Development of Smart Services in Manufacturing Companies

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The digitisation of products and processes is an important trend in manufacturing companies. This also changes business models and influences the offering of product-related services. In particular, a new type of highly IT-based services, the so-called "smart services", will provide various new possibilities for companies. A reference framework consisting of a process-activity model, methods and tools as well as organisational arrangements shows, how such complex services can be developed in a structured way.

1.   The rise of smart services

Information and communication technology has become an integral part of manufacturing industries. In particular, the increasing digitisation of products and processes is triggering new business models and the associated organisational systems, networks and consumption patterns. This paves the way for a new type of highly IT-based services, the so-called "smart services" (Kagermann et al., 2015) like advanced status and diagnostics applications, new control and automation solutions as well as profiling and behaviour tracking. They are making use of the growing volume of data that is being captured every day and are combined in innovative ways in order to create on-demand, personalized solutions for customers. Moreover, product performance and customer behaviours will get visible as they have never been before. Due to the high complexity of smart services, systematic approaches for their development are required, and first promising research can be found in the area of New Service Development, Service Engineering and Service Design (Papastathopoulou; Hultink, 2012, Fähnrich; Meiren, 2007).

Based on two empirical studies – one within the European Project "T-REX" (Saccani; Adrodegari; Alghisi, 2014) and another within a joint initiative of European service researchers (Edvardsson et al., 2015) – the current business models and service offerings of manufacturing companies have been analysed. It has become obvious that their service business has undergone extensive structural changes within the last decade and, also today, they are still facing many challenges, in particular, when it comes to the use of information and communication technologies. Many manufacturing companies are, however, hindered by the fact that their present corporate structures and processes are not designed to enable complex IT-based services to be efficiently developed and launched on the market. Difficulties are frequently encountered because appropriate business models are missing, requirements of customers are not clear, new services are not accurately defined and tested, IT integration is challenging, and the service staff is not sufficiently trained.

2.   Framework for the development of smart services

Taking into account existing knowledge in the area of New Service Development, Service Engineering and Service Design, a reference framework for the development of smart services has been elaborated. In particular, it explains the creation of a new service from its first idea at the beginning to the market launch at the end by reflecting an external perspective (e.g. customers, competitors), an internal perspective (e.g. management, service staff), and an economic perspective.

The aim of the framework is to provide companies with extensive support in developing new smart services or redesigning existing smart services. It puts a particular focus on the economic perspective, i.e. the systematic approach is intended to lower both the costs of the smart services and the total cost of ownership for the products to which they relate.

In addition to a (level 1) typology to distinguish between basic scenarios for the development and refinement of smart services, the framework consists of a (level 2) process-activity model, (level 3) methods and tools, and (level 4) organisational arrangements (see Figure 1).
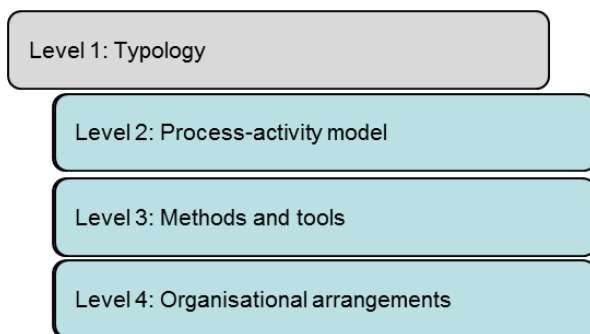

Fig. 1:   Structure of the reference framework

The individual levels of the reference framework are explained in detail in the following chapters.

2.1.   Level 1: Typology

The reference framework aims to help companies develop more professional smart services. This may include the improvement or redesign of existing services, or the development of completely new services. Moreover, it is crucial regarding the choice of process and methods whether the revised or new services are being offered to existing markets or customers, or whether they are to address new target groups. These considerations then provide, on the one hand, the dimension of smart services (existing vs new) and, on the other hand, the dimension of the target market (existing vs new). The resulting typology is depicted in Figure 2.
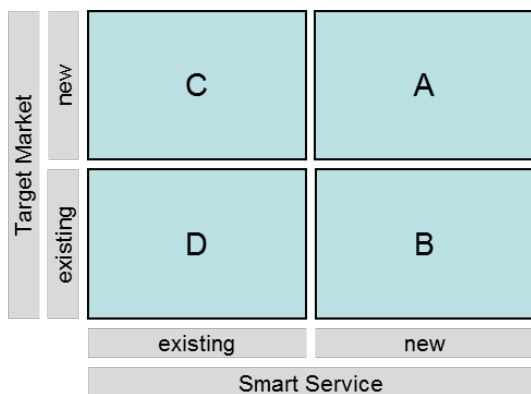
Fig. 2: Typology for development activities

The typology is based on the well-known Ansoff Matrix (e.g. Kotler; Keller, 2012). While this nevertheless serves as a tool for strategic management and is primarily used as an aid for planning corporate growth, the modified typology in the reference framework should pursue operative aims. In particular, the typology is intended to provide support in making key decisions on defining areas of focus and selecting necessary activities right at the start of the development process.

The four basic categories of typology and the ensuing consequences for the development process are explained below.

Type A

What is undoubtedly the most demanding category is the development of new smart services for new markets, where a new range of services is developed for clients with whom the company has not previously worked. In order to ensure success in the development process and to mitigate risk, conducting a run-through of the complete development process is recommended. In particular, the information collated in the development of the initial business model should be supplemented by an extensive market analysis. It is also advisable to adopt a strongly external perspective in the course of the development process and to integrate potential customers on an ongoing basis where possible (e.g. through interviews and workshops).

Type B

Like Type A, the second category is concerned with the development of new smart services, but for existing markets rather than new ones. This has the advantage that market structures (customers, competitors, multipliers, etc.) are generally already familiar, making the communication of the relevant information much less complex. Similar to Type A, conducting a complete run-through of the development process is also recommended, although individual methods that adopt the external perspective may be conducted in a simplified way or even skipped completely. However, they should only be skipped completely if the markets and customers are already very familiar (as is the case, for example, if a new smart service is only to be developed for one lead customer).

Type C

The third category is based on existing smart services that need to be adapted to new target groups. This is a very typical case that often gains importance with the increasing internationalisation of many companies, i.e. existing services need to be adapted to local conditions (e.g. language, cultural requirements, different logistics and new partners). As for Type A, the external perspective is also very important for Type C, and conducting the associated activities consistently is recommended. By contrast, tasks described in the development process that affect the internal, operative design of the service can be skipped – as long as this does not result in any change requests.

Type D

The supposedly simplest category is the redesign of existing smart services for existing target groups. This generally concerns selective adaptations to the range of services (e.g. adapting the delivery process, cooperation with new partners, use of new IT or communications technology). For Type D, a comprehensive requirements analysis should be conducted first and then only those activities from the development process that actually affect the improvements to or the redesign of the smart service should be selected.

The aforementioned typology provides an initial tool for the classification of the development task and for making the first selection decisions with regard to the process and methods to be used in the development.

2.2.   Level 2: Process-activity model

The core element of the reference framework is what is known as the process-activity model. This takes the form of a detailed description of the entire development process for smart services and the tasks to be conducted.

As a result of a literature analysis and requirements derived from practice (i.e. from a study conducted of 95 companies and a workshop with 12 practitioners), the basic type selected is known as a stage-gate model, which describes the development of the service from the requirements analysis to market launch. Stage-gate models are characterised by the linear sequence of the individual, consecutive stages in the process (Cooper, 2008). By doing this, there are clearly defined results after each stage, which can then be used in subsequent stages. For companies, particularly SMEs, stage-gate models are advantageous because they are clearly structured and easy to understand, and the pending development activities are ordered in a clear and logical way.

The process-activity model for the development of smart services is summarised in Figure 3.

Requirements analysis	Service design	Service test	Service implementation	Market launch

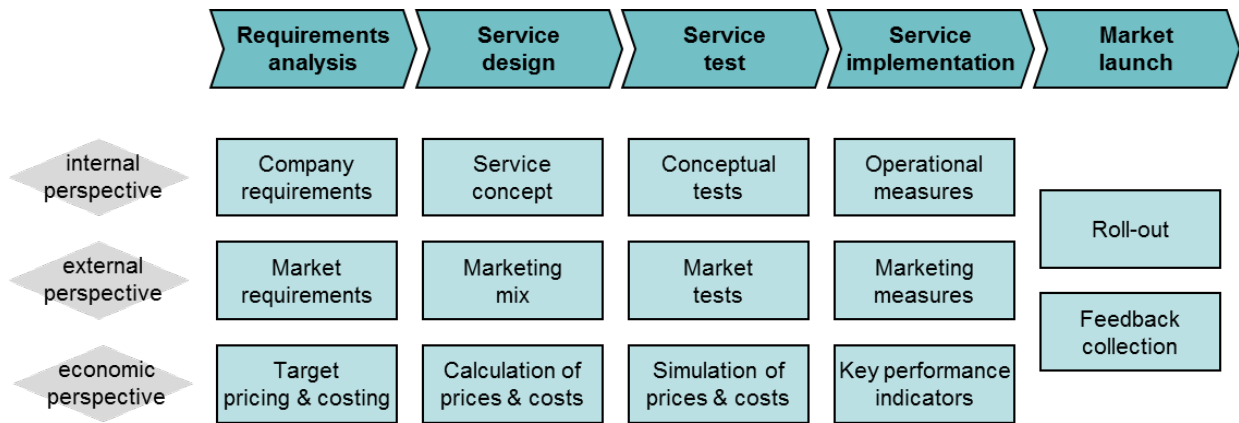|	Requirements analysis	Service design	Service test	Service implementation	Market launch
internal perspective	Company requirements	Service concept	Conceptual tests	Operational measures	Roll-out
external perspective	Market requirements	Marketing mix	Market tests	Marketing measures	Feedback collection
economic perspective	Target pricing & costing	Calculation of prices & costs	Simulation of prices & costs	Key performance indicators	

Fig. 3: Process-activity model

This model follows the important development stages of requirements analysis, service design, service test, service implementation and market launch. It has also been supplemented by three perspectives (internal, external and economic), which must be taken into account in each phase.

Development phases

As discussed at the start of the chapter, the model is based on a clearly described service concept, including the relevant business model. Generally, the information collated here tends to be of a strategic nature, however (e.g. to which markets and which customers will the smart service be offered? Which are the most important value propositions of the service?) It is also necessary to collect information about the operational design of the service.

The actual development work begins with the *requirements analysis*. Requirements are collated and assessed from a company perspective ("What form should the smart service take for the management and staff?") and from a customer point of view ("What form should the smart service take for the customer?"). The aim is to obtain a clear picture of the details of what the smart service needs to be able to do in order to be successful. It is also important to identify critical factors that must be avoided in order to prevent the failure of the service. Fulfilment of those requirements evaluated as the most important provides a clear guideline for the subsequent stages in development.

The next stage is *service design*. Here, the service features to be developed are described, the processes for the later provision of the service are defined and the use of resources planned. In addition, a marketing concept should be developed at this stage in order to integrate market and customer aspects for the subsequent market launch of the new service from an early stage of the development process, as well as carrying out a detailed price and cost calculation of the service.

The *service test* is then the next step. As the previous results are of an overwhelmingly conceptual nature, this stage focuses on carrying out a practical test of the smart service. Even if services seem to be predominantly intangible by nature, a range of approaches are available. They include everything from acceptance tests among staff and customers, partial implementation of the concepts (e.g. IT demonstrators, user interfaces) to initial tests with the actual customer.

Service implementation follows the test phase, and this is where the previous tasks are now implemented within the company. This primarily affects technology/IT tasks (e.g. hardware/software), implementation of organisational measures (e.g. assigning responsibilities, preparing operational instructions and procedural guidelines) and the implementation of HR measures (e.g. filling newly created vacancies, training staff). This stage also includes implementing the previously developed marketing concept and establishing essential KPIs for monitoring and managing the subsequent fulfilment of the service.

After a successful internal implementation of the new service, it is now ready for *market launch*. This predominantly concerns the roll-out of the service, i.e. providing the necessary resources and the approval of the service for the customer. Internal and external information and communication measures should also be conducted in parallel. This stage requires start-up monitoring and checking the success of the service. Final adjustments may have to be made on the basis of customer or staff feedback (e.g. through surveys and the evaluation of complaints).

Once the market launch is complete, the development process has come to an end and the new smart service may be handed over to the relevant department.

Internal, external and economic perspectives

In addition to the chronological sequence of the development stages, the process-activity model also integrated a second structuring level. This involved three different perspectives that have to be taken into account at each stage in order to ensure the most comprehensive process possible and, ultimately, the success of the service.

The *internal perspective* looks at the company's point of view. This primarily focuses on operational aspects of the smart service. Typical examples include the planning of processes and resources. The work carried out should be compared with the requirements of internal stakeholders (staff, management, etc.) on an ongoing basis.

By contrast, the *external perspective* describes the market or customer's point of view. For services that are characterised by the close integration of the customer by their very definition, it is essential that they are not developed from a purely internal perspective. In the same way as internal stakeholders are included in the development process, external stakeholders – primarily, the customer, but also partners, suppliers, etc. – should also be integrated.

The *economic perspective* is the third and final level. As the cost perspective is important for every company – both for the smart services and for the associated (tangible) products – the economic perspective was also integrated into the model. Even in business practice, it is clear that services are not only seen as a 'necessary evil' in order to maintain product business but increasingly also as an opportunity to boost the company's financial results (Neely, 2009).

2.3.   Level 3: Methods and tools

Although the process-activity model forms the 'backbone' of the entire process, it does not describe in detail *how* the tasks described are to be accomplished. Practitioners, in particular, would have difficulty at this point knowing exactly what it is they have to do in order to successfully complete a task. For example, if a task such as

the analysis of market and customer requirements seems obvious, the question still remains as to how exactly it should be carried out and which methods are available.

The third level of the reference framework addresses precisely this challenge and provides a selected set of methods, templates and tools. These are listed according to the specific stages of development in Table 1.

Development phases	Methods
Requirements analysis	Visualisation of service ideas Interviews Workshops Requirements list Target pricing and target costing
Service design	Service description Process steps for smart services Service blueprinting Role concepts for service delivery Interaction design Marketing mix Cost calculation
Service test	Service FMEA Service concept testing Pilot customers and test markets Lab approaches for service testing Simulation of prices and cost
Service implementation	Implementation planning Training Marketing measures Key performance indicators
Market launch	Roll-out planning Customer satisfaction survey

Table 1: Overview of selected methods

The focus is on methods that are specific to services. In addition, methods for project management are also relevant for service development projects, but they can easily be transferred and applied, so that they are not explicitly mentioned in the methods part of the reference framework.

2.4.   Level 4: Organisational arrangements

In contrast to product or software development, the systematic development of services remains uncharted territory for most technology-based companies. There are often no specific units within the company to take on this task, or no clearly defined responsibilities as to who is responsible for which individual activity (Schäfer, 2014; Meiren, 2006). For this reason, the reference model was supplemented by a fourth level in terms of organisational arrangements.

Organisational structures

For larger companies that already have organisational structures in place, the question soon arises as to who will be responsible when it comes to new services. This might be the service department, but it could also be marketing, sales or the strategy department or business development if there is one in the company. Or should an internal R&D department be established in order to develop the service, as is the case for product and software development?

If the issue of organisational structure is abstracted, it is possible to determine whether the company should set up an internal unit for the development of the service or not. In addition, a decision must also be made as to whether such a business unit would work on this task continuously, or just periodically. The possible alternatives are illustrated in Figure 4.

	Service development as an additional task	Service development as a main task
Service development as a permanent task	Existing organisational unit to develop services	Special organisational unit to develop services
Service development as a temporary task	External development of services	Service development by cross-functional project teams

Fig. 4:   Basic organisational alternatives for the development of smart services

Empirical evidence shows that there is no ideal solution here. Rather, it is a business decision that largely depends on the value that is given to new services and the degree to which the company is prepared to invest in them.

Roles and responsibilities

The basic anchoring of service development within organisational structures is a strategic decision for the company. Furthermore, the question also arises from an operational level as to which persons should take care of which tasks and which skills are required for this.

The following comments focus, however, on resource planning for service development projects because in practice it is usually necessary to resort to existing resources, and bottlenecks on the human resource side can often arise very quickly. Furthermore, many service development projects are so complex that they typically involve a large number of employees from different parts of the company. What are frequently referred as role concepts are explained below as a suitable instrument for assigning personnel to development tasks (Bullinger et al., 2003). Role concepts describe the human resource skills necessary to develop a particular service in the form of roles. These roles are defined on the basis of the experience, expertise and skills required to perform each individual task. They do not, however, make any recom-

mendations as to who will actually fill them. A role is characterised by competencies and responsibilities. It is quite possible for one person to be assigned several roles, or for several persons to be responsible for one and the same role.

The fact that the tasks themselves are considered separately from the persons appointed to perform them, make role concepts an extremely flexible planning instrument. Skills and responsibilities can be specified at an early stage, qualification requirements can be estimated and suitable qualification measures initiated. Capacity bottlenecks can be anticipated sooner and, if necessary, new staff taken on in good time.

Role descriptions form the basis for every role concept. They might be structured as follows:

- *Meaningful name*:
  Roles can be given any name depending on the specific requirements of each firm. Possible role names for service development projects could include: project manager, marketing planner, process designer or roll-out manager.

- *Tasks and outcomes*:
  Description of the responsibilities assigned to each role or role owner in connection with service development.

- *Skills*:
  These can be subdivided into various categories, such as technical skills, methodological skills, social skills and media skills.

- *Relationships with other roles*:
  Each role is characterised by relationships with other roles: for example, relationships of a cooperative nature or where one role is considered to be a special variant of another, more general role.

Roles should not be confused with positions. In other words, they are defined solely for the purpose of service development. A 'controller', for instance, does not necessarily have to come from the company's financial controlling department, but simply needs to be someone with the necessary skills in financial controlling to handle the specified project tasks.

The following generic roles (Table 2) could be used for a broad range of service development projects. Nevertheless, it is strongly recommended to adjust the set of roles to the company situation.

Roles	Responsibilities
Project manager	Schedule project (incl. activities, responsibilities, time-table, milestones)
	Allocate the required resources to each activity (e.g. persons, tools, equipment)
	Define of all methods and tools to be used in the project
	Estimate costs on the basis of available key figures
	Contract external partners
	Establish basic reporting for the project
	Coordinate and supervise all project activities, including initialising the process phases and activities as well as decisions about measures to rectify problems
	Monitor the project (completion dates, effort, costs and activities)
	Document of projects activities
Marketing manager	Coordinate customer involvement into the project
	Support the collection of internal and external requirements
	Support the price and cost calculations
	Design and implement the marketing mix (brochures, presentations, publications, trade fairs etc.)
	Support the collection of feedback from customers and employees
Manager prices and costs	Execute the price and cost calculations of the service
	Execute the lifecycle cost calculation of the related products
	Prepare and evaluate make-or-buy decisions
Service product manager	Analyse current and future markets trends
	Collect internal and external requirements
	Support the price and cost calculations
	Specify and describe the service
	Plan and execute service tests
	Document the service
	Collect feedback from customers and employees
Operations manager	Plan and implement suitable organisational structures for the service
	Plan and implement suitable delivery process for the service
	Determine and provide the operating resources necessary to deliver the service
	Plan and deliver the required operating resources for the service
	Define KPI's for the service
HR manager	Coordinate employee involvement into the project
	Define roles for the delivery process of the service
	Identify qualification needs
	Recruit new staff for the service
	Plan and organise the training of the staff for the service
Systems manager	Plan and coordinate IT-related activities of the service
	Test IT components of the service

Table 2: Roles for service development

In many cases, it could also make sense to define customers as a role as well, in particular, if they are directly involved in development projects (e.g. as lead users).

A role concept should be clearly linked to the process-activity model as it is shown for the generic role concept and the process-activity model of the reference framework (see Figure 5).

	Company requirements	Market requirements	Target pricing & costing	Service concept	Marketing mix	Calculation of prices & costs	Conceptual tests	Market tests	Simulation of prices & costs	Operational measures	Marketing measures	Key performance indicators	Roll-out	Feedback collection
E Execute **S** Support **A** Advise														
Project manager														
Marketing manager	S	S	S		E	S		S			E	A	S	S
Manager prices and costs			E			E			E			A		
Service product manager	E	E	S	E	S	S	E	E	S	S	S	S	S	E
Operations manager				S			S	S		E		E	E	
HR manager				S			S	S		S		S	S	
Systems manager				S			S	S		S		S	S	

Fig. 5: Role concept and process-activity model

Within a real project the next step would be the definition of the project team, i.e. the assignment of real people to the defined roles. The objective should be that each project member has the skills that are defined in his role descriptions. If not, qualifications measures should be initiated for the project member. Other alternatives could be the outsourcing of project tasks to external partners that have the relevant competencies, or even the recruitment of new staff according to the role profiles.

3. Outlook

Smart services offer companies which produce machines and equipment an interesting possibility to develop their service business. The advantages are being able to connect with almost every point on the earth through the medium of the internet without additional interruptions. Above all, internationally active companies offer additional services to their customers which could not be achieved previously. For example, small and medium sized companies which do not have the resources for a comprehensive world-wide presence can now deliver services to their customers like remote monitoring, online documentation and online training sessions.

The challenges which are to be overcome with the development of smart services may however not be underestimated. A service is then perceived as excellent by the customers if the details add up, and even small irregularities in the service process, in customer communication or in information technology can lead to the displeasure

of the customer. As shown, it is recommended that a structured procedure with the development of services should be established in order to secure an efficient, customer oriented process and to avoid possible weak points.
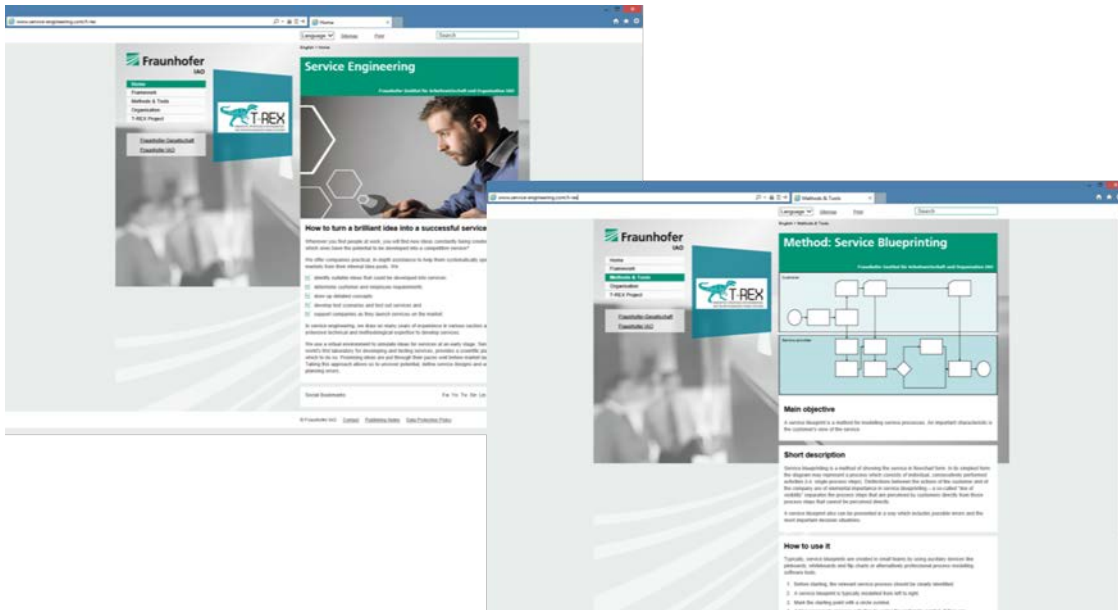

Fig. 6:   Internet-based guideline

The reference framework including more detailed descriptions of the single levels will be published on the Internet, so that a broad number of companies could make benefit of it. A first prototype of this online guideline has already been developed (see Figure 6). It will go public at the end of 2015.

Acknowledgements

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