Service Engineering – Methodical Development of New Service Products

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Abstract
When comparing the research on service topics to those research activities that focus on material goods, an obvious gap can be observed: While there exists a broad range of models, methods and tools for the development of goods, the development of services has hardly become a topic of scientific literature. An approach for capturing services as an R&D object is presented in the following under the general heading of "service engineering", and an attempt made to systematise the development of services.

Key words
Service engineering, New service development, Service typology, R&D Management for services

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1. Introductory remarks

During the past few years, an ongoing transformation of market structures and competitive situations has been observable in many service markets, accompanied by an unmistakable acceleration of innovation cycles. The most important triggers of this development are thought to be the liberalisation and deregulation of a wide range of service sectors - of which telecommunications, insurance and health are just a few examples - as well as the increasing globalisation and internationalisation efforts of numerous service enterprises. These aspects are compounded by the consequences of modern information and communication technologies, which are setting new standards in electronic processing and sales of services, particularly over the internet.

In these increasingly dynamic competitive environments, cost, quality and technology leadership are no longer sufficient for service enterprises to secure crucial advantages. Instead, growing importance is nowadays attached to more subtle differentiations in the form of innovative services, which in many branches are rapidly developing into the unique selling propositions of each firm. The principal challenge facing companies is the need to offer the marketplace continuously improved, if not new, services, while keeping one step ahead of their competitors and at the same time fulfilling the needs and expectations of their customers. Many service providers are however hindered by the fact that their present corporate structures and processes are not designed to enable services to be efficiently developed and launched on the market. Difficulties are frequently encountered because the new services created by firms are not clearly defined, there are no unequivocal descriptions of the service contents, the relevant processes and the necessary resources. As a result, efficient and successful implementation of these new services is considerably impeded by an absence of transparency as well as by interface and quality problems.

The topic of new service development has for a long time been largely neglected, not just in practice but also in service research. Although a number of academic works on *new service development* were published in Anglo-American literature back in the seventies and eighties, they add up to no more than a relatively rudimentary discussion. After completing extensive research, Bowers, for example, comes to the following conclusion: "The single most compelling criticism of the new service development literature is the lack of thereof." (Bowers 1985, p. 42). It is only recently that a fundamental change in this situation has become evident, coinciding with the increasing practical relevance of the topic, as numerous publications in the last few years have confirmed (e.g. Ramaswamy 1996; Cooper/Edgett 1999; Fitzsimmons/Fitzsimmons 2000). Parallel to the concept of "new service development" in America, the term *service engineering* was coined in the mid-nineties in Germany and Israel (Bullinger 1995, Mandelbaum 1998). Service engineering can be understood as a technical discipline concerned with the systematic development and design of services using suitable procedures, methods and tools. In contrast with new service development, which is strictly marketing-oriented, service engineering adopts a more technical-methodological approach, attempting to efficiently utilise existing engineering know-how in the area of traditional product development to develop innovative services. Although service engineering also embraces aspects of service operations management, the main focus of the following observations is on service development.

2. Development of new services

How should we go about developing services? And how can this process be explicitly supported? These are two of the central issues in service engineering, concisely formulated. In particular, the question of how services as can be made tangible as R&D objects and provided with structures has to date remained largely unanswered in the literature (Fähnrich et al 1999). A pragmatic approach which attempts to systematise the R&D object "service", as well as examining the goals and objectives that need to be pursued in connection with the development of service products, is therefore described in the following.

2.1 Services as R&D objects

A good starting point for elaborating a service development methodology can be borrowed from product development theory. According to Pahl and Beitz (1997, p. 5) design methodologies should:

- "Facilitate a problem-oriented approach, in other words they must be fundamentally applicable to all other design activities regardless of specific branches of industry,
- Encourage inventive and cognitive skills, in other words they must make it easier to identify the optimum solution in each case,
- Be compatible with the concepts, methods and findings of other disciplines,
- Generate solutions that are systematic rather than random,
- Allow the identified solutions to be transferred easily to related problems,
- Permit the use of electronic data processing systems,
- Be teachable and learnable,
- Be consistent with the findings of ergonomic analysis, in other words simplify work tasks, save time, prevent incorrect decisions and ensure active, interested collaboration."

If we attempt to apply these requirements to service development, we very quickly come up against a basic problem of definitions within the service sector. Unless we can succeed in establishing unambiguous service terminology, evolving suitable development methods on this basis is likely to prove extremely difficult. Enumerative definition approaches, negative definitions of services (that delimit them from physical goods) and definition approaches based on the make-or-buy principle tend to be inappropriate (service definitions are summarised briefly by Meffert/Bruhn 2000, among others). Constitutive definition approaches (originated by Donabedian 1980), which describe a series of characteristic service attributes, would appear to be significantly more useful. Although these explanatory approaches are likewise not entirely problem-free, it seems expedient to adopt them as a working definition for our particular purposes. A typical service can thus be said to be characterised by three different dimensions:

- A *structure dimension* (the structure determines the ability and willingness to deliver the service in question),
- A *process dimension* (the service is performed on or with the external factors integrated in the processes),
- An *outcome dimension* (the outcome of the service has certain material and immaterial consequences for the external factors).

These three dimensions must be taken into account whenever services are developed. Logically, suitable models and concepts should be provided for each of these dimensions in the development process, in other words the outcomes of service development should be resource concepts, process models and product models (Bullinger 1999; Fähnrich et al 1999; Meiren 1999). Figure 1 illustrates the relationships.

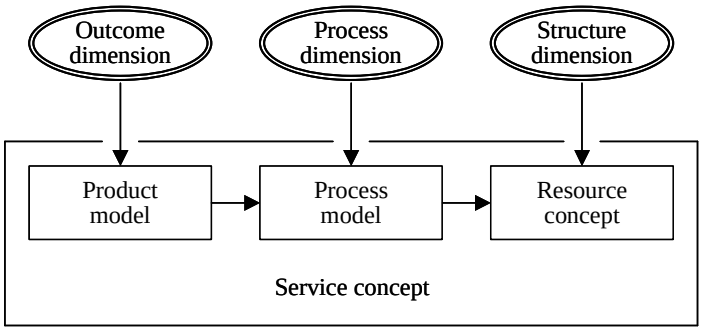

Fig. 1: Service concept

The structure dimension can be represented by means of *product models*, which typically comprise a definition of the service contents and a structural plan of the service products. If the services are relatively complex, it is moreover advisable to split them into partial services, in which case the service offering should ideally have a modular structure. This is desirable, for instance, if the services are offered in the form of a package that regularly has to be adapted to specific customer wants ("customising"). Good examples of complex product models in the service sector can be found in the insurance industry, where they are used mainly to create variants on the basis of generic elementary products (Schönsleben/Leuzinger 1996; GDV 1999), as well as in the German public services sector, where their principal purpose is to catalogue public administration products (KGSt 1997). It should be emphasised at this point that the term *product* is used deliberately. In this context services are considered to be products in the same way as physical goods or software, and they can be developed and marketed accordingly.

Whereas product models map *what* a service does, *process models* describe *how* the outcomes of a service are achieved. The various processes are documented in order to establish transparency from the concept phase onwards and ensure maximum process efficiency right from the very outset. The objective is always to eliminate non-value-adding activities at the earliest possible stage and to remove unnecessary interfaces and media discontinuities. In many cases, efficiency can also be increased by parallelising process sequences and selecting a suitable "process fit" (in other words by tailoring the processes to the standard case rather than the most complicated one). The purpose of these measures is to ensure that (often cost-intensive) process optimisation steps of the kind typically encountered during the service performance phase are avoided early on. Furthermore, it should be stressed that process models facilitate initial cost simulations (insofar as the process costs for performing individual activities can be estimated in advance). They thus form the basis for calculating the costs of new services.

The term *resource concepts* subsumes all development outcomes that relate to the provision of services. The focus here is on planning those resources that are necessary to perform the services subsequently. This includes, in particular, elaborating human resource concepts (especially with regard to the selection and qualification of staff) as well as planning the deployment of operating resources and designing the accessory information and communications technology. One important distinction compared to traditional product development is especially evident when the future deployment of staff is planned. On the one hand employees with direct customer contact must be endowed with the necessary competences to interact with their clients, while on the other hand advance preparation is essential to ensure that these staff are optimally supported during the service performance phase. In practice, these aspects are still neglected only too frequently (Fähnrich et al 1999).

Figure 2 shows the integration and the interaction of product model, process model and resource concept within a basic service model.

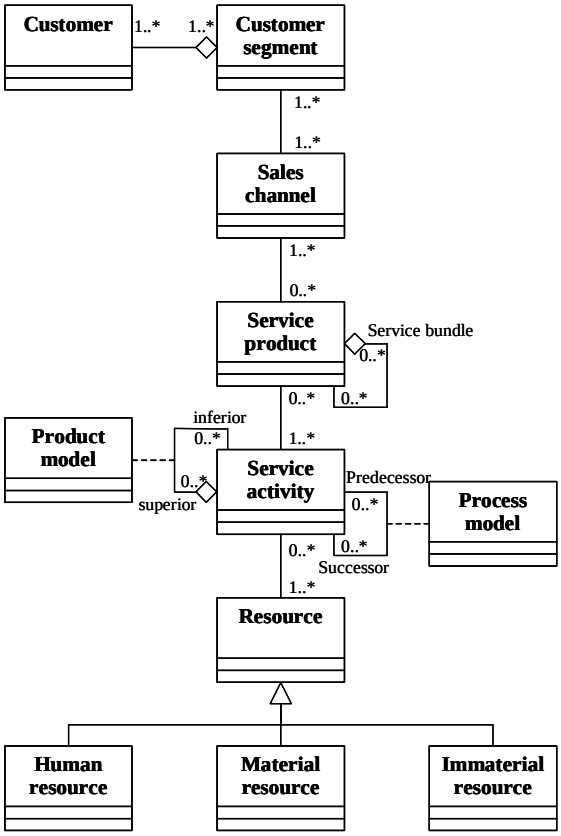

Fig. 2: Basic service model (notation in Unified Modeling Language UML)

The presented approach for systematising services as development objects is sufficiently generic in character to be transferable to the vast majority of services. It thus satisfies the requirements formulated above for service development methodologies. If the development

phase is to be designed such that it also functions in practice, however, concrete methods and processes need to be described.

2.2 Methods

As far as the use of methods to develop services is concerned, an undifferentiated approach is most definitely inappropriate owing to the heterogeneous nature of the service sector. In order to be able to perform meaningful analyses and derive recommendations for action regarding method deployment, it is useful to identify characteristic service "types" and then take these as a basis for a more detailed examination.

Although previous academic studies have already devised a set of so-called *typologies* for the service sector, hardly any of them are explicitly geared to service development. The typologisation approach evolved by Fähnrich et al (1999) represents an exception. It moreover offers the advantage that it was derived empirically from a survey of 282 companies and can hence claim a considerable degree of practical relevance.

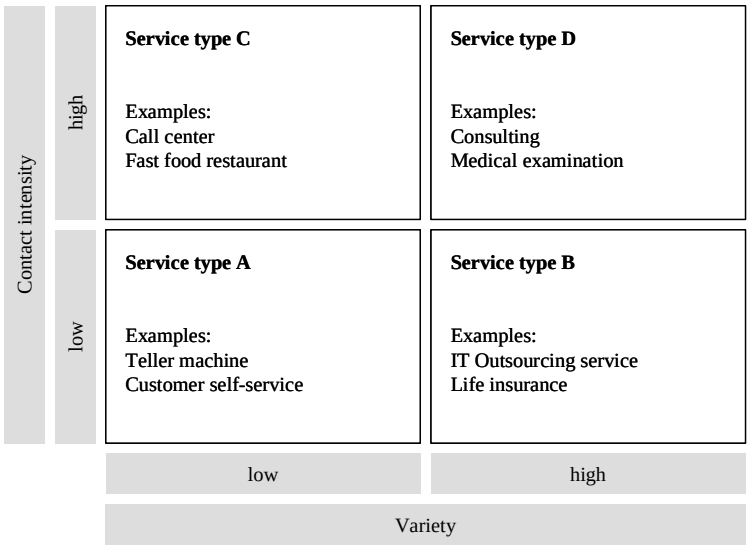

Fig. 3: Service typology

Contact intensity and variety were revealed by a factorial analysis to be the critical typologisation attributes. Contact intensity can be seen as a yardstick of the interrelationships between employees and customers, whereas variety describes the total number of determined manifestations of the service product. These typologisation attributes allow four service types to be defined:

- Service type A is characterised by a low contact intensity and a low variety, making it particularly suitable for highly standardised performance,

- Service Type B has a low contact intensity and a high variety, whereby from the developer's point of view the focus is on the systematic variant creation aspect,
- Service Type C is typified by a high contact intensity and a low variety. It essentially consists of a single, clearly defined standard service, which may however be influenced by the customer within certain limits,
- Service Type D is distinguished by a high contact intensity and a high variety, so that its performance typically necessitates a considerable amount of customising.

It is interesting at this stage to consider which methods are preferred for developing which service types (Fähnrich et al 1999). A series of methods familiar from traditional product development is evidently used in practice for services with a relatively low contact intensity. These include quality function deployment (QFD), failure mode and effects analysis (FMEA) and various product and process modelling methods (the actual dissemination of these methods was confirmed by Ramaswamy 1996 and Saatweber 1997). One possible explanation for this might be that the performance of a small number of contact-intensive services is only influenced to a very limited extent by customer-imposed variances, so that the characteristics exhibited by these services bear numerous resemblances to those of physical goods and the services concerned can consequently be developed using similar methods.

Whereas engineering methods are relatively widespread as instruments for developing services with a low contact intensity, their relevance for the development of contact-intensive services is comparatively minor. Business and recently also service-specific methods predominate here - especially when the aim is to systematically integrate customer retention into the service development process (Fähnrich et al 1999). In the case of Type D, social and behavioural science methods, tailored to qualifying employees or shaping customer interaction, are also encountered.

It is the contact intensity criterion which thus seems to mainly determine the methods preferred in practice. It is evident that, particularly with service types where so-called *soft factors* play a vital role, traditional product development methods are no longer transferable and approaches originally devised by other scientific disciplines are demanded more and more frequently. This is also the conclusion drawn by Fähnrich et al (1999, p. 18): "For this reason, simply transferring traditional product development concepts blindly would appear to be inexpedient, and an exclusively engineering-oriented approach for service development is likewise bound to be inadequate. On the contrary, what is needed are interdisciplinary approaches that are capable of mapping the interaction of human resources, technology and organisation and of rendering them plannable."

2.3 Development processes

In addition to identifying which methods are suitable for developing new services, it is also interesting to examine the order in which certain activities need to take place within the development process. Particularly those companies that develop new services regularly are compelled to search for ways of avoiding redundant working, firstly to prevent repetitions of past mistakes and secondly to enable existing know-how to be reused. In order to accomplish this objective, they generally begin by describing their development processes and by

standardising individual development steps to a certain degree. This *formalisation* extends from predefined, rigid development process on the one hand to flexible, situation-specific processes on the other. Where the term formalisation is used in the following, it is thus in no way intended to imply that development processes are constrained inside an absolutely tight straitjacket. On the contrary, it means that these processes are no longer always arbitrary, but that there are defined guidelines according to which the services are supposed to be developed (Fähnrich et al 1999).

Development processes can be formalised on the basis of so-called *reference models*. Reference models contain detailed documentation about project flows, project structures and the persons responsible for a project, and are hence able to support project planning, steering and monitoring. They are familiar mainly from traditional product development and software engineering, though they can also be applied to the area of service development. In the context of service development, reference models define the activities that are necessary to develop the services in question, determine their interrelationships and specify their order of performance (Hofmann et al 1998). The individual development activities are condensed into clearly delimited process steps, which in their entirety represent the process structure for service development. In addition, process models of this kind also enable resource needs and the deployment of methods to be defined and interfaces to parallel corporate processes to be specified.

Both waterfall models, in other words models characterised by the linear progression of the individual phases, and iterative models, where each phase is repeated several times (spiral or prototyping models, for instance), are conceivable options for service development. These various types of reference model are discussed in more detail in the following.

A *waterfall model* is characterised by a linear progression of discrete, consecutive process steps. Each transition from one phase to the next is conditional on one hundred percent completion of the previous phase. Each individual phase moreover builds on the others, that is to say the outcomes of upstream phases provide the input for downstream phases. Figure 3 shows an example of a simple waterfall model. Subdividing the development process into predefined steps ensures that it remains very transparent. In addition, it makes it ideally suited to outcome-based planning, since the end of each phase provides the perfect milestone for gathering intermediate outcomes. One disadvantage of waterfall models, however, is their lack of flexibility, because the development process follows a rigid pattern that often leaves very little scope for adapting to special service or project-specific features. In addition, potentials for shortening the development cycles are usually not fully exploited, because the process steps take place sequentially and the opportunities that exist for parallelisation tend to be largely neglected. Owing to their straightforward nature, however, waterfall models are presently the most widely used kind among theoreticians and professionals alike. Almost all known service development models can be classed under this heading (e.g. Scheuing/Johnson 1989; Edvardsson/Olsson 1996; Ramaswamy 1996; Tax/Stuart 1997; Jaschinski 1998; Cooper/Edgett 1999).

Spiral models represent a more advanced version of waterfall models. They are iterative reference models in which the linear process steps of the waterfall model are each repeated several times. It is thus possible to obtain initial, meaningful, intermediate outcomes at a very

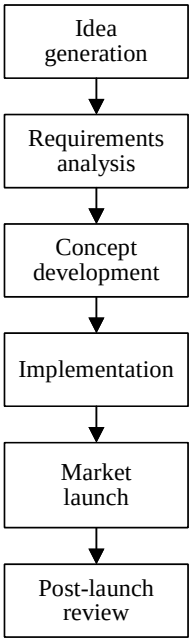

Fig. 4: Service development approach

early stage and then to adapt and customise the process accordingly. Spiral models are based on a top-down approach. This entails progressing gradually from a rough development concept to a refined, market-ready one by iterating the individual development steps. The first outcomes, which already include a substantial share of the specified functionalities, can be assessed as soon as the steps have been completed once. If any errors are identified when the intermediate outcomes are verified, it is possible to eliminate them during iterative runs by repeating the steps that caused them any number of times, until finally a market-ripe service emerges. The advantage of spiral models is that initial, evaluatable outcomes are available very quickly, enabling potential errors in downstream cycles to be rectified. In particular, this method enables learning effects to be benefited from not just across different development projects, but also within a single project. The drawback of the model, however, is its complexity along with the necessary steering intensity. Spiral models are at present practically unknown as a method for developing services. Shostak and Kingman-Brundage's model (1991) is one of a very few exceptions.

Another category of reference models is that formed by the *prototyping models*. A test version ("prototype") of a new service is developed first of all and then taken as a basis for examining and subsequently refining its key attributes and functionalities at an early stage. The development steps of a prototyping model are not discrete and may be partially overlapping. Many different kinds of prototype are found in prototyping models. The most common distinctions are based on the scope of the planned functionalities (complete vs. incomplete prototypes), the level of detail (horizontal vs. vertical prototypes) and the objectives (explorative vs. experimental vs. evolutionary prototypes). The advantages of prototyping models notably include their excellent adaptability to a variety of service development tasks and the rapid availability of a marketable solution. They moreover support communication between developers and customers, because even very early on the latter are able to avail of a

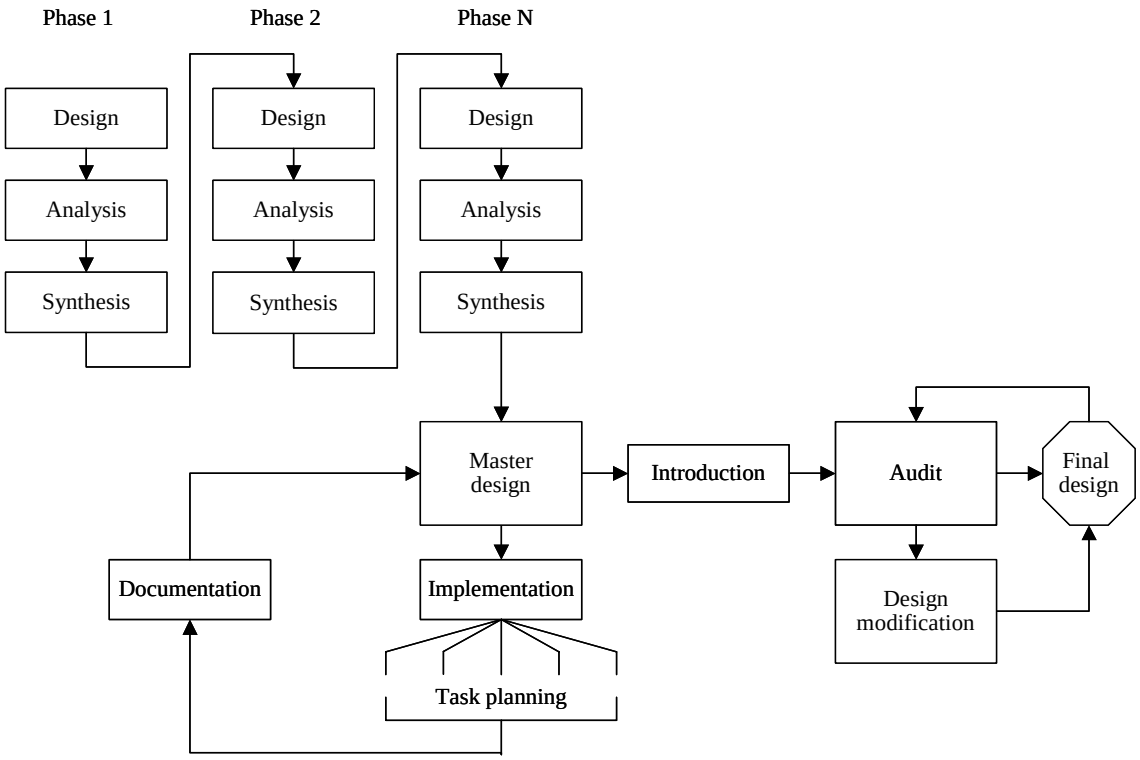

Fig. 5: Service development model according to Shostack/Kingman-Brundage

test version that allows them to incorporate their detailed requirements into the future development process. Among the drawbacks of prototyping models, however, are the complexity of the necessary communication and coordination activities and the difficulty of monitoring targets. Over and above a few general thoughts on the matter (Hope/Mühlemann 1997), there are practically no detailed studies dealing with the use of prototyping models in connection with service development.

The few scientific models that have so far taken up the challenge of service development only seldom cater for the needs of practical users. The following weak points can be observed in all known models elaborated to date:

- Insufficient level of detail:
  The models generally describe the higher-level process steps, but not the concrete activities nor the methods to be deployed,
- Lack of configurability:
  All the models simply define a rigid development process, without allowing any form of adaptation to different service types,
- Lack of practical corroboration:
  All known reference models in the area of service research are the result of theoretical observations and have been only inadequately tried out and tested in practice,

- Lack of ICT support:
  None of the models offer any points of contact that might allow the development process to be supported with modern information and communication technology (ICT).

In conclusion, it can be stated that in the field of new service development there are substantial deficits when it comes to the availability of suitable methods and procedures. Close cooperation transcending different academic disciplines will be necessary in future to enable seamless, integrative methods that are appropriate to practical requirements to be offered.

3. R&D Management of services

Modern engineering approaches are not concerned solely with development methods, but usually also with the complete *development system*, the aim being to generate comprehensive solution concepts for developing products. This is especially true of service engineering, because for many firms the tasks at hand are completely new ones, and implementing and integrating service development in an enterprise results in a whole series of unanswered questions being raised. Against this background, the following topics are particularly relevant to all discussions of service development management:

- Service innovation and development strategies,
- Organisational design aspects in service development,
- Human resource management in service development,
- Information technology support in service development.

In connection with the first of the above points, it is useful to refer to the relevant literature on the topic of service innovation management (e.g. Bacon/Butler 1998, Metcalfe/Miles 1999). Since it is moreover an observable phenomenon that the farther away one moves from the actual R&D object (be it physical goods, software or services), the more generic all statements about R&D management become, we shall likewise refrain from debating every single detail of the other points here. Instead, the following comments will focus on a few of the most interesting, service-specific aspects relevant to R&D management of services.

3.1 Organisational design aspects

Regarding the organisational design of service development, the main question of interest to us concerns the basic options that are available to businesses and the extent to which they are presently made use of in practice. It is possible to distinguish between service development as a permanent or a temporary task within an organisational unit. Figure 6 shows four basic alternatives.

One way of ensuring that service development becomes anchored in an enterprise as a long-term feature is to set up a *separate organisational unit to develop services*. This can take the shape, for instance, of a staff position, a group, a department or even a centre (Luczak et al 2000). These organisational forms offer the advantage that development activities are then distinct from daily operative business, so that service development know-how can be built up and maintained systematically. At the same time, however, they involve a considerable amount

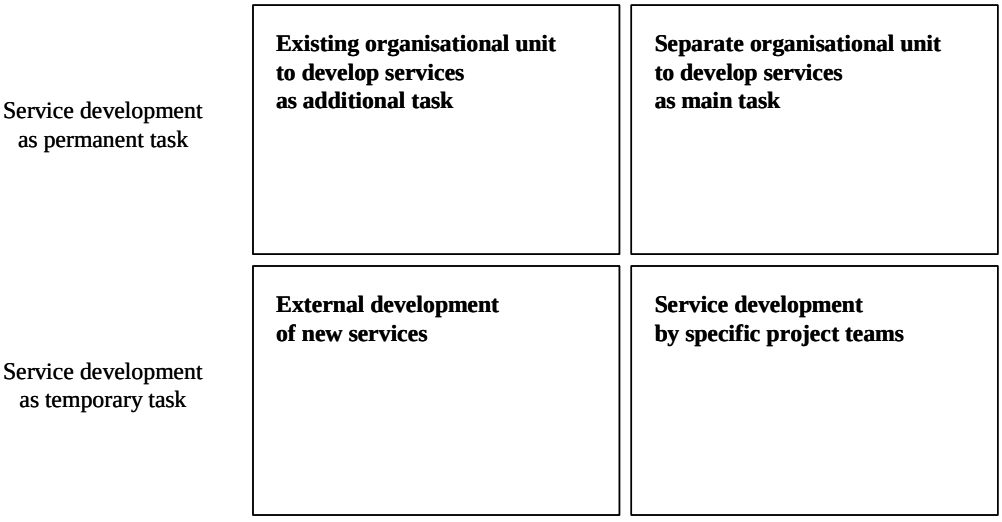

Fig. 6: Organisational alternatives for service development

of work and effort. They may mean, for example, reserving capacities that are often idle if new services are only developed sporadically. The firms surveyed in the study by Fähnrich et al (1999) likewise attributed little importance to this organisational alternative: a mere ten percent of all respondents admitted to having a separate organisational unit to develop services, and in the majority of these cases the unit simply consisted of one staff position, only rarely reaching sufficient proportions to be termed a group.

Another alternative is for *existing organisational units* to assume *service development tasks* (as "additional tasks"). This has the advantage that although development-specific know-how is restricted to a defined organisational unit, the capacity of this unit's members can be controlled more effectively. In practice, this strategy of organisational responsibilities appears to be the most widespread. In the study by Fähnrich et al (1999) as many as 77 percent of the surveyed enterprises mentioned this alternative. The question of which organisational units should take on the job of service development is an interesting one here. The development of new services appears to be a matter for top-level management, because the responsible person is most likely by far to hold an executive position within the enterprise. Since the company management generally has a very wide sphere of action, however, this is at the same time an indication that in reality services are often not developed systematically but rather on an ad hoc basis. It is also striking to note the runners-up in this table, namely sales, marketing and product managers, all of which represent organisational units in very close contact with customers. This can hence be presumed to be a key criterion in all the firms concerned when it comes to delegating service development tasks.

Another alternative which is widely encountered in practice is *service development by specific project teams*. This solution restricts the structural changes within a company to a minimum and the members of the project teams can be appointed on a case-to-case basis according to the task at hand. One disadvantage, however, is that the know-how which is built up during the course of such projects is often lost again once they have been concluded, because the project team members then turn their attention to other tasks instead. The study by Fähnrich et al

(1999) also contains a number of interesting comments on this organisational form. 49 percent of the surveyed firms, for instance, employ specific project teams to develop services, whereby the majority of the team members are representatives either of the corporate management or of organisational units in close contact with customers. An important role is however likewise played by cooperation partners and external consultants. Collaboration in temporary working groups and organisational units in the form of virtual project teams are other interesting alternatives to classic project work in this context.

The fourth alternative, namely *external development of new services*, is the least frequently adopted in practice. A firm may decide either to outsource complete development orders or to purchase services that have already been developed by others. This alternative generates the greatest benefit if the company concerned does not avail of any service development know-how or if it does not consider this area to be part of its core competence. The disadvantage, however, is the effort - not to be underestimated - that is necessary to adapt externally developed service concepts to the specific environment of the purchasing company. Added to this is the probable difficulty of finding suitable vendors of service development activities. The study by Fähnrich et al (1999) confirms that outsourcing service development only represents a viable alternative for seven percent of the surveyed enterprises. This is not particularly surprising if we remember that traditional product development tasks are likewise seldom outsourced entirely to external firms.

3.2 Human resource management aspects

Human resource management plays a crucial role in connection with development tasks, because development outcomes depend to a large extent on the competence and interaction of the persons involved in the development process. Topics such as recruitment, incentive system design, staff appraisals and personnel development in R&D departments are therefore generally the subject of considerable attention (Specht/Beckmann 1996).

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 new service development projects are so complex that they typically involve a large number of employees from different parts of the enterprise. What are frequently referred as *role concepts* are explained in the following as a suitable instrument for assigning personnel to development tasks (Frings/Weisbecker 1999; Meiren 1999). Role concepts describe the human resource competences necessary to develop a particular service in the form of roles. These roles are defined on the basis of the experience, know-how and skills required to perform each individual task. They say nothing about the persons who will actually fill them, however. A role is characterised by competences 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. These interrelationships are summarised in Figure 7.

The fact that the tasks themselves are considered separately from the persons appointed to perform them makes role concepts an extremely flexible planning instrument. Competences and responsibilities can be specified at an early stage, qualification needs can be estimated and

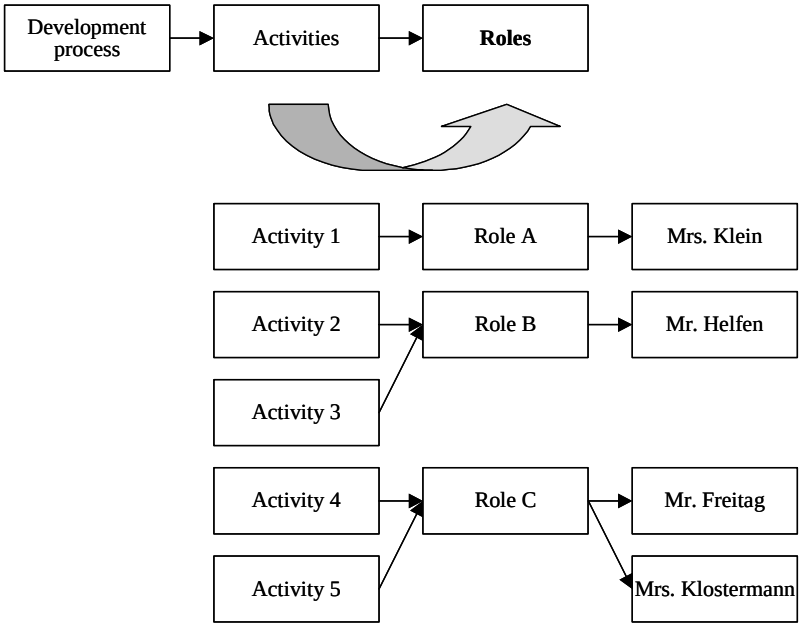

Fig. 7: Principe of a role concept

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 of 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 might be project manager, marketing planner, process designer or rollout manager.
- Tasks and outcomes:
  Description of the responsibilities assigned to each role or role owner in connection with service development.
- Competences:
  These can be subdivided into various categories, such as technical competence, methodological competence, social competence and media competence.
- 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 jobs, in other words they are defined solely for the purpose of service development. A "controller", for instance, does not necessarily have to be drawn from the firm's Controlling department, but simply needs to be someone with the necessary controlling competence to handle the specified project tasks.

3.3 Information technology support aspects

The final aspect of service development management - information technology support for the development of new services - is discussed in the following. Empirical experience has shown that new procedures and methods become established more easily if they are able to be adequately supported by modern information and communication technology. On the other hand - in contrast with traditional product or software development, where most of the development process is supported by computer aided design (CAD) or computer aided software engineering (CASE) - no integrated software tools for developing services are currently available on the market.

In practice, service development is nevertheless assisted by a number of software tools, the most common of which are as follows:

- *Office products* such as word processing, spreadsheet or presentation software for handling simple support tasks,
- *Tools to support specific methods* (e.g. QFD or FMEA), which are useful for selected, individual tasks,
- *(Process) modelling software* for mapping service processes and resource assignments, and in some cases also for data modelling,
- *Project management software* for planning, managing, steering and controlling service development projects.
- *Groupware systems* (e-mail, group calendars, conferencing systems, forums, newsgroups, etc.) to support cooperation, coordination and communication in distributed development teams,
- *Knowledge management systems* to support archiving, retrieval and communication of the know-how that is built up during the service development process.

The above-mentioned software tools simplify interesting and important aspects of service development. Description methods and modelling tools developed specifically for service engineering that are capable of supporting the complete process from end to end - from the original brainstorming and idea appraisal through the elaboration of a concept to the actual service implementation - are essentially lacking, however. Filling this gap undoubtedly represents one of the outstanding challenges of the future.

4. Outlook

The increasing importance of services for the economy has opened the door for a wide variety of service research topics in a growing number of research disciplines. Particularly in the area of applied sciences such as traditional engineering, considerable methodological know-how can also be utilised for service development and design tasks. The objective must not be to transfer existing product and software development concepts blindly, however, or indeed to strive to "automate" service development, but rather to interact with a large number of relevant technical disciplines to develop methods that take the special nature of services adequately into account.

As service engineering is still a very new discipline, the future is likely to reveal a whole series of interesting developments. In particular, fundamental research into *new and further development of models, methods and tools* will give service engineering a valuable boost. The development and dissemination of prototyping methods for services and the introduction of service life cycle models are just two examples. In addition, integrated approaches for *co-engineering physical goods, software and services* will become an established feature, whereby in many cases system leadership will be shifted increasingly in the direction of services. Intensified *standardisation endeavours* in the services sector, observable for example in the area of service-related electronic commerce, will also have consequences for service engineering. Finally, the growing harmonisation of service standards will encourage the specification and efficient development of new services.

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