

- Head business management focuses on higher-level decisions.
- Improved problem-solving capabilities through specialisation.
- Improved problem-solving capabilities through mutual support.
- Sophisticated goal-oriented communication.
- Improved physical organisation.
- Outsourcing of cross-cutting concerns.

Hence, other aspects than the seeming ability of agents to act autonomously and the assertion that a separate optimisation of the agents leads to optimality of the overall system come to the front. These are primarily "beliefs" and "knowledge" as two properties of an *emergent system-specific conceptual system* – a "cooperative world view" – which allows to capture in language form the specific "reduction to essentials" of the system-internal relations between the components. In an agent-based approach the unfolding of such a conceptual system, called "schematisation" by Shchedrovitsky [13], is postulated for the agents as components. But it must also *unfold at the level of the system.* The temporal offset of the unfolding of conceptual systems at different levels is an essential characteristic of dynamics in systemic structures. In view of the reduction of the component properties to their specification, the conceptual systems of the components enter into this new systemic conceptual system only in a reduced form, but must be expanded by conceptualisations and modelling approaches for the essential interactions between the components.

7.3 Agent-based Approaches as a Model of a Market-based Landscape of Independent Producers

Agent-based systems model a basic assumption of the free market concept – the contract-based action of economic subjects as homines oeconomici optimising private benefits leads to an optimal overall economic system. The "blind hand of the market" and thus the "naturally" occurring economic processes (TRIZ Principle 25: By itself) lead "behind the market participants" in most cases to better results and are superior to regulatory interventions in these processes. This belief is in apparent contradiction not only to the importance of institutionalised procedures as pillar 2 in the 3-pillar concept of technology developed in the lecture, but also to all *practical* efforts to standardise business processes, which were addressed in the two previous seminar presentations (APQC-PCF and Business TRIZ).

As explained above, the efficiency of the "blind hand of the market" is essentially linked to the development and unfolding of elements of systemic structures and related conceptualisation processes. Production based on the division of labour is only possible if this division of labour is embedded in overarching institutionalisation processes, in the framework of which communication based on common conceptual systems accompanies real-world cooperative action, especially the exchange of labour products and services between independent third parties.

Hence agent-based approaches represent an important field of gaining experience for precisely such institutionalisation processes, if the corresponding systems are regarded as systems in development that are still in an early phase of interaction networking. *Digital* agent-based systems are a particularly interesting field of experimentation in view of their easy modifiability. Gaming approaches in this field recently received particular popularity.

7.4 Supply Chain Management

The exchange of products and services across company boundaries is not only oriented towards the induced money flows, but also towards the material properties – the *use value* – of the exchange products. The more detailed the corresponding conceptual systems for qualitative and quantitative parameters of the exchange products are developed, the more precisely these use value can be described. Today such cross-company conceptual systems are already well developed in many domains and make it possible to trace the origin and quality of work products and their ingredients over longer supply chains.

In the course of modelling business processes within a company not only the *product quality* of individual commodities that enter the company as resources is of interest, but also the more comprehensive possibility to assess the *quality capability* (process quality) of economic partners. This quality capability of a company does not necessarily mean that *all* its products are of high quality, but in addition to the average high quality of the products, adherence to delivery dates, costs and service within narrow predictable ranges can be expected. Supply chain management focuses on such issues of assessing quality capability in supply chains.

7.5 SCOR – the Supply Chain Operations Reference Model

Similar to APQC-PCF, SCOR as a *reference model* systematises the essential aspects that have to be considered in a structured way during such an assessment of partners in the supply chain. SCOR 1.0 was released in 1996 and has since been developed in various versions. Today, the further development of SCOR is coordinated by the ASCM Foundation – the *Association for Supply Chain Management.*

Peter A. Bolstorff writes on the SCOR history on the ASCM blog [3]:

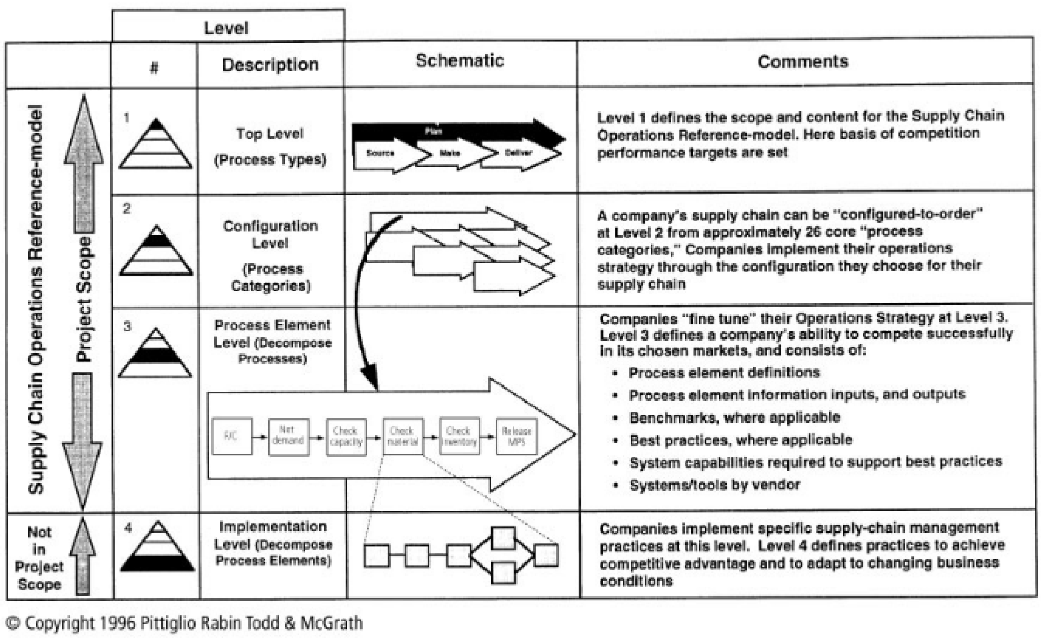
> My journey with SCOR began when I was a delegate from 3M (and then its spin-off Imation) as part of the launch of SCOR 1.0 in 1996. [...] At the time, we needed to define key **performance** indicators that balanced customer requirements with internal capabilities; architect **processes** to leverage the technology; adopt **practices** that were more than just white papers; and develop **people** to have both the knowledge and skills to make it all happen and move the needle of performance and achieve the promised ROI.

[Today] over 5 000 companies have leveraged SCOR as part of their supply chain excellence journey. Innovations in each of the 11 versions of the reference model were driven by practitioners challenged with having to model the future while delivering business value in the present. We're now three years into the APICS and Supply Chain Council merger and our practitioner community is once again sorting out how to innovate SCOR to model a faster set of changes enabled by amazing technology advancements – all the while delivering quarter over quarter results.

The following essential structural elements are taken from [21] and represent the status of 1997.

SCOR as the standard process reference model for supply-chain management brings order to the diverse activities that make up the supply chain, and provides common terminology and standard process descriptions. The model allows companies to:

- evaluate their own processes effectively;
- compare their performance with other companies both within and outside their industry segment;
- pursue specific competitive advantages;
- use benchmarking and best practice information to prioritise their activities;
- quantify the benefits of implementing change; and
- identify software tools best suited to their specific process requirements.



The four level model of SCOR as displayed in [21]

SCOR features four levels of supply-chain management:

- **Level 1** provides a broad definition of the plan, source, make, deliver process types, and is the point at which a company establishes its supply-chain competitive objectives.

- **Level 2** defines 26 *core process categories* that are possible components of a supply chain. A company can configure both its actual and ideal supply chain by selecting from these core processes.
- **Level 3** provides a company with the information it needs to plan and set goals successfully for its supply-chain improvements through detailed process element information for each level 2 category. Planning elements include process element definitions, diagnostic metrics, benchmarks, best practices, and system software capabilities to enable best practices.
- **Level 4** focuses on implementation, when companies put specific supply-chain improvements into play. Since changes at level 4 are unique to each company, the specific elements of the level are not defined within the industry-standard model.

SCOR focuses on four basic supply-chain processes:

(1) **Plan:**
   - *Demand/supply planning:* Assess supply resources; aggregate and prioritize demand requirements; conduct inventory planning; assess distribution requirements; determine production, material, and rough-cut capacity for all products and all channels.
   - *Plan infrastructure:* Make/buy decisions; supply-chain configuration; long-term capacity and resource planning; business planning; product phase-in/phase-out; manufacturing ramp-up; end-of-life management; product line management.

(2) **Source:**
   - *Sourcing/material acquisition:* Obtain, receive, inspect, hold and issue material.
   - *Source infrastructure:* Vendor certification and feedback; sourcing quality; inbound freight; component engineering; vendor contracts; initiation of vendor payment.

(3) **Make:**
   - *Production execution:* Request and receive material; manufacture and test product; package; hold and/or release product.
   - *Make infrastructure:* Engineering changes; facilities and equipment; production status; production quality; shop scheduling/sequencing; short-term capacity.

(4) **Deliver:**
   - *Demand management:* Conduct forecasting; plan promotions; plan projects; plan sales campaigns; collect and analyse point of sale (POS) data and actual customer orders; promote products; price products; measure customer satisfaction; execute efficient customer response (ECR).
   - *Order management:* Enter and maintain orders; generate quotations; configure product; create and maintain customer database; manage allocations; maintain product/price database; manage accounts receivables, credits, collections and invoicing.
   - *Warehouse management:* Receive and stock finished goods; pick and pack; configure products; ship products; create customer specific package labelling; consolidate orders.
   - *Transportation management:* Manage traffic; manage freight; manage prod-uct import/export.

– *Installation management:* Schedule installation activities; perform installation; verify performance.
– *Deliver infrastructure:* Channel business rules; order rules; management of deliver inventories; management of deliver quantity.

8 Business Process Landscaping

In contrast to [5] (see below), the significance of *Business Process Landscapes* (BPL) or – better as verb – *Landscaping* is not primarily in the representation of cross-company Process Landscapes as a generalisation of supply chain structures, but rather in the company-internal shaping of Business Process descriptions.

BPL is thus part of a systemic double relationship of shaping cross-company description structures of practices on the one hand (BPMN, APQC-PCF) and implementing such description structures in the special company on the other. The first process of cross-company standardisation unfolds as a *systemic development process* on the background of the – time-delayed – unfolding of *process instances* of the second kind as systemic development processes at company level.

This phenomenon of further development of a class itself in the course of its repeated instantiations, unknown from (classical) OO programming, is an essential phenomenon of the co-development of systemic structures at different levels of abstraction. It plays a role in particular in the TRIZ construction of the *System Operator*, which relates the developments of the supersystem and the system, although is not addressed that there is a *multitude* of systems related to a supersystem since the considerations are centered at the (given) system.

It was not clearly explained in the presentation and discussion what is the connection between the development of uniform *structural* concepts at the supersystem level and the diversity of *procedural* applications in the individual BPL instances. We mentioned earlier that in the APQC-PCF, from the process level downwards, *variations* allow to adapt the standard to company-specific conditions, which results in a direct correlation between the mapping of the APQC-PCF structures and the BPL practices in the respective company.

The reverse conditionality – the influence of experienced BPL practices on those cross-company standardisation processes – remained completely out of consideration, especially the importance of formalising and structuring "experienced results" of a BP landscaping for the company-wide model structures as a link between BPL practices and those standardisation *processes* that ultimately find their *structural* expression in standards such as the APQC-PCF.

9 Schematisation in the Work of G.P. Shchedrovitsky

In the previous seminars we studied concept formation processes in the context of description of organisations in general and entrepreneurial organisations in particular. These concept formation processes are part of the general formation of systemic structures and are at the same time an essential emergent *product* of these formation processes, i.e. they can only be understood and have effect in the context of the "assembled" system as a whole and its operation.

We further found out that such conceptual systems mark an important moment of systemic "reduction to essentials" and thus form the decisive difference between (simple) immersive and (more complex) submersive systemic structures.

It has been less clear so far how such conceptualisation processes take place in practice in the interplay between modelling and planning as "justified expectations" and the "experienced results" of planned action on this basis.

With the AFQC-PCF, we studied an already firmly established cross-company conceptual system. On the other hand, we observed in seminars in earlier semesters that such conceptual systems emerge as standards from a large excess of theoretical approaches in a lengthy process of consideration and agreement.

We had also found such diversity in the internal modelling of business processes (BP), especially in the concept of BP landscaping. In contrast to the "free conceptualisation" in the course of the standardisation of BPMN or AFQC-PCF, the processes of enterprise-internal BP modelling take place in the context of a supersystem in which various conceptual systems have already established themselves as standards. Nevertheless, we have seen that a simple adoption of these conceptual systems for corporate modelling is not possible, but detailing and varying modifications and instantiations are required.

G.P. Shchedrovitsky has structured such concept formation processes from a philosophical perspective in more detail and summarised it in the approach of "schematisation". These theoretical considerations are at the centre of both the Methodological School of Management as a training institution and the Organisational Activity Games (OAG[5]) organised by him from 1979 until the 1990s, which played a major role in the preparation and transition from a centrally controlled state economy to more market-based forms on the territory of the former Soviet Union.

The notion of *schematisation* is central in Shchedrovitsky's concept of managerial activity, which he develops from a complex understanding of systemic relationships. The notion does not appear in the presentation or in the handout of the seminar that ends with [13, figure 1.2, p. 11] and thus misses all substantial point which are developen in [13] in the further text.

In [13] schematisation is first introduced on p. 66 as follows

> What is important is not so much where we sit and think or even how we think. What is important (this is a crucial point) is what we take as the object of our analysis, and our actions when we start setting out our thoughts on the blackboard or the drawing board. The important thing is what schema we draw on our board, what we represent as our object, what the schema of it is. If we draw an organisational structure, then that will be the object of our action. If we draw the interface of group administrative-managerial structures, they will be the object of our analysis and later of our action. If we draw production lines, they will be the object of our action. Do you see my point?
>
> The actions of an organiser, leader and manager consist in applying specific schemata to reality. The object structure that results will depend on which schemata the individual applies.

It is preceded by conceptual differentiation between

[5] Somewhere also ODI – Организационно-деятельностные игры.

- Organisation, organisational work and form of the life of the collective (p. 25),
- the system-object relationship (p. 30),
- the difference between mental activity (Denktätigkeit) and pure thinking (p. 33),
- the concept of practice of thinking (p. 52),
- the connection between problem, problematisation and systems analysis (p. 63)

to finally arrive at the difference between roles and role occupations ("the administrative-organisational structure of places", p. 64). This is unfolded in two concepts of the notion system, from which "the art of schematisation" (p. 101) is derived. In a next step the question is discussed how such systemic planning ultimately translates into practical action (transition to activity, implementation, processes as ways of reading schemata etc.).

10 Exploitative and Explorative Business Process Improvement Patterns

The planned student presentation was cancelled at short notice, so the topic had to be developed discursively on a quickly created presentation based on [9] and [12]. At the beginning, the *status of the seminar objective* achieved so far was presented once again and the terms BP Modelling, BP Landscaping, BP Execution, BP Management and BP Improvement were demarcated from each other.

We already observed earlier that with APQC-PCF, for example, there exist *established conceptual systems* that *can* be used for a real-world structuring of the process landscape within a company and *should* also be used in order to achieve comparability with other companies. On the one hand, such comparability is the basis for learning from the experiences of others. In an advanced form, such a conceptual system is also the basis for a more precise coordination of supply chain processes beyond company boundaries.

We are dealing with *two systemic levels of abstraction* – the systemic structure of the processes in the company and a cross-company systemic structure. The latter seems strangely unbounded at first, in contradiction to our postulate of the necessity of contextualisation of a system. However, when studying the APQC-PCF we observed that contextualisations on different levels of abstraction play a role and that conceptual systems on a cross-industry level as well as domain-specific conceptual systems for individual industries are of importance. The latter have a more restricted context, but are conceptually richer than the APQC-PCF at cross-industry level. Here, the submersive character of the relation between the various "reductions to essentials" of systems at different levels of abstraction becomes visible once again.

This is particularly evident in the need to provide for a controlled variety of concretisations for the practical implementation of general conceptualisations in special enterprise modelling as tayloring as is built into the APQC-PCF hierarchy starting from the level of processes.

We learned about *BP Landscaping* on the one hand as an instrument for BP modelling of processes in the company related to each other and on the other hand as an instrument for role-specific communication of parts of such models and thus coupling the model to the real-world company processes. The importance of this instrument for the further development of the company as a *living organisation* in the sense of Shchedrovitsky became less evident. This development is primarily driven by the comparison of the *justified expectations* derived from the modelling with the *experienced results* derived from practice. Here, instruments of *measuring* and *benchmarking* play a crucial role, to translate the experienced results back into the language of the model.

However, it is only from such a development perspective that problems can be identified and solved (Shchedrovitsky: "You can only manage something that is in motion.", "A system without problems does not need to be managed."). Thus the object of *Business Process Management* (BPM) is determined as "the body of methods, techniques, and tools to discover, analyze, redesign, execute and monitor business processes" [9]. In this context, *discover* and *analyse* is directed at the identification of problems, *redesign* at the planning of changes initially in the model, *execute* and *monitor* at the practical implementation of these changes and the monitoring of this transformation process. For this cyclic process, also referred to as the *BPM lifecycle*, exists a greater variety of conceptualisations in the literature, see the slides of the presentation for some of them.

BP Improvement (BPI) is a slight variation of the way to view on BPM. While BPM focuses on *resilience* and thus on conservative or conserving goals, BPI is more concerned with looking at the *increment* achieved in the course of running through such a lifecycle.

According to [12], this is also the difference between exploitative and explorative improvement. The former serves to eliminate problems in the "regular" behaviour and thus stabilise the system in the existing context. The latter serves to find ways to adapt the system to (possibly drastically) changing external conditions. The strategies thus refer to different development paths of external conditions. The field of *exploitative improvements* focuses on better internal adaptation to stable external conditions and is clearly elaborated in the literature in more detail. *Explorative improvements* are gaining in importance as the pace of digital change increases. Rosemann's focus on *revenue resilience*, however, is highly unspecific with regard to the *reasons* for such change and focuses on the revenue collapse as a sign of a need for action. The proposed process improvement patterns remain at this level and do not search for possible technical changes as the cause of the observed misery, i.e. they only treat the symptoms.

The discussion focused on the concept of *patterns* as a triple of problem, context and solution (Christopher Alexander), under which successful improvement strategies can be clustered. The *TRIZ patterns*, the *40 principles* or the *76 standards*, are characterised by the fact that the path from the problem to the solution is described and justified in more detail at a suitable level of abstraction, whereas the process and business model patterns are limited to the proposal of solutions.

11 Sustainable Business Model Patterns and Anti-Patterns

With the last topics in the seminar, the perspective shifts from *Business Processes* to *Business Models*. While Business Process Landscaping focuses more on the level of the design of *operational* management tasks, Business Models deal with questions of the *strategic orientation* of the company in order to sustainably secure relevant capital flows and thus the decisive *throughput* required for a viable business system.

In the presentation such a perspective was linked with the questions

- Who is the customer?
- And what does the customer value?
- How do we make money in the business?
- How we can deliver value to customers at an appropriate cost?

In addition to the definition of strategic business areas, it is about identifying and addressing *solvent demand* as well as the *cost-benefit structures* in the company.

However, business models are only one topic in the field of strategic corporate management. A second, equally important topic is the further development of the production-technical basis as the material conditions which restrict the number of possible business models that can be realised. The development and expansion of these material conditions requires long-term capital commitment. This includes the retention and qualification of personnel who can fill the intended roles, as well as stable supply chain conditions.

This material *aspect of the possible* is largely ignored in the perspective of Business Models, which concentrates on finding suitable value propositions, i.e. identification of (additonal) solvent demand structures that could be addressed in the context of the *given* production conditions or can be tapped by *slightly modifying* them. Similar to the view on technical systems as variable bundles of technical functions (see [7]), the company's production system is understood as a variable bundle of business processes whose degrees of variability can be used to adapt the Business Model.

Like the patterns of technical TRIZ, BM patterns abstract from these specific variabilities and claim that a modest number of *abstract patterns* can be identified which recur frequently in such tasks to design a transformation of a Business Model as a system of value propositions.

In the presentation itself, the area was explored using the example of the topic of *sustainability* as a new component of value proposition to be integrated into existing BM. With the anchoring of the topic in public awareness, it increasingly plays a role as an (additional) value proposition.

Sustainability is altogether a difficult topic, as processes on different temporal dimensions with partly contradictory challenges are intertwined here. The increasing attention to ecological issues for the design of BM, which has gained massive increase in importance in recent years, at least in Western Europe, is embedded in a global political process that lasts already 50 years, since the publication of the "Limits to Growth" in 1972. In this process, challenges increasingly get public attention that result from the fact that our current mode of production is undermining the human existence in the long term. In the climate debate, these challenges are increasingly operationalised at the monetary level, whether as a CO_2 tax or in the "Paris gap". Somewhat more abstract statements such as "peak oil", which still dominated the discussions 10 years ago, have stepped into the background. The 17 Sustainable Development Goals (SDG) adopted by the UN, as new reference point of the politicisation of the issue are of particular importance.

The operationalisation in Business Models is faced with the fundamental contradiction that a *crucial change* in the mode of production is required, which cannot be based on even innovative BM based on the *existing organisation of production.* However, the two sides of the contradiction operate on different time horizons and thus on different systemic levels.

The PESTLE approach (political, economical, social, technological, legal, environmental) attempts to bring those long-term challenges as TRIZ *fields* into the modelling of shorter-term systemic transformations of BM.

BM patterns that incorporate such phenomena are thus only at the beginning of a consolidation in corresponding processes of experience. An overview of such patterns was given in the presentation. The suggestions for additional value propositions in such patterns refer to a wide range of new BM approaches that have come up in the context of the digital transformation. It remains to be seen under which contextual conditions these approaches really lead to success.

In another talk Ralf Laue gave an introduction into the concepts of the *St. Gallen Business Model Navigator*.

12 Service Oriented Business Process Management

As a last topic the IMP concepts presented in [5] on Interactive Business Landscapes at an inter-company level were presented and discussed.

In the previous seminars, strategic corporate planning (business model design) was considered from the perspective of an individual company and its world conceptualisation. However, these world conceptualisations are related to each other by *practical dependencies* between the execution of the individual business models. These dependencies can in turn be conceptualised, leading to *systemic development processes at an inter-company level*. This further dimension of cooperative action is addressed in [5] taking the perspective of a rigorous developmental approach, as is also the case with our concept of Cooperative Action.

This research relates to the Industrial Marketing and Purchasing (IMP) Group, which is

> an informal, international network of hundreds of scholars who approach marketing, purchasing, innovation, technological development and management from an interactive perspective, in a B2B and a B2C context. The IMP Group's current work also includes research on public-private networks, policy, and science-technology-business issues. ... (from their Website `https://www.impgroup.org/about.php`,)

As explained there, the IMP Group stands for three main features:

(1) a dynamic approach to economic exchange,
(2) empirically driven research on inter-organizational interactions, and
(3) an informal network of researchers forming a vibrant international community.

Firstly, the IMP Group represents a dynamic approach to economic exchange, which means that emphasis is placed on the interaction processes taking place within and between business actors forming business relationships over time. ...

Secondly, the IMP Group represents a research tradition that places emphasis on empirically-based studies of how companies actually do business and of the various effects emerging when businesses and other organizations interact. Based on the assumption of interdependent business actors, a hallmark of IMP studies is that marketing, purchasing, technological development, innovation, strategic management and logistics need to be investigated *within the context of specific business relationships and networks.*

Thirdly, the IMP Group represents a large informal network of researchers. The IMP Conference and the IMP Journal Seminar are important meeting places for researchers from all over the world, all sharing an interactive perspective on the business landscape. ...

The following explanations are mainly taken from [5].

IMP Conceptualisations are based on a notion of *Business Processes* which are conceptualised as *substantive* interaction between *activities*, *resources* and the *actors* associated with them. The *heterogeneity*, the importance of *specific counterparts*, the *complexity* and *long-term nature* of business interaction argue against generalisations about particular categories of actors such as 'customers', 'suppliers', 'manufacturers' or 'retailers' to conceptualise their interactions.

IMP research is concerned to examine the idiosyncratic *Network Pictures* held by the actors within their *small world* of tight functional dependencies which form the basis of their approaches to interaction. Such analysis suggests that the small world of the business actors does not exhibit the characteristics of a *market* nor is it simply an *agglomeration of many markets*: Its structure is not one of independent companies that have ease of entry or exit from the market or from their dealings with specific counterparts as marketers or customers. Instead, the analysis emphasises that many of the actors in this small world are strongly interdependent with each other through their business.

The pattern of interdependencies across these small worlds and the perspectives that arise from them form the *context for continuing interaction* and the developments. This small world is a *cooperative action space* as developed in the lecture where "relational moments between actors shape the cooperative context more than individual moments of individual actors“ with narrow, but permeable boundaries.

Interactions in business are not restricted to communication, negotiation or to specific transactions but are *substantial* and *material*. In other words, they involve a number of different aspects of the (practical) *activities* and (material) *resources* of the actors which may be changed and transformed and hence *evolve* during action.

In the paper an example is given: The development of ready-meals changes aspects of the activities, resources and the actors involved in this small world. Some activities such as the production systems of food producers becomes more or less specialised towards the requirements of particular counterparts. Resources, such as the stockholding facilities of producers, retailers and logistics companies will have followed a particular *path of investment* or development and the actors themselves will have *co-evolved*.

Co-evolution does not refer to an inevitable increase in the 'closeness' of the relationships between interacting actors. Rather, it suggests that *the operations, characteristics and attitudes of business actors evolve as an outcome of their interactions* over time and thus the set of relationships evolves itself. In this context Vargo and Lusch bring it to the point: "Resources are not, they become".

All the actors are part of a *wider network* of substantial practical dependencies. However, each of these actors has a very restricted picture of this "wider world" and no direct interaction with most of the actors within it. For this reason, actors are dependent on *service provision* by some of its immediate counterparts who have relationships with or provide access to others at a distance. Such service is similar to using *components off the shelf* (COTS) in Component Software but in a production-organisational and not in a technical perspective.

This leads to a view of interaction in business relationships as a unique, evolving, multifaceted process of *'problem-coping' by and for all of the involved actors* (Webster 1965). This relates to Shchedrovitsky's claim: "If there are no problems, no management is required".

The term 'coping' is used to emphasise the interactive and evolving nature of business problems. Such 'problem coping' by service-seeking and offering drives the process of *activity specialisation*, *division of labour by specialisation*, the *path of resources* and the *co-evolution of actors.*

The most significant problems that actors face concern *the relationship structure in which they are embedded.* The business actor should be viewed as a *node* within a network of relationships, so that what happens outside the actor (i.e. inside its "small world") and through its relationships is likely to be more important in the evolution of that actor than what happens inside. More important than the current structure of that network is its development potential. Hence IMP research uses the verb *business networking* to refer to the attempts of actors to change the structure and process of the relationships in which they are involved.

It is through business networking that actors seek to cope with their problems and those of others. Costs of this problem coping by Business Networking can be considered under the following aspects.

- Short-term, *dyadic* problem coping may centre on a single transaction involving the costs associated with transferring cash for one counterpart and the benefits of service for the other (cost-benefit relation).
- Short-term problem coping may involve working together to solve a particular technical problem for *mutual benefit* (mutual benefit relation).
- Short-term problem coping may appear to involve only one actor in benefits and one in only costs. However, these *short-term costs and benefits* received will affect both actors *long-term view* of their relationship. The long-term view considers short-term costs as *investment.*
- In the longer term, problem coping will be based on such *investments* and *adaptations* by the counterparts (*synergy effects*) in one or more aspects of the substance of their interaction.

Business actors commonly face issues over the *trade-offs between potential and actual short-term and long-term costs and benefits* of the counterparts in relationships, expressed in terms of the *extent and timing* of respective activity specialisation, resource path or actor co-evolution.

It is likely that actors would perceive that much of the service actually provided fell short of their expectations or exceeded them. *Unforeseen contingencies* might explain this: late delivery of services or products, not forthcoming cooperation, only partial adaptations, payment less than expected etc. In contrast, technical assistance could produce greater than anticipated cost savings or a cooperative development could enhance an actor's relationship with a third party.

The existence of different perceptions among actors explains why profitable business opportunities may exist whenever *prices fail to reflect the value.* The value to a participant from service is not a characteristic of what is involved in it, whether product, services, payment or generalised ‘performance’.

An interactive and systemic conceptualisation of the business process requires a refinement of this view of value in different directions.

- *Value of problem coping:* As problem-coping process the value to each actor of a service is that *actor’s interpretation* of the worth of the service’s contribution towards coping with one or more specific problems of the actor, *identified by that actor.*
  Hence the value as the ‘perceived worth’ of the same service received by different respondents will be different and in all cases that value is time and problem-specific.
  Empirically, this nature of service value to a counterpart poses great difficulty for the provider in business interaction.
- *Value and reciprocity:* The value of service is not determined solely by the receiving actor but also assessed by the service supplier. Each party makes its own assessment of the problem-specific value to themselves and to their counterparts of a service that they seek or provide.
  These multiple assessments form the basis for their approach to interaction in any single episode and to their expectations and intentions for future episodes and a relationship as a whole.
- *Incidental value:* The business landscape is characterised by recurrent interactions between multiple actors in continuing relationships.
  Service provision and value creation in any of these may lead to incidental value to others, either positive or negative and in line or against the wishes of those involved.

The concept proposed in [5] connects

- *Business interaction* as problem-coping process of actions, reactions and re-reactions between actors,
- *Services* as suuccessive outcomes of business interactions as perceived by the participants and
- *Value* as actor’s perception of the contribution of service to coping with a specific or general problem of particular actors.

Value of service may be identified at the following levels:

- *Episodic service value:* Service provision within a particular interaction episode. Value creation is the outcome of solving a particular problem rather than to conform to current ways of operating.
- *Relational service value:* Continuing or long-term service interaction in a dyadic relationship by developing the potential value of the relationship for future episodes. Relational value at any one time depends on the interdependence of the counterpart’s activities, the heterogeneity of their resources and the jointness of the actors.
- *Service value in the small world:* Network effects for actors when to consolidate interactions within existing relationships, to change their pattern or to develop new relationships.
  The costs and time involved in new relationship development often limit networking opportunities to existing relationships.

However, problem coping in the business landscape *can never be wholly dyadic*. The service offered by a single actor to another always depends on service provision from other relationships. An obvious example of this is seen in the dependence of product suppliers on components supplied by others.

- *Service value in the wider world:* Because of an actor's lack of knowledge or established relationships in the wider world, this networking will either be based on *relationship development* or *service provision* by others.

[5] draw the following conclusions.

1. The conceptualisation of service in an interactive business landscape allows to capture the inherent connectivity among interdependent business actors.
   This connectivity leads to a view of service as the successive and reciprocal outcomes of recurrent interaction between multiple actors as perceived by the involved business actors.
2. The idea of service in an interactive business landscape transforms our view of the process of value creation and appropriation in networks.
   The value of a service is not confined to the provision by one company (supplier) to an apparent receiver (customer). Instead, service in the business landscape is a *systemic process* producing different positive and negative value for multiple actors, including those that appear only to be providers.
   The value of service is not confined to a single episode in which service appears to have been provided.
   A particular interaction episode that provides immediate value is also likely to change the nature of the relationship in which it occurs, leading to relationship value.
3. Taking an interactive approach to service allows to investigate the *dynamics* of problem coping and creation.
   The evolution of problem-coping is observable through a continuing cycle of recurring episodes and evaluations over time ("justified expectations" and "experienced results" in the terminology of the lecture).
   For the management, the idea of service in an interactive business landscape emphasises the importance of *analysing* the evolving problems and uncertainties of specific actors and the perceptions of those involved in the interaction.

The concept of service highlights interaction in continuing relationships as the successive, reciprocal, outcomes of action, reaction and re-reaction of counterparts and thus the *evolution of the "small world"*. This requires perceptive analysis of relationship evolution, of the problems of the company and its counterparts and a well developed, explicit but flexible agenda.

Service in an interactive business landscape also involves a *managerial reorientation* away from things, products and services and towards the evolving problems of the company and its specific counterparts.

Service provision can range from obvious manifestations, such as the payment of an invoice, the delivery of a product or the development of a new technology to the subtle or complex, including the provision of advice or reassurance, organisational transformation or intellectual assets, know-how and expertise.

The nature of service delivery is *defined by the recipient* and its value is determined by the problems of the recipient.

An understanding of the concept of service and value in an interactive business landscape enables managers to *relate their own resources and activities* to those of others as the basis of coping with their respective problems ("The whole is more than the sum of its parts").

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