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Business Process Excellence

Businesses are made of processes. Enterprises strive for excellence in business processes. Different stakeholders perceive the topic of business processes differently. You can approach business processes either from a strategic viewpoint or a technical viewpoint. This, in the first place, means that business processes as an object of investigation are so complex that whole sub communities formed to address the topic appropriately. Strategic issues and IT issues are eventually intertwined if you conduct a business process improvement project. Business processes are supported by IT in today's enterprises, so if your target is to improve business processes of an enterprise you are usually immediately involved in IT issues.

In this chapter we present the strategic view of business processes. We have seen and still see massive business process reengineering efforts in enterprises. Business process reengineering (BPR) [151, 150] is by far not only about business process optimization or business process redesign. It is a management issue, actually, it is a top management issue. Business process reengineering is a paradigm at the level of organizational structure, so it is about business reengineering, and usually about reengineering of large enterprises, i.e., corporate reengineering. After introducing business process reengineering and discussing its intention we will have a look at concrete opportunities to improve processes. Knowing about the motivation of business process improvement and learning about concrete examples of business process optimization is a good start, however, in concrete process improvement projects a systematic approach is needed to proceed successfully. With business process benchmarking we have a concrete approach for this at hand.

A further topic in this chapter is systematic business process management. Business process management is about a group of activities that make the business processes of an enterprise the subject of continuous investigation and improvement – it consists of the definition, execution, monitoring and optimization of business processes. If you set business process management into relationship with business process reengineering, you can see it from two sides. On the one hand, it can be seen as the result of decisions made during

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business process reengineering being responsible for the fine-tuning of business processes in daily operations. On the other hand, it can be seen as a tool for ongoing, continuous business process reengineering. In practice, taking one of these two viewpoints determines whether business process management has rather a tactical or strategic emphasis in an enterprise. In any case, the analysis of benefits of business process management and possible impacts in general is not part of business process management itself, it really belongs to strategic efforts outside business process management.

Finally we need to discuss the strategic role of information technology (IT). Information technology is at the heart of the modern enterprise. As a crosscutting concern it empowers the enterprise both in house and in its context – the competitive market and the hosting society. Furthermore, there is often potential for improving business processes without exploitation of information technology. But usually concrete improvements are enabled by information technology. Information technology can support business processes directly and indirectly by empowering management and reengineering efforts. Once the importance of information technology for business process reengineering and management is recognized and taken for granted, these topics can be discussed independently of technology. However, eventually when it comes to the implementation of reengineering results and the establishment of business process management, concrete information technology must be chosen.

The explanation of business process reengineering, optimization, benchmarking, management and the enabling IT from a strategic viewpoint sets the stage for the discussion of business process technologies like workflow products and business process modeling languages and tools. Advances in these technologies must eventually address business process optimization. What we are seeking are such advancements that make IT systems flexible and integrative. Here, flexibility means a significant reduction of costs for the redefinition and construction of enterprise IT systems compared to today's technologies, so that there is an observable impact on the reactiveness of business process management. Another strand of advancement is towards pervasive integration, i.e., the availability of all information emerging in an enterprise in all potential processes.

2.1 Business Process Reengineering

In order to give an impression of what business process reengineering is about we explain it from the viewpoint of business reorganization first. Later, in Sect. 2.2 we will discuss typical reengineering patterns. These patterns make clear that business process reengineering is not merely about reorganization; it is about migration to process-oriented structures – having reorganization often as a typical result. In a traditional structure the units of the corporation are functional business units, i.e., marketing, production, procurement, sales, accounting, human resources, research and development. Now, large companies offer several products and several services. So business processes crosscut the functional units of a traditional hierarchy. This is where business process reengineering can start. It is about changing the focus to the business processes. It proposes to ask for new organizational structures that eventually enable continuous business process optimization. For example, it would be possible to radically change the organizational structure and make the main processes the top-level units of the enterprise. Now, the managers of the resulting units are no longer department managers or area managers, instead they are process managers in charge of the outcome of one process. Before such a restructuring each of the units was involved in each of the crosscutting processes. This means responsibility was spread with the risk of overhead and not exploiting potential specialization.

Now, after making the main processes top-level units, each of the units reflects the former hierarchical structure inside, i.e., having groups for the various functions. In this way, the functions can be specialized and optimized by streamlining them to activities that add value. Such reorganization can already make sense for small and medium enterprises (SMEs). For example, imagine a small software development and IT consulting company that is organized as a number of profit centers. Now, having a top-level sales department neighboring the profit centers would most likely be an anti-pattern. Usually, it would be more appropriate to have sales persons in each of the profit centers for obvious reasons. However, in general there is no evidence that a process-oriented reorganization of an enterprise makes it perform better, because one has to admit that one may also observe counter effects. Before the restructuring, the process responsibilities were spread over several units, now responsibilities for the major business functions are spread over different units with potentially similar drawbacks – in a traditional hierarchy the know-how with respect to a function is gathered and improved over years in a central unit. At least, it seems to be self-evident that with respect to continuous process optimization the process-oriented organization is the correct choice.

2.1.1 Strategic Nature of Business Process Reengineering

The business process reengineering paradigm as introduced in [151] was a radical approach from the beginning, foreseeing a business revolution. For example, it is emphasized that business process reengineering is not reorganizing, and it is not restructuring. Instead, it is really about creating a fundamentally new work organization in the enterprise. However, in practice, process orientation often evolves in enterprises in a step-wise fashion resulting in matrix-like structures having designated stakeholders on a more or less equal level for both functions and processes. Here, in this book, it is important to understand that business process engineering is a holistic effort that aims to empower the enterprise for process improvement.

Business process reengineering can also go beyond the boundaries of the enterprise, then having inter-enterprise processes as its object. A typical example is the optimization of processes between a manufacturer and one of its suppliers. Opportunities are the reduction of reconciliation by reducing the number of contact points or the relocation of responsibilities. Again, information technology has proven to be a key enabler for better performing processes – we have seen the electronic data interchange (EDI) [118] and business-to-business (B2B) initiatives in this field.

In business process reengineering the restructuring goes hand in hand with adopting best business practices in general. Therefore, when talking about business process reengineering to managers usually a group of innovative management practices on different levels come to their minds that are actually cornerstones of other prominent management approaches of the 1990s like total quality management (TQM) [31] or Kaizen [337, 167], e.g., profit centers, outsourcing, the networked organization, the learning organization, the paperless office, customer relationship management, continuous improvement, team work [225].

2.1.2 Power Shifts Triggered by Business Process Reengineering

In the following few paragraphs we try to sketch the tacit understandings of business process engineering. It may explain why some stakeholders in enterprises support it whereas others do not.

Business process reengineering changes the way the business is done. This also has an impact on the group dynamics [216] in the enterprise, i.e., resulting in the redefinition of roles and a new perception of roles. Many of the changes that come along with business process reengineering efforts are, in principle, well suited to empower employees. So is the reduction of control to a reasonable level and the increase of people's responsibility for tasks, which goes hand in hand with the aforementioned reduction of control. So is also with the allowance of more decision making in operational tasks – we will see more examples that prove this statement correct when we discuss concrete patterns of business process reengineering later in Sect. 2.2.

The efficiency of assembly lines in factories of early industries came along with a monotony of jobs and alienation of workers. In a modern factory the degree of automation in the assembly line increases. We have seen a shift from manufacturing – the second sector of industry – to services and organization – the third sector of industry – in societies [129]. But this trend can be observed not only at the level of economies but also in single enterprises, driven by the demand for more sophisticated products and services, on the one hand, and the increased degree of automation, on the other hand. So, the problems that are addressed by business process reengineering in an enterprise stem from a business culture that lags behind – simplifying a bit, it is not appropriate to manage the processes in a modern enterprise in a similar manner as an assembly line. The awareness of this is increasing – people arrived in the information society [229, 26], which clearly goes beyond the three classical industrial sectors.

Business process reengineering is a rationalization approach, it eventually targets cost savings. However, it does so by encouraging people also to consider solutions that overcome the attitude that people usually associate with rationalization, i.e., high specialization and strict separation of duties. The prosperity of employees has early been an objective in approaches to rationalization – in the approach of scientific management [338] there is the fundamental idea that the prosperity of employers and employees are not antagonistic, on the contrary, there is the conviction that the prosperities of employers and employees are mutual dependent in the long run and that the interests of both groups are actually the same. For us, this leads to the following questions.

Does business process reengineering actually empower staff? Does business process reengineering therefore mean that a power shift [252] from the strategic to the tactical level and from the tactical level to the operational level occurs? With respect to the first question: if processes in an inelastic business hierarchy really obey to the imposed rules and control, yes, reengineering is about actually changing things in daily operations. However, there is sometimes a difference between how things are done and how things are explicitly done. Then, reengineering is about internal business transparency.

If there is a difference between processes and the explicitly defined processes this does not necessarily mean that overall efforts are performed suboptimally. Often, some additional processes are necessary that are not under control of the management. Often, it would mean to trap into the anti-pattern of micro management if the management tries to get into control of all these micro processes that make up a successful enterprise. The same is true for responsibility. Typically, people in enterprises often feel responsible for their tasks and beyond, even if they do not have the responsibility formally. Take software project management as an example for these phenomena. Despite the discussion of sophisticated software processes like the iterative approach [303], spiral model [35], the two-dimensional Rational Unified Process (RUP) [209] or the agile software development approach with Extreme Programming (XP) [20] as prominent representative you see a lot of projects in practice that are simply managed with a stage-wise process model [27]. Some of these projects are successful, others are not. In the successful projects there is usually a tacit commitment of all stakeholders that the stage-wise model with its milestones is just the manager's viewpoint on the project, i.e., a foundation for tracking the project proceedings, but does not enforce a strictly step-wise approach to work organization.

Enterprises encapsulate know-how, also process know-how. Sometimes, the knowledge of how things are actually done is not explicitly available in enterprises but distributed over teams and stakeholders. Then business process engineering is also about making explicit the process know-how. This point is important with respect to the second question we posed, i.e., whether business process reengineering enacts a power shift down the enterprise's hierarchy.

Making explicit the process know-how in an enterprise is an important interest of those who have personnel responsibility – beyond the immediate cost savings that can be gained by business process engineering. In the extreme, through a rigorous definition processes become a kind of software, they then exist independently from the persons that run them and the persons that run them become replaceable.

2.2 Business Process Optimization

The notion of division of labor is central to business process optimization. Division of labor is at the core of industry. The discussion of division of labor always has an economics facet, but it does not have to be conducted always only at the level of economies, where it is about the emergence of professions or industrial branches. Division of labor can also be discussed at the level of work organization – see, e.g., [323] – and that is the level of discussion that interests us here.

Division of labor can save costs, because of the extra dexterity that emerges from added routine or special education connected to the several branches that are the result of a division of labor. This effect can be observed on different levels, ranging from the very macro level of industry sectors to the very micro level of tasks and operations in a factory. However, division of labor can also cause additional critical costs, because of overhead for organization and communication. This phenomenon is very well known from the field of project management [291]. Project management differs from production management in that projects are limited in time. The costs saving effects of division of labor can also be observed in projects; however, that is not the point. Often, a certain task is distributed over the members of a team without the potential to exploit specialization. Here, division of labor is just needed to get a job done by a given deadline. In project management it is known that division of labor always costs extra resources. You can reduce the project time needed by dividing work, however, at the same time you increase the work time needed – due to the extra efforts to manage more people in parallel. It is also known that, sometimes, the overhead of dividing work can even consume the savings in project duration. That is what is expressed by Brook's law with respect to the domain of software project management: "Adding manpower to a late project makes it even later." [45].

Not neglecting the trade-off between potential cost-savings and potential costs of division of work is a center pillar of business process reengineering. In business process reengineering efforts certain patterns of redesigning processes have been observed [151]:

- Defining a new job by combining several existing ones.
- Performing work in the context where it arises.
- Balancing centralization versus decentralization.

- Allowing decision making at the operational level.
- Allowing process steps to be performed in parallel wherever possible.
- Identifying efficient versions of business processes.
- Reducing control.

These patterns must not be understood as a cookbook or "How To"-guide. They can provide some guidance in business process reengineering efforts, because they are examples of results in successful reengineering projects. However, they do not replace systematic approaches to reach business excellence like the ones described in Sect. 2.3.

The patterns explained in this section have their counterpart discussion in currently emerging business process management technology.

2.2.1 Combining Jobs and Naturally Hosting Work

Combining existing jobs into a new one is at the core of the discussion we just started on the trade-off between overhead and cost savings of division of labor. If a task is distributed over several persons it can be, in principle, led back to a single job done by a single person. What you might loose in doing so is the potential extra specialization. However, you might also get rid of overhead in communication between the people involved in getting the task done. This argument might not work for an assembly line where there is no communication needed between the several steps. However, it becomes more and more important the more complex a task is in terms of the amount of knowledge that emerges in each single instance of the task. Such knowledge must be transferred from one step to another.

The overhead for communication is perhaps the most directly observable cost; however, it is not the only one. Distributing a task over several people might lead to an alienation of the involved personnel. Such alienation might have a cost. For potentially creative tasks it can be a severe problem if people loose a holistic viewpoint. For creative people it may be a problem to be restricted to too specialized operations so that human potential is wasted from a general viewpoint. Furthermore, quality of the outcome might suffer, because everybody is concentrated on the concrete operation he is responsible for, but nobody is responsible for the task as a whole anymore.

We use the term cohesion principle for collecting work pieces that are scattered around organizational units in the enterprise and assigning them to a single organizational unit. The cohesion principle is a general pattern in business process reengineering that can be observed on different levels of granularity. The combination of jobs just discussed is the application of this principle to the organizational level of single employees. It can also be applied to the level of teamwork [225]. Here it means that a task is too complex to be handled by a single person with either respect to work load but more likely with respect to expertise needed to get it done. A notion of team can balance the need for division of labor and the need for responsibility for the task.

Figure 2.1 once more shows the application of the cohesion principle at the level of single employees. Figure 2.1 is also meant to illustrate why we have chosen the term cohesion for the principle. Consider process (i). Assume that somehow the person in business unit (b) is the process owner, i.e., he starts the process, finishes the process and is eventually responsible for the outcome of the process. The majority of the job is done by this person and only some work is done by some others in business units (c) and (f). It is fair to say that process (i) actually resides in business unit (b) and that after the business reengineering in Fig. 2.1 the activities in business units (c) and (f) returned to the context from which they originally arose. Criteria like the location of the main part of a process and the main process stakeholder are all very good, but they are not hard criteria. They can give guidance in reengineering but eventually the question must be answered as to where it makes most sense to perform an activity from an overall cost-savings perspective. Eventually, it is the cost-effectiveness of a process that counts. It could be that there is strong rationale for getting parts of the process (i) in Fig. 2.1 done in some other business units and that it makes no sense to remove them from there. Business process reengineering is just about encouragement – it encourages reconsidering the way a current business is run.

If the cohesion principle is applied to the level of business units it can lead to the discussion about process-oriented business reorganization that we had in Sect. 2.1. At this level the principle can be about reconsidering the existing organizational structure with respect to business process awareness.

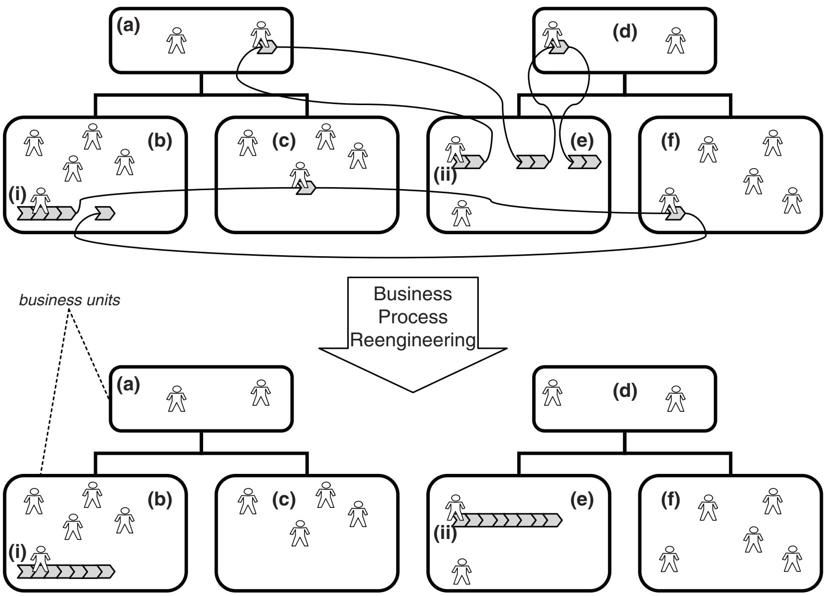

Fig. 2.1. Applying the cohesion principle of business process reengineering.

Reengineering for the purpose of reorganization is often perceived as business process reengineering 'per se', perhaps because of its generally visible impact. Reengineering involving the level of business units can lead to a hard reorganization but it does not have to. Then, reengineering is rather about balancing centralization versus decentralization. The existing business units remain as traditional centers of expertise; nevertheless, some responsibility and know-how is transferred to other business units where the actual processes reside – actually, the processes in Fig. 2.1 are examples of this because the organizational hierarchy is not changed due to the business process adjustments.

2.2.2 Decision Making

A typical application of the described principle of combining work pieces into broader ones that perform more efficiently is to give decision steps in a process to staff at the operational level.

Often, some decision making is given to extra roles just as a matter of principle. Allowing decision making at the operational level can have all of the effects described above, i.e., reducing overhead, reducing alienation, improving responsibility for the task. And perhaps it is even particularly well-suited to foster the effects. However, it is not really justified to consider the pattern of giving decision making from the tactical to the operational level as something fundamentally different as combining work pieces merely from the operational level. From a general viewpoint, and, in particular, from a process-oriented viewpoint it is actually not different – it is just about combining work pieces and the difference is only in the hierarchical level the work pieces stem from. This is illustrated in Fig. 2.1. Here, process (ii) spans two different levels in the organizational hierarchy before reengineering. However, like the reengineering of process (i) it is eventually just about combining work items into a new job.

2.2.3 Parallelism in Business Processes

Exploiting potential parallelism in business processes yields a speed up [112] – see Fig. 2.2. Consecutive dependencies should be limited to causal dependencies. Therefore all of the process and task modeling languages and technologies as well as project planning tools [291] like PERT (Project Evaluation and Review Technique), CPM (Critical Path Method) or the Gantt diagram offer support for the definition of parallel activities. The problem is that the extra complexity of processes with parallel activities inhibits the exploitation of parallelism. It is easier to define a strictly stepwise process. It is easier to monitor the instances of such a process, because each state of such a process instance consists only of one activity. It is even easier to follow a stepwise process, because there is no need for any synchronization mechanism. However, the considerable time savings created by exploiting parallelism justify the extra efforts needed to manage parallelism.

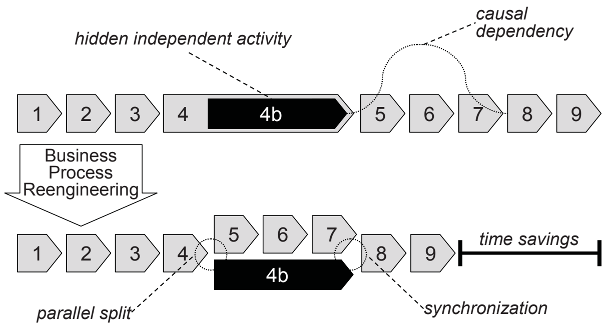

Fig. 2.2. Identifying and extracting a potentially parallel activity.

Nevertheless, the complexity of parallel processes is a hurdle. Consider a successfully running process. First, it is not easy to determine those chunks of work of this process that are not strictly causally dependent. Second, it might be considered a risk to change the process at all. Modern business process management suites offer various kinds of support for parallel activities – a comprehensive overview of the process control mechanisms offered by today's business process management suites is given by [307].

It is always worth looking at the concept of parallelism, not only directly for opportunities of parallelizing activities. For example, imagine a process that is run by one person only. Here, formally there is no difference with respect to throughput in running several process instances sequentially or in parallel. However, in practice there can be differences. For example, the person can start and run a couple of processes A, B and C in parallel, i.e., first finishing the first step of each of the process instances, then finishing the second step of each instance and so on. This can have a the subtle time-saving effect, i.e., the person gains local routine for the performed steps this way – see Fig. 2.3 for an illustration.

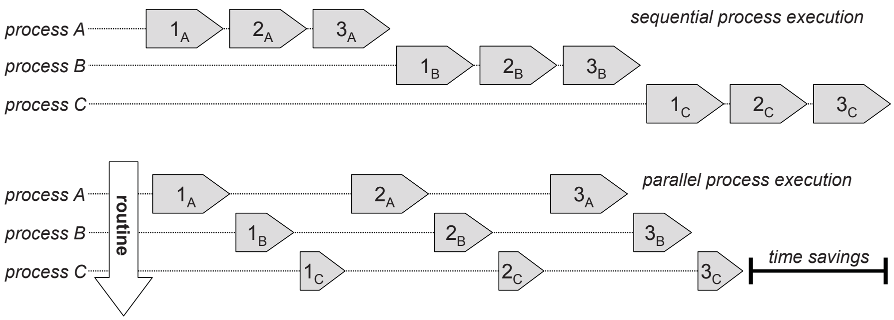

Fig. 2.3. Gaining routine with tasks by running process instances in parallel.

This argument is similar to the one found for the pattern of retaining familiar work items found in [308]. The larger the set of processes that are run that way, the more convincing is the argument. Similarly, the argument is more convincing when long-running processes are considered. However, the counter effect may also be observed for this example, i.e., perhaps the person becomes confused by this parallel approach resulting in additional time needed.

2.2.4 Versions of Business Processes

Parallelization of processes is about identifying chunks of work that are not causally dependent. Versioning of processes is about identifying alternative chunks of work in an existing process and eliminating superfluous activity by distinction of cases.

A business process is a net of activities that work together to achieve a defined goal, i.e., a defined business objective. Once a business objective is defined to be supported, this business objective determines the set of activities that are necessary to achieve this. Sometimes it is possible to distinguish cases dependent from conditions from the business context. Sometimes not all of the activities of a business process are actually needed to achieve the defined goal, but nevertheless all the activities are always executed. A business process that handles all variants of a multi-faceted scenario without decision points can be called a bloated process in which some activities are superfluous in some cases. Then, it makes sense to design a process version for each identified case consisting of activities that are necessary in the respective case and save resources this way.

Figure 2.4 shows an example of such bloated process and its reengineering. Once alternative activities exist you insert decision points. If a decision never relies on information that emerges during process execution it can be drawn to the front of the process now deciding between two versions of the subsequent process. It might be considered a matter of taste whether to consider the resulting process with its initial case analysis as a complex process or rather as a bunch of process versions. For example, in Fig. 2.4 it would be possible to describe the business process with a diagram in which starts with first and second activity, continues with a decision point and then continues with activities of each of the two cases.

In Sect. 4.1 we will distinguish between two different viewpoint on business process, i.e., the viewpoint of business process supervisory, which is the viewpoint of the business process modeler, and the local viewpoint of the worker in a business process. A description of the reengineered business process in Fig. 2.4 that uses an inner decision point instead of an outer decision point might be better to understand from the global viewpoint of business process supervisory, whereas the version of description given in Fig. 2.4 might be better for the local viewpoint. It might be easier to clarify the case as the first activity and to deal with no decision henceforth. Assume that in the case of the business process in Fig. 2.4 it turns out that the first case always can be handed by a certain person and the second case can be handled always by another person. This information is not given in the upper diagram in Fig. 2.4 and, without further comment, it would not be given in a diagram that defers the decision point after the first and second activities – at least not for the first and second activity. However, this important information is given in the lower diagram in Fig. 2.4 .

Most importantly, the question of where to insert the decision point is usually not just a matter of taste. This is so, because the decision point itself is a real-world entity. The choice about where you insert the decision point into your business process model has an impact on where the decision is actually made in processes in the real world. A deeper discussion of such real-world arguments or variants of it like what we call domain-oriented modeling can be found, for example, in Chapters 4 and 6.

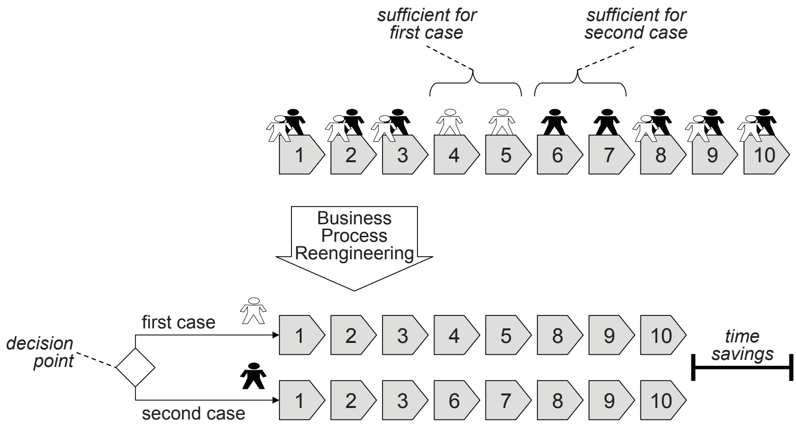

Fig. 2.4. Creating specialized processes for alternative cases.

There are less obvious scenarios than the one just described, in which there is potential for time savings. Sometimes, it makes sense to ask whether in certain cases things can be done differently than in the past. Figure 2.5 shows an instance of such a business process and its refactoring. The issue here is to generate alternatives by analyzing whether existing activities can be specialized to more efficient ones in certain lean cases.

The creation of versions of business processes in the above sense somehow leads to more flexibility. The processes are more flexible in that they react to more cases in a specialized way. However, it is worth mentioning that this is not the kind of flexibility which is currently discussed in the area of adaptive workflow systems – see [294, 296], for example. Here flexibility means adaptivity, i.e., it means that the workflow management technology allows for adopting business processes to new requirements during run-time. As we will discuss in Sect. 2.4, there is an ongoing continuous improvement process (CIP) in the successful enterprise that consists of monitoring business processes and adjusting them to new situations – see also Fig. 2.6. Today's business process management technologies are suitable for managing versions of processes, however, current commercially available products do not offer support for the redefinition and adjustment of processes at run-time, i.e., in the presence of running processes.

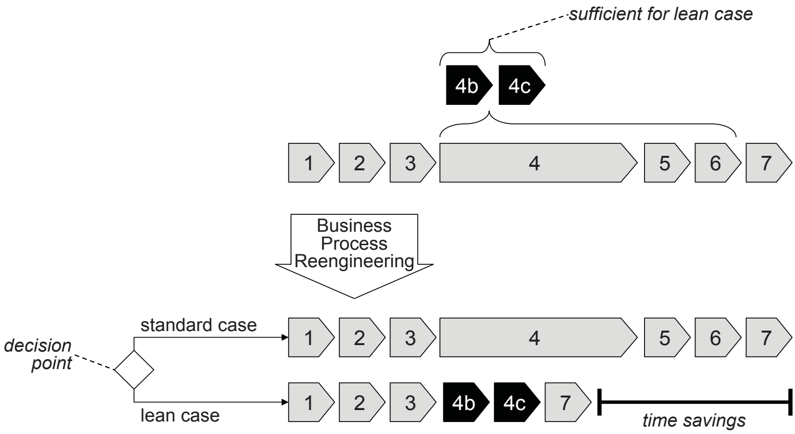

Fig. 2.5. Creating a specialized activity for a lean case.

2.2.5 Reducing Control

Separation of duties is a best practice, in particular, if we have to deal with quality control. For example, in software engineering it is common to define test design and test engineering as separate roles and let people other than the developers fulfill these roles. It is common sense that code reviews and code audits should not be made by the developers of the code themselves.

The theme of reducing control is about something different than quality control. It is about a certain kind of control that stems from a culture of mistrust against employees. So it is about control against abuse of processes – be it accidentally or intentionally. For example, an employee could do a business trip that is actually not necessary or another employee could go for holiday despite the fact there is currently a peak load in one of his or her projects. That is why there are holiday and business trip application forms that are reviewed by management staff. Business process reengineering encourages contrasting the costs of a potential abuse with the costs of control that is necessary to prevent the abuse – all against the background of a fair estimation of the risk of the abuse. Typically, the risk of an abuse is much lower than initially believed.

If some control and checks are about accidental abuse, then, removing the control from managers is hard to distinguish from giving decision making responsibilities to employees that has been discussed in Sect. 2.2.2.

2.3 Business Process Benchmarking

How can business process excellence in the sense of business process reengineering be reached? How is it possible to move towards an optimal performing corporate structure? In Sect. 2.2 we already discussed typical patterns of reengineered business processes. But even with these patterns as background knowledge the question of how to systematically reengineer business processes remains open. Clearly, benchmarking is an approach, i.e., so-called strategic benchmarking [352] or business process benchmarking [53].

Process benchmarking is about conducting an as-is analysis of the existing business processes and then comparing them to similar business processes of other companies that are considered to have outstanding performance – typically market leaders in their domain – and to eventually adopt best practices to optimize one's own business processes. For example, groups of benchmark partners from different domains, i.e., non-competitors, can be formed to conduct process benchmarking. This means process benchmarking is more than process optimization. It eventually targets process optimization, but it is more than measuring, analyzing and improving processes. The crucial point is the comparison with others, i.e., not benchmarking against target performances but benchmarking against performances of others.

2.3.1 Benchmarks in IT Governance

In some domains, there are associations that gather best practices in processes and conduct standardization efforts. The area of IT governance is a good example. Here we have ITIL (IT Infrastructure Library) [56, 267, 189, 305, 210, 54, 55, 268], the ITIL related ISO 20000 [181, 183] and COBIT (Control Objectives for Information and Related Technology) [187, 188]. COBIT is an example of process orientation and process definitions. COBIT defines best practices for IT governance, in doing so it is business-focused. This means it addresses not only the stakeholders that are directly concerned with IT, i.e., the IT executives, IT auditors and users, but also the top management and the owners of the business processes. Furthermore, it is process oriented. This means that the best practices are defined as processes that are organized in a process framework. COBIT defines 34 processes that are grouped into 4 domains, i.e., planning/organization, acquisition/implementation, delivery/support, and monitoring.

As an example, let us have a look at a typical process definition, i.e., define/manage service levels in the process domain of delivery/support. This gives an impression of the level of discussion of COBIT. The process definition consists of four pages of text and tables, divided into a process description, a description of the control objectives, management guidelines and a maturity model – each one page. The process description explains the function and rationale of the definition and management of services levels. The description of control objectives lists concrete actions to take, e.g., the definition of service level agreements (SLA), the definition of operation level agreements (OLA), and the monitoring and reporting of service level agreements. The management guidelines actually connect the process to the other COBIT processes, i.e., it is defined what kind of input the process gets from other processes and what kind of output is delivered to other processes. For example, the 'define/manage service levels' process gets an IT service portfolio from the 'define a strategic IT plan' process in the planning/organization process domain and delivers contract review reports to the 'manage third-party services' process. Furthermore, the management guidelines detail the activities of the control objective description and specify who in the organization is responsible and accountable for them and who should be kept informed about them. The maturity model defines maturity levels in the style of the CMM (Capability Maturity Model) [275, 276, 274], i.e., there are six levels zero to five: initial, repeatable/intuitive, defined, managed/measurable, optimized.

2.3.2 Organizational Learning

Benchmarking for best practices is an inter-organizational effort; however, it is also a very promising approach if it is done in-house. Then, such efforts are usually called organizational learning approaches [77, 280, 63]. Actually, learning is crucial for enterprises. Crucial parts know-how, i.e., know-how about processes and best practices in particular, are kept alive by social interaction [88]. Such know-how is communicated from seniors to juniors, often in daily operations and often ad hoc and in a word-of-mouth fashion. That means that learning takes place on demand – in processes and projects whenever problems have to be solved. With organizational learning typically something different is meant – it is about making explicit these learning activities. On the basis of this, learning can be fostered by creating awareness of it importance. Furthermore, organizational learning is about concrete tools and methods that support learning in the enterprise.

A prominent approach to organizational learning is, for example, action learning [297, 298]. In the action learning approach managers, e.g., project managers, and process stakeholders, e.g., engineers, of the same domain meet in sessions in order to find solutions to concrete problems. The session is moderated by a facilitator. Action learning assumes that learning is based on programmed knowledge and targeted questioning. The programmed knowledge facet is about expert knowledge; it is about the systematic understanding of best practices and also about mistakes that should be avoided. Action learning has is roots in efforts of the Mining Association of Great Britain that brought together coal mining experts in order to learn together and to learn from each other. This means action learning techniques are also suitable for inter-organizational learning. However, unlike process benchmarking, which is not necessarily but typically about benchmarking against excellent enterprises in different domains, it is about bringing together knowledge from enterprises in the same domain.

2.4 Business Process Management

Business process reengineering involves business strategy. However, optimizing business processes on the operational level – fine-tuning of concrete workflows in the main processes – is also an important issue. Business process management is about the controlled execution and continuous improvement of business processes. The objects of business process management are the business processes of an enterprise in general, i.e., business process management considers both activities that are supported by information technology or actually executed full-automatically and those that are processed completely manually. The granularity of activities controlled by business process management is not canonically fixed. Fig. 2.6 shows a possible business process management lifecycle model that is similar to the plenty of those used in practice.

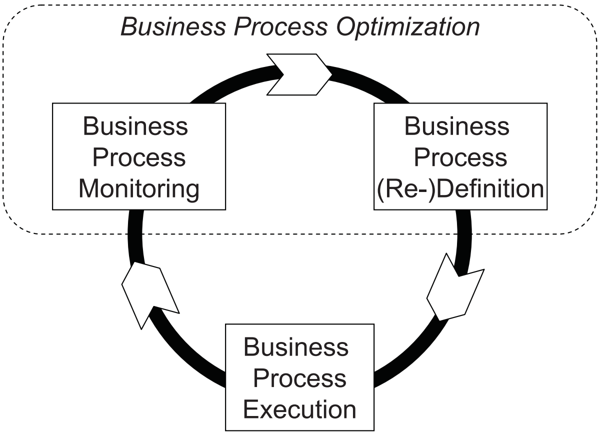

Fig. 2.6. Business process management lifecycle.

The definition of business processes encompasses the description of the goals of the business processes and the definition of service level agreements resp. operation level agreements, in particular, the definition of required performance figures. Furthermore, it encompasses business process modeling, i.e., an elaboration of the interplay of business activities and resources. Then business process execution means that the defined business processes are actually working. It is a matter of taste whether efforts in fine-planning business processes – like the definition of workflows in a workflow management tool or the actual implementation of applications or changes to applications that support business process activities – belong to business process execution or rather to business process definition.

Executed business processes are monitored, i.e., data are gathered about who actually did what, when and why and, ideally, further comments of stakeholders on what was good and what may be improved. Here, business activity monitoring [238, 117, 136, 52, 64, 214] (BAM) comes into play. Business activity monitoring is the real-time extraction, i.e., automatic extraction, of business performance indicators (BPIs) from the enterprise applications. Business activity monitoring is usually understood as a systematic enterprise-wide effort, i.e., it is not about single extractions of information from a few systems but about the massive crosscutting extraction of information from as many enterprise systems as possible. That is why business activity monitoring is also perceived as an enterprise application integration topic.

In a next cycle of the business process management lifecycle the data that were gathered during business process monitoring are analyzed and yield to an improved definition of the business processes. Now, the business process definition becomes a business process redefinition. In our lifecycle model we say that optimization consists of business process monitoring and business process redefinition.

2.4.1 On Business Process Management Lifecycle Models

Lifecycle models – also lifecycles for short – like the one in Fig. 2.6 are used to explain the building blocks of business process management. Business process management products – both technologies and consultant services – often come with their own lifecycle model. Despite the fact that lifecycles, e.g., product lifecycles, usually somehow express sequenced phases, business process management lifecycles cannot be understood as strictly staged models, i.e., temporal models, of what is going on. If at all, they express some causality between the stages in the lifecycle. For example, in Fig. 2.6, business process monitoring is not done after business process execution but during business process execution. Similarly, no business process monitoring can be done without executing business processes.

Different lifecycles consist of different building blocks; in particular the number of building blocks varies greatly. In the lifecycle of Fig. 2.6 we have aggregated several activities like service level agreement definition, business process modeling, workflow definition, process implementation, gathering data, analyzing data and rethinking processes into coarse grained building blocks. In practice, often lifecycles are used that make these fine-granular activities explicit, which sometimes makes it even more difficult to understand the ordering of the activities in the lifecycle as staging – be it temporal or causal. For example, it is very common to have a business process optimization stage in the lifecycle that occurs typically between business process monitoring and business process definition. However, as depicted in Fig. 2.6 business process optimization is rather not an activity in its own but consists of business process monitoring and the redefinition of the processes.

Prominent business process management lifecycles are the DMAIC lifecycle of the process-oriented quality strategy Six Sigma and the PDCA lifecycle. The PDCA lifecycle, also called the Deming wheel [69], Deming cycle or Shewhart cycle is used by established process quality frameworks like CMMi, ISO 9000 [175, 177], COBIT and ITIL. The PDCA lifecycle –see Fig. 2.7 consist of four steps: plan, do, check, act.

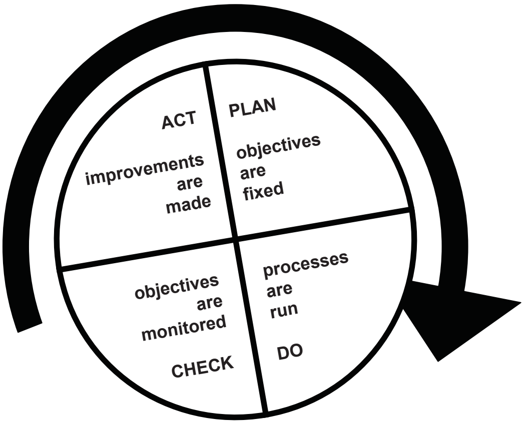

Fig. 2.7. The Deming wheel for quality control.

2.4.2 Six Sigma

Six Sigma [152, 153, 154] – 6σ – is a method for improving process quality by minimizing its variation, i.e., by minimizing the variation of considered target characteristics of the results of the process – see also [319, 320] for the origins of systematic, statistics-based quality control in industrial manufacturing. Six Sigma was developed by Motorola and is considered as a leading process improvement strategy today. A process with little variation is considered more robust. It is better because the outcome of the process is more predictable and the quality of its outcome is more reliable. Six Sigma projects are not restricted to minimizing process variations. The improvement of the quality of the results of a process can also be a target, but then the method to do this also involves understanding impacts on the variation of the exiting processes – observing variations, understanding correlations and minimizing variations is the fundamental approach of Six Sigma. The name Six Sigma stands for six times the standard deviation σ. So, the name Six Sigma indicates the ideal success of a Six Sigma project: with respect to a considered characteristics — called CTQ (critical-to-quality characteristics) in Six Sigma – variations of a result that are not tolerable, i.e., failure outcomes, lie outside the area of six standard deviations to the left and to the right of the mean value. In the case of a standard normal variation this means, for example, that only 0.0003 per cent of the results are still non-tolerable result – so the ideal target of Six Sigma are zero-failure processes so to speak.

Six Sigma can be used to improve both technical processes, i.e., production processes, and non-technical processes, like planning and management processes. However, improvement of production processes are very typical examples of Six Sigma projects and this is where Six Sigma originally stems from. A Six Sigma project follows the so called DMAIC lifecycle consisting of the following phases: define, measure, analyze, improve, control. During definition target characteristics are identified and assumptions are made about which factors might influence the variation of the target characteristics. The target characteristics and factors must be measurable. During measurement, data about the defined characteristics and factors are gathered. It is the task of the analysis to understand which factors actually impact the target characteristics. Standard statistic tools like Minitab are used to conduct the analysis. By understanding the correlation of characteristics and factors based on statistics Six Sigma can be considered as a sophisticated data mining approach: Six Sigma not only looks for plain dependencies of stochastic variables but also has the variations of the variables as input information to its analysis.

Business process management and the Six Sigma approach are hosted by different communities. It is fair to say that business process management evolved rather from planning and controlling enterprise resources and Six Sigma evolved from looking for impact factors on production processes. In business process management the definition and fulfillment of service-level agreements is crucial; in the Six Sigma approach the characteristics that are critical to quality and assumed impact factors of existing processes as well as their relationship are the object of investigation. The Six Sigma approach to analyzing processes is very concrete; it looks at the statistical variations. Six Sigma projects can also be used to improve enterprise resource planning processes and, on the other hand, business process management concepts and, in particular, business process management technologies can be used to establish a framework for conducting Six Sigma projects [198]. However, in general the concrete method of analyzing the correlations of statistical variations is not a must for the improvement of business processes. One thing is very important about Six Sigma: its success once more indicates the pivotal role of industrial manufacturing and the production processes in modern enterprises.

2.5 Business Continuity Management

2.5.1 Threats onto Business Processes

Business continuity is about threats to business processes. It is about those threats that substantially impact the usual operation of business processes in a way that prevents the organization or enterprise from fulfilling its mission with eventually severe impact on costs or revenues. So, the threats dealt within business continuity considerations are severe incidents that typically do not stem from the conditions of the respective business model but rather somehow from the environment the business operates in. Table 3.1 lists some of the typical threats considered in the area of business continuity. Taken as an objective, business continuity aims to maximize the stability of the business against those threats. Therefore, business continuity management [157, 111, 283, 284] is about becoming aware about as many threats as possible and preparing – with commercially reasonable efforts – the business to handle them as well as possible.

Table 2.1 results from a poll conducted by the Chartered Management Institute [360] on disruptions experienced in the UK in the year 2007. It clearly shows that loss of IT heads the list of experienced disruptions. However, the figures also tell that also those risks that are usually considered as non everyday risks like extreme weather conditions or fire clearly occur often enough to be considered for systematic treatment. The table also contains other in-

	experienced	BCP covered	BCP used
Loss of IT	38%	81%	9%
Loss of people	32%	53%	3%
Extreme weather e.g. flood/high winds	28%	58%	5%
Loss of telecommunications	25%	75%	5%
Utility outage e.g. electricity, gas, water, sewage	21%	57%	6%
Loss of key skills	20%	49%	2%
Negative publicity/coverage	19%	36%	2%
Employee health and safety incident	17%	52%	3%
Supply chain disruption	13%	37%	2%
Damage to corporate image/reputation/brand	11%	35%	2%
Pressure group protest	7%	23%	1%
Industrial action	7%	28%	2%
Environmental incident	6%	51%	2%
Customer health/product safety issue/incident	6%	1 %	1%
Fire	6%	68%	2%
Terrorist damage	3%	57%	2%

Table 2.1. Disruptions experienced in UK in 2007 according to a poll conducted by the Chartered Management Institute with a base of 1257 respondents.

teresting figures. It shows that only a part of the respondents of the poll have systematically considered the potential disruptions and eventually addressed them in their business continuity plans. Furthermore, it shows how many respondents were actually able to use an existing business continuity plan. The clear gap between these two latter figures is a key argument for further research and development of tools and techniques in the area of business continuity management.

2.5.2 The British Business Continuity Management Standard

Business continuity management spans the whole cycle of analyzing the business with respect to critical actions, systematically addressing critical actions, designing reactions to unavoidable incidents, and exercising and maintaining those reactions. The British standard BS 25999 [43] is an internationally highly recognized standard in the area of business continuity management. BS 25999 considers business continuity management as a major crosscutting activity, which must be truly embedded in the company in the sense of awareness of it and support for it, in order to be successful.

Figure 2.8 shows the BS 25999 business continuity management lifecycle. A major activity in the understanding of the organization is business impact analysis (BIA). Business impact analysis identifies critical action. It is about determining the impact of failure of critical actions, i.e., eventually it tries to estimate direct and indirect costs of failure of critical actions. Furthermore, it has to be understood which incidents can yield to the disruption of critical actions. A kind of pervasive incident elicitation has to be conducted and then the probability of each single incident occuring has to be estimated.

The stage of determining the business continuity strategy in Fig. 2.8 is about the important fact that the preparation against threats is not only about fixing reactions to possible incidents. It has to be checked whether it is possible to change the existing business processes in a way that makes them

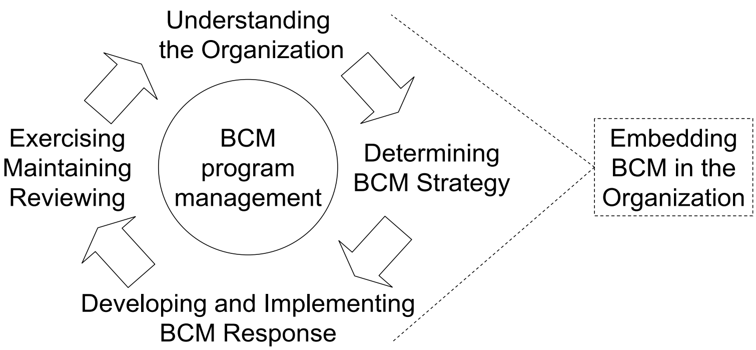

Fig. 2.8. The business continuity management lifecycle according to British standard BS 25999.

more stable against the identified threats from the outset. In some cases it might even be possible to get entirely rid of some of the identified critical actions. Attempts must also be made to diminish the probability of incidents and risks wherever possible at reasonable costs. Also insurances against risks must be considered systematically. Eventually, for those risks for which you have decided to accept, appropriate responses must be defined. All this is sometimes summed up roughly by a 4T model of dealing with risks: treat, tolerate, transfer, or terminate.

Appropriate response to incidents is at the heart of business continuity management. Figure 2.9 shows the incident timeline as presented by BS 25999. The overall target of incident response is to resume to normal operation of the business as soon as possible. As an appropriate response to an incident a defined emergency mode of operation and services must be entered in which the absolutely necessary level of processes to fulfill the enterprise's or organization's mission can be guaranteed. The incident timeline shown in Fig. 2.9 distinguishes between three phases, i.e., incident response, business continuity – here in the narrow sense – and recovery. The target is to have concrete plans for each of the three phases ready to execute. During incident response stakeholders are informed and necessary immediate actions are taken. The business continuity phase is about recovering and executing versions of critical business processes. The recovery phase leads the organization back to normal operation.

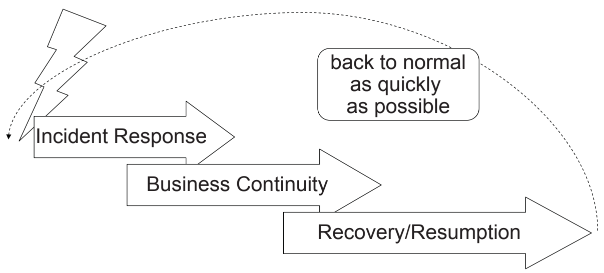

Fig. 2.9. The stages of the incident timeline according to BS 25999.

2.5.3 IT and Business Continuity Management

Business continuity management does not address information technology outage as the only threat. But of course it is an important one, because information technology is a mission critical asset – see Sect. 2.6 – and still the disruption of loss of information technology is the most often experienced one, e.g., according to Table 2.1.

Depending on the branch and the concrete purpose of a computer system, the impact in costs and revenues of information technology outage can be substantial for an enterprise. It is said that in banking the total outage of the core systems, i.e., those that deal with transactions on bank accounts, can yield to the bankruptcy of the bank already after two or three days. Therefore, for the core systems of a bank high availability technology like mainframe computers – often spatially replicated – or high availability clusters are used. Take a medium enterprise from the industrial production domain as another example. Here, the logistics applications that enable the company to deliver these products in extended supply chains are mission-critical. The outage of these applications do not lead to a bankruptcy of the enterprise immediately as in the aforementioned banking example, however, actually every day or even every hour of outage can be directly measured in loss of revenue. Not to speak about the loss of customer satisfaction and trust and therefore indirect loss of revenue in the long run. For such medium-critical systems a really high availability solution might be considered overkill, but still a nearly high available system is desired. For example, midrange computers might yield a solution, in particular if there are spatially distributed.

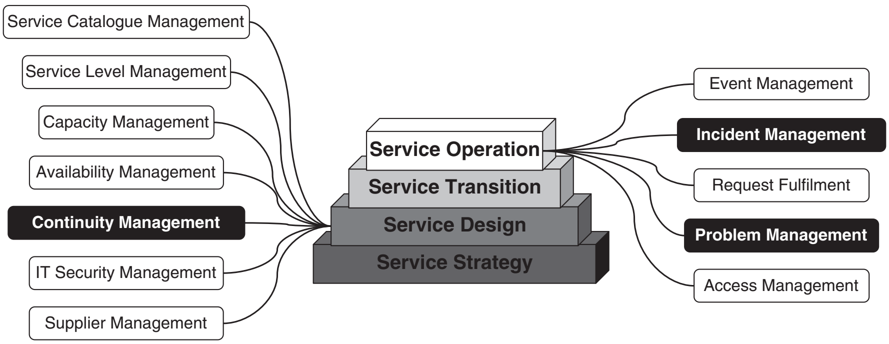

Fig. 2.10. ITIL v3 best practices stack tackling business continuity.

Outage of information technology is a well-perceived threat in business continuity management. IT continuity management as a systematic approach to keep IT running exists in parallel to business continuity management efforts in enterprises. For example, ITIL explains IT service continuity management as supportive to overall business continuity management in an enterprise [189]. But then, a closer look to IT continuity management shows that mature IT continuity management efforts contain also the major activities seen in overall business management, like business impact analysis and risk analysis, of course, with a focus on IT outage. Similarly, in IT service continuity management the same threats as in overall business continuity management are considered, e.g., extreme weather, utility outage – see Table 2.1. IT outage is not a threat considered in IT service continuity management, IT outage is rather the impact of the threats. We believe that ideally teaming together overall business continuity management and IT service continuity management would mean to remove redundancies in activities and considered threats on the level of IT service continuity management.

Figure 2.10 shows an overview of the ITIL service lifecycle [268] with a focus onto topics related to continuity management. Incident management deals with the malfunction of single services as perceived by users of services. A malfunction can indeed be the interruption of a service but also a reduction of quality of a service, e.g., in terms of usability. Incident management is not about reaction to major failure of an entire IT infrastructure or data center, it is about help with everyday incidents of IT services. Systematic incident management is about routing requests via a help desk, prioritizing request and reacting to them in a proper manner. Incident management is at the heart of IT infrastructure management. Therefore, incident management is typically the first ITIL service operation process in ITIL projects, i.e., the process that organizations introduce first when they start with ITIL. Problem management is a service operation process that has been introduced with ITIL version 3. Problem management is about the systematic collection of causes of incidents and events in the everyday IT infrastructure management. In ITIL a problem is not just a synonym for an incident but a source of a kind of incident. The gathered knowledge can be exploited in the sequel to find ways to prevent incidents from the outset.

Incident management and problem management are processes of the service operation element [54] of ITIL. ITIL sees IT service continuity management as the means to resume to normal operation in the case of major failure of IT infrastructure within predefined times. As a consequence, IT service continuity management is tackled within the service design element [305] of ITIL.

2.6 Information Technology as Mission-Critical Asset

Enterprise applications are mission critical for today's enterprises. Information technology improves strategy, tactics and operations. Due to globalization the markets change more quickly and enterprises must react to emerging technologies more rapidly. Information Technology plays a key role in the transformation of businesses, it is at the heart of changes in enterprises.

In the 1990s there were not only rumors about the new economy [327], also the old economy was roaring. Internet technology – the important driver of the new economy – is here to stay and must be considered strategically also in old economy enterprises [289], because it is not only relevant for new marketing and sales channels but also for in-house systems. But even without this, we have seen huge efforts in outsourcing and spin-offs in the 1990s. Note, that splitting a company needs preparation – this means that there is the need for business process reengineering beforehand and it usually means the creation of a decentralized IT system landscape beforehand. In any case, there was an increasing awareness about information technology as a mission-critical asset of an enterprise. This was the decade when chief information officers (CIO) operated on the strategic level.

Actually, in practice, business processes can hardly be discussed without considering the enterprise IT. The overall architecture of the enterprise IT systems is the issue, i.e., the system landscape. New IT products can be the enabling technology of improved business processes, on the other hand, we have to deal with legacy problems, i.e., existing information technology can slow down business process reengineering efforts.

2.6.1 Flexible and Adaptive Information Technology

Flexibility of business processes has always been and still is regarded as an important success factor for enterprises – see also Fig. 2.12. An appropriate information systeminfrastructure [147] is a key enabler for flexible business processes. Major IT players in the enterprise application domain have been strategically preparing their products for flexible and adaptive structure and functionality. Concrete examples of this strategic orientation include IBM's Capacity on Demand technique (CoD) in the midrange computer and mainframe area and SAP's Netweaver initiative in the commercial off-the-shelf area.

IBM's Capacity on Demand is a combined virtualization capability and licensing model for all e-server platforms, i.e., for i-series, p-series and z-series computers. Basically, the machine is delivered with more computing power than the customer actually needs at the moment of delivery. Some of the processors are idle, but if the customer needs more, for example, in times of peak load, he just uses more processors and pays for the extra computing power. In this way the customer is able to react better to changes in his enterprise's context. Obviously, this model brings the advantage of immediate and calculable scalability to individually owned machines that you otherwise only have when using services of a data center. Actually, the Capacity on Demand capability is advertised as an enabler for On Demand Business.

2.6.2 Enterprise Application Integration

The On Demand Business business metaphor is IBM's answer to the challenges of the new globalized and rapidly changing markets. An 'on demand'-business is able to dynamically react to new emerging demands, opportunities and threats in its internal and external business environment [168]. So On Demand Business is about flexibility of the enterprise. However, On Demand Business is not only a business metaphor it is also a conceptual solution framework [186]. It describes business transformation approaches and, in particular, concrete On Demand Business techniques like the aforementioned Capacity on Demand.

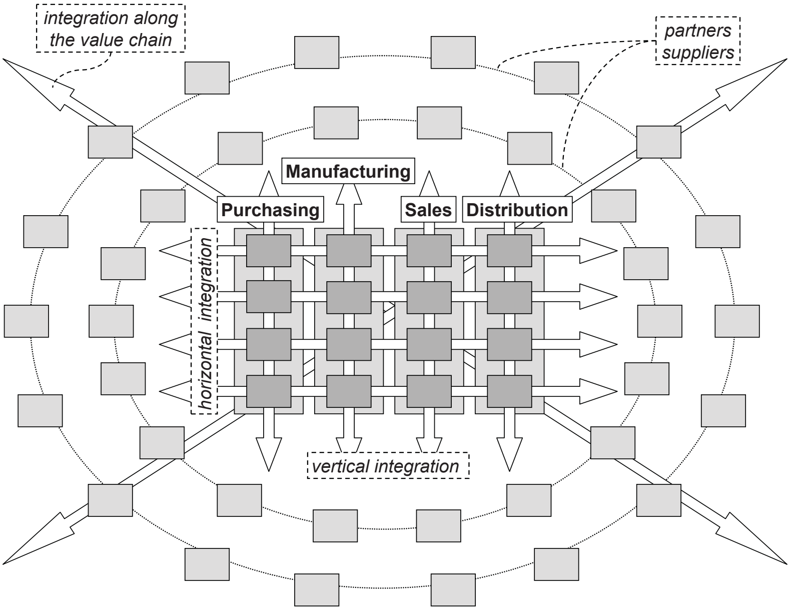

Fig. 2.11. Enterprise application integration as seen by IBM's On Demand Business strategy.

A central theme in the On Demand Business argument is enterprise application integration [147] – three kinds of integration are targeted [168]: vertical integration, horizontal integration and integration along the value chain, see Fig. 2.11. Here, vertical integration means the improvement of the information flow between the silos in one main process resp. line of business, horizontal integration means the improvement of the information flow between main processes, and integration along the value chain actually stands for the improvement of the extended supply chain, i.e., the improvement of the information flow between the enterprise, its direct business partners and suppliers and even beyond with its indirect business partners and suppliers.

Actually, enterprise application integration is said to be the key to the transformation to an 'on demand'-business, i.e., the key to achieve reactiveness and responsiveness. How does enterprise application integration help with the flexibility of an enterprise? Because stakeholders at all level of the enterprise feel that the flexibility of the enterprise is impeded, basically, by lack of information or – to more precisely stated – by the inflexibility of the information flows. As you will see in later chapters, enterprise application architecture [103, 108] is a major issue in business process management addressed by many business process technologies.

In a poll [251, 292] on the challenges posed by business processes, approximately 150 IT executives were asked by Forrester Research which concrete business problems they would classify as important or very important with respect to their current enterprise applications – please have look at Fig. 2.12 for the outcome of this poll. The problem addressed by horizontal integration, i.e., the inadequate support of enterprise applications for cross-functional processes is amongst the top-problems according to the poll visualized in Fig. 2.12. The counterpart of integration along the value chain can be seen in Fig. 2.12, e.g., in the enterprise applications' lack of business process extensibility to external partners and the lack of support for collaboration between employees, business partners and customers.

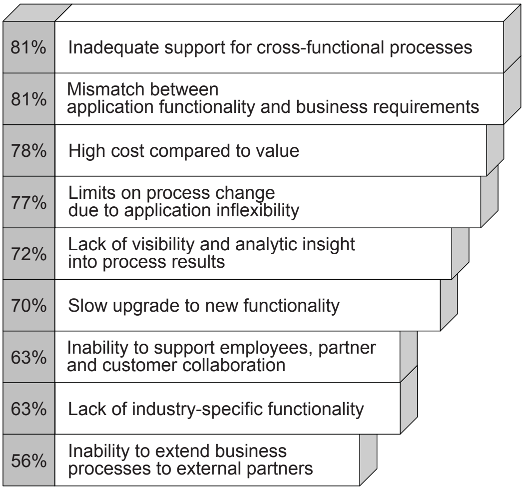

Fig. 2.12. Forrester Research poll on which business problems are important resp. very important.

2.6.3 Total Cost of Ownership

Several objectives must be met to make a successful and stable system: performance, scalability, availability, security, maintainability. In theory, performance has two aspects, i.e., reactiveness and throughput, which are usually mutually dependent. In theory, scalability is about the costs of extending the system, if it is not able to handle the given load any more. A system architecture is scalable, if it is prepared for extension. However, in practice, there is another understanding of scalability. Scalability just stands for the number of clients a system can serve. So, in practice, performance rather stands for the reactiveness of a system – performance and scalability together stand for the load a system can handle properly. With respect to availability it has to be distinguished between planned and unplanned downtimes. Planned downtimes are those that are needed for system administration tasks and known in advance. Usually, it is only the unplanned downtime that is considered by availability considerations. Maintainability addresses costs for the actual system maintenance, i.e., system administration, and also costs for changes to the system. In a broader sense maintainability is also about costs for end-user support services.

If information system products have to be selected, eventually, total cost of ownership (TCO) [201] must be addressed. The total cost of ownership comprises costs for hardware and software, costs of the rollout project and costs for system maintenance and system administration. Therefore the total costs of ownership are always calculated for an assumed lifetime of the considered information system – it is simply not enough to consider the initial purchase costs of an information system. The costs for system operations including costs for system maintenance and system administration are hard to predict and sometimes even hard to determine once the system is running. So, in advance, costs of an information system sometimes can only be estimated rather than calculated. This is even more true if risk management aspects come into play. Then the above definition of total costs of ownership is not completely adequate any more. This problem arises for all of the aforementioned driving forces affecting system stability. For example, with respect to availability you have to estimate the costs of system downtime; or with respect to security you have to estimate the costs of the case that somebody infringes your system. From these estimates you must then derive how much more you are willing to pay for extra availability and extra security.

Formally, e.g., by the Gartner Group, there is a distinction between so-called direct and indirect costs. Direct costs are budgeted expenses, indirect costs are unbudgeted expenses. Unbudgeted expenses are those that are unforeseen or overlooked. They can stem from technological risks or from expenses hidden in overlooked cost units, residing, e.g., in cost centers other then the IT department. In this terminology, typical examples of indirect costs are expenses for end user training and support. Indirect costs can in principle often be made direct costs by estimating them and making them explicit by assigning them to an appropriate cost unit connected to the considered information technology.

Only a holistic treatment of software, middleware, database management systems, hardware, and system administration can balance the several driving forces. In such a holistic treatment of information systems the database technology viewpoint on them has always proven to be a particular mature one in the past – both in practice and in research. The database community helps improving stable system architecture by fostering robust database technology [322, 242, 30, 142, 5].

2.6.4 Total Benefit of Ownership

Care must be taken in analyses that are done to understand whether a certain IT strategy should be taken or a certain IT infrastructure should be created.

Estimations of the total cost of ownership address only the cost side of these even more complicated analyses. Return on investment (ROI) is the widely used term in profit/loss calculations. Formally, it is the ratio of expected profit to needed capital. In practice, return on investment calculations are done on different levels of observation, i.e., financing of a businesses, business units, projects, or technical equipment, e.g., new IT infrastructure. However, with respect to information technology even the viewpoint of return on investment calculations with their focus on measurable cash flow is often to narrow to realistically evaluate the benefits of an optional investment. New opportunities and additional flexibility created by a new IT infrastructure are yet other criteria that often have to be considered. An example of an approach that addresses the real benefits of an IT investment is Forrester Research's Total Economic Impact (TEI) method [245], which considers total costs of ownership, the business value and the options that are created by IT in evaluating it.

As we said in Sect. 2.6.3, indirect costs belong to the total cost of ownership. And actually, in practice stakeholders usually incorporate indirect costs in realistic calculations. The indirect costs that deal with risks of malfunction of information technology, i.e., unplanned down times or security threats can be estimated. However, even if the costs of a single malfunction can be robustly estimated there is another level of indirection, i.e., the problem of estimating the probability of such malfunctions. So, if done correctly there is in general at least a worst case and a best case calculation of total cost of ownership; ideally, the outcome of the total cost of ownership analysis is actually deviation of costs.

The problem of mixing certain costs with probabilistic costs in total costs of ownership is that it opens the door for obfuscation of the certain costs. Therefore, we propose a different viewpoint depicted in Fig. 2.13. Here, the total cost of ownership consists of certain measurable, budgeted costs only. All probabilistic costs – usually indirect costs of uncertain malfunction events but also all other probabilistic costs – are considered separately from the total cost of ownership. The probabilistic costs are considered on the side of the anyhow vague determination of the total benefit of ownership. Some of the benefits of information technology can only be roughly measured or cannot be measured at all. They are often nonetheless important. So it is the case for, e.g., an improved customer relationship on behalf of improved customer processes and also for an improved overall flexibility of the enterprise gained by IT which we have discussed in Sects. 2.6.1 and 2.6.2. Furthermore, the total benefit of ownership is made of assessable profit and cost savings, which are two sides of the same story. Usually, in the area of business process optimization information technology is considered to contribute to cost savings, if information technology is the core asset in a new project or production line its contribution to the profit can be determined. Cost savings and profit together make up a kind of direct, absolute return on investment which is lowered by the probabilistic costs in our model.

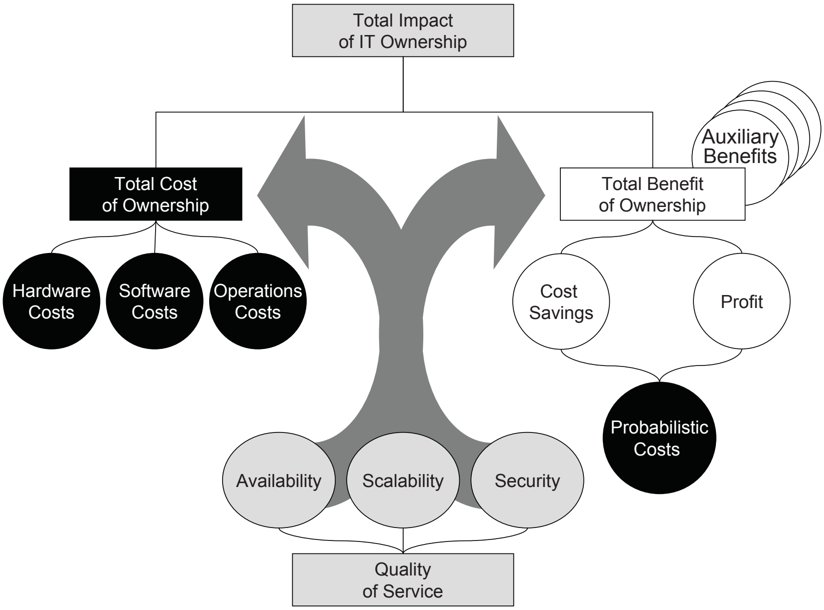

Fig. 2.13. Total impact of IT ownership.

Now, we want to consider the notion of total impact of IT ownership for the areas of business process reengineering and management which can be mutual dependent as discussed in the introductory section of this chapter. Business process reengineering and management lead to better performance and therefore have their impact. Often, the impacts are directly measurable in terms of cost savings or time savings. Often, the impacts are not as easily to determine. Information technology can be used as an enabler of business process reengineering and management. Now, there are two possible views on the total cost of ownership calculation for the supporting IT. The first one sees the decision for the optimizations independently from the decision for a concrete IT support. Then, consequentially the estimated impacts cannot be incorporated into the total cost of ownership calculation. This case usually occurs when a certain kind of optimization is already standard in the sense of strategic benchmarking, i.e., there is no doubt that the enterprise will benefit from the possible changes and the choice of technology boils down to the evaluation of existing products. However, if innovative optimizations that need new comparatively high cost technology have to be evaluated, it is very likely to make sense that the estimated impacts are included into the total cost of ownership calculations.

2.6.5 On Client-Server Computing

It is a commonplace to oppose mainframe-based architectures to client-server architectures in the following way: mainframes are viewed as the still existing legacy systems that are inflexible silos and client-server computing as the modern alternative. First, as a minor comment to this, if an enterprise resource planning system runs on a single host computer, this is usually not a mainframe but a midrange computer [325, 93] or another kind of high-end server. Mainframes are used where extreme system robustness and availability is required. There they have been used are still used, for example, to run the mission-critical core systems of a bank [286]. Midrange computer products are also called servers today and also other high-end servers are used as single host computers for enterprise IT.

IT system architecture is the architecture of software and host computers, i.e., it is about the deployment of software components on host computers and their relationships. This means the client-server paradigm is really not about a mere software architecture only, it is about software distributed over separated server machines. It might be the correct observation that often a legacy silo system on a single host computer is the main reason that a business process reengineering project does not take off; but from this it is not possible to conclude that the reason for this is the deployment of the software on a single host computer. More likely, it is due to the software design of the silo application. Very likely, we have to deal with a programming system that has been written for a single usage scenario on a single machine in such a situation. This means no productizing [45] has occurred when the system was developed, i.e., no investment into the creation of generalized software components has been undertaken. It is the lack of generalized software components that hinders future reuse and makes the system inflexible and hard to adapt to new requirements – it is not the deployment on a single host computer. Obviously, if a programming system is designed for flexibility and adaptivity the deployment on a single host computer is no loss.

Client-server architecture has been often motivated as a cost-saving alternative to silo system architectures. But please pay attention, this cost-saving argument is debatable against the full background of total cost of ownership. With respect to the host architecture aspect the argument of client-server architecture is not true in general. Of course, a bunch of commodity servers can easily provide the same computing power as a given midrange computer for a much lower price. However, if availability and maintainability are major driving forces in a given scenario, the result of a sincere calculation of the total costs of ownership can often tell another story. With respect to the pure software architecture aspect the question that must be answered always is whether the efforts in productizing actually pay off eventually.

Distributed object computing technologies, i.e., CORBA, DCOM and the like, that are identified by their communities themselves with client-server computing, is often used in enterprise application integration, in particular in wrapping legacy systems to make them accessible to current application server technology. For example, the project in [286] that we mention in Sect. 8 uses CORBA technology to wrap banking applications – some of them are important legacy systems based on IMS (Information Management System) transaction monitors and hierarchical databases. In enterprise application integration projects client-server technology is not used to design a system landscape from scratch, on the contrary, it is used to wrap and glue existing applications.

But there are reasons why real client-server architecture, i.e., distributed deployment of software components, is relevant for enterprises. The first issue is ownership. Based on business culture, enterprise units might want to own and run their own IT independently. Second, if the target of splitting a company is the major driving force of corporate reengineering efforts, introducing a decentralized IT exploiting client-server architecture principles might be necessary as a preliminary action.

2.7 Quality Management Systems

In this section we discuss a quality management system model that is reductionist in terms of organizational functions but sophisticated in terms of interfaces between the organizational functions. Established quality management systems [182, 178, 181] are process-oriented. For conformance with concrete quality management systems the definition of processes is crucial. A mature – or let us say viable – quality management system, is a spiral feedback control system, i.e., a feedback control system that itself is subject to controlled change and therefore evolves in conjunction with the business that it aims to improve. Cybernetic management models are very elaborated feedback control systems [21, 22, 23] . Quality management systems are cybernetic. If applied in the intended manner a quality management system becomes so pervasive in an enterprise that it becomes the management model of the enterprise.

A mature quality management system consists of two mutual dependent functions, i.e., a business process steering function and a business process execution function. Usually, quality management systems are presented on the basis of a business process management lifecycle. We have described the notion of business process management lifecycle in Sect. 2.4.1 – see Figs. 2.6 and 2.7. We have already discussed the problem that business problem management lifecycles can hardly be understood as strictly staged models against the practice of business operations in Sect. 2.4.1. Here, in our model we do not use the term lifecycle but the term feedback control system, partly also in order to emphasize that, in general, we should also be prepared for continuous or at least quasi-continuous control with real-time reports and extremely rapid reaction. We have chosen the term business process steering function to have a new term that is not in conflict with the names of phases of one of the existing major business process management lifecycles. Other terms like business process adjustment function or business process supervision function would also be possible. For example, in terms of the PDCA lifecycle the business process steering function consists of checking, acting and planning, whereas the business process execution function corresponds to the doing phase in the PDCA lifecycle.

There are two interfaces between the business process steering function and the business process execution function, i.e., a steering interface and a feedback interface. For each point in time, the steering interface consists of a set S of steering parameters $S_{t,1}, \cdots, S_{t,l_t}$, a set T of additional target agreements $T_{t,1}, \cdots, T_{t,m_t}$ and a set A of additional business improvement activities $A_{t,1}, \cdots, A_{t,n_t}$. The feedback interface consists of a set K of key performance indicators $K_{t,1}, \cdots, K_{t,o_t}$ and a set R of additional performance reports $R_{t,1}, \cdots, R_{t,p_t}$.

The steering parameters S are target agreements between stakeholders of the steering function and stakeholders of the execution function. A steering parameter is a well-defined, measurable figure of a defined business process. The target agreements T are further target agreements that cannot be defined as measurable figures in terms of defined business processes. The business improvement activities are all kinds of activities other than target agreements that are intended to improve the efficiency or effectiveness of the enterprise. The key performance indicators K are measurable figures about defined business processes. The performance reports R are further information about the performance of the enterprise that cannot be defined as measurable figures in terms of defined business processes.

The steering function analyzes the performance of the enterprise. It analyzes the environment of the enterprise. It analyzes and adjusts the strategy [326] of the enterprise. It analyzes the key performance indicators and additional performance reports. It reviews the business processes of the business process execution function. It reviews the functioning of the business process execution function in general. As a result of this, it resets the steering parameters, negotiates further target agreements and instructs further business improvement activities. Furthermore, it continuously improves the steering interface and the feedback interface.

We call a viewpoint that tries to understand as much of the functioning of an enterprise as possible in terms of the parameter sets S, T, K and R a mechanical viewpoint. We call a viewpoint that tries to understand as much of the functioning of the enterprise as possible in terms of the parameter sets S and K a purely mechanically viewpoint. The gap between a mechanical or even purely mechanical viewpoint and the actual functioning of the enterprise should not be neglected in quality management system projects. The parts of the functioning of the enterprise that are not amenable to a mechanical viewpoint may contribute substantially to the targeted results and the success of the enterprise.

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