

Professional design of clinical working systems according to human factors

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Introduction: Clinical working systems (CWS) are under pressure: patients are increasingly informed and demanding, critical treatment incidents are under public discussion, resources are limited, and, as a result, clinicians are over-challenged. Their valuable intrinsic motivation is getting lost by stressing working conditions. CWS have been organically evolved; no doubt a lot of optimization potential can be presumed. A sustainable re-engineering according to human factors is required. But how to proceed and who is in charge?

F. W. Taylor has defined “Principles of Scientific Management” for industry almost a century ago [1]. The application of these principles to CWS seems to be obvious but must fail due to two strong reasons: 1) patient treatment is a complex task with severe limitations for standardization and work flow planning; 2) the work is performed by experts, who deal with complexity, not comparable with workers at an assembly-line. But if a “simple” industrial working system requires scientific management; this must be even more necessary in complex CWS. Medicine is using scientific methods to demonstrate the effectiveness of new procedure or drugs. Curiously there are no established methods to measure, prove or compare the quality and the efficiency of clinical working processes (HOW is the medical procedure performed?) [2].

Starting with Taylor’s principles a lot of research was done leading to a human centered scientific management. A lot of knowledge and experience has been achieved in several domains e.g. in manufacturing, aerospace, agriculture, transportation, power supply. Health care is still at the beginning. Today we see several different scientific communities dealing worldwide with humans & work: Ergonomics, Human Factors, Human Factors Engineering, Human Computer Interaction, and others with overlapping scopes. We prefer Ergonomics, which provides the comprehensive consideration of human, technology and organization:

“Ergonomics (or human factors) is the scientific discipline concerned with the understanding of the interactions among humans and other elements of a system, and the profession that applies theoretical principles, data and methods to design in order to optimize human well being and overall system performance. Practitioners of ergonomics, ergonomists, contribute to the planning, design and evaluation of tasks, jobs, products, organizations, environments and systems in order to make them compatible with the needs, abilities and limitations of people.” [3]

Goal: Ergonomics/human factors as a scientific discipline should understand the special requirements of a patient treatment and should supplement theories, methods, and tools accordingly. Hospitals, industry (medical products) and especially medical societies should make use of ergonomics competence. Yoel Donchin has coined the term “Medico-Ergonomics”, which describes the cross section between medical needs, technical possibilities, and ergonomic rules excellently [4]. The goal is to vitalize Medico-Ergonomics.

Concept: Within simple working systems an external counselor (e.g. an ergonomist) can analyze working processes and give advice for optimization. It is easy for her/him to understand the given production-line as well as the technical and organizational options. In comparison the complexity of a clinical working system is rather difficult to understand by counselors without medical background (expert system). This does not mean, that a counselor

must be trained in different disciplines (interdisciplinary background), but rather that Medico-Ergonomics requires a co-operation between disciplines (multidisciplinary concept) as well as between structures; all stakeholders should be involved. A systems approach with three levels could support the selection of stakeholders.

- 1) *Micro-Ergonomics* comprises the interactions between the system elements: patient, clinicians (physician, nurses, etc), and technology (medical products).
- 2) *Process-Ergonomics* is concerned with treatment tasks performed on a time axis; activities and interactions from the micro-level are done in serial and in parallel to complete a given task. This level includes the organization of work flow.
- 3) *Macro-Ergonomics* covers the hospital as an institution within a health care market (external view) and with all aspects of running a human centered company (internal view). Table 1 shows groups of stakeholders and their influence/contribution.

System level	Optimization Potential	Clinicians ¹⁾	Hospital Operators	Industry	Politics
Macro-Ergonomics	++	++	+++	+ ²⁾	+++
Process-Ergonomics	+++	+++	++	+++	+ ³⁾
Micro-Ergonomics	+	+++	+	+++	0

Table 1: Optimization potential and influence/contribution of stakeholders based on our experience

¹⁾ representative for physicians, nurses and other clinical experts, including the patients' requirements;

²⁾ hospital information systems should support the management;

³⁾ regulations/incentives for integrated treatment solutions.

The counselor gets into the coordination role, taking care for the communication between the stakeholders and the integration of their knowledge [5].

Realization: For implementation a business model has been developed named "Fabrica medica", including a project format with the following steps: 1) Focus definition; 2) Stakeholder selection; 3) Three workshops a) Synchronization (shared mental model), b) Fabrication (multidisciplinary solution), c) Validation; 4) Exploitation. The time frame is 9 to 12 months per project. The first projects have been defined and are in progress.

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