



Barbara Deml · Patricia Stock
Ralph Bruder · Christopher Marc Schlick *Eds.*

Advances in Ergonomic Design of Systems, Products and Processes

Proceedings of the
Annual Meeting of GfA 2015

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Editors

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Editorial

These proceedings include a selection of papers presented at the 2015 Annual Meeting of the German Gesellschaft für Arbeitswissenschaft, held at Karlsruhe Institute of Technology (KIT) from February 26 to 28. The conference featured more than 160 presentations and 30 posters reflecting the diversity of subject matter in the field of ergonomics, human factors and industrial engineering.

The first part of the book deals with the *design of work systems* against the background of current socio-technical challenges. The contributions take up relevant research topics caused by the demographic change (Jungmann et al.; Wassmann et al.), important issues concerning occupational health (Bockelmann et al.; Hillebrecht et al.; Penzkofer et al.; Rivkin and Schmidt; Rücker and Brombach) and current changes in working time (Stock; Tegtmeier et al.). Furthermore, the effect on outcome variables, such as motivation (Kassirra and Rausch), quality (Sattler et al.) or efficiency/effectiveness (Tackenberg et al.) is regarded.

Within the second part of the book the *design of products* is considered. Here, too, the contributions cover a wide spectrum addressing the assessment of both cognitive (Arenius et al., Schneider and Deml) and physiological user states (Bürkle and Schmauder; Franzke and Walther; König and Jaschinski; Jaschinski et al.), the design of both input (Meyer et al.) and output (Knott et al.; Nelles et al.; Streng et al.) processes in the field of human-machine interaction as well as new approaches for measuring working environment variables (Spitzhirm et al.).

Finally, in the third part of the book the *design of processes* is taken into account. Again it is current socio-technical developments that are reflected by the research papers. The contributions address topics such as flexible-mobile working (Gisin et al.), interdisciplinary collaboration (Brandtstädter and Sonntag), age-appropriate working processes (Büttner et al.; Kugler et al.), complex project planning (Terstegen et al.) or ecological aspects (Lüderitz et al.).

Considering the wide range of topics covered and the variety of scientific methods applied, it is apparent that advances in ergonomics may only be achieved by a multidisciplinary approach. Thus, these proceedings address human factors

and safety specialists, industrial engineers, work and organizational psychologists, specialists in occupational medicine as well as production planners and design engineers.

Karlsruhe, Germany
Dortmund, Germany
Darmstadt, Germany
Aachen, Germany

Barbara Deml
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Part I

Design of Work Systems

Assessment of the Individual Work Organization During a Service Provision

Sven Tackenberg, Sönke Duckwitz, Julia Seibold,
and Christopher M. Schlick

Abstract

Employees of knowledge-intensive service companies organize their work individually. Therefore, an inadequate coordination of people may lead to an exceeding of service time and costs. In order to avoid this, a method-based work analysis provides an appropriate, but also time-consuming procedure to evaluate the efficiency and effectiveness of operations at an individual employee level. In this paper, we introduce a new approach for the assessment of an individual work organization during a service provision. To achieve this objective, a performance measurement system and a software tool for tablets and smartphones are presented. The software tool will be introduced, and tested by a verification study in a service company.

Keywords

Work organization • Service management • Self assessment tool

1 Introduction

For the most part, service research-to-date contains a variety of generic models to describe service productivity [2, 11, 23]. All these models have in common that they focus on the sales department, human resource management, the design of work processes, and the application of technologies [11]. But, knowledge-intensive services are based on service provisions that mainly rely on the expertise of individuals. Therefore, the processes contain a high degree of individualization and interaction between persons, as well as high uncertainty with regard to the performance potential and the work results. Hence, those service productivity

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models are of limited suitability in practice. According to this understanding, the work processes of a service provision as well as the individual work organization of the involved working persons determine the success of sustainable services.

In this paper, we have interpreted the measurement of service productivity from the perspective of the individual work organization of an employee. Yet, there are only very few studies about individual planning and knowledge-intensive activities [3, 17, 21], which investigated the relationship between the individual work organizations of employees and service productivity. This is surprising, as the studies were able to show that an individual work organization and the working conditions influence the required time, strain, and the work outcome. Based on the results of [10], service productivity can be defined as the result of the invested time, the quality of results, and of the individual work organization. Therefore, we interpret a service as productive, if there is an efficient and effective collaboration of persons with an optimal individual work organization. Accordingly, it raises the question, which performance indicators of an individual work organization exist, and how is it possible to measure and control them.

2 Work Analysis: State of Research

2.1 Conceptual Classification

Work analysis is often characterized as the initial starting point for almost any other effort to measure and improve work. Thereby, work analysis methodology is the foundation of work analysis [28]. For the most part, work analysis focuses on a systematic structuring of tasks and activities, which are processed by an employee of a work system [26]. Such a work system is a regulatory model to systematically describe a workplace using various elements, such as employees, requirements and tasks [27]. To perform a work analysis, various methods, procedures and instruments are available to capture, process, and interpret information about tasks, the organizational-technical working conditions, the required work equipment, as well as their impact on the involved employees [27]. The different methodological approaches can be applied to a theoretical issue or to specific elements of a work system. Therefore, a work analysis proceeds not just analytically, but also for evaluation and design purposes [14]. In particular, a distinction must be drawn between the psychological and the task-centered work analysis [5, 6]. The former is restricted to the effect of working conditions and the requirements imposed on the employee [5], whereas a task-centered work analysis gather data about the work content and the target oriented processing of tasks [6].

In our approach of a performance measurement system we provide a conceptual framework for the assessment of an individual work organization by focusing on processes that exhibit two critical characteristics: knowledge-intensive and weakly-structured:

- Knowledge-intensive: Such processes are characterized by a heavy reliance on employees and significant incidents of problem solving as well as non-standardized production [1]. These employees are the primary sources of information and knowledge which are used to produce intermediary services for the customer.
- Weakly-structured: Such workflows represent task sequences which are not strict and predetermined [27]. Due to missing standards and incomplete information, an employee has to identify and to choose the best strategy to solve and schedule the assigned tasks.

2.2 Background: Work Analysis

In the last 50 years in fields as task scheduling, organizational behavior, and management science, many studies have been conducted in order to understand how employees distribute their working time [10]. Most studies have focused on the role of managers, to identify the characteristic of their tasks and to analyze their simultaneous management of activities [17, 19, 20]. In the field of service research the focus was solely laid on the relations between actors and communication processes [11]. In real service provision, the employees communicate asynchronously, i.e., via email, messenger, and document postings in a cloud. Therefore, the sender of a message may not know exactly how long a response will take. Due to the lack of information the person might switch to another task and reorganize his/her work plan. Rubinstein et al. examined the effects of task switching depending on the familiarity and complexity of tasks [25]. Their results indicate that employees create a delay before they start working effectively on another task. Furthermore, they could show that each task switch causes a time loss. There is even more time loss, when switching from a familiar to an unfamiliar task and from a simple to a complex one.

An external interruption of work is defined as a synchronous interaction, which is unscheduled and not initiated by the employee of the considered work system. Such an interruption results in a discontinuing of the current activity of the recipient [4, 24]. For improving the productivity of an employee it is essential to know whether and when interruptions constitute disruptions and which kinds of interruptions have negative or positive effects on task performance. Therefore, in the field of interruption research, efficiency and effectiveness are measured based on the work conditions [9, 21, 22].

In the late 1960's, Horne and Lupton found that middle managers spend most of their work time in managing various activities, but very little time for reflection and decision-making [13]. To obtain the relevant data, managers recorded their own activities on a specific form, which contained several terms, the "*Managers Activity Record*". If one of the terms was appropriate for describing the work day, the manager had to mark it.

Mintzberg proposed that the best way to describe and evaluate the work of managers is to focus on the managers' activities [17–19]. He conducted a 5-day