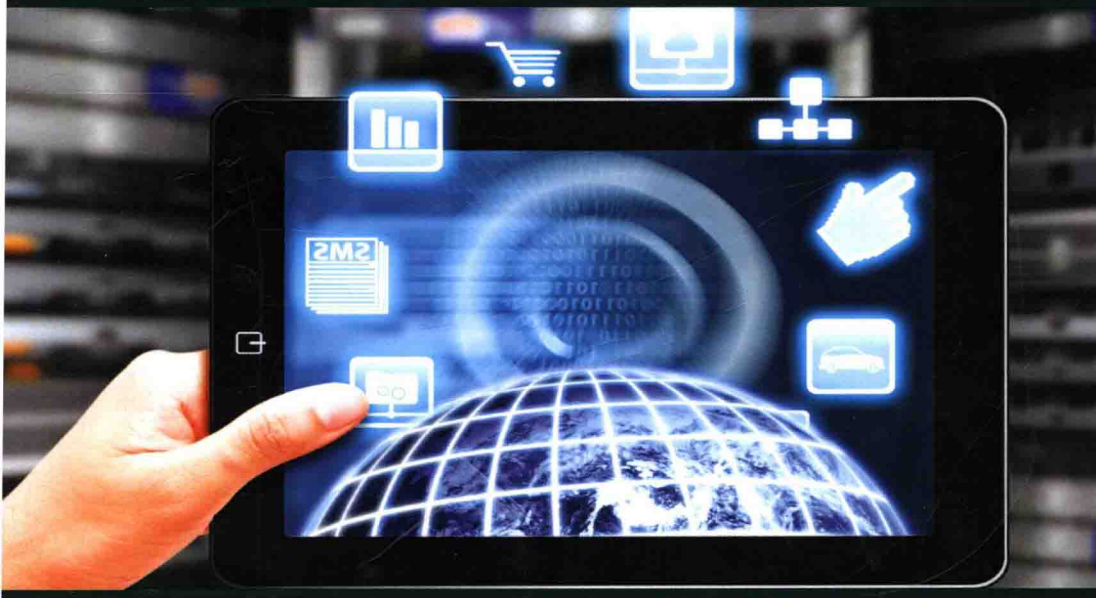
INFORMATION SYSTEMS, WEB AND PERVASIVE COMPUTING SERIES

HUMAN–MACHINE INTERACTION SET



Volume 4

Prospective Ergonomics

André Liem

iSTE

WILEY

HUMAN-MACHINE INTERACTION SET

Coordinated by Jérôme Dinet

This book argues for a prospective turn in ergonomics to challenge the established fields of strategic design (SD) and management. Its multi-disciplinary outlook builds upon concepts derived from Management, Innovation and Design Science.

Differences, similarities and relationships between strategic design and prospective ergonomics are reviewed using existing theories and frameworks from design, ergonomics, and strategic and innovation management.

To complement the theory, 12 cases have been analyzed in greater depth according to 4 main dimensions of analysis. Outcomes have shown that innovating through the Prospective Ergonomics (PE) approach is about finding the right balance between, on the one hand, meeting primary objectives such as profit maximization or solving the design problem, and on the other, acknowledging that human activity is bounded by rationality. This means that humans have diverse motives and intentions connected to their well-being, personal interest, ambitions, family relations and cultural values, to make and transform the world in which they live or want to live.

André Liem is Associate Professor at the Norwegian University of Science and Technology. Prior to this, he taught and developed the Industrial Design programs at two institutions: National University of Singapore (NUS) and Nanyang Polytechnic (Singapore). Dr. Liem has a PhD in Ergonomics from the University of Lorraine, France, and an MSc in Industrial Design Engineering from TU Delft, Netherlands.

ISTE
www.iste.co.uk
WILEY

4

André Liem

Prospective Ergonomics

WILEY
ISTE

Human-Machine Interaction Set

coordinated by
Jérôme Dinet

Volume 4

Prospective Ergonomics

André Liem

ISTE

WILEY

First published 2017 in Great Britain and the United States by ISTE Ltd and John Wiley & Sons, Inc.

ISTE Ltd
27-37 St George's Road
London SW19 4EU
UK

www.iste.co.uk

John Wiley & Sons, Inc.
111 River Street
Hoboken, NJ 07030
USA

www.wiley.com

Library of Congress Control Number: 2017948830

British Library Cataloguing-in-Publication Data
A CIP record for this book is available from the British Library
ISBN 978-1-78630-256-4

Prospective Ergonomics

Preface

My motivation to write this book on strategic design and prospective ergonomics (PE) has been driven by more than 20 years of experiences as an educator, researcher and design practitioner.

As user needs become increasingly complex, I stress the importance of strategic management for PE and strategic design. Forces of globalization, the proliferation of multicultural societies and emphasis on user experiences have changed the ergonomic, business and design landscape. The concept of "user experience", with respect to products and services, whether in terms of purely use, ownership or a combination of it, has become a topic of debate among designers, ergonomists, user interaction experts, business management and social science authorities.

Moreover, the significant growth of new technologies has revolutionized the way firms use these technologies both internally and externally to improve operations, increase efficiencies and provide functional benefits for customers. For example, in the service industry, providers and retailers are using a wide range of self-service technologies, including the internet, to allow customers to produce and consume services electronically without direct contact from firm employees [MEU 00]. At present and in the future, these new technologies will continue to challenge the different stakeholders, who are engaged in "innovation"; a process of transforming an idea or invention into a good or service that creates value for customers (www.businessdictionary.com).

However, when adopting a more sustainable and altruistic perspective toward innovation, the discrepancy between technology-driven positivism

and the desired role of technology in society can be perceived as one of the largest paradoxes of our time.

In this book, I attempt to develop a prospective ergonomic framework to structure and connect generic strategies [WHI 01], worldviews and modes of design reasoning. As exemplified in Whittington's perspectives on strategizing[1], I have been convinced during these years that the main objectives in business and design are broader than just profit maximization and sales. Different stakeholders have diverse ambitions and interests, and designers are creating new roles for themselves in response to new industrial and societal challenges. The current attention on designing experiences, whether tangible or intangible, has placed a significant emphasis on human-centered and design-driven approaches, methods and tools.

Within the polarities of deliberate versus emergent "processes" and targeted versus plural "outcomes", I am convinced that strong similarities between generic strategies and modes of design reasoning can be identified, which may justify a typical ergonomic or design intervention. For example, a classical approach in strategizing resembles a problem solving approach in designing. Both activities are based upon deliberate processes and outcomes are in terms of management "profit maximization", whereas in design it is about "solving a design problem". Furthermore, similarities between design and strategic management/innovation are noticeable in the transient application of methods and tools. For example, visual tools, which are predominantly assistive in projecting an imaginary vision of the future, can be applied in both fields. In other words, the convergence of strategizing perspectives and modes of design reasoning, complemented by their methods and tools brings us to the core of "prospective ergonomics", which is characterized by its anticipative and imaginary nature [ROB 09].

In this work, I argue for a prospective turn in ergonomics to challenge the established fields of strategic design and management. Differences, similarities and relationships between strategic design and PE are being reviewed using existing theories and frameworks from design, ergonomics, strategic and innovation management. PE has developed from corrective and

1 Whittington's generic strategy framework is an important element in my thesis. In conjunction with the evaluation of selected worldviews and models of design reasoning, it provides a foundation for discussing different ergonomic and design interventions. Furthermore, the axial dimensions of Whittington's framework, which are "Process *(deliberate versus emergent)*" and "Outcome *(Plural versus specific)*", also form the basis for positioning the selected worldviews as well as modes of design reasoning.

preventive ergonomics to be more "forward looking in time" by emphasizing on context, user-experience and human-centeredness. In terms of practice, PE creates awareness among actors that the anticipation of user needs and imagination of radically new products and services are essential for the survival of organizations, their business ecosystems, and formation of societal contexts. The latter encourages PE to adopt stances and reinvent social contexts, which have been impacted by technological advancement and disruptive innovation. Considering the complex constellation of collaborators and context embeddedness in specific design and development projects, PE interventions particularly support innovation activities, which capitalize on deliberate processes by making use of prescriptive methods and tools as well as by aiming for pluralistic results. In the first instance, this book presents several theoretical frameworks to discern the relationship between PE and SD, built upon existing business management and innovation theories. To complement the theoretical part, 12 cases have been organized and analyzed in greater depth according to four main dimensions of analysis. These dimensions were as follows: (1) orientation, (2) type of design reasoning models they were subjected to, (3) their significance for practice, and finally (4) their value contribution to society and stakeholders. Furthermore, cross comparisons were made based upon these dimensions of analysis and reference to how these cases were positioned according to a generic strategy framework. From an educational perspective, results have implicated how design knowledge and skills should be transferred to students. Namely, a hermeneutic, reflective and participatory mode of designing, supported by a constructivist worldview, requires a mentorship and scholarship approach in research- or practice-based learning. In the discussion and conclusion sections, outcomes from individual cases as well as their cross-comparisons have been taken into account by theoretical frameworks in answering five research questions. These outcomes have indicated that innovating through a PE approach is about finding the right balance between, on the one hand, meeting primary objectives, such as profit maximization or solving the design problem, and, on the other hand, achieving social and human well-being, personal interest and ambitions, family relations, etc. Moreover, intervention of PE within a classical strategy perspective requires organizations to couple push–pull market strategies while considering the interest of different stakeholders throughout all stages of the development process. This means that prescriptive approaches, methods and tools in the positivist mode should be complemented with constructive modes of reasoning and designing as well as reflective methods and tools, while taking into consideration all levels and perspectives of value creation.

In future research, I suggest developing sustainable product-service innovation, business and design strategies to become more pluralistic and contextually embedded in nature, whether deliberate or emergent. Involving the participation of a broad network of stakeholders, these strategies are to be applied to selected key areas such as (1) processes, methods and tools, (2) perspectives and mindsets and (3) challenges pertaining to typical focal areas within the context of PE. Identified focal areas are (1) aesthetics and experience design, (2) transportation design, (3) culture, acculturation and interaction design, (4) service design, (5) inclusive design and (6) healthcare and welfare design.

To further elaborate on the above, providing organizations with an understanding of the situated context and dynamic interaction among stakeholders is more important than helping them to positivistically aim for precise, logical and rational innovations and designs. This can be established by creating awareness among researchers, ergonomists and designers that constructivist, reflective and hermeneutic methods and practices are increasingly taking center stage in PE. Moreover, the need for more prominent constructive approaches has been instigated by a change in outlook from different actors in business settings to be more pluralistic oriented, as well as emerging trends and developments in the areas of sustainable product and service design, welfare technologies, corporate social responsibility, etc.

On a personal note, based upon my technical educational background in industrial design engineering (TU Delft), and my current employment at the Norwegian University of Science and Technology, Department of Product Design, I am predominantly approaching and writing this book from a positivistic and structured perspective. However, having frequent interactions with other non-engineering institutions in design teaching and research has guided me to adopt a broader perspective toward designing and design processes, acknowledging and promoting reflective, hermeneutic and participative modes of thinking through more constructivist worldviews.

André LIEM
August 2017

Contents

1

Perspectives and Transitions in Ergonomics

In this chapter, a historical introduction as well as an overview of the present and prospective developments of ergonomics will be given. The aim is to provide an outline for approaching theory building within prospective ergonomics (PE), which in Chapters 2 and 3 will be aligned with ancillary fields of strategic design, innovation, systems and industrial design. To contextualize the work, a range of design approaches, such as systems design, design driven and human/user-centered design, will be introduced with respect to different ergonomic perspectives.

Moreover, this chapter sets the tone for developing the construct of prospection and prospective ergonomics by arguing that this new field of ergonomics is driven by a focus on well-being, by being future oriented and design driven and by the fact that product-service innovation, performance and profit should be sought after within systematically embedded contexts. From this perspective of prospection, the intention is to contextually bring the study of preventive and corrective ergonomics closer to the fields of design and strategic management. Consequences are that with the proliferation of services, human–product interactions and sustainable design, where innovation is usually a concern of many stakeholders, the field of preventive ergonomics is extended to PE and design to strategic design. To conclude this introductory chapter as well as initiate the formation and application of theoretical frameworks, it has been brought forward that pluralism toward the creation of new products and services is a typical trait of PE, which enhances company's competitive advantage.

1.1. History and definition of ergonomics

Ergonomics is the scientific discipline investigating the interaction between humans and artifacts and the design of systems where people participate. It applies systematic methods and knowledge about people to evaluate and approve the interactions between individuals, technology and organizations at work and during leisure. The purpose of design activities is to match systems, jobs, products and environments to the physical and mental abilities and limitations of people [HEL 97]. The aim is to create a working environment (as far as possible) that contributes to achieving healthy, effective and safe operations.

The study of ergonomics (Gr. ergon + nomos) was originally defined and proposed by the Polish scientist Jastrzebowski in 1857, as a scientific discipline with a very broad scope and a comprehensive range of interests and applications, encompassing each human activity, including labor, entertainment, reasoning and dedication [KAR 05]. A historical overview of ergonomics will be presented in the textbox below to make certain events explicit, where business strategies, the design of products and services, and different ergonomic interventions connect. The historical timeline indicates that ergonomics has engaged in systemic ways of strategizing as early as the beginning of 20th Century ergonomics. However, only in the past 25 years has ergonomics gained acceptance among business managers.

According to Perrow [PER 83], the problem of ergonomics is that too few ergonomists work in companies, that they have no control over budgets and people, and that they are seen solely as protectors of workers, rather than creators of products, systems and services. Presently, the value of ergonomics extends beyond occupational health and safety and related legislation. While maintaining health and safety of consumers and workers, ergonomics has become more valuable in supporting company's business strategies to stay competitive. This has led to the acceptance of the following broader definition of ergonomics:

– ergonomics (or human factors) is a scientific discipline, which aims to develop an understanding about the interaction between humans and other system elements. Furthermore, the profession applies theory, principles, data and design methods to optimize human well-being and overall system performance [IEA 00];

– compared to Jastrzebowski's definition, the field of ergonomics has become more proactive with respect to problem solving, design, functional