Service-oriented innovation in R&D

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Abstract: In this article the concept of service orientation in R&D is explored. Three forms of service-orientation are discussed: integrated products, service offering, and service competence. The first form, integrated products, addresses the development of complex integrated products in which service offering has been incorporated. The second one, service offering, concerns the knowledge present in an R&D department. This knowledge as such can be used for providing advice or solving problems elsewhere. Finally, service competence denotes a service attitude for the people involved in realising the services required. Adequate means, processes, and R&D organisation should support the accomplishment of the desired service competence. From the point of view of a specific R&D function, service can be offered to other functions internally or externally, but can also be acquired from other R&D departments inside or outside the company.

Implementation of service orientation is becoming more and more important for organisations to be innovative and requires radical innovation in R&D. We illustrate the concepts introduced with examples from a recent study tour in the southern part of Germany.

Keywords: Organisational innovation; service competencies; collaboration.

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1 Introduction

Many organisations involved in technology innovation consider research and development (R&D) as a source and driver of development and continuity. This applies to separate companies, to branches of industry such as the automotive industry, for sectors like the health care sector, but also to administrative bodies supporting regional and national research and development programmes.

Apparently, innovation is important, maybe more important than ever, leading to increasing attention for R&D. Much seems to change in those organisations and business units that develop knowledge and new products and processes. The function and, consequently, the position and organisation of R&D change. Research and development are no longer restricted to the starting phase, 'upstream', of the production chain. Activities in R&D should contribute primarily and in a broad sense to the development of the innovative power enterprises must possess to survive in an environment of growing competition (in terms of functionality, quality, costs, time-to-market) and uncertainty [1]. In Section 3, we will discuss the R&D function and indicate the changes in the R&D function in more detail. In this discussion, we will introduce the concept of service-orientation of R&D. A competence view on R&D will be adopted.

In Section 4, we will describe in more detail which service elements can be distinguished in the R&D function. First of all, service is more and more a component of products that are offered to the market, also by traditional industrial companies. Viewed in this way, service is a characteristic of products to be developed. In addition, R&D departments to an increasing extent will offer services, for example in supporting purchasing of knowledge or goods by the company. In such situations, service is a characteristic of the task or function of R&D. In the same vein, R&D may also request services to support or extend their research and development task.

A highly important aspect is the attitude of serviceability, which is needed from R&D employees. Serviceability has to become a characteristic of the culture of an R&D organisation. It will be stressed that product and organisation development are both necessary to achieve innovative organisations with service-orientation as a fundamental characteristic.

We will start the presentation of our work with describing the methodology used for our research into service in R&D. Examples from practice will be used as illustration throughout the text. The paper will end with a brief summary and a description of future research.

2 Research into service in R&D

2.1 Methodology

This paper contains a reflection on current developments in R&D. The concepts and findings as presented in this article are based on research performed in our group (see [2–6]). Most of the research is based on extensive case studies. Case study research is most suited when the goal is to understand phenomena in their context [7]. In particular, we wish to understand the impact of and conditions for innovation in and by R&D. With respect to the research presented in this paper, our goal is to understand

changes in R&D with respect to integrated products, service offering and service competence.

2.2 Empirical findings

We have applied the concepts presented in this paper on recordings of case studies made during a one-week study tour in the southern part of Germany. During the study tour we extensively visited amongst others a big car company, a supplier of sheet metal components for car manufacturers, and a producer of industrial cleaning equipment.

The ***supplier of sheet metal parts*** is involved in the R&D process of a large car manufacturing company. The supplier provides services to the car manufacturer by giving advice on and by critiquing design proposals with respect to consequences for the development of production tools and the production process.

The ***large car manufacturer*** requires its main suppliers to deliver their products on time, in the right order, and customer-specific in the final assembly line. The suppliers offer integrated products to this car manufacturer, since the service offered is incorporated in the way the products are delivered to the car manufacturer. In addition, the suppliers take the customer specifications used by the car manufacturer into account. The suppliers are also forced to deliver services when something fails in the delivery and use of their products in the assembly line.

Another car manufacturer studied during the tour has long-term relationships with a few suppliers. Both the car manufacturer and the suppliers deliver services in the process of designing the parts to deliver. Because of the high quality standards of the car manufacturer, suppliers cannot easily be replaced. Conversely, the suppliers are also largely dependent on the car manufacturer.

Finally, the ***producer of industrial cleaning equipment*** is outsourcing parts to suppliers. Increasingly it requires its suppliers to deliver on time to the assembly line. This means, that suppliers are forced to deliver integrated products. Conversely, the client, the final producer, has to deliver services, in terms of knowledge of the assembly process, to the future suppliers to accomplish the desired situation. The problem the producer of industrial cleaning equipment is facing is the determination of which processes to keep and which to outsource. At the same time the cleaning equipment producer is changing its products towards integrated products to finally deliver integrated products, including e.g., maintenance contracts, to clients like cleaning agencies.

In this paper we will mainly refer to one of the companies we visited on our study tour. We use the cleaning equipment company to illustrate our concepts and general findings.

3 The R&D function

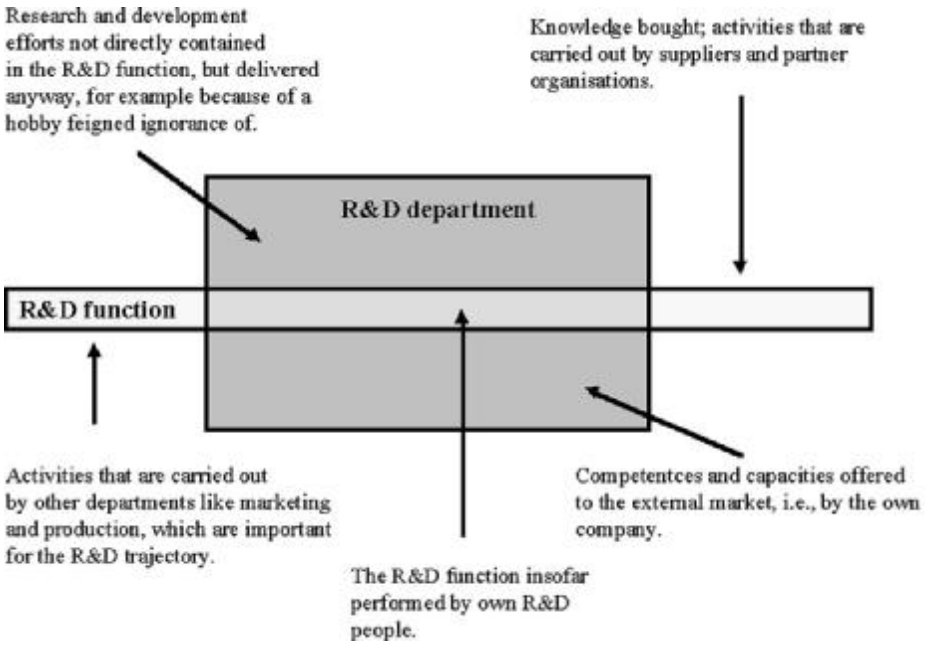
R&D is usually associated with a first step in the production chain of new products and with a department or unit in an organisation responsible for this first phase. An appealing example is the Philips Laboratory (NatLab). Many of the products that made Philips famous have originated from knowledge developed in this laboratory. This fact has been used to justify the costs of the laboratory and the freedom its employees enjoyed in the past.

This situation ceased to exist a long time ago. Most of the current activities can be classified as assignments and are based on agreements (specified in terms of results, time and money) with market-oriented business units. R&D has become a capacity that is used by a business unit to perform a specified research and development function. For Philips, traditionally, this capacity is available internally. However, Philips can also acquire knowledge externally, like many other companies.

For example, R&D projects can be outsourced to knowledge suppliers that perform best. The primary aim is to satisfy the R&D function in an adequate way. Who performs the function and how is a secondary question. Knowledge has become a commodity. The fact that a substantial backlog in the development of, for example, the flat tube technology by Philips could be solved at once by taking over a company with the necessary knowledge, will be a disappointment for one, but a revelation for another.

Kerssens-van Drongelen [5] has rightfully distinguished the 'functional view' and the 'departmental view'. Performing the R&D function usually requires more competencies and activities than can be offered by the own R&D department. Vice versa, the R&D department has more competencies and delivers services that may not be directly necessary from the point of view of the R&D function, but which are useful in one way or another. In Figure 1, the possible distinction between function and department is depicted.

Figure 1 R&D function and department



Below, we will identify requirements for organising the R&D function in order to achieve the necessary service-orientation.

3.1 Strategic flexibility

Roussel *et al.* [8] distinguished several phases in the development of R&D management. The so-called third-generation R&D management means that R&D efforts are aligned with the company strategy as a whole with respect to the area of working as well as the degree of innovativeness and risk. Normally, at this level, a balanced portfolio of R&D activities exists. Strategic R&D management also involves a good communication network between R&D managers, general management, and functional managers in other areas, such as production and marketing. In an atmosphere of collaboration and mutual interest the skeleton of R&D efforts has to be determined, which incorporates aspects with regard to content, size, time schedule, and, especially, intention.

In accordance with the model of Roussel *et al.* [8] it is important to distinguish the strategic dimension of R&D management. R&D should contribute to realising the company strategy, while it is strategically controlled at the same time. This is emphasised in the research of De Weerd-Nederhof [4], in which she calls the combination of operational effectiveness and strategic flexibility an important measure of New Product Development (NPD) success.

Operational effectiveness means that specific NPD projects are executed effectively and efficiently and lead to results within the time planned. Strategic flexibility implies room to anticipate future situations. Short-term results should not hamper future success. On the contrary, it should enable future success and even offer a basis for that.

Orientation on strategic flexibility fits in a more encompassing development in theory and practice. Managers and researchers in the area of organisation theory and strategic management have long searched for an optimal alignment of the organisation to the internal and external environment. It is suitable in this so-called contingency approach to organise innovative environments in a more organic way, while stable production environments fit to a more mechanistic organisation (see [9]). The research of De Weerd-Nederhof [4] is, in fact, also aimed at finding suitable configurations that lead to short-term success and guarantee future continuity.

Given the increasing uncertainty about future business environments and the necessity of strategic choices for the use of scarce capital equipment, we observe a shifting focus towards determining and developing competencies and resources. Hamel and Prahalad [10] speak of ‘core competencies’. Attention for a resource-based approach of organisations is increasing. Deliberate choices for core competencies and resources, available in-house or externally accessible, form the basis for strategic flexibility. Choice and development of these core competencies and acquiring access to external resources are primarily part of the R&D function.

3.2 A competence view of the R&D function

To organise the R&D function the specific character of research and development should be taken into account. In the past, the focus of research was finding a fit between different contingency factors and organisational forms. Arguments were given to tune the R&D organisation to, amongst others:

- The type of R&D work, which may vary between more/less fundamental/applied and between more/less experimental [11].
- The degree of technological and commercial uncertainty concerning the possible result of an R&D project (see [5]).
- The type of strategy, which can be distinguished into, for example, prospector, defender, analyser, and reactor strategies [12].

In this paper, we will not further explore this fit between organisation and control systems on the one hand and the different contingency factors on the other. Instead, we will restrict ourselves to competencies needed for achieving the R&D function in the context of realising strategic flexibility as mentioned above.

First, we discuss the competence development necessary for achieving strategic flexibility. For the R&D function the following areas can be identified in which competencies have to be developed: [13]:

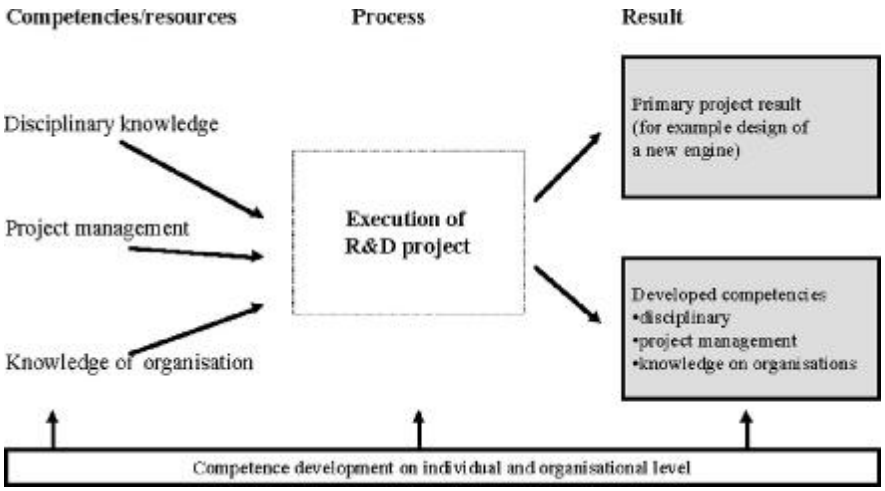
- Disciplinary knowledge consisting of science and technology: specific disciplines and working areas, which are of primary importance for the organisation;

  In a cleaning equipment company a small basic research department takes care of competence development in what is seen as the core of the business: sweeping and scrubbing systems, cleaning without water, infrared cleaning, noise reduction. Issues which are not seen as core competencies are for instance battery technology internal combustion motors. In this basic research department the number of employees is about 3. Next to this, a vast majority of engineers (+/- 130) are working on specific development projects. In the New Product Development process quite a number of suppliers are participating. Incidentally the development of a new machine is outsourced completely.

  The engineering capacity is not offered to the external market.

- Project Management, i.e., management of NPD processes: management of research projects with attention for interfaces between functions (marketing, R&D, production, etc.) and between relevant partner organisations (co-makers, suppliers, or buyers). Many people in the organisation must have this management competence, including people at lower levels (see e.g., [2]).
- Knowledge of the organisation, including strategy, structure and culture of the client organisation: the client organisation can be the firm's own mother company of which the R&D department is a part, but can be a third party as well with whom collaboration exists or to whom products or services are delivered.

Figure 2 Development of a competence / resource base



As an organisation intends to develop the competencies mentioned above, the determination of what needs to be learned for subsequent projects becomes necessary next to the primary project result (e.g., a new product). When Volkswagen develops a new motor, it is important to determine, record, transfer, and to make accessible important learning experiences. This, in fact, concerns the development of a learning organisation and knowledge management. Competencies can be developed for the organisation as a whole, but also on individual level.

The importance of individual competence development and of experiences gained from this process has been described by Brugman [14]. He argues that operational R&D processes and human resource processes (such as career and competence management) must be organised independently and separately. Competence development should be organised explicitly as a separate primary process.

In the search for strategic flexibility and appropriate competence development and the creation of a broad resource base, organisations have taken initiatives in many areas such as strategic alliances, networks, virtual organisations, multi-disciplinary and multi-functional teams, platforms etc. Many of these initiatives can be characterised by:

- Crossing borders between companies, departments, functional areas, etc.;
- Development of relationships between, for example, suppliers and clients;
- Determination of competencies of one's own organisation and of partner organisations;
- Strategic choices for competencies, markets, partners, and products and product families.

In the automotive industry we can observe, for example, that to a growing extent partners are being sought who can deliver (sub)systems instead of components. R&D is often also performed at the supplier's site on behalf of development of these systems. In this way, a

car manufacturer can purchase an engine from a supplier instead of developing one himself. The consequences of this trend are, amongst others:

- R&D capacity is transferred to suppliers. For the firm's own R&D department this may mean a certain amount of run-down. Spreading risks or passing them onto suppliers may be one of the motives. Another consideration may be that suppliers, by focusing on the development of certain components or systems, can achieve a level of specialisation that is beyond the reach of a car manufacturer.

  To be able to guarantee full service, the cleaning equipment company is very strict in formatting conditions for the development of new products. The overall condition may be called 'simplicity in design'. This includes at least the following aspects:

  - *cleaning equipment should be reliable and easy to operate and service. Therefore a preference exists for proven technology. The design should be operator friendly. Even unprofessional use and maintenance should not influence the quality and sustainability of the equipment.*
  - *modularity in design makes maintenance easier. Even the operator should be able to exchange subsystems like motor assemblies and cables.*
  - *use of the same components and (sub)systems in different types of the machine program enables both the equipment company itself and client companies who own a fleet of different types to limit storage and specific maintenance skills.*

- Extra resources are made available by outsourcing and partnership. By engaging in long-lasting collaborative relationships and regulating them well with contracts, trust and openness will grow. The resource base will, under certain conditions, be also available for collaborating parties.
- Work in R&D departments will change. Development will (partly) be replaced by specification of knowledge or products to be purchased as well as supervision and guidance of the purchasing process.
- The required competencies change. More emphasis will be put on the ability to communicate (listening, explaining, translating). This means that intentions and specifications must be recorded and clarified. In addition, during project execution, the necessary interaction and information exchange needs to take place.
- There is a danger of loss of expertise. The longer ago a certain product has been developed, the more difficult it will be to develop it again. This will lead to dependence of suppliers. This dependence will grow as the company, by loss of knowledge and experience, is no longer capable of functioning as a sparring partner and of critically judging supplied products and performance.
- The R&D department will have to make clear which capabilities are still present and which services can be offered. The internal R&D department can be envisioned to operate on a market where also external parties are offering their services. In such a situation client-orientation and a service attitude are indispensable.

Asking services, service offering and a service attitude are becoming important in R&D, given the developments sketched above, as these are becoming visible in the function, position and organisation of R&D in current enterprises.

4 Service in R&D

In this section we describe in more detail the concept of service–oriented R&D. We will first address the concept of integrated products, which denotes the intertwining of goods and services. Secondly, we will discuss the concept of service offering. A service offering represents all problem-solving activities, which are:

1 performed by the R&D function on behalf of other functions inside or outside the company

2 asked from or delivered to other (R&D) organisations, or

3 performed as part of a service contract.

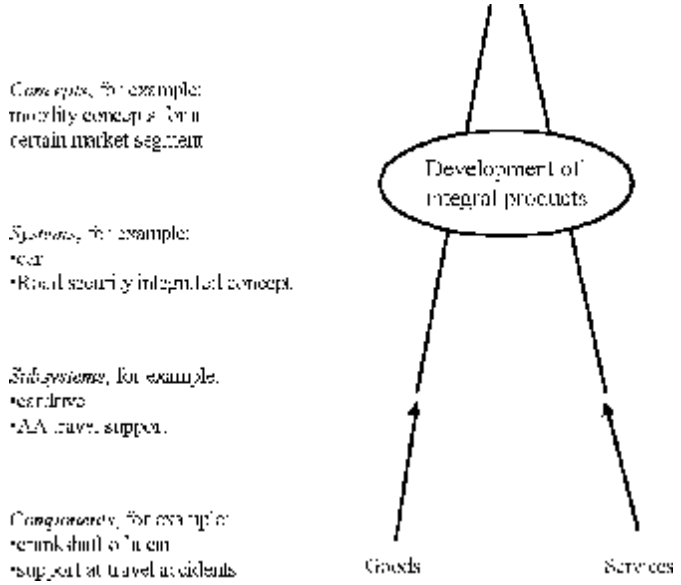
Although the last type of activity does not belong to the R&D function, we will briefly indicate the nature of this class. Finally, the concept of service competence is discussed, which addresses the competencies an R&D organisation needs to receive or deliver services or to develop integrated products. We will argue that, in essence, service competence is the competence an R&D function requires to collaborate with others inside or outside the organisation.

4.1 Integrated products

Not so long ago, a garage-owner would not dare draw the customer's attention to the expiry date of the warranty. Customers would definitely use this to formulate complaints and the dealer would incur extra expense. In essence, the manufacturer/importer was not very keen on taking over responsibilities and corresponding costs. Nowadays, a product [15] must be a hundred per cent reliable, while competition is mainly based on the service offering. This is more than just customer friendliness. Products become part of service concepts. A copying machine, for example, is becoming part of a service ***reliable copying facility*** offered to the market. ***Reliability*** and ***copying facility*** are valued in the most literal sense, depending on the specification. In addition, in the same environment of office machines we can observe a strong integration of functions such as printing, copying, faxing, with additional links to computer and telecommunication facilities.

Goods and services are becoming more and more intertwined and are being offered as integrated products. In view of these developments innovation is not limited to the development of (combinations of) new products, processes, markets, technologies, and organisational forms [16]. Innovation is also a matter of the development of products and systems, which combine to an increasing extent physical products, software, and services. This development of innovation at higher levels of aggregation comprising the integration of (physically tangible) products with services is depicted schematically in Figure 3.

Figure 3 Development towards integrated products



Service as part of an integrated product often takes the form of a contract for service or maintenance of the product after product delivery (see also the next section). The design and development of integrated products require collaboration between the R&D function and many other functions within or outside the organisation. For example, in designing cars and related services collaboration may be needed with suppliers of sensor systems, with the production and assembly function, with car dealers, with repair centres, with destruction companies for parts or material recovery, etc. The design, delivery, and maintenance of production tooling for sheet metal parts, like car doors or hoods, by a tool supplier requires close collaboration with the large car manufacturer requesting the tool. In insurance offices, collaboration between many functions in the organisation as well as with other organisations is needed to develop an insurance package including services the customer desires when needed. The design and development of an SOS service requires (international) collaboration with the police, transport organisations, trauma teams, rescue agencies, and others. Also, in health care integral treatment and service gradually come into use, for example where patient-oriented instead of physician-oriented care requires collaboration between different departments and health care institutes. Coupling with informing and preventing activities is obvious here. Finally, in the world of banks, insurance companies, engineering offices, and advocacy, numerous other examples can be found.

Actually in the cleaning equipment company a strong movement can be found into the direction of integrated products.

> *There is a definite trend towards 'rent per hour' in which the manufacturer guarantees 24 hour seven days a week operation of equipment at an agreed cost per hour. In the package delivery of the equipment, training of the operator(s), routine maintenance of the machine(s), and repair service is included.*

Integrated products not only involve business-to-consumer, but also business-to-business contracts. Lease companies, for example, would be happy to take over the mobility function as a whole. Their often-convincing argument is that companies can then focus on their core business. Another example in the area of industrial cleaning equipment is a full service contract by the equipment manufacturer for cleaning contractors buying the equipment. Close interaction with the client is needed to develop an integrated product that satisfies this client's wishes.

Most importantly, the development of integrated products requires alignment and interaction with the end-client or end-customer(s), or at least a thorough investigation of their requirements. Service implies a process in which the client/customer is involved [17]. Conversely, without involvement of the client/customer service cannot be delivered at all.

> *The concept of integrated products is leading to functional shifts within and between organisations. The importance of the purchase function, for example, is rapidly increasing [18]. Since the knowledge needed in earlier days to develop parts and subsystems is now needed to assess and select suppliers, knowledge has to be transferred from the R&D function to the purchase function. Moreover, the R&D function has to maintain the knowledge to be able to collaborate with suppliers. Maintaining this knowledge is a major issue, while new knowledge must be acquired to enable collaboration with suppliers of added product functionality. Acquisition of new knowledge may involve collaboration with R&D functions elsewhere within or outside the organisation.*

4.2 Service offering by R&D

In discussing the concept of service offering, we will distinguish service at the strategic level from service at the operational level. At the strategic level, R&D functions may be given the task to advise with respect to necessary strategic choices. In developing this advice, the R&D function acts as a strategy consultant. Any mature R&D function should be capable of doing this on behalf of the firm's own organisation or external ones.

At the operational level, service may be offered either in a structured or in an ad hoc way. Ad hoc service often takes the form of problem solving. R&D people as professional knowledge workers like this kind of activity. They like the challenge of problems to be solved and find much satisfaction in providing this type of support and getting appreciation for it. Sometimes it is experienced as an important base for legitimating R&D expenses. However, service of this type often interferes severely with the primary task of R&D, namely product and process innovation. When the problem-solving service is provided without any refunding, R&D might be in danger of missing its targets. The necessity and nature of ad hoc services must be judged more carefully to decide on the way they may be offered.

> *In the cleaning equipment company, during the 12 months after launching a new product, the product development team keeps the responsibility for*

improving products and production processes. In addition to ideas from within the development team, complaints from customers and others involved in, for instance, commercial and production departments are important resources for improvements in functionality, reliability and manufacturability. This is theory, while in practice it is very difficult for engineers to keep dedicated to such a project, which is not really challenging any more.

Although they may argue a lack of time, in fact often there seems to be a lack of motivation. Engineers are eager to move their attention and prefer to concentrate on the development of really new products. This motivation causes conflicts between the required focus on often very profitable current products and NPD. In order to guarantee continuity in engineering capacity for current products after 12 months a specific team is made responsible for current products.

Before ad hoc services are offered, the R&D function should determine which ones belong to their core business or which ones remain worth offering. These services should then be considered more closely. Firstly, ad hoc services may provide a basis for learning. For example, problems occurring downstream R&D because of an insufficiently integrated way of working [19], for whatever reason, have to be closely studied. The knowledge thus gained may lead to improved ways of working in R&D. In this way future problems may be limited to inevitable ones. Secondly, ad hoc problems may recur over and over again. Studying such problems may lead to knowledge that should be disseminated to the organisation to prevent unnecessary requests in future. Learning will, however, not happen without resources assigned to this task. The R&D function should (re)consider how to spend its budget. In any case, the R&D function should decide which of the ad hoc services still should be offered freely. Other services should then be offered in a structured way including payment, while the remaining ones may be refused because they are designated to fall outside the core tasks of R&D.

Services offered in a structured way often comprise projects consisting of design and development tasks requested by other functions or organisations. Examples can be found in innovation and engineering offices. Such a service offering, to be competitive, requires a thorough insight into the resources needed to perform the tasks. This insight is also a result of learning. At present, R&D functions still pay limited attention to this type of learning. One of the reasons is that learning has to be performed as an internal project for a large part. Internal projects put a claim on the R&D budget just like learning with respect to ad hoc services. Time and budget constraints often limit or even prevent learning.

Finally, service is offered as part of the execution of service contracts. There are several ways in which such services may be offered. Firstly, service offering may be continuous. One example is the continuous monitoring of private homes and public buildings starting with the installation of a security system. Secondly, service offerings may be periodic. The periods between services may be static, e.g., the periodic check-ups of central heating systems, or dynamic depending on use behaviour. To this end, sensors registering the wear of certain functions may have been installed in the product. Finally, the service is offered instantaneously when required by the customer. Instances of this type of service are all actions induced by calamities, instant failures, alarms, etc. according to contract specifications. Although this type of service is not offered by R&D, the R&D function has to know about the types of services that can be offered and which parties are involved in offering the services. In designing the integrated product as

described above, all those parties should be involved at some stage in the development of the product.

4.3 Service competences

In the former paragraph it was argued that competencies must not only be seen as resources, needed for the execution of R&D projects but also as a main result of the projects itself. Next to the competencies as mentioned in Figure 2 (disciplinary, project management, knowledge of organisation) service competencies also can be seen as an important result and as a contribution to the resource base for future success. In order to find out what kind of service competencies could be relevant we start with a focus on processes.

First of all, *primary processes of design and development*, related to production, selling, maintenance, and servicing, imply in many cases supportive activities or even execution of complete work packages with primary responsibility by R&D. This means, in terms of competencies, capabilities to cooperate and coordinate complex interdisciplinary, interfunctional, and interorganisational situations. It also means knowledge of resources needed as well as resources that are available, both quantitatively and qualitatively.

> *The cleaning equipment manufacturer has a very well defined new product development process. The process starts with idea generation from people inside as well as outside the organisation. This process runs for 6 months until June of a given year. The product managers co-ordinate follow-up after idea generation to generate project proposals and conduct feasibility analysis (mainly by R&D with respect to technology barriers and Finance with respect to return analysis). The top X priorities are discussed by the new product idea council in September (represented by Marketing, Finance, Engineering, Sales and Operations as well as people from around the globe to secure local applicability). The selected projects have to be submitted to senior management in October for approval. After approval, projects are put in the budgets for next year to be worked on by R&D/engineering*

As far as cooperation and execution of the task may be characterised by intensive interaction with R&D people and other stakeholders' processes can be seen as ***processes of service***. In such cases the quality of the result in the eyes of the internal or external client will be based not only on disciplinary and technical competencies, but also on social competencies [20–21], as well as relational competencies [22–23]. An attitude of serviceability and respect for other parties is a fundamental element of process oriented competencies.

The same counts for the knowledge of other parties. In order to understand other parties' interests and to find an adequate fit between one's own capabilities and given or latent requests, it is important to have knowledge about the ***strategy development processes*** of internal and external partners. Maybe it is even possible to take part in strategy development processes of clients.

Last but not least, serviceability should be brought on a level of collective *learning. Learning processes* should be facilitated and organised with respect to the service aspect: learn to serve.

The question is how competencies like service orientation can be developed by organisations. Important conditions for this learning purpose (according to Fisscher, [13]) are:

- *Reflection* on experiences in the light of what generally is considered important. Reflection concerns questions like: What can we learn from concrete experiences and incidents for the innovative capability to be developed and the corresponding service capability?; Which consequences for the conduct of an organisation can be deduced from general goals and assumptions around service?
- *Communication* between employees and also with stakeholders in the environment. Communication concerns questions like: Are employees from relevant parts of the organisation involved in the process of reflection, mentioned above?; Is there room for sharing of experiences, considerations, and personal values to allow mature choices to be made and emergence of a broad basis and trust?
- *Integration* of different perspectives. Integration concerns questions like: Are, apart from technical aspects, financial, strategic, and market aspects taken into account in decision making? Is attention rational and task-oriented as well as relational and human-oriented?

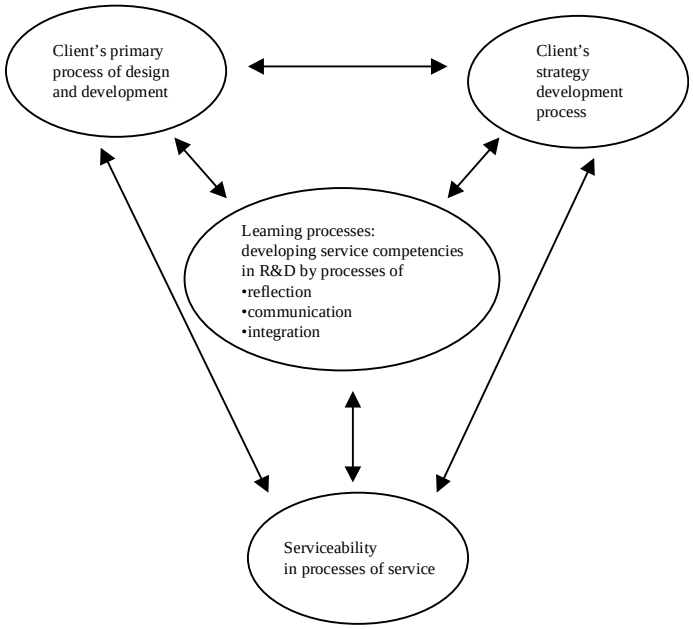
The above stated conditions for the development of the capability for service offering imply that employees consult each other, listen to each other, relate their own perspective to those of others, etc. In practice in R&D environments an essential problem can be encountered in this respect. R&D employees (researchers, engineers, technicians, inventors, to mention some of the categories) highly value their autonomy and are proverbially stubborn.

Nevertheless, collective performance, in service offering, satisfying current needs in the environment, can only be realised if there is sufficient subordination [24]. Next to the possibilities of win-win situations, subordination of self-interest to the interest of the collective will be an important condition. We may call such attitude ***serviceability to the collective interest***. Such serviceability does not concern an abstract general interest, but a commitment to the direction chosen in a deliberate and well-considered way.

Creating service competencies in a learning mode by processes of reflection, communication and integration in fact presupposes exactly that what they are aiming for, namely serviceability. Serviceability is at least required in a sense that people should accept and respect other's contribution as needed for future success. How does one set this flywheel going? Methods of organisational change and intensive efforts of leadership and championship will be required undoubtedly.

In the foregoing, developing service competencies is described as oriented on several processes in order to facilitate them and as a process in itself. This process in fact is a process of learning that must be established and maintained by processes of reflection, communication and integration. In Figure 4, we have depicted this orientation.

Figure 4 Developing process-based service competencies



5 Summary and future research

Innovativeness in organisations requires more than new knowledge and new products. It requires new competencies and organisational forms, a renewal in many areas, not aimed at creating a new fit between enterprise and environment. For merely creating fit the environment is too turbulent and also in the organisation there are too many new developments and experiments. Attention is more focused on strategic flexibility and the competencies and resources needed to achieve such flexibility.

For innovativeness in R&D service has proven to be an important factor. Service is an important integral component of new products, which to a growing extent have an encompassing system and concept nature. Service has also proven to be important as a product of R&D either delivered to the company of which it is a part, or to external partners or clients, or acquired from other, often external, parties.

Finally, service, in the sense of serviceable, subordination of self-interest, and commitment to the relationship with colleagues and partners in research and development, is an important condition to perform as a group (project team, R&D department).

Service appears in many forms and on many levels and it appears both as a goal and a condition. In short, service goes hand in hand with organisation, at least this should be the case. In those R&D environments where these integral service characteristics emerge, one could speak in most cases of a radical innovation in R&D aimed at service offering.

In our future research we will use the concepts presented in this paper to describe, analyse, and classify innovations in R&D with respect to service. The research aim is to gradually build knowledge on opportunities to be identified and conditions, organisational as well as technological, necessary for achieving a sufficient level of innovativeness. This knowledge will be built by means of extensive case studies in supplier and client companies that collaborate in the development of new products and processes.

References and Notes

1 Bolwijn, P.T. and Kumpe, T. (1990) 'Manufacturing in the 1990's. Productivity, flexibility and innovation', *Long Range Planning*, Vol. 23, No. 4, pp.44–75.

2 Paashuis, V.J.B.J. (1997) 'The organisation of integrated product development', *PhD Thesis*, University of Twente. Enschede, the Netherlands.

3 Wognum, P.M., Weerd-Nederhof, P.C. de , Boer, H. (1997) 'Challenges in organising and managing integrated product development processes. Results of case studies into state-of-the-art in concurrent engineering in industry in the Netherlands', *Research Report 97W-001/T&O-001*, School of Management Studies, University of Twente, Enschede, the Netherlands.

4 Weerd-Nederhof, P.C. De (1998) 'New product development systems', *PhD Thesis*, University of Twente, Enschede, the Netherlands.

5 Kerssens-van Drongelen, I.C. (1999) 'Systematic design of R&D-performance measurement systems', *PhD Thesis*, University of Twente, Enschede, the Netherlands.

6 Weenink, S.A.J., Wognum, P.M. and Fisscher, O.A.M. (1999) 'Balanced relationships. Managing client-supplier relationships in product development', in *Proceedings of the R&D Management Conference*, New Delhi, pp.343–351.

7 Miles, M.B. and Huberman, A.M. (1994) *Qualitative Data Analysis*, SAGE Publications (second edition), London.

8 Roussel, Ph.A., Saad, K.N. and Erckson, T.J. (1991) *Third Generation R&D*, Harvard Business School Press, Boston.

9 Burns, T. and Stalker, G.M. (1961) *The Management of Innovation*, Tavistock, London.

10 Hamel, G. and Prahalad, C.K. (1994) *Competing for the Future*, Harvard Business School Press, USA.

11 Omta, S.W.F. (1995) 'Management control in biomedical research and pharmaceutical innovation', *PhD Thesis*, University of Groningen, Groningen, the Netherlands.

12 Miles, R.E. and Snow, C.C. (1978) *Organizational Strategy, Structure, and Process*, Mc Graw-Hill, New York, USA.

13 Fisscher, O.A.M. (1999) 'Personal quality of organisations', in D. van de Lagemaat and P. de Mos (Eds.), *Processes in Movement*, Samson, Utrecht, the Netherlands, (in Dutch).

14 Brugman, O.P.G. (1999) 'Organizing for competence development in research and development', *PhD Thesis*, University of Nijmegen, Nijmegen, the Netherlands.

15 The concept of product is easily understood as a tangible good. Strictly speaking, the concept of *product* refers to both goods and services. Characteristic of services is, for example, that they are not tangible, that their production is primarily performed in the presence of and interaction with the client, and that repair of errors is difficult or even impossible.

16 Roveda, M. and Muffatto, M. (1999) 'Developing product platforms: analysis of the development process', in W. Werther, J. Takala and D.J. Sumanth (Eds.), *Productivity & Quality Management*, MCB University Press, Bradfort, pp.11–32.

17 Sundbo, J. and Gallouj, F. (2000) *Int. J. Services Technology and Management*, Vol. 1, No. 1, pp.15–36.

18 Lamming, R., (2000) 'Assessing performance in supply', in J. Tidd (Ed.), *From Knowledge Management to Strategic Competence*, Imperial College Press, pp.229–348.

19 With the term *integrated* we denote all approaches aimed at improving the design process in terms of time, costs, quality. Examples of such approaches are Concurrent Engineering, Design-for-X approaches, and currently also Collaborative Engineering. In the literature many examples of specific approaches can be found.

20 Hardjono, T.W. (1995) 'Rhythm and organisational dynamics. Four-phase model', *PhD Thesis*, Eindhoven Technical University, Kluwer, Deventer, the Netherlands, (in Dutch).

21 Lindkvist, L., Söderlund, J. and Tell, F. (1996) 'Managing knowledge concurrently: complexity and learning in projects', in *Proceedings of the R&D Management Conference*, University of Twente, Enschede, the Netherlands, pp.213-227.

22 Weisenfeld, U., Fisscher, O.A.M., Pearson, A. and Brockhoff, K. (1998) 'Managing technology as a virtual enterprise', in *Proceedings of the R&D Management Conference*, Avila, No. 53.

23 Vinkenburg, H.H.M. (1995) 'Stimulating to perfection. Critical factors in improving service', *PhD Thesis*, University of Groningen, Groningen, the Netherlands (in Dutch).

24 Weick, K.E. and Roberts, K.H. (1993) 'Collective mind in organizations: heedful interrelating on flight decks', *Administrative Science Quarterly*, Vol. 38, No. 3, pp.357–381.