2011 22nd International Workshop on Database and Expert Systems Applications

# On the Design of IT Key Performance Indicators

Dirk Draheim
*IT Service Management Division*
*University of Innsbruck*
*Innsbruck, Austria*
*draheim@acm.org*

***Abstract*—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 workshop contribution we aim at characterizing the role of key performance indicators in management system, 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 can understand 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, 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 enterprises 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. More concrete objectives that are 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 workshop 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.

## II. Quality Management Systems

Today's quality management systems are feedback control systems. A feedback control system consists out 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), see Fig. 1 also known as Deming wheel [4] 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*. The planning stage identifies and negotiates objectives for the processes controlled by the quality management life-cycle. It occurs from time to time, e.g., on an annual basis or a monthly basis. Further monitoring and reaction at finer granularity is done by the responsible stakeholder of the process.
- *Evolving.* A mature – or let us say viable – quality management system is itself the subject to controlled change and therefore evolves in conjunction with the business that it aims to improve. This means that the action and planning stage change the process. They also change the objectives and the indicators that are monitored.

1529-4188/11 $26.00 © 2011 IEEE
DOI 10.1109/DEXA.2011.59

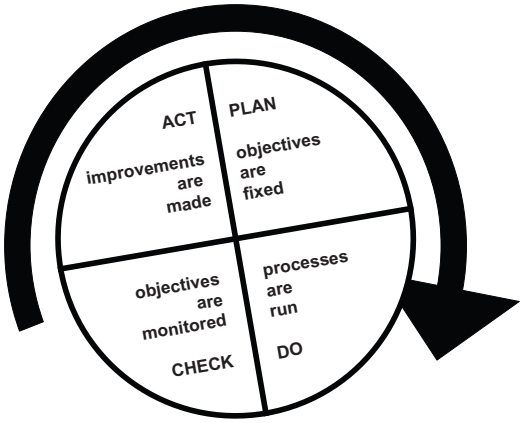


Figure 1. PDCA-like business process management life cycle

- *Process-oriented.* Established quality management systems [8], [9] are process-oriented. For conformance with concrete quality management systems the definition of processes is crucial.

A quality management system can be established in parallel to an existing management system. A quality management system can become so pervasive in an enterprise that it actually becomes the management model of the enterprise. Cybernetic management models are very elaborated feedback control systems [1], [2], [3]. The feedback control systems of cybernetic management are recursive, i.e., the same steering principle is repeated at the several levels of the enterprise.

ITIL (IT Infrastructure Library) [19], [20] is the IT service management body of knowledge. As such it emerged as a collection of best practices in IT service management. The standard corresponding to ITIL is ISO 20000 [10]. Over the years more and more elements of IT governance emerged in ITIL so that it now spans both IT governance and IT service management. However, still it is perceived rather as an IT service management framework and in projects it is introduced as an IT service management tool in first place, usually starting with establishment of a robust incident management process. ISO 38500 [11] and CoBit [12], [13] emerged as IT governance frameworks. In particular, CoBit also operates on the level of IT service management, however, usually CoBit is perceives as a genuine IT governance tool. Actually, you may find enterprises in which ISO 385000 or CoBit are used in parallel with ISO 20000 or ITIL.

The IT governance viewpoint onto IT management initiatives is always a quality management viewpoint and all the arguments given in Sect. III fully apply to IT management scenarios.

## III. Describing and Measuring Objectives

The identification of objectives of processes and negotiation of targets is crucial for quality management. Against the more basic viewpoint of agent theory [15] it is a center pillar of management in general.

Objectives and targets can be described by several means:

- *Steering parameters.* The steering parameters are target agreements between stakeholders of the steering function and stakeholders of the process execution function. A steering parameter is a well-defined, measurable figure of a defined business process.
- *Informal target agreements.* Informal target agreements are further target agreements that cannot be defined as measurable figures in terms of defined business processes.
- *Additional business improvement activities.* 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 distinction between informal target agreements and additional business improvement activities is somehow artificial. However, we think that it is important to distinguish between those target agreements that can be expressed in terms of the objectives of the processes, on the one hand side, and those that address other dimensions of business improvement, e.g., the organizational structure or the development and training of staff. For the former notion we use the term informal target agreements and the term additional improvement activities for the latter. The listed means of objectives and targets is not complete and rather loose. For example, also the formal steering parameters can be refined to those that are directly related to the process outcome and those that are related to other activities that influence the outcome of processes and services indirectly.

Similarly, achievements can be assessed by several means:

- *Key performance indicators.* The key performance indicators are measurable figures about defined business processes. Performance indicators correspond to steering parameters.
- *Informal performance reports.* The performance reports are further information about the performance of the enterprise that cannot be defined as measurable figures in terms of defined business processes. Informal performance reports correspond to informal target agreements and additional business improvement activities.

On the basis of this, we now want to distinguish between three different kinds of viewpoints on management systems, in general, and quality management systems and IT service management systems, in particular:

- Knowledge management viewpoint. The knowledge management viewpoint understands the existence of informal processes that accompany the formalizable

processes in an enterprise. It cares for the externalization of knowledge and its distribution [18], [6].

- Objective viewpoint. We call a viewpoint that tries to understand as much of the functioning of an enterprise as possible in terms of steering parameters, informal target agreements, key performance indicators and performance reports as objective viewpoint.
- Mechanical viewpoint. We call a viewpoint that tries to understand the functioning of an enterprise merely in terms of steering parameters, informal target agreements, key performance indicators and performance reports as mechanical viewpoint.
- Purely mechanical viewpoint. We call a viewpoint that tries to understand as much of the functioning of an enterprise merely in terms of steering parameters and key performance indicators as purely mechanical viewpoint.

The difference between an objective viewpoint and mechanical viewpoint lays in the role granted to the definition of objectives. In an objective viewpoint the definition of objectives is considered a crucial element, but in an mechanical viewpoint the definition of objectives rules. An objective viewpoint is aware of the importance of the quality of the overall design of the management system and its components. It is also aware of the impact of auxiliary management functions the quality. The balanced scorecard approach [14] is example of an approach that is shows such awareness in the way it taught and applied in projects in practice.

Against the background of this discussion, we eventually come up with the following statement:

> *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.*

From the above discussion we conclude that IT service provision, see Fig. 2, with all its facets of incident management, problem management, service specification and service control needs an objective viewpoint that should ideally combined with a knowledge management viewpoint.

## IV. On the Assessment of IT Assets

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) [16] must be addressed.

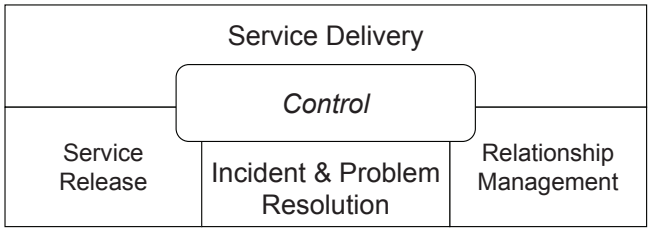


Figure 2. IT service management issues according to ISO 20000.

### A. Total Cost of Ownership

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.

### B. Total Benefit of IT 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 [17], which considers total costs of ownership, the business value and the options that are created by IT in evaluating it.

### C. Assessment of the Total Impact of IT Ownership

As we said in Sect. IV-A, 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. 3. 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. Furthermore, the total benefit of ownership is made of assessable

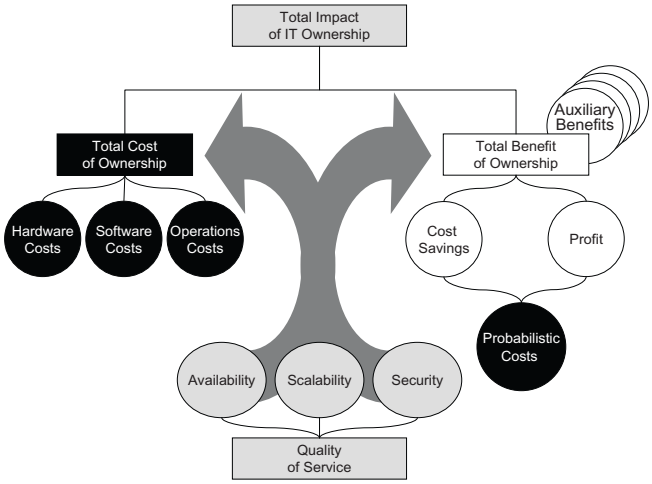


Figure 3. Total impact of IT ownership.

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 [7] and management [5] 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.

## V. Conclusion

A mature quality management system consists of two mutual dependent functions, i.e., a steering function and a process execution function. The steering function analyzes the performance of the enterprise. It analyzes the environment of the enterprise. It analyzes and adjusts the strategy [21] of the enterprise. It analyzes the key performance indicators and additional performance reports. It reviews the functioning of the business process execution function. 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.

Against the background of quality management we have distinguished between a knowledge management viewpoint, an objective viewpoint, a mechanical viewpoint and a purely mechanical viewpoint onto management systems. We have identified the need of an objective viewpoint, ideally combined with a knowledge management viewpoint, for successful IT service management initiatives.

## References


[1] S. Beer. Fanfare for Effective Management – Cybernetic Praxis in Government. The $3^{rd}$ Richard Goodman Memorial Lecture, Delivered at Brighton Polytechnic, Moulsecoomb, Brighton, $14^{th}$ February 1973.

[2] S. Beer. The Heart of Enterprise – Companion Volume to: The Brain of the Firm. John Wiley & Sons, 1994.

[3] S. Beer. The Brain of the Firm – Companion Volume to:The Heart of Enterprise. John Wiley & Sons, 1994.

[4] W. E. Deming. Out of the Crisis. MIT, Center for Advanced Educational Services, 1982.

[5] D. Draheim. Business Process Technology – A Unified View on Business Processes, Workflows and Enterprise Applications. Springer, 2010.

[6] D. Draheim. Smart Business Process Management. In (Layna Fisher, Herausgeber): 2011 BPM and Workflow Handbook, Digital Edition. Future Strategies, Workflow Management Coalition, 2011.

[7] M. Hammer, J. Champy. Reengineering the Corporation: A Manifesto for Business Revolution. HarperCollins Publishers, 1993.

[8] International Organization for Standardization. International Standard ISO 9000:2005(E). Quality Management Systems – Fundamentals and Vocabulary. ISO, 2005.

[9] International Organization for Standardization. International Standard ISO 9000:2005(E). Quality Management Systems – Guidelines for Performance Improvements. ISO, 2000.

[10] International Organization for Standardization. International Standard ISO/IEC 20000-1:2005(E). Information Technology – Service Management – Part 1: Specification. International Organization for Standardization, 2005.

[11] International Organization for Standardization. International Standard ISO/IEC 38500:2008. Corporate Governance of Information Technology. ISO, 2008.

[12] IT Governance Institute. COBIT 4.1 – Framework, Control Objectives, Management Guidelines, Maturity Models. ISBN 1-933284-72-2, IT Governance Institute, 2007.

[13] IT Governance Institute. COBIT Quickstart, IT Governance Institute, 2007.

[14] R.S. Kaplan, D.P. Norton. The Balanced Scorecard: Translating Strategy into Action. Harvard Business School Press, 1996.

[15] M. Jensen, W. Meckling. Theory of the Firm – Managerial Behavior, Agency Costs, and Ownership Structure. In: Journal of Financial Economics, vol. 3, no. 4, 1976, pp. 305–360.

[16] B. Kirwin. CIO Update: To Control TCO, It Must Be Measured and Managed. ID Number IGG-04162003-02. Gartner Group, April 2003.

[17] D. Merriman. Total Economic Impact: Really Understanding the IT Cost/Benefit Equation. Giga Information Group, 2003.

[18] I. Nonaka. The Knowledge-Creating Company. Harvard Business School Press, 2008.

[19] Office of Government Commerce. ICT Infrastructure Management. Bernan, 2002.

[20] Office of Government Commerce. Official Introduction to the ITIL Service Lifecycle. Stationery Office Books, August 2007.

[21] C.W. Stern, M. S. Deimler. The Boston Consulting Group on Strategy: Classic Concepts and New Perspectives. Wiley & Sons, June 2006.