What is productivity in knowledge work?
- A cross-industrial view -

Rainer Erne
(Leeds Metropolitan University
Rainer.Erne@idp-lab.org)

Abstract: Experts in specific professional domains form the fastest increasing workforce in OECD countries. Since this fact has been realised by management researchers, they have focussed on the question of how to measure and enhance the productivity of said workforce. According to the author's cross-industrial research undertaken in five different knowledge-intensive organisations, it is, however, not productivity in the traditional meaning of the term which is to be regarded as the crucial performance indicator in expert work. There rather exist multiple performance indicators, each of which is, moreover, differently graded as to its importance by different stakeholders. These findings, firstly, indicate the need for an alternative definition and way of measurement of productivity when the term is applied to knowledge work, and, secondly, they indicate the need for alternative management strategies in order to generate an increase in the productivity of knowledge workers. This paper describes and summarises the key performance indicators for expert work as well as the major 'managing forces' and their general strategies in assessing knowledge workers' performance across five different business segments. It further delineates consequences for the management of knowledge workers – consequences affecting various 'knowledge-intensive' industries.

Keywords: expert, knowledge worker, professional, performance, productivity, management

1 The search for knowledge workers' productivity

One of Peter F. Drucker's great achievements is said to have been his ability to anticipate key management challenges decades in advance [Byrne & Gerdes, 05]. In 1969, he defined one such challenge as follows: *"To make knowledge work productive will be the great management task of this century, just as to make manual work productive was the great management task of the last century."* [Drucker, 69, p.290].

In one respect, Drucker was unquestionably right: Nearly all surveys of past decades point to a fundamental structural change in the labour markets of the OECD countries:

- There has been, from 1985 onwards, a 10 percentage-points increase in so-called 'derivative services', e.g. consulting, coaching, teaching, researching, development and management work [Weidig et al., 99; Dostal & Reinberg, 99; Dostal, 01; Reinberg & Hummel, 02].

- The number of occupations of the categories 'manager', 'professional occupation' as well as 'associate professional' and 'technical occupation' has increased by 10 percentage-points over the last two decades [UK National Statistics, 00; Baldwin

& Beckstead, 03; Beckstead & Gellatly, 04; UK National Statistics, 06; Davenport, 05; US Department of Labor, 06; Brinkley, 06].

- The demand for employees with an academic education has increased by 190 percentage-points between 1975 and 2004, whereas the demand for employees with a lower educational background is continually decreasing [Weidig et al., 99; Kleinert et al., 00; Dostal, 01; Reinberg & Hummel, 02; Reinberg & Hummel, 05; OECD, 06a; OECD, 06b].
- Levy & Murnane [06] noted a disproportional increase in the demand for two skill requirements within the US labour force between 1979 and 1999: 'expert thinking' and 'complex communication'. In contrast to this development, they observed that the demand for manual and routine cognitive skills has been continually decreasing within the same time frame (Figure 1).

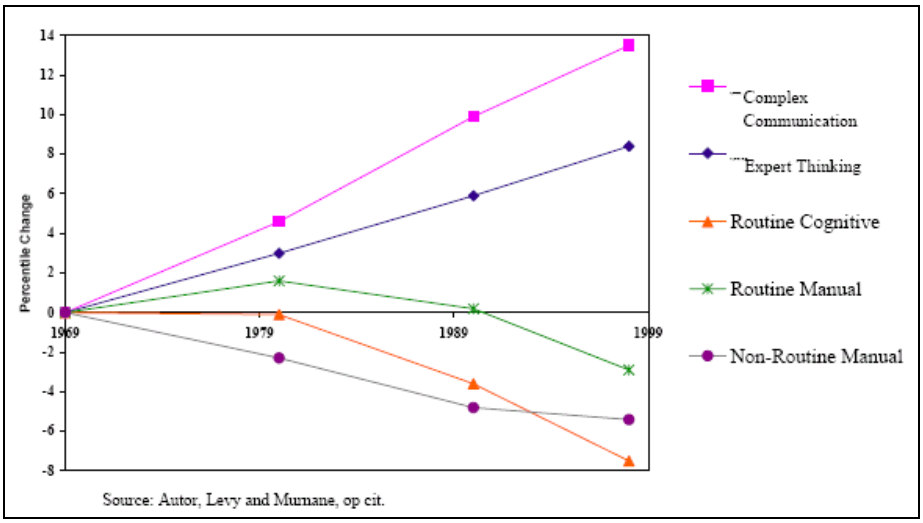

Figure 1: Economy-Wide Measures of Routine and Non-Routine Task 1969 -1998 [Levy & Murnane, 2006, p.15]

In regard to Drucker's other thesis, i.e. that the productivity of knowledge workers will be the crucial challenge for 21st century management, it can be stated that he initiated an abundance of research in the description, measurement and enhancement of knowledge workers' productivity [Ray & Sahu, 89; Sumanth, Omachonu & Beruvides, 90; Drucker, 91; Sveiby, 98; Drucker, 99; Horibe, 99; Pfiffner & Stadelmann, 99; Amar, 02; Davenport et al., 02; Hauber, 02; Newell et al., 02; Paradi et al., 02; Ahn & Chang, 04; Balazova, 04; Herman, 04; Ramirez & Nembhard, 04; Davenport, 05; Hube, 05; Suff & Reilly, 05; Malik, 06; Stam, 07; North & Gueldenberg, 08; Dörhöfer, 10] – a stream of research that does not seem to come to an end, neither in the near nor in the remote future.

With respect to the first aspect, i.e. the need for an alternative description of productivity, it can be noted that a lot of indicators have been brought forward to delineate what 'knowledge workers' productivity' means [Ramirez & Nembhard, 04]:

- Traditional definitions of productivity, which is the quantity of output in relation to the quantity of input, like time spent in order to produce the output
- Cost or return on investment metrics, like the monetary value of the output in relation to working costs
- Innovation metrics, like the number of ideas developed to improve products, services or processes
- Customer or staff satisfaction indices, based on interviews or absenteeism
- Self estimations of the knowledge workers regarding their productivity
- Qualitative indicators, like assessments of the quality of results or the proper prioritisation of tasks.

The two main challenges to defining knowledge workers' productivity seem to integrate multiple indicators into a valid system on the one hand, and, thereby, to achieve an appropriate balance between quantitative and qualitative indicators on the other.

With respect to the second aspect, i.e. the need for alternative measurement strategies for knowledge workers' productivity, it becomes evident that such indicators are predominant which are grounded in a principle developed more than a hundred years ago by the American engineer Frederick Winslow Taylor: *"They develop a science for each element of a man's work, which replaces the old rule-of-thumb method."* [Taylor, 98, p.15]. In other words, measurement is only possible when elements of knowledge workers' work are being standardised, as Taylor designed it for manual work. On this basis, the methods for measuring knowledge workers' productivity can be traced back to the methods of Scientific Management at the beginning of the last but one century. This statement can be corroborated by three examples:

- Function Point Analysis: The productivity in software development is measured by implemented software functions at customer request and standardised by 'function points' in relation to the time invested in order to develop the functions [Garmus&Herron, 00].
- Operations-based Productivity Measurement: Another method to measure knowledge workers' productivity consists in categorising knowledge work by its content components, such as decision taking, complexity, knowledge use, structure, repetition, time and/or skill level, and in measuring the time required to perform these operations resp. in assessing the output quality in relation to certain operational indices [Ray & Sahu, 89].
- Data Envelopment Analysis: A third approach to measuring knowledge workers' productivity consists in rating decision categories by employing 'decision making units (DMUs)' and in comparing the DMUs of a single knowledge worker with the DMUs of other knowledge workers from the same cultural background [Paradi et al., 02].

The three examples show clearly that the measurement of productivity calls for the standardisation of work elements as well as for the establishment of an indicator

baseline with a view to an assessment of individual performance in said work elements – equivalent to Taylor's Scientific Management approach for manual work.
In order to get hold of the rather qualitative aspects of knowledge workers' productivity, one is, again, relegated to one of Peter Drucker's notions: *"But by and large we have, so far, mainly judgements rather than measures regarding the quality of a great deal of knowledge work."* [Drucker, 99, p.146f].

With respect to the third aspect, i.e. the need for alternative enhancement strategies of knowledge workers' productivity, one can accordingly observe two streams of research:

The rather Tayloristic approach tries to standardise portions of knowledge work in processes with the intention of making 'best practices' in work productively applicable to and for any- and everybody. The term 'Tayloristic' has been used by Gary Hamel [95, p.B26]: *"When I am in a mean mood, I call re-engineering '21st century Taylorism'. If you read Frederick Winslow Taylor from the beginning of the century, there are three fundamental things he taught: Find the best practice wherever it exists. Today we call it benchmarking. Decompose the task into its constituent elements. We call it business process re-design. Get rid of things that don't add value. Work out, we call it now. So we're doing these things one more time and we need to do them."*
The Sociologic approach, on the other hand, deals with the question of how knowledge workers can retrieve appropriate work places for themselves in order to be productive. Such work places are usually characterised by a mixture of various features, e.g. autonomy, team work, office architecture as well as information retrieval and communication systems. *"Success depends, rather, on harnessing the intellectual capital of all employees. Moreover, in such situations people will often work together in teams to create new solutions, integrating their knowledge and experience to develop new products and services. Both the structural and cultural conditions within organizations will play an important part in creating an environment in which knowledge workers demonstrate responsible autonomy."* [Newell et al., 02, p.173].
In short: Management research on the topic of how to define, measure and enhance knowledge workers' productivity seems to revive the old discussion between the 'scientific' and the 'human relation' approaches, which took place in the first half of the last century.

Moreover, within existing research on the subject matter, three types of methodological approaches can be distinguished: Firstly, purely theoretical approaches stating general characteristics of 'experts', 'professionals' respectively 'knowledge workers' and citing corresponding management guidelines on the basis of literature reviewed and of personal experience, however, missing any systematical and empirical foundation [e.g. Horibe, 99; Pfiffner & Stadelmann, 99; Davenport, 05]. Secondly, deductive approaches testing particular hypotheses regarding performance, motivation, identification or commitment of engineers, researchers, consultants, physicians and university graduates in a narrow business segment by usage of quantitative statistical methods, and generalising the outcome as attributes of

‘experts’, ‘professionals’ resp. ‘knowledge workers’ on the whole [e.g. Wallace, 95; Hron, 00; Baldry et al., 05]. Thirdly, inductive approaches generating a theoretical framework for the management of engineers, researchers, consultants, physicians or university graduates in a narrow business segment by usage of qualitative methods, and generalising the outcome as attributes of ‘experts’, ‘professionals’ resp. ‘knowledge workers’ [e.g. Alvesson, 95; Keuken, 96; Blackler, 95]. The first type of studies can be regarded as insufficient in empirical foundation, the last two types as too narrow in scope for any generalisation. This finding calls for further empirical research, aiming at an inclusion of different types of knowledge-intensive business segments into its scope.

This paper intends to close at least one gap in current research on the productivity of knowledge workers by attempting to find answers to three crucial questions, which are, firstly, founded in empirical research, and, secondly, applicable to different ‘knowledge-intensive’ industries:

1. What does performance in knowledge work mean?
2. How and by whom is this performance measured?
3. What does this imply for the management of knowledge workers’ performance?

In the paper here presented, the design of the author’s empirical study on five different knowledge-intensive industries is, in an initial step, being briefly depicted (chapter 2). Secondly, the key findings of the study with respect to abovementioned questions are being summarised (chapter 3). Finally, the implications for the management of knowledge workers are being delineated (chapter 4).

2 Design of the study

The research question of the empirical study at hand is: What are the performance factors in expert work and which strategies for their measurement and enhancement are being employed? Therefore, the study’s focus is not on knowledge workers in the general, but on that proportion of knowledge workers termed ‘experts’. Davenport [05] provides a useful classification for a differentiation between a specific class of experts and knowledge workers in general (Figure 2).

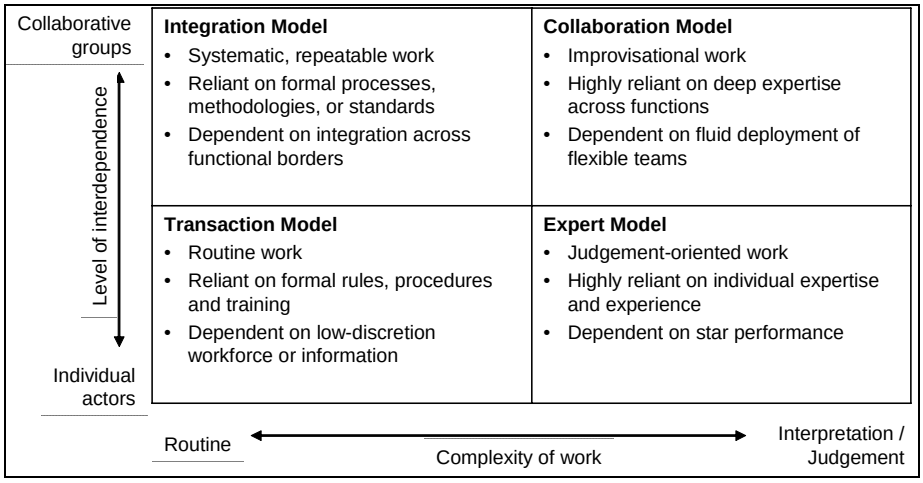

Figure 2: A classification structure for knowledge workers [Davenport, 05, p.27]

Following his approach, different types of knowledge workers differ in the way in which they transform knowledge into business value: by carrying out routine or complex tasks, by performing individual or collaborative work etc. [Davenport, 05]. The specific contribution of experts to business value consists in their capability of professional discernment, i.e. in their capability of applying a comprehensive body of knowledge to individual and rather complex cases. This is the core feature in the work of engineers and consultants as well as of researchers, teachers and physicians.
The 'objects of interest' of the study were five different organisations commonly regarded as 'expert', 'professional' or 'knowledge-intensive' organisations in previous treatises [Grossmann, Pellert & Gotwald, 97; Alvesson, 04; Davenport, 05; Brinkley, 06]: a software development company, a hardware development company, a consulting company, a hospital and a university. In these organisations, 42 semi-structured episodic face-to-face interviews [Bortz & Döring, 03; Lamnek, 05] with experts in their respective fields and with their managers from three hierarchical levels were conducted by the author. The data gathered by means of interviews were subsequently coded and interpreted with the aid of Atlas.ti, Version 5.5.4.

Owing to confidentiality agreements with all participating organisations, the results here presented have been described in an aggregated and abstracted manner. Hence, the original data cannot be disclosed, only referenced.

3 Findings of the study

3.1 What does performance in knowledge work mean?

Since productivity in its traditional meaning of 'relation between quantity of output in relation to amount of input' [Gutenberg, 58; Pedell, 85], as other scholars have

already noted, does not reflect any possible indicators for an expert's performance, the question raised by the study and posed to experts as well as to their line managers was: "What is performance in your respective type of expert work?" In this study, only those performance factors are referred to, which have been named by experts and their managers independently. Therefore, it can be concluded that these indicators are shared collectively within the respective organisation, that they may be regarded as collectively motivationally directive and, hence, part of the organisational culture [Sackmann, 91; Sackmann, 02].

For the software development company [Erne, 09a], the predominant performance indicators were:

1. 'Good software', further specified by terms like 'correctness', 'stability', 'maintainability', 'expandability' as well as 'clarity and transparency of the coding'.
2. 'Planning compliance', indicated by 'achievement of milestones' and 'correctness of resource estimation'.
3. 'Quality of interaction', perceived in the 'communication and cooperation behaviour' of the software developers, in an 'appropriate broaching of topics towards different stakeholders' as well as in the 'proactive communication of relevant topics to management representatives'.
4. 'Innovation behaviour' with respect to the products and processes of the organisation, measured by 'patent filings', 'integration of existing solutions', measures 'to reduce lead times' and to 'detect software bugs earlier in the development process'.
5. 'Personal skill development', which was basically regarded by management representatives to be the 'ability to move on to other topics according to business demand' and 'development of comprehension for the entire software system' beyond single functions was a crucial factor for the experts.
6. 'Compliance with organisational standards', which includes development processes deployed by the head office - despite criticism from experts as well as line managers - and project-specific agreements.

For the hardware development company [Erne, 09b] we found a very similar picture:

1. 'Good hardware quality', which can be measured by static and dynamic hardware tests, by 'parts per million (PPM) failure rates in the operational area' and, moreover, by 'conformance to specifications'.
2. 'Planning compliance', which is represented by the indicators 'conformance to specifications', 'achievement of milestones', 'compliance with the planned development budget as well as the product target costs' and the 'correctness of resource estimation' for a development project.
3. 'Acquisition rate': Since hardware developers have direct contact to their customers, the increase of hardware projects is viewed as another success factor of an hardware developer's work.
4. 'Quality of interaction with the relevant stakeholders', which refers to 'communication and cooperation behaviour with all internal interfaces as well as with different customers', a 'low escalation rate within the

organisation' and the 'appropriate broaching of topics towards different stakeholders'.

5. 'Innovation behaviour', which is indicated by the development of 'competitive solutions for the future' in regard to critical topics, such as 'power dissipation concepts' and 'electromagnetic compatibility'.
6. 'Personal skill development', which refers to an 'enhancement in the appreciation of the whole circuit system' beyond the particular task as well as to the 'development of know-how as to specific topics'.
7. 'Compliance with organisational standards', which refers to the observance of development processes which control the cooperation of the different specialists in hardware development.

The experts and managers in the consulting company [Erne, 09c] mentioned:

1. 'Accepted solutions and working solutions', which means, above all, 'functioning systems' on the customer's side, secondly, 're-usable solutions' and, thirdly, the number of critical situations'.
2. 'Number of requests for a certain consultant', which is indicated, to describe it quite vividly, by "how often the phone rings" when a client tries to reach a certain consultant.
3. 'Acquisition rate' in customer projects, which can be measured in turnover achieved by the end of the business year.
4. 'Quality of interaction with relevant stakeholders', which is represented by the 'quality in which a consultant broaches topics within and outside of the organisation', by 'one's visibility within the business sector', by the 'creation of an image of being a trusted advisor for the customers', by the 'visibility within the organisation and the professional community' as well as by 'cooperation and communication with customers and other stakeholders' in general.
5. 'Innovation behaviour', which refers to the ability of the consultants to take up new topics on a yearly basis, like 'Green IT' or 'Service-Oriented Architecture (SOA)' which, in turn, can be used for public relations activities, customer projects, development projects and acquisition projects.
6. 'Number of parallel activities': Any consultant has to handle several activities in parallel, thereby reacting to requirements from within her/his organisation on the one hand and to market demands on the other hand.
7. 'Personal skill development' with respect to the acquisition of knowledge required for actual projects at hand as well as to the acquisition of knowledge which is marketable to customers, colleagues and the expert community.
8. 'Compliance with organisational standards', which refers to an observance of conformity with common documentation standards, with defined methods as well as with general organisational administrative rules.

The doctors and chief physicians in the hospital [Erne, 09d] stated the following performance factors:

1. 'Medical outcome', which can be measured by clinical indicators, like blood loss, mortality rates, post-operative complication rates on the one hand and

by more subjective indicators, like patient condition and patient satisfaction, on the other hand.

2. ‘Compliance with professional and organisational standards’, which affects transparency and tidiness when performing a surgery on the one hand as well as compliance with diagnostic and therapeutic methods proven in use.
3. ‘Quality of interaction’, which relates, again, to the proactive communication of newsworthy issues to the chief physician, and to the target-group related broaching of topics, e.g. the condition of a patient in ward meetings or the description of treatment and its outcomes in discharge letters.
4. ‘Medical skill development’ is regarded as one of the crucial indicators for an individual’s performance and is being ensured by various measures, such as regular trainings and conferences, individual discussion before and after surgery, personal feedback, joint ward rounds and the controlled delegation of responsibilities.
5. ‘Innovation behaviour’, which relates to the institutionalisation of interdisciplinary core areas within the hospital, such as the collaboration between surgeons and internists on certain kinds of cancer treatments, and to the establishment and financing of research activities.

The professors and deans of a university [Erne, 09e] mentioned the following performance indicators:

1. ‘Quality of research and lectures’, which can be assessed by indicators like ‘internationality and topicality of research projects and lectures’, ‘academic success of students’, the ‘organization of conferences’ as well as the ‘number and rating of papers published’.
2. ‘Acquisition of resources rate’, such as third-party funds or internal budgets for research projects, the number of research positions and, especially, professorships in a faculty or team and the attractiveness of an academic activity for scholars.
3. ‘Quality of interaction with relevant stakeholders’, in this case, the representation of a faculty or research team to other stakeholders, the ability to bring forth convincing arguments for the acquisition of resources as well as the ability to build up supporting networks within the university.
4. ‘Innovation behaviour’, which refers to all activities listed above in order to establish a focal centre of research on a certain topic.

In short: It is explicitly not productivity in the traditional meaning of the term which is regarded to be the key performance factor in the work of experts. Rather, five discrete key factors can be regarded to be the predominant performance indicators for expert work in all investigated business segments. These performance indicators have been named by managers as well as experts of all organisations independently, though with different emphasis, and have been marked in Figure 3 in dark grey (heavily emphasised) respectively light grey and dotted lines (less emphasised):

- Quantity and/or quality of daily work results, which differ widely between the different business segments.

- Quality of interaction, which relates to the cooperation and communication with the different stakeholders as well as to the quality of representation of specific topics within the respective organisation as well as to varying target groups.
- Innovation behaviour with respect to business or professional improvements, which is of varying importance to different individuals and in differing business segments, but always named as an important indicator together with the quality of day-to-day work.
- Compliance with professional and/or organisational standards, whereby either the professional or the organisational standards have been stressed.
- Skill development with respect either to the depths of skills, to the ability to arrive at an overview over a particular topic or to the adaptation of skills to new market demands.

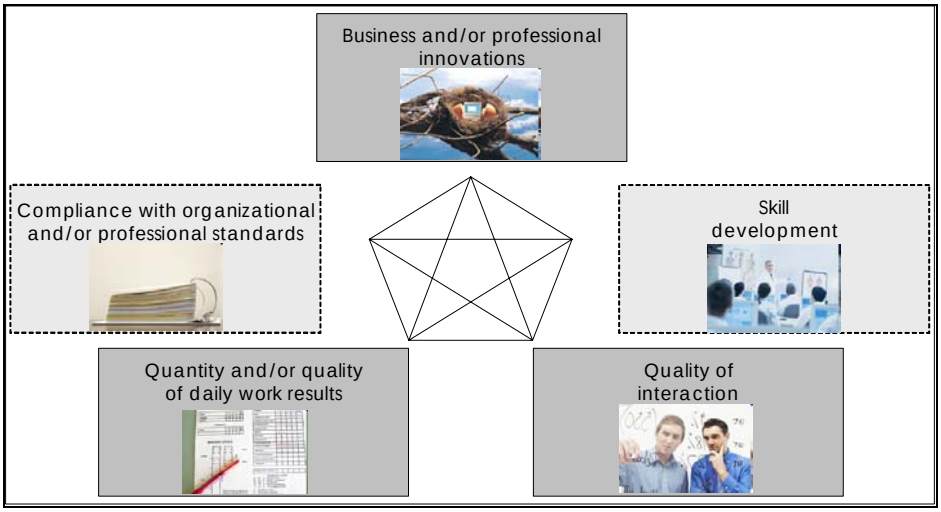

Figure 3: Performance indicators for the work of experts

It is evident that only a small proportion of abovementioned performance factors are measurable, namely quantifiable results in day-to-day work and in innovation work. All other performance indicators are subject to individual assessment. What are these auxiliary indicators by which the performance of experts is being assessed? And who assesses their performance?

3.2 How and by whom is performance in knowledge work measured?

With respect to the second question of by whom and how these performance indicators are measured, the first focus is on the managers of experts, e.g. line managers, who have to appraise the performance of their respective associates.

According to the author's study, the indicators and measures by which such an assessment is effected vary. In all organisations studied, two different strategies of appraising and managing the performance of experts were found:

The first strategy could be named 'black box management' and has been followed in all organisations examined. This strategy is best described in the words of the managers themselves:

In the software development company, software developers and their department heads were concerned: *"You have to take care that you do not intrude the space of these techies."* [Erne, 09a, p.115]. *"Don't interfere!"* [Erne, 09a, p.103].
At least partly **in the hardware development organisation**, the hardware developers and their line managers were concerned: *"As a manager, I am not the best expert. I think, once, in the past, in this company, there was an approach which said that the manager has to be the best hardware developer. Today, this is fortunately no longer required. Moreover, it would no longer be achievable."* [Erne, 09b, p.69].
In the consulting company, the consultants and their line managers were affected: *"What we have here, in this organisation, are nothing but prima donnae. Don't tell them."* [Erne, 09c, p.93].
In the hospital, the administrative director and the physicians were affected: "*As an administration manager, I have a decisional authority. (…) But this is a theoretical authority. (…) Since, if I issued a directive here … every department would demonstrate to me that it does not work this way."* [Erne, 09d, p.90].
In the university, the deans and the professors in their respective departments were affected: *"A dean can govern a faculty … with respect to budget topics. He is less able to exert influence in issues of research or contents of research."* [Erne, 09d, p.55].

To sum up, in this system, a sphere of professional work exists on the one side and a sphere of business work on the other side with a few overlaps in the area of definition and prioritisation of topics (not objectives) as well as in the sphere of performance appraisal. A system a consultant called *'governance'* in contrast to 'management' [Erne, 09c, p.63].

How is the performance of experts appraised in this 'black box management' system? With respect to day-to-day work results, the supervisors have to rely on visible and measurable indicators, such as the achievement of defined milestones, compliance with a budget planned, the number of test findings or of customer complaints, capacity utilisation or acquisition rate. In other words: The quantitative business aspects of daily work results are subject to measurements. However, since there are many 'interfering variables' between an expert's actions and their effects – e.g. the customer or patient who does not agree to something or changes his mind, unknown conditions or restrictions, which have not been communicated before, political relations which interfere – one cannot not know if low performance in quantitative indicators is due to the expert or to other variables [Luhmann & Schorr, 82; Stichweh, 94]. Qualitative analyses are, therefore, necessary for the assessment of the expert's performance.

For this task, the statement of a business unit head from the software development organisation can be viewed as being paradigmatic for all other statements: *"We try to make the performance of our associates measurable. (…) But we are not in a timbering, we are in a high technology business segment. (…) Therefore, we have to use auxiliary indicators."* [Erne, 09c, p.53]. These auxiliary indicators are: 'positive feedback by two customers, 'peer recognition, … which refers to the level of recognition a developer obtains from his team colleagues …, managers, team members' [Erne, 09a, pp.49-53]. In other words: For the qualitative part, the scope of performance indicators, which is assessed by the supervisors, comprises: quality of interaction, especially a convincing and visible representation of competence and performance to important stakeholders [Pfadenhauer, 03a; Pfadenhauer, 03b], visible activities in the field of product and process innovations and compliance with organisational standards. From these 'auxiliary indicators', supervisors in the 'black box management' system try to deduce the expert's performance potential which, then, serves as a basis for a yearly performance appraisal. Indicators belonging to the professional sphere, namely the quality of day-to-day work results, compliance with professional standards and individual skill development, are being necessarily neglected in direct assessment.

The question whether professional performance indicators are also 'measured' and, if so, how and by whom, remains unanswered so far.

This question leads to a second strategy which could be labelled as 'white box management'. 'White box management' was also identified in all organisations examined:

In the software development company, the software developers and their team leaders were concerned: *"The technical team leaders are responsible for controlling the code. (…) A few people are reviewing the code, are reviewing the code together. Then the code is checked with respect to maintainability."* [Erne, 09a, p.101].

In the hardware development organisation, this applied to the hardware developers and their group and team managers: *"That is what we expect from a manager that, when he is in a technical business that he does not simply act on an abstract level, but that he has a bit more comprehension of it. Otherwise he is unable to assess if … he has been told the truth or if things are going out of track since he cannot assess these things by himself. And that would be bad."* [Erne, 09b, p.93].

In the consulting company, first-level certified consultants and second-level certified colleagues as well as their stakeholders in the project were affected: *" … ,yes, as I worked together with a second-level certified colleague, this colleague defined which meetings we were going to schedule together with the customer and what we wanted to achieve in each meeting. (…) By structuring it this way, it turned out: Okay, what do we have to do in between meetings in order to be well-prepared for the next one."* [Erne, 09c, p.71]. *"… important is also the feedback I obtain from the associates working in the same project, i.e. not from the consultant, but from the others /ehm./ … colleagues from sales, in the first place."* [Erne, 09c, p.37].

In the hospital, the chief physicians and the physicians as well as the scientific community in- and outside of the hospital were concerned: *"I always tell my*

physicians: … When I observe that one of you becomes sleazy, for example, in stitching up or anything else, … I tell them: Please take care that you do it properly. (…). Since if we do not do it properly, then our trainees do not see any necessity in doing it properly either." [Erne, 09d, p.93]. *"Since today, tumor treatment is not any longer unilateral; that means not only a matter of surgery or radiation therapy or of internists' intervention, but rather an interplay of these three disciplines, … we hold regular interdisciplinary meetings on every case. In these meetings, the therapeutic path is being defined by consensus. Certainly there are different opinions from time to time. Therefore, you have to take care to define it by consensus.*"[Erne, 09d, p.77].
In the university, this applied to professors and research assistants as well as the scientific community: *"I told my employee, the first I had hired, I told him: Okay, we do a journal paper together. I have here the preliminary version, which I have done. /Eh/ Make something of it. (…) Then we tried, in joint discussions, to produce a journal paper. We were lucky that the first one was accepted. /Eh/ For him this meant great success. /Eh/ In the first place, for my employee, since he learned what you have to do here: How do I quote properly? How can I define a problem accurately? What are the objectives of my paper?"* [Erne, 09e, p.25]. *"I want to experience the success. I think, when I do work in the field of differential equations, when I go to a conference, then I want, when I go to this conference, I want to do a great presentation for which I obtain the feedback: That is great what this guy has done. You see. That is, we want to play in the first league and be competitive on a global scale."* [Erne, 09e, p.33].

In summary: Alongside the 'black box management' system there exists another system, in which the rather professional performance indicators for experts are being assessed. This system is more difficult to pin down, in most cases, since it does not follow the formal paths of the organisation charts and goes beyond the limits of the organisation in scope, comprising technical managers, colleagues, expert communities and sometimes even customers.

As was to be seen in the statements cited, the methods by which the performance of experts is assessed in the 'white box management' system also heavily rely on qualitative assessments, even more than those of the 'black box management' system. However, the basis for subjective assessment varies from stakeholder to stakeholder: In domains in which a set of professional standards exists, e.g. in software and hardware development, in academic research or in medicine, a 'senior expert' can base his assessment on these standards. Yet, it can also be observed that the interpretation of the validity and importance of these standards varies widely from senior expert to senior expert. Moreover, in every domain, there is always a variety of standards which could be followed. These two facts allow for an extensive range of individually differing professional assessments. Therefore, the measurement of performance in the 'white box management' system is very similar to that in the 'black-box management' system. There is, however, one striking difference between the two systems: the scope of performance indicators assessed. In the 'white box management' systems, the focus is on the quality of day-to-day work results, the compliance with professional standards, skill development and the professional innovations an expert achieves.

The difference between the two appraisal systems for expert performance is depicted in Figure 4:

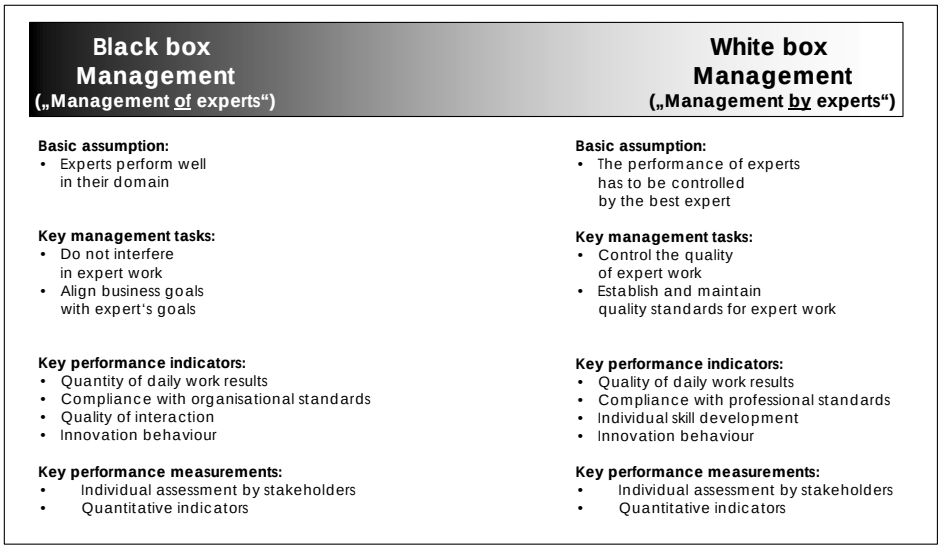

Figure 4: Performance indicators for the work of experts

As Figure 4 shows, there is not only ‘black box’ or ‘white box’ management of experts, but also a large area of ‘grey box’ management. This means that experts are connected to numerous stakeholders who act as ‘managing forces’ of an expert’s performance and – according to their individual level of expertise and/or their own role perception – either tend more to the left hand or more to the right hand side of this spectrum.

According to the author’s study, at least five stakeholder groups can be identified in any of the examined organisations; stakeholder groups, which measure and assess an expert’s performance: Besides business management, there is always the group of the technical management, such as project, team or group managers supervising experts’ work on a professional level, as described above.

In addition, there are colleagues and a broader expert community inside and outside of the respective organisation, who assess the work of their associates and – on the basis of this assessment – ‘label’ a certain associate an expert or not. For instance, in hospital work: *“Since today, tumor treatment is not any longer unilateral, that means not only a matter of surgery or radiation therapy or of internists’ intervention, but rather an interplay of these three disciplines, … we hold regular interdisciplinary meetings on every case. In these meetings, the therapeutic path is being defined by consensus. Certainly there are different opinions from time to time. Therefore, you have to take care to define it by consensus.“* [Erne, 09d, p.77].

Or expressed in a statement by a university professor: *"I want to experience the success. I think, when I do work in the field of differential equations, when I go to a conference, then I want, when I go to this conference, I want to do a great presentation for which I get the feedback: That is great what this guy has done. You see. That is, we want to play in the first league and be competitive on a global scale."* [Erne, 09e, p.33].

Last, but not least, all experts have internal and external clients with individually different levels of expertise, who are using the experts' products and services, as one of the consultants stated: *" (…) What energises me most … is when during a quotation phase and a presentation of a concept the customer starts to engage in it, yes, and starts to discuss it and when he eventually adopts your ideas and takes your concept /eh/ slightly further in his own direction. (…) That shows to me a special kind of /eh/ relationship. The customer discusses with me, I am a credible partner for him."* [Erne, 09c, p.37] (Figure 5).

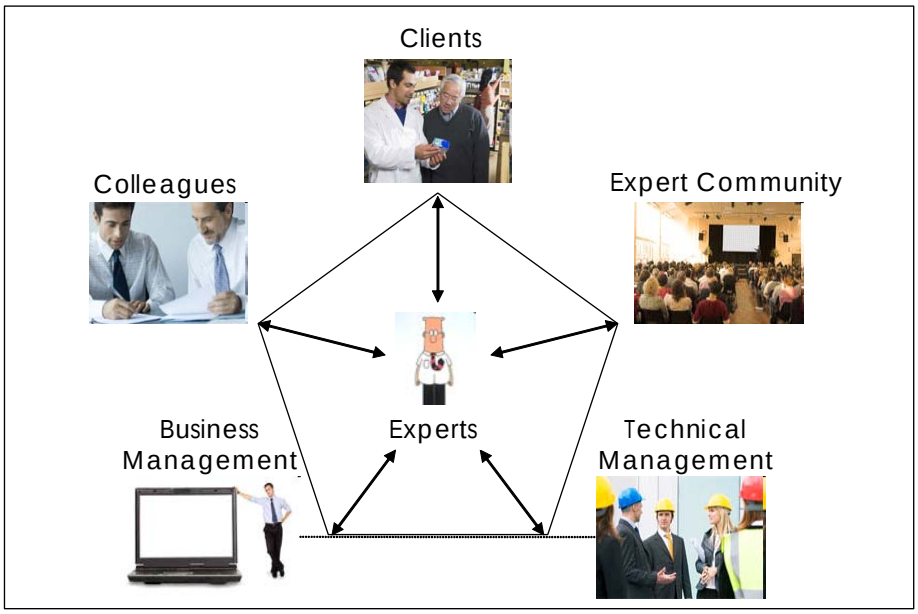

Figure 5: Stakeholders of expert work

These stakeholder groups are called 'managing forces' since they have certain explicitly communicated or implicitly postulated expectations with respect to the quantity and/or quality of the expert's daily work results, to the quality of interaction, to innovation behaviour, to the compliance with standards and to experts' skill development. Governed by these expectations, they try to influence the expert's work in a certain direction and they assess him by the criterion of how well their expectations were met. According to the author's study, quantitative indicators only

serve as very generic hints to how well an individual expert has performed. For experts, individual feedback and the assessment by relevant stakeholders are much more valid than quantitative objectives by which they are appraised in annual intervals.

Moreover, which stakeholder is being regarded as relevant, differs from industry to industry: In industries like software and hardware development as well as consultancy, the customers and senior experts are of the highest importance to the experts. In hospital work, the most relevant stakeholders are the chief physicians and patients. In university work, the scientific community is being regarded as the most significant stakeholder.

It should also be mentioned that, in the context of expertise, the author does not follow the suggestion of Kerr & Jermier [78] to call these stakeholders 'substitutes for leadership'. Their approach is based on the assumption that a manager is able and obliged to manage people in every aspect of their work, and that there are intervening variables which level out leadership effects. The author's perspective, with respect to experts, is an alternative one: A business manager is neither able nor obliged to manage experts in every aspect of their work. Therefore, a business manager is to be regarded as one of several 'managing forces' – and not infrequently is he not the most relevant one.

All aspects considered, the question of by whom and how these performance indicators are measured can be answered as follows:
We have at least five different stakeholder groups which act as 'managing forces' for an expert's performance: business management, technical management, clients, colleagues and expert communities. These different stakeholders assess the expert's performance according to different performance indicators: the quantity and/or quality of an expert's daily work results, the quality of interaction with stakeholders, their innovation behaviour, their compliance with organisational and/or professional standards, their skill development - based on the stakeholders' individual expectations.

What does this situational description imply for the management of experts' performance?

3.3 What does this imply for the management of knowledge workers' performance?

Facing the situation that there are five different stakeholder groups who define, influence and assess the performance of experts according to five different sets of performance indicators, three basic challenges, which are specific for the management of experts across different industries and which have to be tackled in order to render experts 'productive', come to the fore and could translate into the following management instructions:

1. Focus on expert work
2. Clarify what 'performance' in an expert's task means
3. Account for an adequate representation of expertise

Ad 1: Focus on expert work

According to the author's research, there is one common issue across all industries, which impedes expert performance; an issue labelled 'time management' in current literature [e.g. Seiwert, 09]. The interviewees expressed this as follows: *"One constant issue is, certainly, time management. (…) I think a lot of tasks are already scheduled. (…) But a lot of tasks are dropped spontaneously - triggered mainly by mails."* [Erne, 09a, p.55]. *"The main challenge [in our work] is not to lose overview."* [Erne, 09b, p.69]. *"For my own work, the main problem is to structure and to prioritise the different tasks which we perform in parallel in a reasonable way somehow."* [Erne, 09c, p.95]. *"Yes, frequent interrupts during work are a difficulty. (…) The operating theatre is the area where you can do your work in the most concentrated and undisturbed manner – and you have to do it in such a way, certainly."* [Erne, 09d, p.85] *"What I have learned in the meantime is that you need to have very good time management. In former times, it was not necessary to that extent."* [Erne, 09e, p.101].

The various approaches dealing with 'time management' are based on the assumption that the task of keeping focus is a task that has to be mastered individually. The same assumption is being shared, as the statements show, by the interviewees. According to the author's study, the tendency to lose focus is a constant threat for expert performance across different industries; a finding which has also been identified by Peter Drucker: *"But the crucial question in knowledge-worker productivity is the first one: WHAT IS THE TASK? (…) One reason for this is that knowledge work, unlike manual work, does not program the worker."* [Drucker, 99, p.143f].

This finding calls for a collective solution on the level of business management since multitasking and task switching are regarded - by cognitive psychology - as one source for a 20% - 40% loss in productivity [Rubinstein, Meyer & Evans, 01; Monsell, 03; Spira & Feintuch, 05]. Therefore, the first challenge for business management is: By which means can I focus expert work on only a few tasks, on only a few performance indicators and on only few stakeholders by means of management methods, such as job design and assignment control, but also by means of attaining an appropriate role perception of business management through other 'managing forces' along the process of a specific case or project. In other words: If an expert's work is managed by a client or colleague, it might be required from business management not to interfere with the expert's business for the sake of promoting focus on the part of the expert.

Ad 2: Clarify what performance in an expert's task means

The author's study showed clearly that a specific task and specific stakeholders determine what performance in expert work means. There is no set of key performance indicators which could be applied to expert work universally, and, at the same time, be specific in governing expert work. In order to govern expert work, it

has to be clarified, who the – few – relevant stakeholders are, what they expect, and, hence, how the critical performance indicator can be defined.

This thesis can also be corroborated through statements by the interviewees. In software development: *"I cannot simply take a quantitative value and conclude: He does not perform well. I would just make things easy for myself then."* [Erne, 09a, p.47] In hardware development: *"The specification, i.e. what the test should look like, this specification is not provided by the customer. The customer rather assumes that we are up to date here. (…) Therefore, we elaborate these specifications together with the workshop. (…) That means we have to discuss with them: What do we have to test precisely?"* [Erne, 09b, p.137]. In consulting: *"[The biggest challenge] is, from my point of view, the quality of inputs from the customer. (…) /Eh/ How can I obtain a precise listing of the customer's enterprise infrastructure? /Eh/ the detailed project requirements for what the customer wants to achieve for himself? Yes, how is the quality of these things? (…) And, in this context, in addition, how do I get adequate information when I do not have it in the first place."* [Erne, 09c, p.101]. In hospital work: *"With each of my employees, when he has to perform extensive surgery, … then I schedule a meeting with him. (...) We have a look at the x-rays of a tumor, for example, if it is a difficult one. (…) Then I ask: How do you want to proceed in this case? (…) What kind of incision do you plan? (…) What are we going to do if a vein intersects? And so on."* [Erne, 09d, p.57]. In university work: *"There are no simple … okay, yes, there are some simple indicators for success: Which kind of publications has been produced? (…) But with respect to this indicator, there are different cultures in a university. You cannot compare apples with oranges. (…) Yes, because, in informatics, the practice of publishing is simply different from that in physics. Therefore, I cannot measure both with the same ruler. What is required is rather a lot of /eh/ communication. That means you have to put yourself into the shoes of the other in order to grasp the specific situation and the specific problem."* [Erne, 09e, p.27].

In other words: A management system for experts may have some quantitative measurement methods as a kind of rapid alert system on the case or project level. However, it has to have a task-specific definition of performance, which lies in the responsibility of business management's delegation practices.

Ad 3: Account for an adequate representation of expertise

The core feature in expert work consists, as Andrew Abbott [88] put it, of three basic operations: the (re-)definition of problems, the evaluation thereof, and the definition of measures in order to solve them. That means that expert work requires a considerable amount of communication with business managers, technical managers, clients, colleagues and the expert community.

This is applicable to all industries investigated: In software development: *"The biggest challenge is /eh/ ... to align the interfaces with all counterparts."* [Erne, 09a, p.55]. In hardware development: *"With what I struggle most, at the moment, is the time-consuming process of reconciliation."* [Erne, 09b, p.83]. In consulting: *"The type of person we expect is someone who can display his competence."* [Erne, 09c, p.45]. In hospital work: *"When we think we have identified a problem with a certain*

patient, we present this during the next conference." [Erne, 09d, p.43]. In university work: *"The responsible person for research applications is a physicist. (…) He does not really know anything about business research topics contentwise. /Eh/ That means all he can do is to check applications formally. /Ehm/ Okay, he does that. (...) If there are any critical issues regarding the application, your task is to argue for it, and it happens very rarely that, if you have argued reasonably and well, that you are /eh/ overruled."* [Erne, 09e, p.89].

In other words: Expertise is too costly if its owners are unable to communicate it in a way in which it creates value. That was the precise core problem observed in all five organisations investigated. None of the industries examined exhibited difficulties with expertise contentwise. The critical issues broached always centred on adequate, i.e. target-group related, representation of expertise [Alvesson, 95; Alvesson, 04; Pfadenhauer, 03a].

Therefore, a target-group related representation of expertise is a precondition for the generation of value. The enhance- and assessment of this specific performance indicator could be regarded as a third area for improvement which, again, lies in the responsibility of business management.

4 Conclusions

According to the author's study, 'productivity' in expert work cannot be adequately understood with reference to the traditional meaning of the term which sets the amount of output against the amount of input.

There are, however, specific parameters which indicate expert performance across various industries: quantity and/or quality of day-to-day work results, quality of interaction with different stakeholders, innovation behaviour with respect to business and/or professional innovations, compliance with professional and/or organisational standards and skill development in experts.

The relevance of these performance indicators predominantly depends on the stakeholders, who are expecting, influencing and assessing expert performance: business managers, technical managers, clients, colleagues and expert communities. Therefore, the measurement of expert performance is, to a large part, effected through individual assessments by the relevant stakeholders, who either pursue 'black box management' or 'white box management'.

Business management, in this situation, ought to concentrate on three basic tasks specific to the management of experts, but valid across varied industries: a reduction in multitasking and task switching, an enhancement in the focus on only a few tasks, support of an early clarification of the significance of performance specific to a particular task, and the suitable representation and communication of expertise as a performance indicator.

The author's contribution stops at this point. Yet, at this point, a series of crucial questions remains unanswered. Can the findings also be applied to other expert industries, such as to finance or pharmaceutical research? Can any basic suggestions be made as to in which situation 'black box management' and in which situation 'white box management' is more effective? What exactly has to be done in a specific situation in order to evoke and promote focus in experts, and how can the effects be measured? Is there a model or checklist for the definition of performance for specific classes of tasks? Are there any methods which could guide an expert in his representation of expertise in an adequate and target-group related way?

These questions go far beyond the scope of this paper and may be a basis or starting point for further papers and treatises on the subject.

References

[Abbott, 88] Abbott, A. (1988) The system of professions: an essay on the division of expert labor. Chicago, University of Chicago Press.

[Ahn & Chang, 04] Ahn, J.H. & Chang, S.G. (2004) Assessing the contribution of knowledge to business performance: the KP3 methodology. Decision Support Systems, 36 (4), pp.403-416.

[Alvesson, 95] Alvesson, M. (1995) Management of knowledge intensive companies. Berlin, De Gruyter.

[Alvesson, 04] Alvesson, M. (2004) Knowledge work and knowledge-intensive firms. Oxford, University Press.

[Amar, 02] Amar, A.D. (2002) Managing knowledge workers: unleashing innovation and productivity. Westport, Quorum.

[Balazova, 04] Balazova, M. (2004) Methode zur Leistungsbewertung und Leistungssteigerung in der Mechatronikentwicklung. Dissertation. Paderborn, Universität Paderborn.

[Baldry et al., 05] Baldry, C. et al. (2005) Knowledge workers, commitment and occupational community. Paper presented at the International Labour Process Conference 2005. Glasgow, University of Strathclyde.

[Baldwin & Beckstead, 03] Baldwin, J.R. & Beckstead, D. (2003) Knowledge workers in Canada's economy, 1971-2001. Statistics Canada Analytical Paper. Ottawa, Statistics Canada.

[Beckstead & Gellatly, 04] Beckstead, D. & Gellatly, G. (2004) Are Knowledge Workers found only in high-technology industries? Statistics Canada Analytical Paper. Ottawa, Statistics Canada.

[Blackler, 95] Blackler, F. (1995) Knowledge, knowledge work and organisations. An overview and interpretation. Organisation Studies, 16 (6), pp.1021-1046.

[Bortz & Döring, 03] Bortz, J. & Döring, N. (2003) Forschungsmethoden und Evaluation für Human- und Sozialwissenschaftler. 3. überarb. Aufl. Berlin, Springer.

[Brinkley, 06] Brinkley, I. (2006) Defining the knowledge economy: knowledge economy programme report. Research Paper. London, The Work Foundation.

[Byrne & Gerdes, 05] Byrne, J.A. & Gerdes, L. (2005) The man who invented management: why Peter Drucker's ideas still matter. Businessweek [Internet], November 28, 2005. Available from: <http://www.businessweek.com/magazine/content/05_48/b3961001.htm> [Accessed 20 January 2009].

[Davenport, 05] Davenport, T.H. (2005) Thinking for a living: how to get better performance and results from knowledge workers. Boston, Harvard Business School Press.

[Davenport et al., 02] Davenport, T.H., Thomas, R.J. & Cantrell, S. (2002) The mysterious art and science of knowledge-worker performance. Sloan Management Review, 44 (1), pp.23-30.

[Dörhöfer, 10] Dörhöfer, S. (2010) Management und Organisation von Wissensarbeit: Strategie, Arbeitssystem und organisationale Praktiken in wissensbasierten Unternehmen. Wiesbaden, VS Verlag für Sozialwissenschaften.

[Dostal, 01] Dostal, W. (2001) Neue Herausforderungen an Qualifikation und Weiterbildung im Zeitalter der Globalisierung. Berlin, Deutscher Bundestag.

[Dostal & Reinberg, 99] Dostal, W. & Reinberg, A. (1999) Arbeitslandschaft 2010. Teil 2: Ungebrochener Trend in die Wissensgesellschaft. IAB-Kurzbericht, Nr.10. Nürnberg, Institut für Arbeitsmarkt- und Berufsforschung.

[Drucker, 69] Drucker, P.F. (1969) The age of discontinuity: guidelines to our changing society. New York, Harper & Row.

[Drucker, 91] Drucker, P.F. (1991) The new productivity challenge. Harvard Business Review, 69 (6), pp. 69-79.

[Drucker, 99] Drucker, P.F. (1999) Management challenges for the 21st century. New York, Harper.

[Erne, 09a] Erne, R. (2009) Interview Transcripts F&E_SW. Data Analysis in Atlas.ti V.5.6.3. Manuscript. Stuttgart.

[Erne, 09b] Erne, R. (2009) Interview Transcripts F&E_PE. Data Analysis in Atlas.ti V.5.6.3. Manuscript. Stuttgart.

[Erne, 09c] Erne, R. (2009) Interview Transcripts Consulting. Data Analysis in Atlas.ti V.5.6.3. Manuscript. Stuttgart.

[Erne, 09d] Erne, R. (2009) Interview Transcripts Medizinische Versorgung KH. Data Analysis in Atlas.ti V.5.6.3. Manuscript. Stuttgart.

[Erne, 09e] Erne, R. (2009) Interview Transcripts Forschung & Lehre Univ. Data Analysis in Atlas.ti V.5.6.3. Manuscript. Stuttgart.

[Garmus & Herron, 00] Garmus, D. & Herron, D. (2000) Function Point Analysis. Measurement practices for successful software projects. Upper Saddle River, Addison-Weslay.

[Grossmann, Pellert & Gotwald, 97] Grossmann, R.; Pellert, A. & Gotwald, V. (1997) Krankenhaus, Schule, Universität: Charakteristika und Optimierungspotentiale. In: Grossmann, R. Hrsg. Besser Billiger Mehr: Zur Reform der Expertenorganisation Krankenhaus, Schule, Universität. Wien, Springer, S.24-35.

[Gutenberg, 58] Gutenberg, E. (1958) Einführung in die Betriebswirtschaftslehre. Wiesbaden, Gabler.

[Hamel, 95] Hamel, G. (1995) Taylor's ideas today. The Globe and Mail January, 26th, 1995, p.B26.

[Hauber, 02] Hauber, R. (2002) Performance Measurement in der Forschung und Entwicklung: Konzeption und Methodik. Wiesbaden, Deutscher Universitäts Verlag.

[Herman, 04] Herman, S. (2004) Produktive Wissensarbeit: Eine Herausforderung. In: Hermann, S. Hrsg. Ressourcen strategisch nutzen: Wissen als Basis für den Dienstleistungserfolg. Stuttgart, Fraunhofer IRB-Verlag, S.207-228.

[Horibe, 99] Horibe, F. (1999) Managing knowledge workers: new skills and attitudes to unlock the intellectual capital in your organization. Toronto, John Wiley.

[Hron, 00] Hron, J. (2000) Motivationale Aspekte von beruflicher Expertise: Welche Ziele und Motive spornen Experten im Rahmen ihrer Arbeit an? München, Utz.

[Hube, 05] Hube, G. (2005) Beitrag zur Beschreibung und Analyse von Wissensarbeit. Dissertation, Institut für Arbeitswissenschaft und Technologiemanagement der Universität Stuttgart.

[Kerr & Jermier, 78] Kerr, S. & Jermier, J.M. (1978) Substitutes for leadership: their meaning and measurement. Organizational Behaviour and Human Performance, 22 (3), pp. 375-403.

[Keuken, 96] Keuken, F. W. (1996) Management von Akademikerorganisationen. Hamburg, Kovac.

[Kleinert et al., 00] Kleinert, J. et al. (2000) Globalisierung, Strukturwandel und Beschäftigung. Tübingen, Mohr Siebeck.

[Lamnek, 05] Lamnek, S. (2005) Qualitative Sozialforschung: Lehrbuch. 4. vollst. überarb. Aufl. Weinheim, Beltz.

[Levy & Murnane, 06] Levy, F. & Murnane, R.J. (2006) How computerized work and globalization shape human skill demands. MIT IPC Working Paper 05-006 [Internet]. Boston, Massachusetts Institute of Technology. Available from: <http://web.mit.edu/ipc/publications/pdf/05-006.pdf> [Accessed 09 January 2007].

[Luhmann & Schorr, 82] Luhmann, N. & Schorr, K.-E. (1982) Das Technologiedefizit der Erziehung und die Pädagogik. In: Luhmann, N. & Schorr, K.E. Hrsg. Zwischen Technologie und Selbstreferenz: Fragen an die Pädagogik. Frankfurt, Suhrkamp, S.11-40.

[Malik, 06] Malik, F. (2006) Führen, leisten, leben: Wirksames Management für eine neue Zeit. Komplett überarb. Neuaufl. Frankfurt, Campus.

[Monsell, 03] Monsell, S. (2003) Task Switching. Trends in Cognitive Sciences, 7 (3), pp.134-140.

[Newell et al., 02] Newell, S. et al. (2002) Managing knowledge work. Houndmills, Palgrave Macmillan.

[North & Gueldenberg, 08] North, K. & Gueldenberg, S. (2008) Produktive Wissensarbeit(er): Antworten auf die Management-Herausforderung des 21. Jahrhunderts. Wiesbaden, Gabler.

[OECD, 06a] OECD (2006) OECD employment outlook. 2006 edition: boosting jobs and incomes. Paris, Organisation for Economic Co-operation and Development.

[OECD, 06b] OECD (2006) Education at a glance. OECD indicators 2006. Indicator A8: labour force participation by level of educational attainment [Internet]. Paris, Organisation for Economic Co-operation and Development. Accessible at: <http://www.oecd.org/document/6/0,2340,en_2649_34515_37344774_1_1_1_1,00.html> [Accessed 07 January 2007].

[Paradi et al., 02] Paradi, J.C.; Smith, S. & Schaffnit-Chatterjee, C. (2002) Knowledge worker performance analysis using DEA: an application to engineering design teams at Bell Canada. IEEE Transactions on Engineering Management, 49 (2), p.161.

[Pedell, 85] Pedell, K.L. (1985) Analyse und Planung von Produktivitätsveränderungen. Zeitschrift für betriebswirtschaftliche Forschung, 37 (12), S.1078-1097.

[Pfadenhauer, 03a] Pfadenhauer, M. (2003) Professionalität: Eine wissenssoziologische Rekonstruktion institutionalisierter Kompetenzdarstellungskompetenz. Opladen, Leske & Budrich.

[Pfadenhauer, 03b] Pfadenhauer, M. (2003) Macht – Funktion – Leistung: Zur Korrespondenz von Eliten und Professionstheorien. In: Mieg, H.A. & Pfadenhauer, M. Hrsg. Professionelle Leistung – Professional Performance: Positionen der Professionssoziologie. Konstanz, UVK, S. 71-87.

[Pfiffner & Stadelmann, 99] Pfiffner, M. & Stadelmann, P. (1999) Wissen wirksam machen: Wie Kopfarbeiter produktiv werden. 2. unveränd. Aufl. Bern, Haupt.

[Ramirez & Nembhard, 04] Ramirez, Y.W. & Nembhard, D.A. (2004) Measuring knowledge worker productivity: a taxonomy. Journal of Intellectual Capital, 5 (4), pp.602-628.

[Ray & Sahu, 89] Ray, P.K. & Sahu, S. (1989) The measurement and evaluation of white-collar productivity. International Journal of Operation & Production Management, 9 (4), pp.28-48.

[Reinberg & Hummel, 02] Reinberg, A. & Hummel, M. (2002) Zur langfristigen Entwicklung des qualifikationsspezifischen Arbeitskräfteangebots und –bedarfs in Deutschland: Empirische Befunde und aktuelle Projektionsergebnisse. Mitteilungen aus der Arbeitsmarkt- und Berufsforschung, 35 (4), S.580-600.

[Reinberg & Hummel, 05] Reinberg, A. & Hummel, M. (2005) Höhere Bildung schützt auch in der Krise vor Arbeitslosigkeit. IAB-Kurzbericht Nr.9. Nürnberg, Institut für Arbeitsmarkt- und Berufsforschung.

[Rubinstein, Meyer & Evans, 01] Rubinstein, J.S.; Meyer, D.E. & Evans, J.E. (2001) Executive Control of Cognitive Processes in Task Switching. Journal of Experimental Psychology, Human Perception and Performance, 27 (4), pp.763-797.

[Sackmann, 91] Sackmann, S.A. (1991) Cultural knowledge in organizations: exploring the collective mind. Newsbury Park, Sage.

[Sackmann, 02] Sackmann, S.A. (2002) Unternehmenskultur: Erkennen – Entwickeln – Verändern. Neuwied, Luchterhand.

[Seiwert, 09] Seiwert, J. (2009) Noch mehr Zeit für das Wesentliche: Zeitmanagement neu entdecken. München, Hugendubel.

[Spira & Feintuch, 05] Spira, J.B. & Feintuch, J.B. (2005) The cost of not paying attention: how interruption impacts knowledge worker productivity. New York, Basex.

[Stam, 07] Stam, C. (2007) Knowledge productivity: designing and testing a method to diagnose knowledge productivity and plan for enhancement. Ph.D. thesis, Universiteit Twente.

[Stichweh, 94] Stichweh, R. (1994) Wissenschaft, Universität, Professionen: Soziologische Analysen. Frankfurt, Suhrkamp.

[Suff & Reilly, 05] Suff, P. & Reilly, P. (2005) In the know: reward and performance management of knowledge workers. HR Network Paper, MP47. Brighton, Institute for Employment Studies.

[Sumanth, Omachonu & Beruvides, 90] Sumanth, D.J.; Omachonu, V.K. & Beruvides, M. G. (1990) A review of the state-of-the-art research on white collar / knowledge-worker productivity. International Journal of Technology Management, 5 (3), pp.337-355.

[Sveiby, 98] Sveiby, K.E. (1998) Wissenskapital – das unentdeckte Vermögen: Immaterielle Unternehmenswerte aufspüren, messen und steigern. Landsberg, Moderne Industrie.

[Taylor, 98] Taylor, F.W. (1998) The principles of scientific management (first 1911). New York, Dover.

[UK National Statistics, 00] UK National Statistics (2000) Standard occupational classification 2000 (SOC 2000): Summary of Structure [Internet]. London, UK National Statistics. Available at <www.statistics.gov.uk/methods_quality/ns_sec/downloads/ SOC2000.doc> [Accessed 09 January 2007].

[UK National Statistics, 06] UK National Statistics (2006) All in employment by socio-economic classification (NS-SEC) (Not seasonally adjusted) [Internet]. London, UK National Statistics. Accessible at: <http://www.statistics.gov.uk/STATBASE/ ssdataset.asp?vlnk=7919> [Accessed 20 August 2008].

[US Department of Labor, 06] US Department of Labor (2006) Occupational outlook handbook [Internet]. Washington, Bureau of Labor. Accessible at: <http://www.bls.gov/ oco/home.htm> [Accessed 09 January 2007].

[Wallace, 95] Wallace, J.E. (1995) Organizational and professional commitment in professional and nonprofessional organizations. Administrative Science Quarterly, 40 (2), pp. 228 - 255.

[Weidig et al., 99] Weidig, I. et al. (1999) Arbeitslandschaft 2010 nach Tätigkeiten und Tätigkeitsniveau. Beiträge zur Arbeitsmarkt- und Berufsforschung, Nr. 227. Nürnberg, Institut für Arbeitsmarkt- und Berufsforschung.