On the Design of
IT Key Performance Indicators

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Abstract—IT service management
Today's successful IT service providers need to continuously improve the transparency of their service provision. The selection and negotiation of key performance indicators is an important component in establishing transparency. In this paper we aim at characterizing the role of key performance indicators in management systems, in general, and IT service management systems, in particular. We discuss the theoretical background of process-oriented quality management systems, i.e., the management school of cybernetic feedback-control systems. We express our opinion that a purely mechanical application of quality management systems comes at the risk of misunderstanding or overlooking important parts of the functioning of a successful enterprise. Against the background of these findings we describe mainstream IT governance and IT service management systems as process-oriented quality management systems. As part of the discussion, we reconsider the mainstream IT planning instruments of total cost of ownership and total economic impact and extend them by a means to incorporate probabilistic risk assessment.

Keywords—ISO 9000, ISO 20000, ISO 38500, ISO 42010, BS 25999, CoBit, ITIL, IT service management, IT governance, quality management systems, cybernetic management, key performance indicators

I. INTRODUCTION

Today's successful IT service providers need to continuously improve the transparency of their service provision. For external IT providers, this is required by customers. For internal IT providers, e.g., the enterprise's IT service management division, it is required by the enterprise's IT governance stakeholders. Transparency of IT services is a buzzword that we can hear in many IT service management initiatives, as well as in smaller and larger IT sourcing debates in today’s companies. The more concrete objectives that addressed by such initiatives and debates are reliability of services, cost calculability and cost predictability, flexibility of the IT infrastructure and the strategic alignment of the emerging future IT infrastructure with the business goals of the enterprise.

The selection of appropriate performance indicators and their negotiation among stakeholders are important components in establishing transparency in IT service management. In practice we have experienced that stakeholders concentrate and rely too much on the definition of key performance indicators. We believe that performance indicators are no silver bullet in IT service management. And so they are not for quality management in general. In this paper we discuss the role of key performance indicators. We do so by attempting to characterize the design space for management systems that are based on a notion of target negotiation.

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Sect. III

II. QUALITY MANAGEMENT SYSTEMS

Today’s quality management systems are feedback control systems. A feedback control system consists of an inner system that is controlled, a sensor or measurement function that observes the controlled system and a controller or steering function that adjusts the behavior of the system on the basis of measurement data. The interplay of the system, its sensor and its controller is also called a feedback control loop. The plan-do-check-act cycle (PDCA), also known as Deming wheel or Shewart cycle, is the established terminology for the feedback control loop in the discipline of quality management systems. The planning and acting stages correspond to the steering function, the doing stage corresponds to the controlled system and the checking stage corresponds to the measurement function.

The notion of feedback control system is a very general one. Quality management systems have certain characteristics that make them special feedback control systems:

- Discrete.
- Evolving.
- Process-oriented.

III. 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 [6], [7], [8] are process-oriented. For conformance with concrete quality management systems the definition of processes is crucial. A mature – or let us say viable
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. ?? – see Figs. ?? and ?? . 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. ?? . 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 $S_{t,1}, \ldots, S_{t,n}$, a set $T$ of additional target agreements $T_{t,1}, \ldots, T_{t,m}$, and a set $A$ of additional business improvement activities $A_{t,1}, \ldots, A_{t,n}$. The feedback interface consists of a set $K$ of key performance indicators $K_{t,1}, \ldots, K_{t,o}$, and a set $R$ of additional performance reports $R_{t,1}, \ldots, R_{t,p}$.

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 [18] 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.

IV. 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 [19], 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 [17], 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.

A. Total Cost of Ownership

Several objectives must be met to make a successful and stable system: performance, scalability, availability, security, maintainability. If information system products have to be selected, eventually, total cost of ownership (TCO) [13] 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 than 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.

B. 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 [14], 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. ??, 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. ??, here. 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. ?? and ??, 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.

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, consequential 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.

V. CONCLUSION

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REFERENCES


