



ERCIS

European

Research

Center for

Information

Systems

Working Paper No. 2

Teubner, R. A. ■

The IT21 Checkup for IT

Fitness:

Experiences and Empirical

Evidence from 4 Years of

Evaluation Practice



**WORKING
PAPERS**

ERCIS – European Research Center for Information Systems

Editors J. Becker, K. Backhaus, H. L. Grob, T. Hoeren, S. Klein, H. Kuchen,
U. Müller-Funk, U. W. Thonemann, G. Vossen



**Westfälische
Wilhelms-Universität
Münster**

Working Papers

ERCIS – European Research Center for Information Systems

Editors: J. Becker, K. Backhaus, H. L. Grob, T. Hoeren, S. Klein,
H. Kuchen, U. Müller-Funk, U. W. Thonemann, G. Vossen

Working Paper No. 2

The IT21 Checkup for IT Fitness: Experiences and Empirical Evidence from 4 Years of Evaluation Practice

Rolf Alexander Teubner

ISSN 1614-7448

Teubner, R. A.: The IT21 Checkup for IT Fitness: Experiences and Empirical Evidence from 4 Years of Evaluation Practice. In: Working Papers, European Research Center for Information Systems No. 2. Eds.: Becker, J. et al. Münster, March 2005.

Contents

| | |
|--|----|
| Working Paper Sketch..... | 4 |
| 1 The Need for IT Evaluation in Practice | 5 |
| 2 IT21: Vision and Objectives | 7 |
| 3 Lessons from Information Systems Evaluation Research | 9 |
| 3.1 IT: What to evaluate?..... | 9 |
| 3.2 Fitness: When is IT successful? | 10 |
| 3.3 Assessment: How to evaluate IT effects? | 11 |
| 4 The IT21 Framework..... | 14 |
| 4.1 IT: What to evaluate?..... | 14 |
| 4.2 Fitness: When is IT successful? | 15 |
| 4.3 Assessment: How to evaluate the effects of IT? | 17 |
| 5 The IT21 Toolset | 19 |
| 5.1 Relevant Topics | 19 |
| 5.2 Items and Scales | 20 |
| 5.3 Questionnaire Design | 21 |
| 5.4 Interview and Interviewer Instructions | 22 |
| 5.5 Analysis and Reporting..... | 23 |
| 6 Experiences: Instrument Validity..... | 24 |
| 6.1 Face and Expert Validity..... | 24 |
| 6.2 Construct and Predictive Validity | 24 |
| 7 Conclusions..... | 30 |
| Appendix | 35 |
| Items Measuring IM Quality | 35 |
| CEO Questionnaire..... | 35 |
| CIO Questionnaire | 36 |
| Items Measuring IIS Quality | 37 |
| CEO Questionnaire..... | 37 |
| CIO Questionnaire | 37 |
| Items Measuring Alignment | 38 |
| Strategic Alignment..... | 38 |
| Operational Integration | 38 |

List of Figures

| | | |
|------------|--|----|
| Figure 1: | Scope of IT fitness | 15 |
| Figure 2: | Explanation of the IT productivity paradox | 16 |
| Figure 3: | Strategic Alignment Model..... | 16 |
| Figure 4: | IT Productivity Framework..... | 17 |
| Figure 5: | The complete IT21 Framework..... | 18 |
| Figure 6: | Rating-scale | 20 |
| Figure 7: | Value-scales | 21 |
| Figure 8: | Multiple-choice-scale | 21 |
| Figure 9: | Scatter-plot of Information Management practices and performance | 26 |
| Figure 10: | Scatter-plot of Information Management and Information Infrastructure..... | 27 |
| Figure 11: | IIS practices and performance in categories of productivity..... | 28 |

List of Tables

| | |
|--|----|
| Table 1: Questionnaire structure | 22 |
|--|----|

Working Paper Sketch

Type

Research report

Title

A Framework for Assessing IT Fitness: Conceptual Insights and Empirical Evidence from the ABC Project

Author

Alexander Teubner, Research Group on Strategic Information Management, ERCIS, University of Muenster/Germany, alexander.teubner@ercis.de

Abstract

This paper reports on the development and application of an instrument to evaluate the overall IT fitness of medium sized enterprises. The instrument was designed in 1997 as part of an applied research project with the close co-operation of scientists and consultants, as well as various market and technology experts.

The resulting toolset has by now been applied to approximately one thousand enterprises mainly in Germany, Switzerland and Austria. This paper discusses the underlying framework for the measurement of IT fitness and describes the basic decisions involved in instrument design.

- A basic problem for developing such an evaluation instrument is the so called “IT productivity paradox”: Empirical studies do not yield direct positive relationships between the intensity of IT-usage and business productivity.
- The paper introduces explanations for the productivity paradox and discusses assumptions on the productive use of IT. This discussion serves as a basis for the formulation of a number of hypotheses on IT-fitness that have entered the framework underlying the IT21 Toolset.

The fundamental hypotheses of the framework are finally reassessed statistically based on the data collected with the instrument during the years from 1998 to 2002.

Keywords

IT fitness, IT evaluation, benchmarking, IT productivity paradox, strategic alignment, information management, information infrastructure

1 The Need for IT Evaluation in Practice

As IT expenditure rises, the measurement of its benefits to business becomes a natural concern for managers. Expenditure on IT typically ranges between 1% and 3% of turnover. However, it is not uncommon in service industries for it to be well in excess of 5% and thus exceeding the expenditure on research and development activities¹. As such a cost factor, the efficiency of IT usage is a natural concern for management even in those companies that do not view IT strategically. From the CIO's point of view, there are two basic reasons for appraising the benefits of IT.

Firstly, the CIO must consider the relative merits expected to accrue from IT/IS investments. Evaluation may help him/her to exercise authority over expenditure, choose between competing projects, decide whether a particular project is worth pursuing or not, and set demanding yet realistic objectives for the future. Furthermore, information about the success of past decisions is needed to aid learning and improvement.

Secondly, from a more political point of view, IT-managers have to demonstrate both the effectiveness and efficiency of IT-related services. The budgets of the IT-department must often be 'sold' to the CEO by demonstrating positive returns on investment at the bottom line. If internal services are concerned, it is not sufficient for them to yield a positive ROI, but rather the ROI of the insourcing alternative must also be superior to that of outsourcing². The ongoing outsourcing discussion and current cost pressure make this issue even more salient.

However, evaluation activities in practice are found to be poor. Studies from the first half of the 1990's suggest that only few companies carry out detailed comparisons between in- and outsourcing options. According to SCHMIDT, HÄNTSCHEL who conducted interviews with experts from 24 enterprises in Austria, evaluation in general appears to be of minor relevance in practice³. The authors conclude that if evaluation takes place at all it is only for selected projects that have a very high, or at least a high, impact on business success. It is mainly conducted ex ante as a decision aid and with respect to technical components. But even in these cases the outcomes are scarcely taken into account in management-decision making. Similar deficits are exhibited by another survey conducted by WILLCOCKS, LESTER who interviewed 150 senior IT-managers in the UK⁴: Evaluation is often carried out by developers in a 'pack up and get out' manner and with a narrow focus on technical issues. This manner of performing evaluation could often be observed when it was applied as a project closing procedure soon after implementation. Further deficits exhibited by the study are IT managers' lack of understanding of evaluation issues and options as well as the poor definition of business objectives and strategy that could be used to direct evaluation. Other surveys and case studies add to this picture⁵. Thus, evaluation practice does not appear to be in line with the striking need to make profitable decisions regarding IT investments. CIOs and IT managers obviously still seem to rely more on 'instinct' or 'faith' than on the results of a systematic evaluation.

1 Gomolski, Grigg, Potter (2001).

2 See White, James (1996), for example.

3 Schmidt, Häntschel (2000).

4 Willcocks, Lester (1997).

5 See Smithson, Hirschheim (1998), Ballantine, Galliers, Stray (1996) and Powell (1996), for example.

The problems and deficits uncovered are especially valid for small and medium sized businesses⁶. Smaller enterprises typically have a lower turnover, lower IT budgets, and smaller projects. As a consequence, they have only a limited capacity to develop appropriate and apply an evaluation instrument. In most cases there is only little information on project success, strengths and weaknesses of current IT support and benefits expected from new IT investments. IBM Germany perceived this as an essential need and problem of their customers that an IT vendor and service partner should address⁷. This gave rise to an applied research project named “IT fitness in the twenty first century (IT21)”. The aim of the project was to develop a standardised instrument to assess “IT fitness” in medium sized enterprises based on a questionnaire.

Section 2 describes the vision and objectives of the IT21 project, which are reflected upon in the light of current literature. Section 3 will identify the current state of evaluation research as premature and controversial, which is mainly due to the absence of a theory of IT productivity. On foot of this and before going into detail on the different and competing propositions of how to measure (aspects of) IT and its related business success, it is expedient to focus on the missing theoretical assumptions, which are also a main concern of this paper. In Section 4 we introduce a preliminary theory of IT productivity, which is the basis for the framework that we used to assess IT fitness with the IT21 checkup. The framework is later on (in Section 6) reassessed statistically based on the data from more than 900 enterprises that have been gathered from the IT21 checkup between 1998 and 2002. However, the operationalisation of the framework would overly extend the scope of this working paper. The questionnaires and interviewer guidelines alone cover more than 30 pages. For this reason, Section 5 introduces the reader only to the main decisions made throughout the design of the IT21 instrument. It is intended to convey a basic understanding of how data was collected with the IT21 questionnaire. In addition to this, examples of the scales and measures employed are given and are complemented by a list of all items included in the data analysis as an appendix.

⁶ See Ballantine, Levy, Powell (1998), or Powell (1996).

⁷ IBM Germany, business unit for small and medium-sized business (SMB) in the Central Region (Germany, Austria, Switzerland).

2 IT21: Vision and Objectives

The vision of the IT21 project was to provide medium sized enterprises with a comprehensible instrument to assess their particular IT situation. Such an assessment must not be restricted to a technical qualification of current IT use but must also give insight into the economic threats resulting from the current IT situation. It was also intended to identify potential benefits of IT, which have not yet been realised. This fundamental vision can be illustrated by means of an analogy taken from medicine where fitness checkups are used to identify the overall health of patients. Such checkups are standardised and applicable to a broad spectrum of people. They provide indications of vitality and threats to healthiness, but are no substitute for differential diagnosis. In-depth medical inspection, in contrast, must be conducted by a specialist, a medical doctor, and is specific to the patient. For example, a heart and circulation checkup may provide clues as to the risk of myocardial infarction. It may point out areas of concern and eventually give rise to further diagnosis but it does not draw a detailed clinical picture. Five visionary objectives were derived from this analogy of a medical *fitness checkup*:

1. *'Draw an overall picture'*: A checkup must not identify specific diseases but must draw a broader picture of healthiness. Accordingly, an IT checkup must not focus on technical aspects or specific IT application alone. Instead, it should address information infrastructure as a whole and its related IT-services.
2. *'Analyse fitness'*: Fitness is more than healthiness – it is associated with the capacity of an organism to do something or to compete with others, for example in sports. Thus, an IT checkup should relate IT measures to the IT capacity necessary for the enterprise to successfully compete in its current business setting.
3. *'Identify risk factors'*: A checkup should not only look at the current health situation but should also consider issues affecting future health and the threats of becoming ill. Risk of *myocardial infarction*, for example, may be indicated by genetic predisposition, nourishment and/or living habits. By analogy, an IT checkup should identify factors and contingencies that determine future IT fitness.
4. *'Propose health care measures'*: Ideally, Checkups do not only rate fitness but also give rise to concrete measures for keeping fit. Accordingly, an IT checkup should propose measures to improve IT fitness in areas of special concern (opportunities, threats).
5. *'Suitable for patients of different sex and age'*: The checkup should be applicable to enterprises of different industries and sizes within the target group, i.e. medium-sized enterprises (50 to 2000 employees in general) and not part of a corporate group.

The IT21 checkup is intended to be a standardised and easy-to-use instrument that can be applied not only by highly specialised experts but also by adequately trained sales and service personnel. Such personnel typically have a lot of knowledge in technology and its applications, but are not trained for “differential diagnosis” of IT efficiency problems. This is traditionally seen as a professional’s job that should be placed into the hands of experienced consultants, for example. The request for an easy-to-use instrument resulted in a number of very practical requirements:

■ 8

- The questionnaire should be comprehensible, standardised and easy-to-use, even by non-experts,
- personnel should be given detailed guidance in applying the questionnaire correctly and efficiently,
- data analysis should be automated,
- presentation and explanation of results should be supported by reports.

This initial vision and objectives turned out to be very challenging when we took a closer look at the current state of evaluation research.

3 Lessons from Information Systems Evaluation Research

Evaluation In the context of Information Systems Research (ISR) is defined as the process of establishing the value, worth or usefulness of Information Technology (IT) to an organisation. The relevance of good evaluation practices for ISR is obvious: a discipline whose methodology strongly builds on the development and prototyping of IT solutions and related artefacts needs clear judgements of their effectiveness and efficiency in order to learn what is good about them and what is not. Consequently, evaluation research as established by SUCHMANN in 1967⁸ was adopted in ISR early on and has been undergoing a debate for more than two decades. Some even suggest looking upon *Evaluation Research* as a sub-discipline of ISR⁹. But although there is common agreement on the importance of evaluation and despite the fact that much research effort has been undertaken, results are more than controversial. There exist great differences in objectives, scope, objects, criteria, and measures, even for methods with the same relatively narrow purpose¹⁰. One basic reason for this, as mentioned before, is the absence of a common theory for IT/IS evaluation. However, Evaluation Research added much to our awareness of the problem.

The next section provides a cursory description of the state of Evaluation Research. It is organised according to three questions that drove the design of the IT21 checkup. Firstly, the questions for the objects: *What has to be taken into account when assessing IT and its use* in an enterprise? Secondly, the question for the aims of IT usage: *When is IT use* in an enterprise *successful*? And thirdly, the question for the evaluation method: *How to measure* IT fitness? These three guiding questions are also used in Section 4 which deals with the construction of a theoretical evaluation framework.

3.1 IT: What to evaluate?

In the context of information systems research and evaluation, the term IT is not restricted to technology but, generally, used in a wider sense. It has become a “generally accepted umbrella term for a rapidly expanding range of equipment, applications, services, and basic technologies”¹¹. IT does not only cover computers, networks information systems (IS) and software applications but often includes the services and people dedicated to their operation and management as well. With such a broad understanding of IT, the spectrum of evaluation objects is considerably large¹²:

- the components of information technology,
- the business software applications,

⁸ Suchmann (1967).

⁹ Heinrich, Häntschel (2000).

¹⁰ See Irani, Love (2000). For a critical review of IT/IS investment evaluation methods see Berghout, Renkema (2001).

¹¹ Katz (1993), cited from Lin, Pervan (2001), p. 3.

¹² Heinrich, Häntschel (2000).

■ 10

- the way IT and software are applied in information systems,
- the business processes supported or enabled by IT/IS,
- the IT/IS related development processes,
- the techniques, methods and tools used in development,
- the artefacts and models built during the development process,
- IT-related management and service processes.

The focus of current literature is on software applications or single information systems. Some authors have extended the scope to (IT-enabled) business processes¹³. With the growing discussion on outsourcing, the evaluation of IT/IS related services and development processes and the choice between in- and outsourcing alternatives have received increased attention¹⁴. Whilst the evaluation of each of these areas is difficult enough, the problem becomes virtually impossible to solve when it comes to an evaluation of the full spectrum of objects, including multiple effects and interactions. Perhaps the broadest propositions come from LEWIS, SNYDER, RAINER and LEWIS, BYRD¹⁵. These authors propose measurement instruments that aggregate a broad spectrum of objects and activities that are discussed in the literature as being related to the constructs “information resource management” and “information technology infrastructure”, respectively. The underlying assumption is that all these aspects of information resource management and IT infrastructure add some value to the organisation. However, the question of whether this assumption is true and, if so, what these values are is still unresolved.

3.2 Fitness: When is IT successful?

The fundamental interest of ISR and Evaluation Research, in particular, lies in the economic effects of IT, i.e. the benefits and costs of IT use in business. The cost associated with IT can be defined as IT-related inputs to the production process, including write-offs on related investments, expenditure on services and the cost of running IT. In an even broader sense, IT costs can be understood as all effects that IT investments have on the cost of an enterprise. For example, such effects may be IT-caused perturbations or increased IT/IS skill requirements in the organisation.

Benefits are twofold: on the one hand, IT may substitute other production factors such as human labour (e.g. through automation and rationalisation) and thus reduce expenditure on these inputs. On the other hand, it may increase the output of production in terms of quantity, quality and increased revenue¹⁶.

¹³ Remenyi, Whittaker (1996).

¹⁴ Smithson, Hirscheim (1998), pp. 158 ff.

¹⁵ Lewis, Snyder, Rainer (2001); Lewis, Byrd (2003).

¹⁶ See Parker, Benson, Trainor (1997), pp. 1.

The basic rationale underlying all IT investment decisions is the expectation that IT benefits will surpass related costs. The cost-benefit-ratio is often expressed as productivity, a measurement that basically relates inputs in IT to outputs in terms of enhanced operations. Although increased productivity is a commonly assumed outcome of each IT investment, several high profile studies at the levels of both the national economy and industrial sectors have come to the conclusion that despite massive investments in IT there is no increase and sometimes even a decline in productivity¹⁷. These findings have brought up the so-called productivity paradox. This paradox suggests, in principle, that if there is an IT-payoff it is minimal and hardly justifies the investments¹⁸.

The unexpected finding of the productivity paradox has led some researchers to question the data used in the high profile studies mentioned. They argue that high level studies aggregated on the level of the political economy cannot measure an overall trend because IT effects are complex and sometimes contrary. They also argue that since industry level data are an abstraction of real business experience they neither convey a deeper understanding of IT adoption nor allow an analysis of factors that intermediate the relationship between IT investments and business success. Consequently, these critics call for more detailed studies on the firm or industry level, at least. Indeed, a number of subsequent studies find strong positive relationships between IT investments and productivity¹⁹. In summary, the productivity paradox can no longer be seen as a general phenomenon. The picture has become multi-faceted and detailed but it is far from clear. There is no common explanation for cases of productivity and non-productivity. ISR still lacks a theory that could explain human and organizational effects of IT and their impact on business performance. However, such a theory is imperative when it comes to developing reliable evaluation instruments.

3.3 Assessment: How to evaluate IT effects?

Another point that can be learned from the productivity paradox is that measurement of IT productivity is more than difficult. For WILLCOCKS, LESTER the studies supporting a productivity paradox say as much “about the deficiencies in assessment methods and measurement, and the rigor with which they are applied, as about mismanagement of the development and use of information-based technologies”²⁰. The core problem lies in the identification and quantification of IT related costs and benefits. Whilst there are already substantial difficulties in determining the costs beyond direct expenditure on IT and IT services, the identification and measurement of benefits is an even greater problem. Benefits are mostly indirect and partly intangible. For this reason, most quantitative measures currently available are restricted to a technical level (increased capacity, processing rate) where outcomes can be easily measured. The few measures that try to capture the economic impact of IT are not widely accepted and are either criticised as

¹⁷ For some early studies uncovering this paradox see Strassmann (1985) or Roach (1991).

¹⁸ See Thurow (1991), and Brynjolfsson (1993), for example.

¹⁹ For an overview see Potthoff (1998). Also see Willcocks, Lester (1997) and the studies referred to, there.

²⁰ Willcocks, Lester (1997), p. 1083.

inconclusive or faulty²¹. There are a number of reasons why it is difficult to capture IT-related costs and benefits (turnover, return on investment)²²:

- *Technical Embedding*: Single IT components are embedded in an overall IT infrastructure. Therefore, it is critical to isolate single objects and assign particular effects to them.
- *Organisational Embedding*: IT infrastructures have become an inextricable part of organisations, its processes and structures. Accordingly, it has become increasingly difficult to separate the impact of IT infrastructure solutions and measures from that of other organisational assets and actions.
- *Social Construction*: An IS is not merely a technical phenomenon, but also a sociological one. Thus, any assessment must exceed the technical aspects that lay in the core of initial evaluation techniques. Changes in IT are, in most cases, inevitably tied to changes in work practice. Consequently, human and organisational sense-making must also be considered.
- *Social Adoption*: IT does not show the intended effects before it is socially adopted. Because the related learning and adoption processes evolve over time, there is a time lag between IT implementation and the delivery of benefits, which in turn makes it difficult to relate them to one other.

In the light of missing theoretical foundations and in the absence of commonly accepted criteria for measuring IT and its benefits, the evaluation of user satisfaction and a comparison with industry standards have gained increasing attention²³. Both approaches bypass the theoretical problems mentioned by making either user opinions or standards their criterion for success. This approach uses the state-of-the-art, best-of-breed or norms and standards for touchstone evaluation. It is called benchmarking and focuses on either performances or practices²⁴:

- *Performance Benchmarking*: Performance benchmarking is what IT professionals are familiar with. Early benchmarking was concerned with product-to-product comparison of individual hardware and software components in terms of technical measures such as throughput and processing capacity. Performance benchmarking has been extended to quantitative measures of Information System and IT-enabled work process effectiveness. Measurements are compared to industry norms, the performance of best-of-breed, the performance of comparable business areas or simply to prior experience.
- *Practice Benchmarking* is the analysis of work practices, techniques and heuristics for performing common tasks, and comparison to industry standards, practices in best-of-class organizations or in related fields within the enterprise.

Benchmarking does not measure economic benefits directly but rather it looks at practices and performances that are assumed to add to business success. The underlying assumption is that there are standards for practices and performance – to be found in leading organisations, com-

²¹ See Irani, Love (2001), p. 183, or Kanungo, Duda, Srinivas (1999), p. 496 f.

²² See Orlikowski (1992); see also Smithson, Hirschheim (1998), pp. 161.

²³ Kanungo, Duda, Srinivas (1999), pp. 496.

²⁴ The role of benchmarking in demonstrating IT/IS performance is discussed in Lacity, Hirschheim (1996).

petitive or best-of-breed, or industry norms and standards – which lead to economic benefit independently of the enterprise situation (determined by industry, markets, size or organisational structure)²⁵. Benchmarking is especially favoured in applied research²⁶.

²⁵ Gordon (1994).

²⁶ Frank (2000), pp. 42.

4 The IT21 Framework

On the one hand, we realized there was a great need for standardised evaluation instruments in practice. On the other hand, ISR and Evaluation Research neither provided us with well established instruments nor with a common theory to build on. It may be concluded that the gap between evaluation needs and evaluation practice stated in Section 1 is – at least in large – due to deficits in proven techniques which help management to assess IT usage, to prioritise, realise, monitor and control IT investments²⁷ and to guide sourcing decisions²⁸. It would have been unrealistic of us had we expected to totally overcome these deficits with a single research project. However, the IT21 project faced these problems by addressing the dilemma step-by-step answering each of the three guiding questions introduced in the preceding section. Firstly, we defined the scope of the instrument, i.e. *what* has to be assessed. Secondly, we revisited the productivity paradox in order to derive a framework, as a substitute for the missing theory that throws light on the ways in which IT delivers business value. The hypotheses included in this framework guided us in answering the question of *when* IT is used successfully. Thirdly, we decided *how* to measure IT, judge its value and identify threats to the current infrastructure and future potential of IT.

4.1 IT: What to evaluate?

It is clearly obvious that an IT assessment must exceed technical aspects. As the term “application system” already expresses, the way in which IT is applied to business is of much importance. Even broader is the concept of an “information system”. An IS also includes the organisational structure a system is embedded in, as well as the humans that use it. A technically perfect application system might fail because of missing capabilities on the user side or their resistance to it. IT, in its technical sense, and information systems, as the socio-technical phenomenon, are both part of the so-called information infrastructure (IIS). The IIS contains all technical and non-technical prerequisites for information and communication within an enterprise.

However, the notion of IT fitness goes beyond the quality of an existing information infrastructure (see Section 2). Given the case that the IIS has been built and maintained by an external supplier in the past, the IT situation is far from safe, if this supplier is out of business, now. A similar critical situation may arise if internal IT professionals move to another enterprise. What can be seen from these examples is that the capacity to plan, build, control and maintain the IIS is at least as important to IT fitness as the existing infrastructure²⁹. Consequently, we included management actions and IS/IT development processes in our evaluation (Figure 1).

²⁷ Ballantine, Levy, Powell (1998); Pijl, Zee, Ribbers (1997); Whiting, Davies, Knul (1996).

²⁸ Willcocks, Fitzgerald, Lacity (1996).

²⁹ Clark (1993); Lewis, Snyder, Rainer (1995).

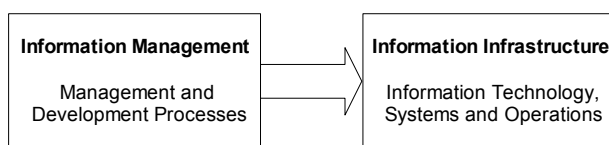


Figure 1: Scope of IT fitness

4.2 Fitness: When is IT successful?

In the light of the productivity paradox, the main challenge of the project was to find valid indicators of the overall fitness of an enterprise's IT. This proved to be impossible without any assumptions about the way IT impacts on business and success. For this purpose we revisited the productivity paradox and the findings of subsequent industry and business-level studies.

A number of the studies that investigate the productivity paradox in more detail report on specific cases in which ICT has permitted huge increases in output or decreases in cost. However, the opposite is true in other cases³⁰. These contradictory findings can be explained by the so-called "*amplifier effect of IT*": IT use reinforces existing management approaches, splitting firms more clearly into high and low performers³¹. STRASSMANN concludes that successful enterprises use ICT to their advantage, whilst ICT by itself is not capable of making unsuccessful enterprises successful. The latter often only manage to implement a costly automation of prevailing disorder³². WIGAND et al. build on this explanation. They see an indirect rather than a direct relationship between IT and corresponding payoffs through the effects that IT has on business processes (Figure 2). Their argument is closely related to some basic assumptions of Business Process Reengineering (BPR)³³. Firstly, the belief that organizations should be viewed in terms of processes, which perform customer-related tasks. In contrast, traditional thinking in business functions splits up work processes and tends to lose sight of the values delivered to the customer by these processes. Secondly, there exists the idea that IT is an enabler that has rule-breaking effects on the ways business processes are carried out. Both suppositions lead BPR to the recommendation that existing processes have to be rethought from scratch due to the increasing capabilities of IT. Though this radical approach, described as a "Manifesto for Business Revolution" by one of its promoters³⁴, proved to be difficult to apply in practice, it is important to note that its claimed ability for radical change extends the discussion from an operational to a strategic level. While traditional approaches such as Requirements Engineering or System Analysis have always started from existing business processes, BPR for the first time not only questions the existing organisational solutions but also the business processes itself³⁵.

³⁰ See Potthof (1998).

³¹ According to Willcocks, Lester (1997), p. 1085, this effect has been identified by Cron, Sobol (1983) for the first time.

³² Strassmann (1988).

³³ Hammer, Champy (1993), Davenport (1993).

³⁴ Subtitle of Hammer, Champy (1993).

³⁵ See the title of Hammer (1991): "Reengineering work: Don't Automate, Obliterate".

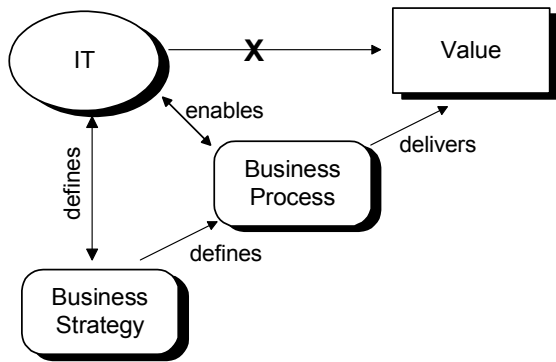


Figure 2: Explanation of the IT productivity paradox³⁶

The model in Figure 2 distinguishes between two levels of discussion, an operational level (“business processes”) and a strategic one (“business strategy”). HENDERSON and VENKATRAMAN elaborate these two levels in their so-called “Strategic Alignment Model”³⁷. According to this model, strategic decisions are concerned with *externally* positioning the enterprise, i.e. defining the mission, purpose, governance structures and the resources needed to establish the distinctive competencies in competition. In contrast, the decisions at the infrastructural level are concerned with the deployment of *internal* resources and their operation. Accordingly, the IT dimension distinguishes between “I/T Strategy” and “I/S Infrastructure” (Figure 3).

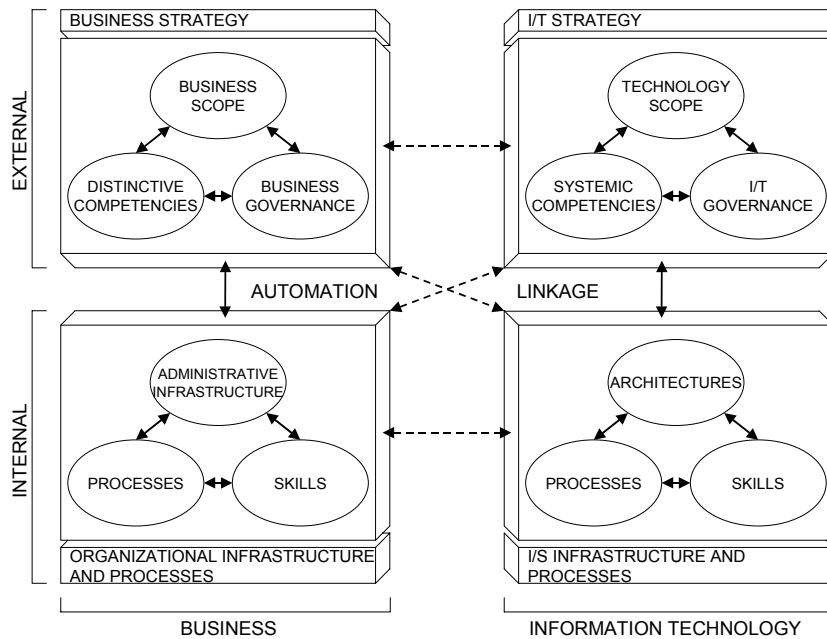


Figure 3: Strategic Alignment Model³⁸

³⁶ Wigand et al. (1998).

³⁷ Henderson, Venkatraman (1993); Henderson, Venkatraman, Oldach (1996).

³⁸ Henderson, Venkatraman (1993), p. 8.

The central hypothesis of the framework is that, in order to generate value, all four quadrants must be coordinated (dotted arrows in Figure 3). Thus, it is not sufficient to only integrate IT and business at the level of the (existing) infrastructures (operational integration). Only if an alignment at the strategic level can be established (“strategic alignment”) will the resulting infrastructure be fully supportive and effective to business.

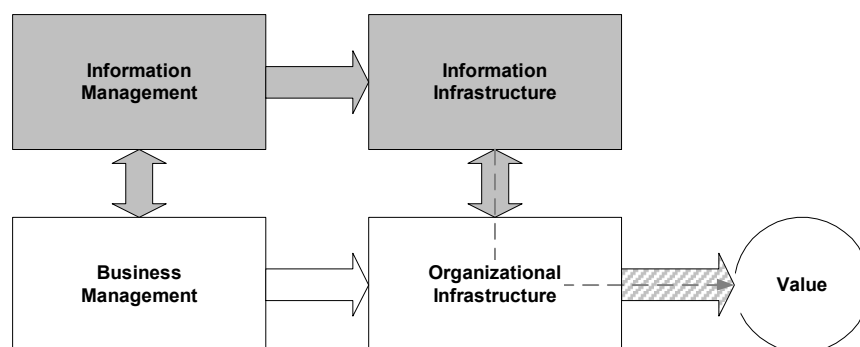


Figure 4: IT Productivity Framework

Figure 4 sums up our considerations so far. Our hypothesis is that IT will deliver value only if it is organised in an IIS that effectively supports the organisational infrastructure. For this reason, we did not restrict the scope to the IIS alone but we also included its effects on business processes. Another insight that comes out of the literature is that the capability to plan and build an integrated information and organisational infrastructure strongly depends on effective information management and its alignment with business management³⁹. Thus, we also had to take information management and its link to business management into closer consideration. IM in this context is primarily concerned with strategic information planning⁴⁰ and executing the resulting information strategy. Strategy execution includes tasks such as IT/IS investment planning⁴¹, project management, systems design and implementation⁴².

4.3 Assessment: How to evaluate the effects of IT?

Although an evaluation framework such as the one proposed in Figure 4 is an important and helpful approach to IT evaluation in practice⁴³, it does not provide detailed guidance on how to measure IT productivity. Aware of the controversial state of discussion concerning the measurement of IIS and IM success (as outlined in Section 3), we built our instrument on the benchmarking approach. Benchmarking simply hypothesises that specific practices and performance standards add to business success. The deficits of this approach lie in the fact that there are basic assumptions that have not yet been confirmed: Firstly, it has scarcely been proved that the performance criteria and practices proposed for benchmarking do really deliver value. Secondly, it is questionable whether such value is generated independently of the enterprise situa-

³⁹ See Chan et al. (1997); Luftmann (2000).

⁴⁰ See Lederer, Sethi (1991); Lederer, Sethi (1996); Segars, Groover, Teng (1998).

⁴¹ See Clemons (1991); Ballantine, Galliers, Stray (1995); Huerta, Sánchez (1989).

⁴² See Jones, Harrison (1996); Deifel et al. (1999).

⁴³ See Clark (1993), p. 65 and 67.

tion, irrespective of different business types, enterprise sizes, industry structures, or competitive threats. However, the problems of the second approach cannot be overcome without solving the problems of the first. Thus, we decided to combine both approaches: We developed a preliminary explanation of IT productivity in order to identify relevant domains and then applied benchmarking to them. In terms of the latter, we applied both, performance and practice benchmarking and combined the two. By comparing practice and performance measures we were able to check whether certain “best practices” from literature are really successful. If so, we would expect good practice to coincide with high performance.

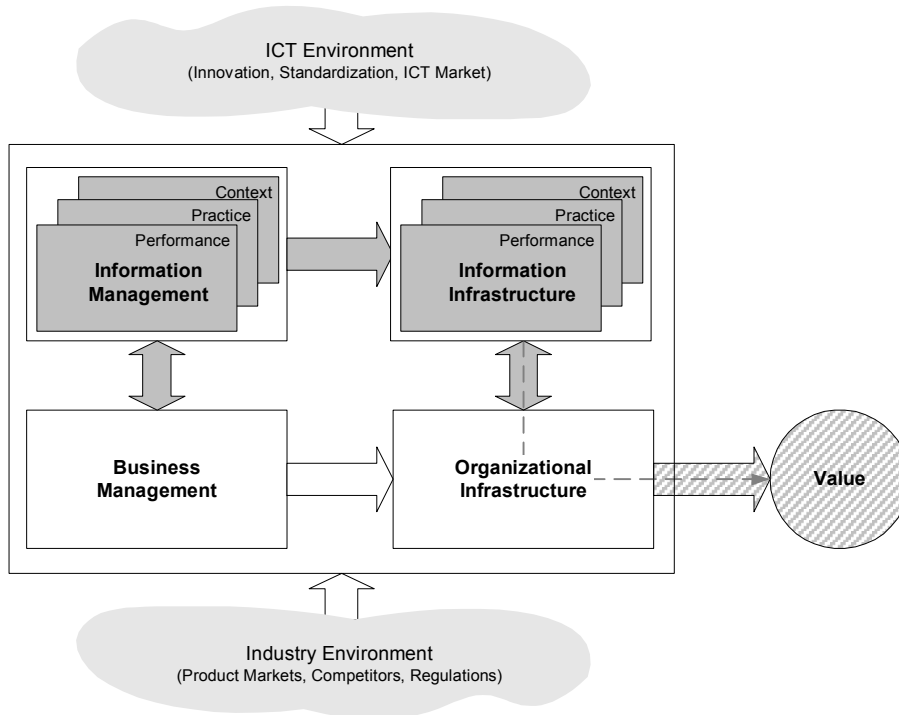


Figure 5: The complete IT21 Framework

A further extension here when compared to traditional benchmarking is that we explicitly take into account the enterprise situation. In traditional benchmarking the situation is either ignored or only addressed indirectly by comparing the results for the enterprise under investigation with those of other enterprises in a similar situation or by matching them with an industry-specific norm. The underlying assumption is that the situation is comparable for enterprises within the same industry and of the same size, etc. As Figure 5 depicts, we decided to consider the situation in more detail. In such a way, we expect to capture a much richer picture that allows us to contextualise, interpret and validate certain practices and performance standards found in a concrete enterprise setting. For example, specific practices and performance standards in security may have to be judged differently even in firms of the same sector and size (external context) or technical infrastructural type (internal context).

5 The IT21 Toolset

Literature confirms that frameworks such as the one we have depicted in figure 5 are a useful way to approach the problem of IT evaluation. The work of CLARK is exemplary⁴⁴. He interviewed 30 senior IT executives and discussed a framework for assessing IT productivity with them. He reports that most of the executives felt it to be a useful approach while about 40% of the interviewees also felt that such a framework was not suitable for an IT assessment at an enterprise level. They saw problems in measuring the broad scale of variables to be necessarily included in such a framework and linking them to each other. For CLARK, this is an obvious area in need of more extensive study.

In our research, the framework acted as the reference point for an extensive operationalisation process. The latter resulted in two complex questionnaires and corresponding interviewer guidelines, as well as in prescriptions on how to analyse the results of the interviews. We call these results the IT21 toolset. The following illustration of items and scales must remain as examples for two reasons. Firstly, a complete discussion of how we made the areas of concern measurable, especially how we identified the relevant topics, decomposed them into separate items, constructed scales, and designed the analysis of the interviews would extend the scope of this paper. The full instrument covers more than 30 pages of questionnaire and interviewer guidelines and it takes 2-4 hours to carry out each interview⁴⁵. Secondly, in light of the current state of evaluation theory most decisions in relation to specific measures were a matter of debate and had to be based on good practical judgement in the end. However, we will discuss the most important design decisions here in order to provide the reader with a basic understanding of the process of data collection with the IT21-questionnaire⁴⁶.

5.1 Relevant Topics

Even though our framework points out the relevance of IM and IIS in assessing IT fitness, we still had to decide on topics that best represent practices and performances in these areas. This decision was made by an expert group comprising three to four academics and the same amount of consultants. The expert group compiled relevant items in a brainstorming session, combining deductive and inductive reasoning. In terms of deduction, we started with general recommendations from literature and related them to practical experience. Since scientific studies on good practices and performance in IM and on the criteria governing the quality of an IIS were limited⁴⁷, academic textbooks on Information Management and on the state of the art in Information Technology were also included in the discussion⁴⁸. Literature did not only inform us about good (and bad) practices, but also helped us to identify relevant situational variables. For

⁴⁴ See, for example, Clark (1993), p. 67, and the framework proposed on p. 65.

⁴⁵ IBM (1998).

⁴⁶ For more details of instrument design see Teubner; Rentmeister, Klein (2000).

⁴⁷ See, for example, O'Brian, Morgan (1991); Clark (1993); Lederer, Sethi (1991); Lederer, Sethi (1992); Premkumar, King (1994); Lederer, Sethi (1996); Chan et al. (1997).

⁴⁸ Brenner (1993); Österle, Brenner, Hilbers (1993); Heinrich (1996); Krcmar (1997); Biethan, Muksch, Ruf (1996) and (1997).

example, the classification scheme for measuring the application system landscape is based on a proposition by STEINBOCK and BRENNER⁴⁹.

In terms of induction, we started from concrete issues and practical problems from consulting practice were taken as starting point and analysed for causes, consequences und possible solutions. The question, whether the results could be generalised, was again answered by literature. This discussion process resulted in an extensive catalogue of topics that was organized and condensed to about 70 core themes, which were in turn broken down to more than 170 items relating to performance, practice and situation variables.

5.2 Items and Scales

As regards the assessment method, CEOs and CIOs were asked to rate themselves during an interview, from which their perceptions of business and information management were gleaned. Such a self-assessment seems to be justified by the fact that key individuals' perceptions may be more adequate in capturing IS as a socio-technical phenomenon than hard technical facts (see Section 3.3).

Though shared by CEO and CIO, answering more than 170 items would require a great deal of time. Thus, it was necessary to keep answering the questions as quick and easy as possible. We decided to measure performances and practices with closed questions on a five-grade Likert scale. Figure 6 presents a typical practice item and performance item both from the CEO and CIO part of the questionnaire, respectively. We turned to literature in order to determine which items were considered best and those that were deemed to be worst. However, in some cases these suggestions seemed to be overly theoretical and so adjusted them in line with what appeared to be observable and realistic in practice by building upon the experience of the project participants, especially the consultants and technology experts.

| Please indicate r. h. s. (1-5) | 1 | 2 | 3 | 4 | 5 |
|---|--------------------------|---|---|---|--|
| How regularly do planning meetings take place involving IT-management and management of all other departments? | Almost no co-ordination | | Regular meetings scheduled | | Regular meetings; logging of items discussed; checking of objectives |
| To what extent are data processed by application systems documented? | No current documentation | | For data of company critical applications: detailed and mainly current documentation of formats and file operations (...) | | Complete and current documentation in a data dictionary |

Figure 6: Rating-scale⁵⁰

The resulting scale reflects some kind of norm on its own: a rating of three suggests a medium level of a certain quality and is often found to be typical for a practice or performance. Current data supports this assumption. For most items we found unimodal, in several cases bimodal

⁴⁹ Steinbock (1994), S. 26; Brenner (1994), S. 68.

⁵⁰ IBM (1999), p. 3 and 11.

distributions, often with skewness towards grade 4 or sometimes grade 2. Extreme values (1, 5) were rare⁵¹.

| | | | |
|--|--|--|--|
| How long does it take until the following problems will arise when an IT-disaster takes place, i. e. when all precautions fail? | Customer services, delivery, payments and invoicing do not work any longer | Customers turn to competitors; suppliers are upset | Goodwill and corporate image are damaged heavily |
| Please fill in time in hours → | | | |

| | | |
|--|------------------------------------|----------|
| Percentage of employees unable to continue working in case of IT running in a totally out-of-operation situation (taking longer than half a day?) | Please fill in percentage → | % |
|--|------------------------------------|----------|

Figure 7: Value-scales⁵²

Where numbers were concerned we asked for explicit specification. For situational items we used nominal scales as these items are descriptive in nature. Figure 7 depicts an example of a value scale from the CEO part of the questionnaire and a multiple-choice-item from the CIO part.

| | | | | | | | | |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|---|
| What kinds of media are used for business partner communication? | Fax | Phone | Mail | E-mail | EDI | File transfer | Data-base access | Direct communication between applications |
| Please indicate | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Figure 8: Multiple-choice-scale⁵³

The comprehensiveness, preciseness, and separation of the scales were checked in a number of test interviews. Some argue that self assessment scales for practices and performances might palliate results⁵⁴. However, as long as this effect is somewhat stable throughout all of the interviews, the results remain comparable.

5.3 Questionnaire Design

The resulting catalogue of items was of considerable breadth of content. It covered technical questions as well as management issues and details on the overall situation of the enterprise under consideration. In order to receive valid information on these issues, it was necessary to identify interviewees that were well informed of the issues under investigation⁵⁵. However, it was not possible to deal with more than one or even a few interviewees. Therefore, we decided to divide the questionnaire into two parts: one part was assigned to the Chief Executive Officer (CEO) or another member of the top management who had responsibility for business issues; the other was assigned to the highest ranking manager responsible for IT, the so-called Chief Information Officer (CIO). While the first part of the questionnaire mainly covered strategic issues and business topics, the second part was leaned to administrative and IT-related themes.

⁵¹ See Rentmeister, Teubner, Meier (2002). Best approximations were derived by the multinomial distribution.

⁵² IBM (1999), p. 5.

⁵³ IBM (1999), p. 12.

⁵⁴ Methodological problems are discussed in Schnell, Hill, Esser (1999), pp. 330.

⁵⁵ See Müller-Böling, Klandt (1993), p. 34.

In such a way, we could assume CEO and CIO to be competent respondents in their relative fields.

Dividing the questionnaire into a CEO- and a CIO-part opened up a promising new opportunity to measure strategic alignment, which in traditional approaches is commonly assessed by asking directly for alignment practices and performance⁵⁶. The division of the questionnaire allowed us to extend the measurement of alignment by checking for inconsistencies in the answers of the two key representatives for business and information management⁵⁷. Whilst similarities in perceptions and intended actions can be taken as an indicator for good co-ordination and alignment, the opposite is true for contradictions⁵⁸.

| CEO questionnaire | CIO questionnaire |
|--|--|
| <ul style="list-style-type: none"> • General enterprise description • Role and position of IT within the company • Information and communication • End-user orientation • Safety and threads • Innovative solutions • IT-strategy • Business situation and success | <ul style="list-style-type: none"> • Characteristics of the IT situation / function • IT-strategy • Project management • User orientation • System administration • IT-penetration of business processes • Safety and threats • Flexibility and capability for innovations • Application systems landscape • IT infrastructure |

Table 1: Questionnaire structure

The items within each of the two (sub-)questionnaires were organised by subjects in order to provide a common interpretative context that facilitate the answering of single questions. Figure 8 depicts the subject structure of both questionnaires. Another feature to speed up the answering process was the full standardisation and closed nature of the questions. We conducted pre-tests to verify single items and scales as well as to check the impact of item arrangement, understanding and answering tendencies⁵⁹.

5.4 Interview and Interviewer Instructions

Since the questionnaires were fully standardised it was possible to carry out written interviews by letter. Nevertheless, we decided to make use of interviewers for three reasons. Firstly, the personal attention devoted might increase the willingness of managers to take part in the interview and allocate time to it. Secondly, a guided interview where the interviewer asks questions and fills out the forms is more convenient. And thirdly, the interviewers can increase the quality of the answers and perhaps reduce the time spent by explaining the items and giving additional information on demand. The interviewers themselves are supported by interviewer guidelines that explain all items and the intended interpretations in detail. Interviewers are urged to comply

⁵⁶ See, for example, Kanellis, Lycett, Paul (1999), or Luftmann (2000).

⁵⁷ See Ross, Weil (2002). The authors discuss a number of IT decisions that should not be made by IT management, independently of senior business management.

⁵⁸ Also see Tai, Phelps (2000).

⁵⁹ See Teubner, Rentmeister, Klein (2000), pp. 85.

with this guide in order to minimize the influence of interviewers and avoid subjective interpretations. Furthermore, the interviewers, which were to a large extent IBM personnel, had to go through an interviewer training process.

5.5 Analysis and Reporting

Based on the results of the interview, an enterprise specific analysis was conducted (which must not be confused with the statistical analysis presented in Section 6). This analysis was done automatically by computer-supported tools. The resulting report for each enterprise covers up to 100 pages. A core part of the report is the *benchmark* in fitness factors that covers about 20 charts. Also included are an enterprise specific profile of *strengths and weaknesses* that drills down from aggregated indices to single practices and performances. A last part of the report identifies *enterprise specific problems*.

In order to derive concise statements in the *benchmarking* part of the analysis, the practice and performance items are aggregated to a number of factors assumed to be critical to IT success. Among others, these fitness factors include “IT cost structure”, “IT leverage”, “quality of IT service”, “capability to innovate”, “IIS adaptability”, “IT security”, “ability to communicate”, “IT control”, and “alignment”⁶⁰. Most of the fitness factors are calculated from performance/practice items as summed ratings⁶¹. The resulting values were standardised by transforming them to a scale from 0 (all worst) to 100 (all best). Thus, the indices give perspicuous information on critical issues in IT fitness. Enterprises can easily locate their results on the theoretical scale that tells them what is achieved in relation to what is theoretically possible and desirable (values 0 to 100)?

The *analysis of strengths and weaknesses* builds on the comparison with the industry benchmark or with other enterprises in a comparable situation. For each index, the items with the highest and lowest ratings are identified and analysed in more detail. The results are displayed in strength-weakness profiles.

Data analysis is not complete until situational factors are considered in more detail. For example, an enterprise that is strongly dependent on IT/IS (see Figure 7, first item) will generally have to plan and make provisions for possible IT failure and sabotage and engage more in catastrophe management and recovery than others. The situational analysis, on one hand, combined with the strengths and weaknesses identified, on the other, represent the constituents of *problem analysis*, which identifies areas of concern and suggests ideas and arguments for possible improvements.

⁶⁰ The fitness factors were derived from an analysis of the topics assumed to be most relevant to IT fitness (see identification of relevant topics in chapter 4.1) and literature study. Nearly all of the items used relate to at least one of these fitness factors. See Teubner, Rentmeister, Klein (2000), pp. 87.

⁶¹ Summed rating is a common practice in social science, although adding up ordinal values is incorrect from a strict mathematical point of view. See, for example, Schnell, Hill, Esser (1999), or Friedrichs (1990).

6 Experiences: Instrument Validity

A final but central question is whether our instrument really measures IT fitness as intended. If an instrument measures what it purports to measure it is said to be valid. Validity is traditionally subdivided into three categories: content validity, criterion-related validity and construct validity. Content validity, in short, asks whether an empirical instrument includes all relevant aspects of the phenomenon under consideration (e.g. mathematical capability alone would not be a sufficient representation of intelligence). Criterion validity relates the results of an empirical instrument to an external criterion (e.g. results of an intelligence test and success in school). Construct validity, which is the most important category can be declared if the empirical data reflect the theoretical assumptions (constructs and their interrelations) underlying the instrument. We will now investigate aspects of each of these validity dimensions.

6.1 Face and Expert Validity

Face validity is a very basic form of validity which determines if an instrument (on the face of it) appears to measure what it is intended to. It is generally assumed to be true if the instrument makes common sense or is persuasive. At first glance, face validity looks similar to expert validity. However, expert validity refers to the judgement of experts with regard to the relevance and completeness of the contents of an instrument. Expert validity looks for agreement in judgements from multiple experts⁶².

In the case of the IT21 toolset, the results could be compared with the perceptions of IBM personnel that conducted the assessment. In general, the sales specialists chosen for the interviews were experienced professionals. From the IBM staff we chose consultants who knew the enterprises under investigation for years and had detailed knowledge of their IT situation. They confirmed that the problems exhibited by the instrument correspond to their previous experience and match their estimation of problems and necessary improvements. Another source of expert judgement came from the CEOs and CIOs interviewed. Overall, their feedback was very positive. Significant deviations between their estimations and the results of the IT21 assessment were not reported. Most managers saw the outcomes of the fitness test as a comprehensive – though not always exhaustive – description of their IT situation. What they appreciated was the capability of the instrument to provide a good survey of important IT issues, on the one hand, and to give insight into enterprise-specific problems on the other. However, positive feedback from experts urges a word of caution: we received greater part of the feedback from CEOs and CIOs indirectly via the hands of IBM personnel who conducted the interviews.

6.2 Construct and Predictive Validity

Each empirical instrument purports to measure one or more theoretical constructs. Since these constructs are theoretical concepts in nature it is important to demonstrate that the empirical

⁶² See Schnell, Hill, Esser (1999), p. 223; Fürtjes (1982), pp. 89.

instrument represents the underlying constructs empirically⁶³. The IT21 framework includes three core constructs: Information Infrastructure, Information Management and Alignment. IIS and IM are further distinguished into practice and performance sub-concepts. Furthermore, we have elaborated a preliminary theory on how these constructs are supposed to relate to each other (see Section 4 and the resulting model in Figure 5). Construct validity in our case is the degree to which the data collected with the instrument reflects these constructs and the theoretical relations the model claims. The most important hypotheses are:

- **H₁**: Good practices in information management lead to good IM performance.
- **H₂**: Good information management practices and performance result in a good information infrastructure!
- **H₃**: Alignment between Information Management and Business Management leads to an organisationally integrated information infrastructures!
- **H₄**: A good and organisationally well integrated IIS is productive and contributes to enterprise success!

The first hypothesis would appear to be common sense if we assume valid best practices to exist. But it is not when examined in more detail. Firstly, practices and performance measures do not correspond one for one. For example, good documentation practices may result in less faulty information systems as well as in better capabilities to recover from a breakdown. Secondly, practice and performance measures included in the questionnaire are not necessarily related to the same objects. We address practice areas of IM where we do not address performance measures, and vice versa. Nevertheless, Figure 9 depicts a strong association between practice and performance measures: enterprises that apply good IM practices also succeed in achieving good IM performance. The performance and practice measures plotted have been calculated as summed ratings from 15 IM practice and 31 IM performance variables including Alignment (see Appendix). The resulting sums have been transformed to a standardised scale ranging from 0 (all worst) to 100 (all best).

⁶³ See Schnell, Hill, Esser (1999), pp. 150; Friedrichs (1990), p.101.

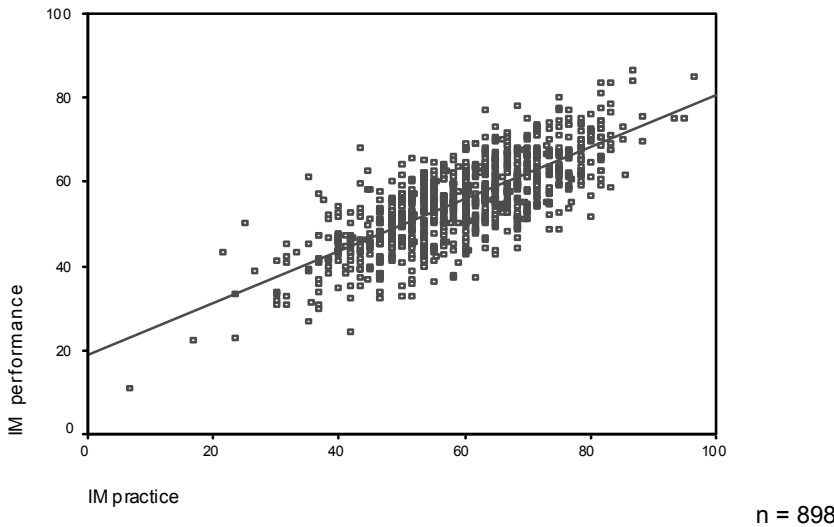


Figure 9: Scatter-plot of Information Management practices and performance⁶⁴

The plot shows a monotonous, positive correlation between IM practices and performances. Spearman’s σ for ordinal data is 0.733. Pearson’s r coefficient – strictly applied only to interval scaled data – yields 0.758. In other words, if we assume our summed rating items to be intervally scaled, a regression model can explain nearly 62% of variance in IM performance from IM practices. Both coefficients are highly significant at a 0.01% error level.

The second hypothesis is strongly supported by the data, too. Spearman’s σ for ordinal data yields 0.63, Pearson’s r 0.66. The latter coefficient indicates that in a linear model more than 44% of variance in IIS quality could be explained by IM quality. IIS quality has again been calculated as a summed rating from 23 IIS practice and performance variables that are assumed to add to success in all types of organisations under investigation (see Appendix). The resulting sums have been transformed to a standardised scale ranging from 0 (all worst) to 100 (all best). Both coefficients are highly significant at a 0.01% error level. This is a remarkable correlation as we can also expect other factors such as investments in IT and the quality of external service providers to affect the IIS quality. Again, there are strong links between IM and IIS quality as the regression line in figure 10 indicates – its slope is 0.67.

⁶⁴ At the end of 2002 the BIT-fit (benchmarking IT fitness) database contained 954 records. 27 records were excluded through intensive plausibility checks. A further 23 records were replications of earlier assessment. We included only the latest records. See Rentmeister, Teubner, Meier (2002). The gap between our sample (n) and the remaining 904 records stems from missing values for the variables calculated in our statistics.

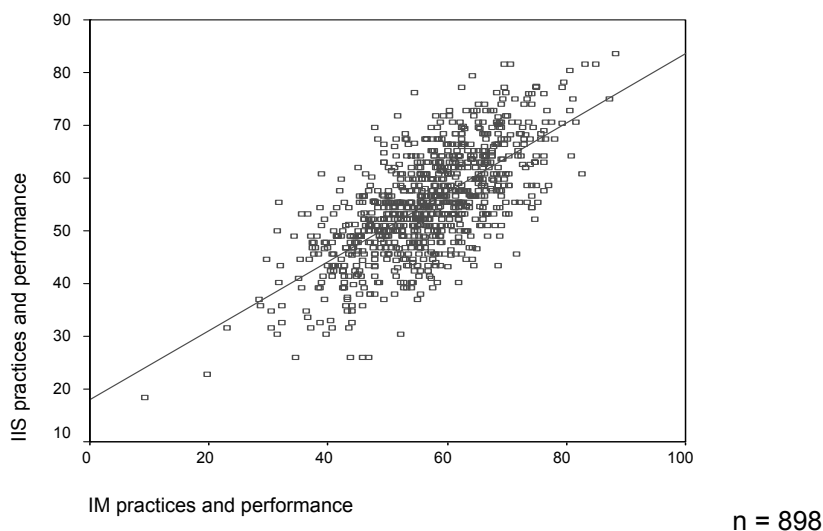


Figure 10: Scatter-plot of Information Management and Information Infrastructure

The correlation between management alignment (coordination between CEO, CIO and business units) on the one hand, and the organisational integration of information systems – measured in terms of task fit, absence of workarounds and media breaks (see Appendix) – on the other is moderate but also highly significant at a 0.01% level: Spearman's $\sigma = 0.32$ and Pearson's $r = 0.33$. If we include alignment (IM) and organizational integration (IIS), the overall correlation rises to 0.65 for the Spearman coefficient and to 0.68 for the Pearson one (Figure 11).

The fourth hypothesis may be seen as extending construct validity since it relates IIS success to overall business success, which was not a central component of the IT21-questionnaires. Nevertheless, we have collected information on business performance, especially profitability and productivity. Since such data is highly sensitive, we did not ask for concrete figures. Instead, we requested an indication of enterprise profitability in relation to competitors: a "1" denoting "considerably lower than" and "5" "higher profitability than" than competitors. For productivity, we asked for the trend: 1, declining, to 5, rising. If we view enterprise success as an external criterion we would expect an instrument measuring IT fitness to have some predictive value for the overall performance of the enterprise. In other words, our last investigation may also be seen as an investigation of predictive validity.

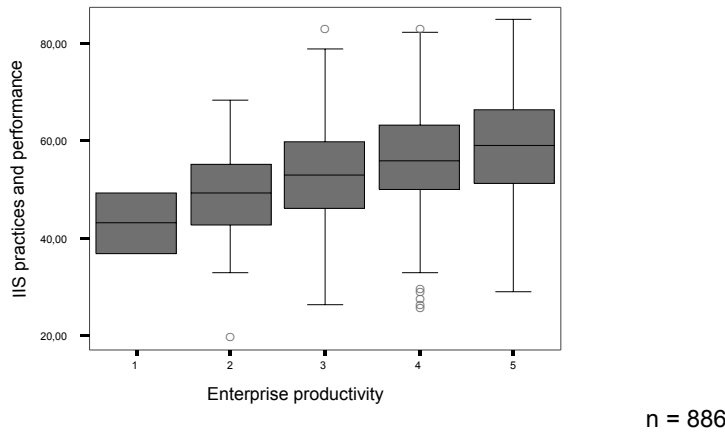


Figure 11: IIS practices and performance in categories of productivity

In order to test predictive validity, we plotted the IIS practices and performance (organisational integration excluded) against profitability and productivity, each scaled from 1 to 5. We found differences in IIS quality in the categories of business performance. Figure 12 depicts median (indicated by the lines within the boxes) and central 50%-quartile (indicated by the length of the boxes) of each category of IIS quality. For a further cross-tabulation analysis we classified IIS quality into five categories, covering the spectrum from very low to very high quality. Cross-tabulation delivered remarkable associations of IIS quality with both profitability and productivity: Kendall's T_a and T_b , Somer's d and Goodman and Kruskal's γ are highly significant for positive associations. We choose the γ coefficient because its value has a clear interpretation as a proportional reduction in error (pre). The values of γ are 0.24 for profitability and 0.32 for productivity. The 'pre'-interpretation of these values is that knowing IIS quality of an enterprise can enhance prognosis of its profitability and productivity by 24% and 32%, respectively, compared to a prognosis based solely on the marginal distribution of IIS quality.

Including organisational integration in the analysis increased the correlations presented above. However, its contribution was not as striking as assumed (see Section 4.2) or as suggested in literature and other studies⁶⁵. A cross-tabulation of IIS-quality and business success, controlling for alignment, revealed that there are a number of enterprises with a very successful IIS but that do not have good values for alignment. On the other hand, we found a number of enterprises with good alignment values but where the IIS only added little to enterprise success. Thus, our fourth hypothesis is only partly confirmed: alignment at the management level adds to the quality of the IIS deployed, which again adds to enterprise success. However, alignment does not turn out to be the *conditio sine qua non* as suggested in literature. One explanation may be that alignment is a contingent phenomenon. If so, there are no best-of-breed recommendations for alignment but rather the effects depend on the specific enterprise situation and the IM and IIS context⁶⁶. Another reason for our supposed 'indistinctive' findings may owe to the fact that, due to the broad scope of the IT21 toolset, we could only devote seven items to the measurement of alignment (see Appendix). This would seem to be only a rough measure compared to

⁶⁵ For example Chan et al. (1997), p. 139.

⁶⁶ Chan (2001), p. 25; Chan (2002), p. 104.

other propositions from literature⁶⁷. Thus, we also took into account the homogeneity of CEO's and CIO's perceptions (see Section 5.3) in a number of corresponding items as a further indicator for management alignment. However, homogeneity did not add much to an explanation. There were strong correlations between IIS quality and success indicators even in cases of discrepancies of CEO's and CIO's views. Furthermore, we did only find a weak correlation ($<0,2$) between the homogeneity of CEO's and CIO's views and the alignment measures.

⁶⁷ See Chan et al. (1997), or Luftman (2000), for example.

7 Conclusions

Rising expenditure in IT, on the one hand, and uncertainty about its contribution to business success, on the other, make IT evaluation a central management challenge. While large enterprises may have the capacity to define specific evaluation criteria and tools, there is a strong need for standardised tools in medium-sized enterprises. However, as yet evaluation research in IT/IS does not provide such instruments. There is still a massive and controversial on-going discussion on the assumptions, objects, and characteristics of IS/IT and their impact on success. We do not claim to have found a “silver bullet” approach to IT/IS evaluation. Due to the heterogeneity and complexity of IT as well as the unresolved problems in determining its economic impact we chose a partly pragmatic approach. Our first step was to develop a preliminary theory of IT fitness, the so called IT21-framework, based on current literature. In a second step, we operationalised the resulting framework and developed two questionnaires, one for the CEO and one for the CIO of each enterprise. Once completed, the data collected with the questionnaires allowed us to reassess the theoretical assumptions underlying the instrument. The data lent much support to the IT21 framework. Our validity investigations so far are at a general and necessarily coarsely-grained level. We will conduct more detailed investigations on the validity of the IT21 instrument and on opportunities and limitations of standardised IT evaluation in general. However, the validity of the measurement instrument shall not be confused with the consultation capability and counselling quality of the IT21-toolset, which was not a matter of this working paper.

Finally, the IT21 toolset gave us access to the broad research field of “IT usage and management in medium sized enterprises”. We will use the large and still growing BIT-fit database (benchmarking IT fitness) for further detailed investigations into the effectiveness of information management and the organisational effects of information infrastructures. In such a way, we also hope to contribute to an organisational theory of IS/IT, which is urgently needed but still lacking in IS research.

Literature

- Ballantine, J. A.; Galliers, R. D.; Stray, S.: The use and importance of financial appraisal techniques in the IS/IT investment decision-making process. In: *Project Appraisal*, 10 (1995) 4, pp. 233-241.
- Ballantine, J. A.; Galliers, R. D.; Stray, S. J.: Information Systems/Technology Evaluation Practices: Evidence from UK Organisations. In: Willcocks, L. P.; Lester, S. (eds.): *Beyond the IT Productivity Paradox*. Chichester et al. 1996, pp. 123-149.
- Ballantine, J. A.; Levy, M.; Powell, P.: Evaluating information systems in small and medium sized enterprises: issues and evidence. In: *European Journal of Information Systems*, 7 (1998) 4, pp. 241-251.
- Berghout, E.; Renkema, T.-J.: Methodologies for IT Investment Evaluation: A Review and Assessment. In: Grembergen, W. v. (ed.): *Information Technology Evaluation Methods and Management*. Hershey et al. 2001, pp. 78-97.
- Biethahn, Jörg; Mucksch, Harry; Ruf, Walter: *Ganzheitliches Informationsmanagement*. Band 1, Grundlagen, 4. Aufl., München, Wien 1996.
- Biethahn, Jörg; Mucksch, Harry; Ruf, Walter: *Ganzheitliches Informationsmanagement*. Band 2. Daten- und Entwicklungsmanagement. 2. Aufl., München, Wien 1997.
- Brenner, W.: *Grundzüge des Informationsmanagements*. Berlin et al. 1994.
- Brynjolfsson, E.: The Productivity Paradox of Information Technology. In: *Communications of the ACM*, 36 (1993) 12/December, pp. 67-77.
- Chan, Y. E.: Why Haven't We Mastered Alignment? The Importance Of The Informal Organization Structure. In: *MIS Quarterly Executive*, 1 (2002) 2/June, pp. 97-112.
- Chan, Y. E.; Huff, S. L.; Barclay, D. W.; Copeland, D. G.: Business Strategic Orientation, Information Systems Strategic Orientation, and Strategic Alignment. In: *Information Systems Research*, 8 (1997) 2, pp. 125-150.
- Clark, T. D.: Corporate Systems Management. An Overview and Research Perspective. In: *Communications of the ACM*, 35 (1993) 2/February, pp. 60-75.
- Clemons, E.: Evaluation of Strategic Investments in Information Technology. In: *Communications of the ACM*, 34 (1991) 1, pp. 22-36.
- Davenport, T.H.: *Process Innovation: Reengineering Work through Information Technology*. Boston 1993.
- Deifel, B.; Hinkel, U.; Paech, B.; Scholz, P.; Thurner, V.: Die Praxis der Softwareentwicklung: Eine Erhebung. In: *Informatik Spektrum*, 22 (1999) 1, pp. 24-36.
- Frank, U.: Evaluation von Artefakten in der Wirtschaftsinformatik. In: Heinrich, L. J.; Häntschel, I. (eds.): *Evaluation und Evaluationsforschung in der Wirtschaftsinformatik*. München, Wien 2000, pp. 35-48.
- Friedrichs, J.: *Methoden empirischer Sozialforschung*. 12. Aufl., Opladen 1990.
- Fürtjes, H.-T.: *Das Gestaltungspotential von Instrumenten der empirischen Wirtschafts- und Sozialforschung*. Berlin 1982.
- Gomolski, G.; Grigg, J.; Potter, K.: *IT Spending and Staffing Survey Results*. Gartner Group 2001.
- Gordon, St.: *Benchmarking The Information Systems Function*. CIMS Working Paper 94-08, Babson College, Massachusetts 1994.
- Hammer, M.; Champy, J.: *Reengineering the Corporation. A Manifesto for Business Revolution*. New York 1993.

- Harris S. E., Katz J. L.: Firm size and the information technology investment intensity of lifer insurers. In: *MIS Quarterly*, 15 (1991) September, pp. 333-352.
- Heinrich, L. J.: *Planung, Überwachung und Steuerung der Informations-Infrastruktur*. 5. Auflage, München, Wien 1996.
- Heinrich, L. J.; Häntschel, I. (eds.): *Evaluation und Evaluationsforschung in der Wirtschaftsinformatik*. München, Wien 2000.
- Henderson, J. C.; Venkatraman, N.: Strategic alignment: Leveraging information technology for transforming organizations. In: *IBM Systems Journal*, 32 (1993) 1, pp. 4-16.
- IBM Deutschland GmbH: *IT21 Analyse für den Mittelstand. Fragebogen und Interviewleitfaden für Geschäftsleitung (IBM Form GM 12-6115-0 und GM 12-6113-0) und IT-Leitung (GM 12-6111-0 und GM 12-6110-0)*, Stuttgart 1998.
- IBM Deutschland GmbH: *IT21 Analysis. Questionnaire and Guide to Interviewers for CEO and CIO*, Stuttgart 1999.
- Irani, Z.; Love, P. E. D.: Information systems evaluation: past, present and future. In: *European Journal of Information Systems*, 10 (2001) 3, pp. 183-188.
- Jones, M. C.; Harrison, A. W.: IS project team performance: An empirical assessment. In: *Information and Management*, 31 (1996) 2, pp. 57-65.
- Kanellis, P.; Lycett, M.; Pul, R. J.: Evaluating business information systems fit: from concept to practical application. In: *European Journal of Information Systems*, 8 (1999) 1, pp. 65-73.
- Kanugo, S.; Duda, S.; Srivinas, Y.: A Structured Model for Evaluation Information Systems Effectiveness. In: *Systems Research and Behavioural Science*, 16 (1999), pp. 495-518.
- Katz, A. I.: Measuring technology's business value: organizations seek to prove IT benefits. In: *Information Systems Management* 10 (1993) Winter, pp. 33-39.
- Krcmar, H.: *Informationsmanagement*. Berlin et al. 1997.
- Lacity, M. C.; Hirschheim, R.: The role of benchmarking in demonstrating IS performance. In: Willcocks, L. P.; Lester, S. (eds.): *Beyond the IT Productivity Paradox*, Chichester et al. 1996, pp. 313-332.
- Lederer, A. L.; Sethi, V.: Critical dimensions of strategic information planning. In: *Decision Sciences*, 22 (1991) 1, pp. 104-109.
- Lederer, A. L.; Sethi, V.: Meeting the Challenges of Information Systems Planning. In: *Long Range Planning*, 25 (1992) 2, pp. 69-80.
- Lederer, A. L.; Sethi, V.: Key Prescriptions for Strategic Information Systems Planning. In: *Journal of Management Information Systems*, 13 (1996) 1/Summer, pp. 35-62.
- Lewis, B. R.; Byrd, T. A.: Development of a measure for the information technology infrastructure construct. In: *European Journal of Information Systems*, 12 (2003) 2, pp. 93-109.
- Lewis, B. R.; Snyder, C. A.; Rainer, R. K. Jr.: An Empirical Assessment of the Information Management Construct. In: *Journal of Management Information Systems*, 12 (1995) 1, pp. 199-233.
- Lin, Ch.; Pervan, G. P.: A Review of IS/IT Investment Evaluation and Benefits. *Management Issues, Problems, and Processes*. In: Grembergen, W. v. (ed.): *Information Technology Evaluation Methods and Management*. Hershey et al. 2001, pp. 2-24.
- Luftmann, J.: Assessing Business-IT Alignment Maturity. In: *Communications of AIS*, 4 (2000) Article No. 14, 49 pages.
- O'Brian, J. A.; Morgan, J. N.: A multidimensional model of information resource management. In: *Information Resources Management Journal*, 5 (1992) 2/Spring, pp. 2-11.

- Orlikowski, W. J.: The duality of technology: Rethinking the concept of technology in organizations. In: *Organizational Science* 3 (1992) 3, pp. 398-427.
- Österle, H.; Brenner, W.; Hilbers, K.: *Total Information Systems Management. A European Approach*. Chichester et al 1993.
- Parker, M. M.; Benson, R. J.; Trainor, H. E.: *Information Economics. Linking Business Performance to Information Technology*. Upper Saddle River, New Jersey (1997).
- Pijl, G. J. van der; Zee, H. T. M. van der; Ribbers, P. M. A.; Norton, N.: The value of information technology: A case study and a framework. In: Buhalis, D.; Tjoa, A. M.; Jafari, J. (eds.): *Information and Communication Technologies in Tourism. Proceedings of the International Conference in Istanbul, Turkey*. Wien, New York 1997, pp. 85-100.
- Potthof, I.: Empirische Studien zum wirtschaftlichen Erfolg der Informationsverarbeitung. In: *Wirtschaftsinformatik* 40, (1998) 1, pp. 54-65.
- Powell, Philip L.: Evaluation of Information Technology Investments: Business as Usual? In: Willcocks, L. P.; Lester, S. (eds.): *Beyond the IT Productivity Paradox*, Chichester et al. 1996, pp. 151-182.
- Premkumar, G.; King, W. R.: The evaluation of strategic information system planning. In: *Information and Management*, 26 (1994) 6, pp. 327-340.
- Remenyi, D.; Whittaker, L.: The evaluation of business process re-engineering projects. In: Willcocks, L.: *Investing in Information Systems – Evaluation and Management*. London et al. 1996, pp. 143-167.
- Rentmeister, J.; Teubner, A.; with Meier, M.: *Interner Bericht zum IT21-Teilprojekt „Plausibilitätsprüfung und Datenbereinigung“*. Münster, Dezember 2002.
- Roach, S.: Service under siege - the restructuring imperative. In: *Harvard Business Review*, 65 (1991) 5, pp. 82-91.
- Ross, W.; Weil, P.: Six Decisions Your IT People Shouldn't Make. In: *Harvard Business Review*, 80 (2002) 11/November, pp. 85-91.
- Schmidt, H.; Häntschel, I.: Verbreitung von Evaluation und Evaluationsforschung in der Wirtschaftsinformatik. In: Heinrich, L. J.; Häntschel, I. (eds.): *Evaluation und Evaluationsforschung in der Wirtschaftsinformatik*. München, Wien 2000, pp. 23-34.
- Schnell, R.; Hill, P. B.; Esser, E.: *Methoden der empirischen Sozialforschung*. 6. Aufl., München, Wien 1999.
- Segars, A. H., Grover, V.; Teng, J. T.C.: Strategic Information Systems Planning: Planning System Dimensions, Internal Coalignment, and Implications for Planning Effectiveness. In: *Decision Sciences*, 29 (1998) 2, pp. 303-245.
- Smithson, S.; Hirschheim, R.: Analysing information system evaluation: another look at an old problem, In: *European Journal of Information Systems*, 7 (1998) 3, pp. 158-174.
- Strassmann, P. A.: *Information Payoff*. New York 1985.
- Strassmann, P. A.: Justifications of Investments in Information Technology. In: Diebold Deutschland GmbH (ed.): *Erfolgsfaktor Information*. 2. Internationales Managementsymposium, Eschborn 1988, pp. 403-448.
- Suchmann, E. A.: *Evaluative Research*. New York 1967.
- Tai, L. A.; Phelps, R.: CEO and CIO perceptions in information systems strategy: evidence from Hong Kong. In: *European Journal of Information Systems*, 9 (2000) 3, pp. 163-172.
- Teubner, A.; Rentmeister, J.; Klein, S.: IT-Fitness für das 21. Jahrhundert - Konzeption eines Evaluationsinstruments. In: Heinrich, L. J.; Häntschel, I. (eds.): *Evaluation und Evaluationsforschung in der Wirtschaftsinformatik*, München, Wien 2000, pp. 75-92.

- Thurow, L. C.: Foreword. In: Morton, S. (ed.): *The Corporation of the 1990's: information Technology and Organizational Transformation*. New York 1991, pp. V-VII.
- White, R.; James, B.: *The Outsourcing Manual*. Aldershot 1996.
- Whiting, R.; Davies, J.; Knul, M.: Investment appraisal for IT systems. In: Willcocks, L.: *Investing in Information Systems – Evaluation and Management*. London et al. 1996, pp. 37-57
- Wigand, R. et al.: *Information, Organization and Management: Expanding Markets and Corporate Boundaries*. Chichester et al. 1998.
- Willcocks, L.; Fitzgerald, G.; Lacity, M.: To Outsource or not? Research on Economic and Evaluation Practice. In: Willcocks, L.; Lester, S. (eds.): *Beyond the Productivity Paradox*. Chichester et al. 1996, pp. 293-329.
- Willcocks, L. P.; Lester, S.: In search of information technology productivity: Assessment issues. In: *Journal of the Operations Research Society*, 48 (1997) 11, pp. 1082-1094.

Appendix

For statistical analysis, we chose 66 practice and performance items that apply independently of the situation. In other words, the items selected are supposed to be valid on a broad scale and not susceptible to specific enterprise characteristics. (In contrast, 24hr availability is only valid in particular cases and thus is not a general indicator of good performance.)

Items Measuring IM Quality

CEO Questionnaire

Practice

- Rationale behind IT-strategies and investments (technology, cost, business impact)
- Self-conception and role of the IT-department (technology- vs. user-oriented)
- Organisational analysis and design responsibilities during IS introduction
- Evaluation of the organisational impact of IT investments
- Cross-functional co-ordination of IT projects

Performance

- Quality of user-service-processes
- Workstation design and ergonomics
- Preparedness for the loss of critical staff
- Concept for data backup
- Action plan for the case of IT-breakdown
- Organisation by means of workflow management systems
- IT market observed and IT opportunities evaluated
- Analysis of business potential of mobile technologies
- Outsourcing options evaluated
- Procurement guidelines to avoid unintended IT heterogeneity
- IT potential exploited (cost reduction, performance improvement, competitive advantage)

■ 36

- Criteria for IT investments: quantitative (costs, measurable benefits) vs. qualitative

CIO Questionnaire

Practice

- Information base for IT investments and product decisions
- Maturity of project work
- CASE-tool support in IT projects
- Evaluation of IS effectiveness and efficiency
- Method and tool support for system administration and monitoring
- Role and responsibilities of the IT-department in redesigning business processes
- Integrated planning of data processing systems, networks and communication media

Performance

- Documentation and publicity of IT strategy
- Cost planning in preparation for IT product decisions
- Development of IT-personnel
- Definition of objectives for IT-projects and investments
- Measurement of goal attainment of IT projects/investments
- Service-level definitions between IT-department and functional units
- Cost assignment according to the use of IT services
- User training established
- Application systems landscape documented
- System interfaces documented
- Plans for and documentation of the IS life-cycle
- Documentation of data used by the IT applications (Figure 6, first item)
- Documentation of the network infrastructure solution
- Rules for granting user accounts and rights

- Share of IT personnel that is occupied with administrative tasks
- Recovery after a breakdown of critical IT applications (Figure 7, first item)
- Free capacity for fulfilling user requirements and change requests
- Pro-active planning that anticipates future requirements

Items Measuring IIS Quality

CEO Questionnaire

- IT support for and coverage of business operations
- Information and communication culture: unhesitant vs. restrictive
- IT-based identification and provision of know-how
- IT support for central information supply (push)
- IT support for exploitation of data resources
- IT support for intra-organisational business communication
- Data mining capabilities
- Electronic b2c-communication
- IS improve inter-organisational communication and co-operation
- Electronic archives (half weight)
- Document delivery and print on demand solutions (half weight)
- New media for information acquisition

CIO Questionnaire

- User satisfaction with terminal deployment
- Organisation of print resources
- IT support in b2b-communication
- Recovery in case of a critical IS breakdown
- Maintenance of critical IS

■ 38

- Technical security
- Scalability of IT applications
- Portability of IT applications

Items Measuring Alignment

Strategic Alignment

- Cooperation of IT department and functional departments (practice)
- User participation in IS planning, development and introduction (practice)
- Links between business and IT strategy (performance)
- Involvement of functional departments in IT projects (practice)

Operational Integration

- Existing IT applications inhibit organisational change
- Inappropriate IS require manual workarounds
- Media breaks

Working Papers, ERCIS

- Nr. 1 Becker, J.; Backhaus, K.; Grob, H. L.; Hoeren, T.; Klein, S.; Kuchen, H.; Müller-Funk, U.; Thonemann, U. W.; Vossen, G.: European Research Center for Information Systems (ERCIS). Gründungsveranstaltung Münster, 12. Oktober 2004. Oktober 2004.
- Nr. 2 Teubner, R. A.: The IT21 Checkup for IT Fitness: Experiences and Empirical Evidence from 4 Years of Evaluation Practice. Münster, March 2005.