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# Challenges in the Organisational Implementation of Technology Management in Companies

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**Technology management (TM) in bigger companies requires a far more formalised organisational implementation as in smaller companies, because the relevant tasks are realised by employees of different departments and therefore have to be linked organisationally in an effective and efficient way. However a suitable organisational implementation in theory and practice represents a big challenge as various parameter and perspectives need to be considered to select appropriate linking within companies. Therefore this article takes the organisational point of view on TM to illustrate that different essential organisational fields need to be integrated, like the aspects of knowledge, strategy, individuals, processes and culture.**

**Most publications are illustrating only a section of the overall variety of available instruments to realise organisational links. More holistic approaches, on the other hand, are rather described on a quite abstract level that a lack of a practical solution can be determined. For this reason this article overviews common existing approaches of organisational implementation of TM like temporary forms of organisation, processes and roles and arranges them into clusters in order to formalise a summary of methodical deficits. In conclusion, an appropriate method for an organisational implementation for TM in companies which consists of a set of integrated and adjusted approaches is yet missing.**

## 1. Introduction

Technology is the enabler for innovation and represents an important asset in technology driven companies to remain successful in a competitive environment. For an effective application of technologies in products or processes it is essential to organise (vertically and laterally) efficiently all activities and members.

Coordinated utilization of technologies in companies is summed up under the term technology management (TM). The organisational implementation represents especially for larger companies various challenges. This article provides a systematic overview of the challenges and the corresponding solutions of TM in medium-sized and large companies. Based on literature analysis this article deduces the necessity for new approaches in organisational implementation of TM.

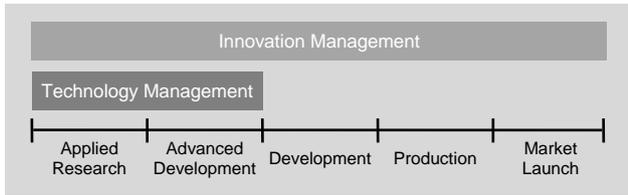
## 2. Definition and Demarcation of Technology Management

In the understanding of innovation management new ideas or products can be pulled or pushed through the development. Market or customers pull products with

functional requirements; on the contrary technology management (TM) pushes functional solutions provided by technologies (Warschat & Spath 2008:10). For this reason TM is grounded in the early innovation phases, see Figure 1 below.

The role of technology management (TM) is to manage, generate, provide, enforce, store and exploit technical solutions respectively; technologies which safeguard the successful strategic position and its associated competitive advantage (Gerpott 2005:57–59). In business practice TM is mostly carried out in the Research and Development (RnD) department. In the narrower sense, only the applied research and advance development department pursues TM. Downstream departments, such as development, form an interface to TM. However, in the strict sense they are not part of TM (Macharzina 1999:561).

This is due to the fact that in technology-intensive and larger companies the development department primarily generates products for selected markets - on the contrary to an advanced development department or even an applied research department, which independently develops technologies for products, markets or costumers. Product- and process innovation lead to very different technologic, economic, task specific and organisational activities. In the following the focus stays on technologies



Source: Based on Macharzina (1999:561).

Figure 1. Definition of Technology Management in a Company

for product innovation (Gerpott 2005:54).

Due to these constraints, only companies with the following properties are addressed in this article:

- Company size: at least mid-size and larger companies
- Type of company: technology intensive companies
- Structure of company: either applied research or advanced development departments
- Type of technology: product technology

### 2.1 The Core Function of TM

Nowadays different definitions exist for the tasks that have to be undertaken within TM<sup>1</sup>. Brockhoff (1999:39) states that in sum knowledge management represents the core function of TM (see Figure 2). For instance an applied research department seeks to generate new knowledge, which in turn can be transformed into existing knowledge in development for new products. Developing, capturing and using knowledge is therefore a key role within many tasks of TM (Gerpott 2005:64). Knowledge can be used to forecast future developments (e.g. by technology scouts) or to convert environmental information into market-oriented technology strategies. For that purpose scientific and technical knowledge is transmuted from development of technologies and applications in products up to resulting market services (Bullinger 1994:41; Zahn 1995:16).

After all, various models and methods exist to represent technologies in companies. However Gregory (1995:349) states that the main challenge is the proper strategic and operational mapping of technological knowledge, information and decisions in a company. In companies and between departments the appropriate level and the appropriate language are required to link technological knowledge, information and decisions (Gregory 1995:349).

### 2.2 Objectives of an Organisational Implementation of TM in Companies

The main objective of an organisational implementation of technology management is to be able to realise tasks in the best possible way. Despite increasing divisional structures, the cross-functional tasks of TM and the resulting organisational coordination challenges have still to ensure delivering technology driven innovations (technology-push). In this context three objectives emerge: Firstly TM aims to integrate and create synergies. Secondly TM should achieve a wide use of technical and technological knowledge throughout the company and lastly TM should represent technological competence at the top management level.

In companies TM must be designed in a specific way so that internal departmental synergies can be used effectively and efficiently. In RnD and other departments synergic potentials can take effect, if for instance internal as well as external research offers and research demands correspond to the corporate strategy. This can lead to cost reductions due to faster transfer of research results, to improved exploitation of competences and capacities and to shorting of research and development periods (Weule 1995:731).

TM has to reach a wide use of technological knowledge throughout the company. This is especially important, if considering Weule (1995:732), who states that the high expenses in RnD have to be profitable as early as possible, because of the significant risk of success. An organisational implementation of TM counteract this problem, because it aims at harnessing technical findings as extensively as possible in the various company departments in order to ensure knowledge and technologic transfer (Weule 1995:732).

In a company it is essential to have technological competences represented at the top management level (Tschirky 1998:280). For this reason an organisational implementation of TM has the objective to achieve this e.g. with committees and roles (such as a chief technology officer CTO). This way companies are not only led by economic decisions but also by technologic decisions.

### 2.3 Challenges of TM in Companies

To successfully put into practise the objectives of TM it is not sufficient to only ask the question where TM explicitly could be embedded, e.g. as a separate department or as an independent unit within an organisation. Far more critical challenges have to be considered for an organisational implementation of TM

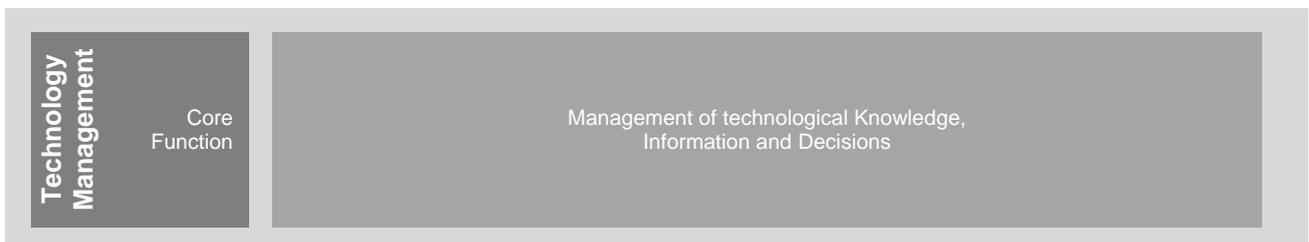


Figure 2. Core Function of Technology Management

and are described in the following:

1. Structures become more divided
2. Augmented integration is requested
3. Task become more specialised
4. TM activities are hard to measure and to quantify

1. With an increasing size of a company, *structures become more and more divided* into separate units and departments. Additionally companies face the increasing global complexity with separated flexible strategic organisational units. This makes it possible to parallelise different tasks in the context of global competition with regional and cultural differences (Tschirky 1998:321). Reflecting this only on RnD, the organisational structure of RnD often gets organised with a central research or advanced development besides several decentralised development departments. This fragmentation is being aggravated by the fact that this distribution of RnD units occurs even within business units, which leads to a separation of several RnD units in functional and business units across the whole company (Brockhoff 1995:444).

2. Interfaces between TM, RnD and other departments have to be integrated to deliver economically successful technologies. Despite increasing decentralisation, companies claim for *integration of subtasks into holistic collaboration and strategies* (Tschirky 1998:321). This requires, besides the transformation from technologies into products within RnD, many coordinating tasks with other departments for example: Sales, Marketing and Product Management. Only then a technology application within a product can be a success across the whole company until market launch (Gerpott 2005:62). As a result TM has to facilitate more and more interfaces in a company. In terms of the field strategy for instance, TM influences many other company areas, like strategic management, corporate strategy, market strategies and product strategies and vice versa.

3. With an increasing size of a company the structure is more and more divided and more importantly: *tasks become more specialized*. This means that work is more and more divided into subtasks (Möslein 1999:23–25). This applies generally to all departments in a company, but this leads for TM tasks<sup>2</sup> to challenges. Tasks of TM have a strong cross-sectional character and need the collaboration of task bearer, which now are scattered throughout several departments all over a company, including RnD (Zahn 1995:15; Spur 1998:114; Gerpott 2005:61). Therefore individuals require crossing organisational boundaries and this turns out to be particularly difficult as various goals, values, time horizons lead to different behaviours, rules and cultures (Gerpott 2005:64). So employees involved with the observation of new technologies, new markets for technologies, development of technologic knowledge or application of technologies into products are dispersed in different organisational units and have to be connected.

4. TM activities and their *outputs are hard to measure, quantify* and materialise only towards the end of the production of products (Gerpott 2005:64). For this reason it is often difficult to assign a TM activity to a specific unit or cost centre. Furthermore this can lead to rash cuts of TM implementations due to rationalisation of

workflows.

## 2.4 An Organisational Perspective is needed to embed TM

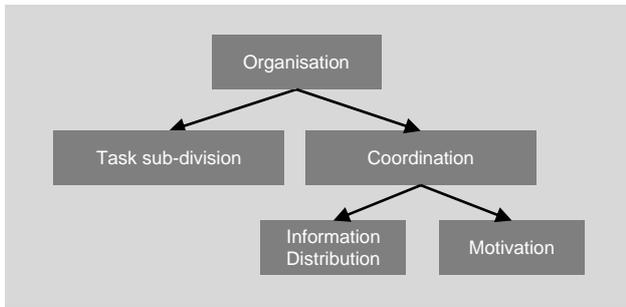
In general the definition of the term management involves apart from development and leading also designing (Tschirky 1998:218). However in most cases TM is only reflected from a one-sided perspective (only development and leading). For instance, which leader or role (CTO, Promoter, etc.) should be used in companies and which methods (Scenario Analysis, Technology Portfolio, Road Mapping, etc.) are supposed to support planning and decision making? To close this gap this article takes the point of view of organisational design at the discipline management and TM. More precisely, this article illuminates independently from single TM methods or approaches, which design requirements have to be met to enable technological communication, information and knowledge transfer in companies.

## 3. Organisations and their Design Fields

Given the aforementioned implications of TM and subsequent difficulties thereof, this chapter describes in which way organisations are defined and deduct a framework for organisational design which should be considered during the embedment of TM in organisations. Overall designing organisations cannot be reduced to their structure and it is more than just moving boxes within an organisational chart (Galbraith *et al.* 2002:2).

### 3.1 Organisation in General

What is an organisation and how can it be designed? Different theoretical definitions exist how organisations should be understood and designed (Werder 2004:1090). The theory defines an organisation as soon as an individual is no longer capable to carry out on his own the business objective. Once a certain level of complexity and order of magnitude exceeds the limits of a single person, the business objectives can only be achieved by additional persons (Frese *et al.* 2012:4). As a consequence the individuals have to organise themselves to work as an organisation. This requires organisations to sub-divide tasks and to coordinate them adequately, see Figure 3 (Möslein 1999:12). For this purpose it is necessary to find an appropriate balance between task sub-divisions and coordination because of limited resources in business practice. In this context it is essential to achieve the objectives (effectiveness) with a minimum of resource-input (efficiency) (Möslein 1999:12). For the coordination of subtasks two requirements have to be fulfilled concerning the involved individuals: Firstly, the necessary information and knowledge need to be available (information distribution). Secondly, the individuals have to realize the expected performance and follow the agreed rules (motivation) (Möslein 1999:13). These requirements



Source: Based on Möslein (1999:14)

Figure 3. Structure of the organisation problem

do not, by any means, exist in organisations automatically. However different mechanisms and instruments are necessary to fulfil the requested duties (Möslein 1999:13) (more details see chapter 4).

### 3.2 Organisational Theories

For a better understanding of organisations it is helpful to briefly reflect upon organisational theories<sup>3</sup>, which provide a deeper understanding on organisations. In general there is no single theory which describes an organisation completely<sup>4</sup>. However against the background of an implementation of TM it is worthwhile to use the overview of organisational theories as described by Möslein (1999). Möslein (1999) classifies the theories into groups<sup>5</sup> with similar organisational problem areas:

- Classic organisational theories: rationalisation and optimisation of costs and profits realized by hierarchy and subdivision of tasks (Schreyögg 2008:29–39).
- Organisational behaviour theories: humans and its social needs, human relations, informal structures and processes inside and with organisations (Möslein 1999:18).
- Organisational architecture theories: explains organisation on the basis of the systems theory. In a systemic point of view an organisation is a dynamic and complex system which has to operate in a continuous changing environment (Möslein 1999:18).
- Organisational economic theories: internal structure of an organisation by means of typical market behaviour e.g. theory of transaction costs (Schreyögg 2008:59–61).
- Organisational cognition theories: these theories point

out the problem area that an organisation consists of persons, who are part of a same symbolic sensemaking community. As organisations form a sensemaking community it provides the meaning of reality and organisational actions to members (Schreyögg 2008:76–77).

- Organisation theories, which focus on the problem area of organisations in a strategic competitive environment. These theories deal with the strategic reorientation of organisations to gain an improved position in global competition, e.g. by focusing core competencies (Möslein 1999:19).

This brief overview on grouped organisation theories demonstrates that certain generic design fields seem to exist for defining an organization. For this reason this article is based on several theories respectively problem areas instead of a single one. This makes it easier to understand a real organisation from different angles.

### 3.3 Design Fields of an Organisation

Which general or generic factors constitute an organisation? As mentioned before the literature illustrates diverse approaches for describing organisations. A study of Schatten & Zugaj (2007) provides a summary of several organisational design approaches including a general organisation model<sup>6</sup>. For this article two in Schatten & Zugaj (2007) presented approaches come into consideration: on the one hand the work of Galbraith *et al.* (2002) and his “5-Star organisational design model” and on the other hand the „congruence model for organisational analyses“ by Nadler & Tushman (1997)<sup>7</sup>. The following section is based on design fields by Schatten & Zugaj (2007) and revisited against the background of TM. Hence the following overview is adapted and enriched with definition based on Schatten, Galbraith and Nadler. Figure4 shows the five design fields of an organisation, namely Strategy, Vertical Structure, Lateral Collaboration, Individuals and Informal Organisation.

Each design field is described in detail in chapter 4 regarding the design possibilities of a TM implementation within a company. However to provide a brief overview, each design field is outlined in the following (Definitions of each design field are summed up in Figure 5):

Design field of an organisation:	Strategy	Vertical Structure	Lateral Collaboration	Individuals	Informal and Culture
According to Galbraith et al. (2002)	Strategy	Structure	Processes and Lateral Capability	People Practices	Reward Systems
According to Nadler & Tushman (1997)	Strategy	Formal Organisational Arrangements		Individual Tasks	Informal Organisation

Source: Based on Galbraith *et al.*(2002), Nadler & Tushman (1997) and Schatten & Zugaj (2007)

Figure4. Comparison of organisational definitions

Design Field:	Strategy	Vertical Structure	Lateral Collaboration	Individuals	Informal and Culture
	Definition	Sets organisations direction, which technologies, products and markets will be pursued and not pursued	Hierarchical structures and formal power: from functional and business units until job description	Processes, networks, matrix relationships, lateral integration, coordination and collaboration	Human resources, knowledge, skills, competencies, capabilities, talents, tasks and reward systems

Source: Based on Galbraith *et al.*(2002), Nadler & Tushman (1997) and Schatten & Zugaj (2007)

Figure 5. Design Fields of Organisations

- *Strategy* derived from a vision and a mission describes what an organisation pursues in the future. Strategy is the cornerstone to design an organisation (Galbraith *et al.* 2002:3). It defines the goals and the way to achieve them and prepares the ground for rational choices of the other areas in a design process (Galbraith *et al.* 2002:3).
- *Vertical Structure* defines the hierarchical order and formal power in an organisation. Furthermore it defines how departments stand to each other, where employees are allocated and who in general has to perform which tasks.
- *Lateral Collaboration* is the integration of the borders created by structure. Mostly the design of this field only considers processes and workflows. However many further possibilities are available to connect and transfer decisions and knowledge.
- *Individuals* are the people of an organization. They form the collective organisational capabilities with their individual abilities (Galbraith *et al.* 2002:4). The design range from specific task design, using suitable employees with proper knowledge and skills, to ensuring alignments and motivation of each individual to the overall business objectives. In addition the designing of this field requires possibilities of individual development and reward mechanisms.
- *Informal organisation and Culture* are the unwritten guidelines that influence groups and individual behaviour (Nadler & Tushman 1997:166). It represents for example values, goals, habits, cognition and the complex social dynamics of the people (Spur 1998:122) due to learning processes in the history of a company. These learning processes arise out of making successful or unsuccessful decisions and behaviour patterns.

Therefore an organisation consists of five design criteria, whereby each field has to be considered and configured. Every design field with its numerous configuration possibilities represents a major element to define an organisation. However it must be considered that the design fields depend or influence each other. Galbraith *et al.* (2002:3) states all fields have to be designed in alignment to each other. In fact the separation into fields is theoretical and in business practice the transitions are rather smooth and difficult to demarcate.

For this reason the design of a single individual field is not favourable. All five design fields need to be configured equally in order to achieve a successful design, which is more than the sum of its parts.

### 3.4 Efficient Organisational Design

There is no best way of designing an organisation, because various possibilities and solutions exist for each design field to achieve the same objective. Furthermore organisational design is a result of several contingencies, like the industry sector, the size of a company, the period of product life cycle and the competitive environment (Spath 2008:8). Consequently the design of an organisation has to fit to the contingencies factors<sup>8</sup>. In other words the design of all fields has to be built up under the criteria of efficiency. To evaluate efficiency Johnson *et al.* (1973)describes general but nonspecific requirements such as simplicity, flexibility, reliability, economy and acceptability. For reason of precision this article relies on the following three specific evaluation criteria based on Werder (2004) (seeFigure 6):

- *Sub-Target Orientation*: an organisation needs to be designed in a way that the main business objective of an organisation is accomplished through corresponding sub-targets all over the company.
- *Considering contingencies*: designs and solutions need to be selected according to the situation<sup>9</sup> of the company and its diverse contingencies factors.
- *Behaviour dependency*: designs and solutions need to be chosen to influence the right behaviour of the employees.

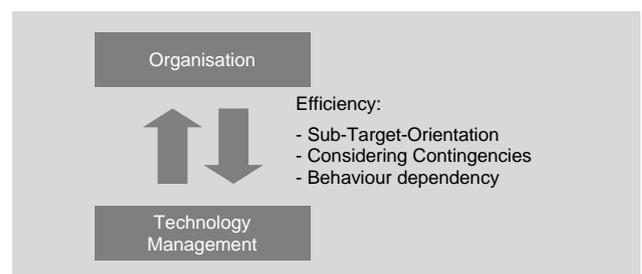


Figure 6. Efficient Implementation of Technology Management

#### 4. Merging TM and Organisational Design into one Framework

It is most likely that dependencies occur to every design field of an organisational design by implementing TM in a company. The following section illustrates these dependencies and the necessary requirements in every design field against the background of TM. For this purpose the generic overview of organisational design fields (chapter 3) is used as a holistic framework for designing the implementation of TM in companies.

It is understood that for a permanent implementation of TM and its core function all five design fields: strategy, vertical structure, lateral collaboration, individuals and informal organisation & culture have to be considered and configured (see Figure 7).

In the following, the meaning of every design field according to TM is explained concisely, clearly and enriched by typical solution approaches and their representatives in literature:

*Strategy* describes what an organisation pursues in the future by defining the goals and the way to achieve them. TM highly ensures and supports the strategic success of an organisation in a competitive environment. Taking this into consideration, the requirement of a design perspective of TM is the embedding of technological key aspects in a corporate strategy and / or the development of preferable inter-divisional and synchronised technology strategies with the corporate strategy (Tschirky 1998:293). Especially in larger companies with several business and functional units it is more difficult to align technology strategies among various organisational units (Gerpott 2005:63).

Typical approaches introduce how to establish a technology strategy with the help of technology fields (Ewald 1989) or technology platforms (Breuer 2006).

*Vertical Structure* defines the hierarchical order and formal power in an organisation. Mostly the configuration of this design field only considers a formal embedment of TM as a department or a similar organisational unit. However TM usually builds upon given structures of a company. This implies that two elements in this field should be taken into account: Firstly, setting up TM on a given structure means that TM is only be able to make minor changes on the structure. Secondly, a given structure defines the manageable interfaces, which consequently TM has to link to, with its cross-sectional tasks.

Typical approaches how to explicitly embed TM for instance as a form of support function, committee or department are given and compared by Moll *et al.* (2009). This author comes to the conclusion that there is no single suited form. As a consequence several forms have to be combined, but it is not mentioned which specific combination of forms is necessary (Moll *et al.* 2009:91).

*Lateral Collaboration* is the integration of the borders created by structure. From the TM point of view this design field is particularly important. In TM it is characteristic that many necessary tasks and information are distributed and have to be integrated among various company units. Hence, it is appropriate create suited possibilities for development, exchange, matching and transfer of technological knowledge. For instance circles with decision makers from different business units have to be initiated to pursue overall topics.

Typical approaches can be divided into procedural and instrumental solutions. For general process-related works of Cetindamar *et al.* (2009) and Schuh *et al.* (2011:14) have to be highlighted. Approaches for concrete planning are provided by (Phaal *et al.* 2004) or for roadmapping eds. Moehrle & Isenmann (2008) and for general technology planning by Gomeringer (2007). Cetindamar *et al.* (2009) formulates mostly based on Gregory (1995)

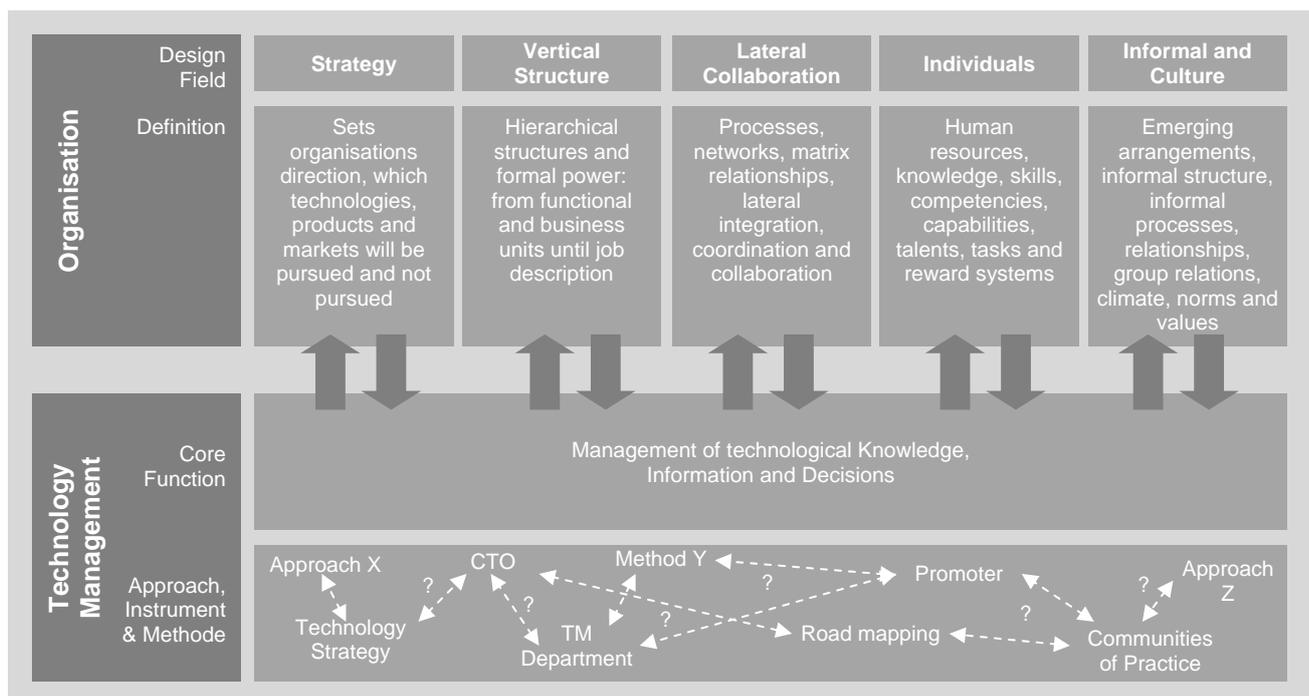


Figure 7. Organisational Implementation Framework for Technology Management

six generic TM processes<sup>10</sup>(Cetindamar *et al.* 2009:242–243): Identification, Selection, Acquisition, Exploitation, Protection and Learning. Even if the sequence of processes seems to match with the lifecycle of a technology from the emergence until the exploitation, these authors highlight that the processes are independent, solely and non-linear (Cetindamar *et al.* 2009:243). In addition these authors emphasises that this avoids several things: enforcing a hierarchy between processes, the perception that one-model-fits-all and that not every process has to be available in a company (Cetindamar *et al.* 2009:243). However Cetindamar *et al.* (2009) does not elaborate in which circumstances which set of processes should be used. For instrumental approaches works by Reiß have to be highlighted, like general organisational integration instruments in Reiß (2003:8) and suited temporarily organisation forms of TM in Reiß (1995). In this case again this author does not mention, which one of the presented instruments precisely should be taken for a TM implementation (Reiß 1995:548).

*Individuals* are the people, which form the collective organisational capabilities with their individual abilities in an organisation. The collaboration of every single individual with their technological knowledge is the most important bearer of TM. Therefore the objective is to design tasks, responsibility and motivation for employees in a way that the persons engage themselves in TM. This means that the persons engage themselves in tasks about technologies which are complex, lengthy and for the time being far from markets and profits instead to tasks of their daily simple and short-term routine (Reiß 1995:523).

Typical approaches consider the following three areas: instrumental solutions, roles and incentive systems for employees. An overview of instrumental approaches is provided by (Reiß 2003:8). Approaches based on roles describe in which way a single person can support and ensure cross-divisional connections e.g. as Boundary Spanners or Promoters for innovation processes, see overview by Weinkauff *et al.* (2005). Additionally roles can optimise and accelerate technology adaption respectively, technology transfer in companies with so called technology drivers (Kremer & Leyh 2010). Approaches for incentive systems in research and development are presented in detail by Weber (2005).

*Informal Organisation and Culture* are the unwritten guidelines that influence groups and individual behaviour. TM tasks and decisions are especially affected by uncertainties and lack of information. For this reason it is very important to have openness, trust and an organisational climate willing to compromise. In terms of TM a culture of learning and innovation has to be implemented (Tschirky 1998:281). It supports intensive information and communication with the help of leadership behaviour despite cultural differences in subdivisions, like in RnD and Marketing or even within RnD (Bullinger 1994:82; Tschirky 1998:288–289).

Typical approaches consider cultures of innovation are stated and distinguished by Meyer (2011:100–107). Other approaches consider informal networks e.g. on the basis

of Communities of Practice (North *et al.* 2004).

In this framework examples are presented in which a range of possibilities exists to design TM in organisations. This overview makes no claim to be complete. However the description of every design field reveals that a single approach is not sufficient to achieve a functioning TM in companies. Borchert & Hagenhoff (2003:77) states that isolated approaches are not adequate and because of this a functional, well coordinated interplay of several TM approaches is needed. Especially larger companies have to implement and integrate several TM approaches. However up to now, most approaches are still considered separately and not in the connection with others.

Even within a single design field most of the authors distance themselves, as to how their approach can be applied in organisation practice. It is either stated which part of the approach should be, at least used but not as to which context the approach could be applied. Nor the way their approach is connected or influenced to others is taken into account. The justification is often that the approach should flexibly be applied according to the prevailing context (e.g. Cetindamar *et al.* (2009:245), Reiß (1995:548), Meyer (2011:195)). Though the reader is left to conclude how to characterise a company context or for which context the stated approach is suited.

## 5. Conclusion and Outlook

Technology management (TM) summarizes the coordinated utilization of technology in companies. This discipline ensures self driven innovations in a competitive environment, but its organisational implementation represents, especially for larger companies, various challenges. First, in larger companies with decentralised structures, it is important and necessary that this segmented structure also is integrated in the sense of TM. Secondly, larger companies mostly have to introduce several TM approaches. However most of the TM studies do not consider how their suggested methods or approaches could be holistically put in place and implemented in an organisation.

This article combines TM and organisational design to offer a framework, as to which design fields in the implementation of TM in companies should be considered and adapted. Furthermore, along with general definitions about TM, five central design fields are defined and elaborated which effects they have for TM in respective companies.

This article also highlights how TM from the perspective of organisational design should be understood. The provided framework allows a holistic implementation understanding, which is independent from single studies and their specific TM approaches. This ensures general requirements for technological communication, information and knowledge transfer in companies.

Furthermore the article demonstrates with the holistic framework that in practice companies still face various challenges, when they try to implement TM in functional

areas. This holistic framework illustrates that in even in every single design field only sole TM approaches or methods exist. Most of the authors with their TM approaches do not explain how their TM solutions should be embedded into company practice. They leave unclear, under which conditions their solution should be applied in a company and how their solution can be combined with other solutions. The authors emphasize that on the one hand the complexity of organisations is too high and yet, on the other hand the specific context must be considered. However this article demonstrates that isolated solutions are not adequate and because of this a functional, well coordinated interplay of several solutions is needed.

Based on the framework of this article future research should seek out, how common approaches of TM can holistically be implemented permanently in a company. Furthermore, a set of integrated and adjusted approaches for the implementation of TM should be explored on the basis of a selection of common prevailing context factors (see e.g. chapter 1) in companies.

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<sup>1</sup>An overview provides Schuh *et al.* (2011:14)

<sup>2</sup> According to Cetindamar *et al.* (2009) typical TM tasks are for example technology identification, selection, acquisition, exploitation, protection and learning.

<sup>3</sup> Relevant literatures on organisation theories are e.g. Schreyögg (2012) and Frese *et al.* (2012). Concise overviews are given by Reichenwald & Möslin (1997) and by Schreyögg (2004:1069–1088) in the handbook of organisation.

<sup>4</sup> The reason is that business practice is highly complex and real activities in companies are so manifold and multiple cross-linked, that a single theory is not able to translate it true to scale (Gmür 1993:66).

<sup>5</sup> A short overview of further classification possibilities of organisation theories can be found in the handbook for organisation by Schreyögg (2004:1070).

<sup>6</sup> Schatten & Zugaj (2007) design fields of an organisation are based on a literature research.

<sup>7</sup> Also Ewald (1989:78) uses the model as a part of his pragmatic reference framework for implementation in his work about the organisation of strategic technology management.

<sup>8</sup> This demonstrates the fundamental problem of every organisation design. According to Picot (1993:113); Möslin (1999:25) states that the main focus of business studies is “under which conditions which kind of organisational design is identified (descriptive question) or is preferred (constitutive-normative question)”

<sup>9</sup> Representatives of the contingency theory adopt this point of view.

<sup>10</sup> The six TM process stated by Cetindamar *et al.* (2009) are almost conform to the ones stated by Schuh *et al.* (2011:14), where several German publications are summarised. Cetindamar *et al.* (2009) Identification corresponds to Schuh *et al.* (2011:14) "Technologiefrühaufklärung", Selection for the most part to "Technologieplanung und Technologiebewertung", Acquisition to "Technologieentwicklung", Exploitation to "Technologieverwertung", Protection to "Technologieschutz" and Learning has no explicit correspondent.