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STRATEGIC DESIGN AND PROSPECTIVE ERGONOMICS: DIFFERENCES, SIMILARITIES AND RELATIONSHIPS

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ABSTRACT

This article argues for a prospective turn in ergonomics to challenge the established fields of strategic design and management. Differences, similarities and relationships between strategic design and prospective ergonomics are being reviewed using existing theories and frameworks from design, ergonomics, strategic and innovation management. Prospective ergonomics has developed from macro-ergonomics to be more "forward looking in time" by emphasising on context, user-experience and human-centeredness. In terms of practice, prospective ergonomics create awareness among actors that the anticipation of user needs and imagination of radically new product and services are essential for the survival of organisations and their business eco-systems. Considering the complex constellation of collaborators and their plural objectives, prospective ergonomic interventions support innovation activities, which capitalise on deliberate processes by making use of prescriptive methods and tools.

Keywords: Prospective Ergonomics, Strategic Design, Strategic Management

1 INTRODUCTION

In the past 25 years, ergonomics did not gain much acceptance by business managers. According to the Administrative Science Quarterly, too few ergonomists working in companies claimed that they have control over budgets and people (Perrow, 1983). Furthermore, they view themselves as protectors of workers, rather than creators of products, systems and services. Presently, the value of ergonomics has been extended beyond occupational health and safety and related legislation. While maintaining to address health and safety issues for consumers and workers, ergonomics has become more valuable in supporting company's business strategies to stay competitive. These changing paradigms about ergonomics led to the introduction of a "prospective turn" in the field.

Robert & Brangier (2009) have extended the meaning of "preventive" ergonomics to "prospective" ergonomics (PE), emphasising the "forward looking in time" aspect (as opposed to retrospection) by analysing individual, social, cultural, political, economic, scientific, technological, and environmental factors. The emphasis on selected factors depends on how they influence the strategic management of companies with respect to the anticipation of user needs and development of new products and services that will be useful and provide positive user experience. The four characteristics of PE are (Brangier & Robert, 2012):

- Its human-centeredness and orientation towards future technologies.
- Its ability to investigate prospective users' activities through the usage of artifacts in context by trying to understand human needs, motivations, interests and experiences when doing these activities.
- Its ambition to imagine the future by relying on different quantitative and qualitative foresight methods.

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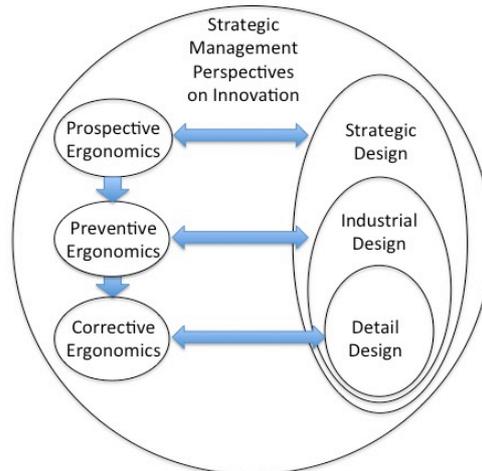
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- Its position to foster creativity, which lies at the origin of innovation.

2 RESEARCH OBJECTIVES AND QUESTIONS

De Montmollin (1967) has categorized ergonomics into corrective ergonomics and preventive ergonomics. The former is about correcting existing artifacts, and the latter deals with systems that do not exist yet in reality. Laurig (1986) associates "corrective ergonomics" with traditional ergonomics and describes it as developing "corrections through scientific studies". In this context, "developing corrections" refers to situations where the ergonomist or designer makes user functional improvement to existing products, systems or processes in a reactive manner. In other words "redesigning". Recently, Robert & Brangier (2009) and Brangier & Robert (2014) have mapped out the differences and similarities among corrective, preventive and prospective ergonomics. The emergence of PE as a human-centered intervention in the anticipation of future needs and the conceptualization of new products and service has created opportunities for multi-disciplinary and exploratory studies to determine the link



with strategic design.

Figure 1 – Alignment of ergonomic and design interventions at different levels of comprehension.

The aim of this article is to discuss the relationship between PE and strategic design from an overarching strategic management perspective (see figure 1). Hereby, relationships among strategic management, strategic design and prospective ergonomics will be elaborated using selected business, design and ergonomic frameworks and models. This has led to the formulation of the following research questions:

- RQ1. What are the theoretical and conceptual differences and similarities between strategic design and prospective ergonomics?
- RQ2. How do management strategy perspectives and schools of thought (Whittington, 2001) influence strategic design and PE?
- RQ3. Does strategic design focus on how to prescriptively plan innovative products and service, whereas innovation opportunities in PE centre around human involvement?
- RQ4. How does a PE approach add value to the field of strategic, industrial and service design?

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3 THEORETICAL FRAMEWORKS

In this article, a worldview perspective on design theories has been adopted (see figure 2), as an overarching reference framework to align different strategy and innovation models with different ergonomic domains, interventions and specialisations. These alignments occur in three stages. In the first stage, Rationalist-Historicist and Empirical-Idealistic dimensions, which are contextualised and positioned according to different technology-push and market-pull approaches, will be aligned with the generic strategy dimensions, deliberate – emergent and profit-maximisation – plural. The second stage suggests the connectivity among generic strategies, worldviews and models of design reasoning, juxtaposed according to a framework of process and outcome. In the third stage, different ergonomic interventions and specialisations will be positioned according to the selected strategic management, innovation and design models. The purpose of these alignments is to contextualise PE within different perspectives of innovation and strategic design and to provide a management foundation for anticipating and imagining future needs and wants as well as to create prospective design solutions.

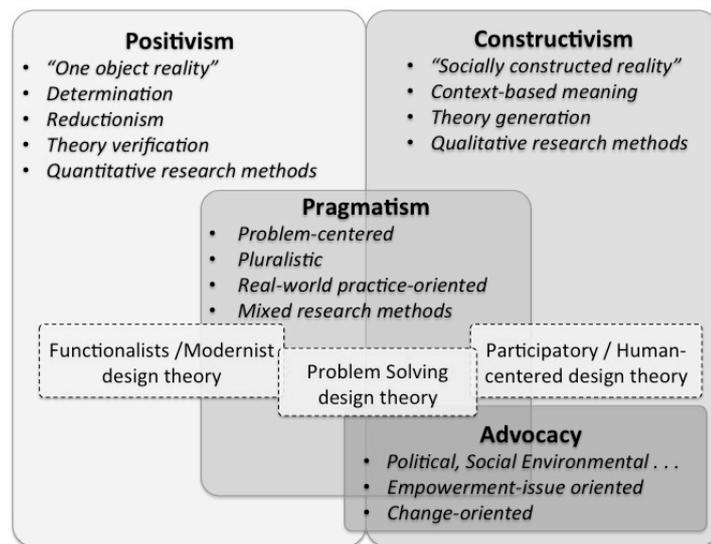


Figure 2: A Worldview perspective on Design Theories

3.1 ALIGNING GENERIC STRATEGIES WITH INNOVATION APPROACHES THROUGH WORLDVIEW PERSPECTIVES

Using different worldview perspectives, Whittington’s generic strategy perspectives can be aligned with the Technology-Push / Market-Pull innovation approaches (figure 3). The typical worldview transfers connecting the Technology-Push / Market-Pull innovation approaches with the generic strategy perspectives are purposely presented in a simplistic manner to demonstrate the dominant relationships.

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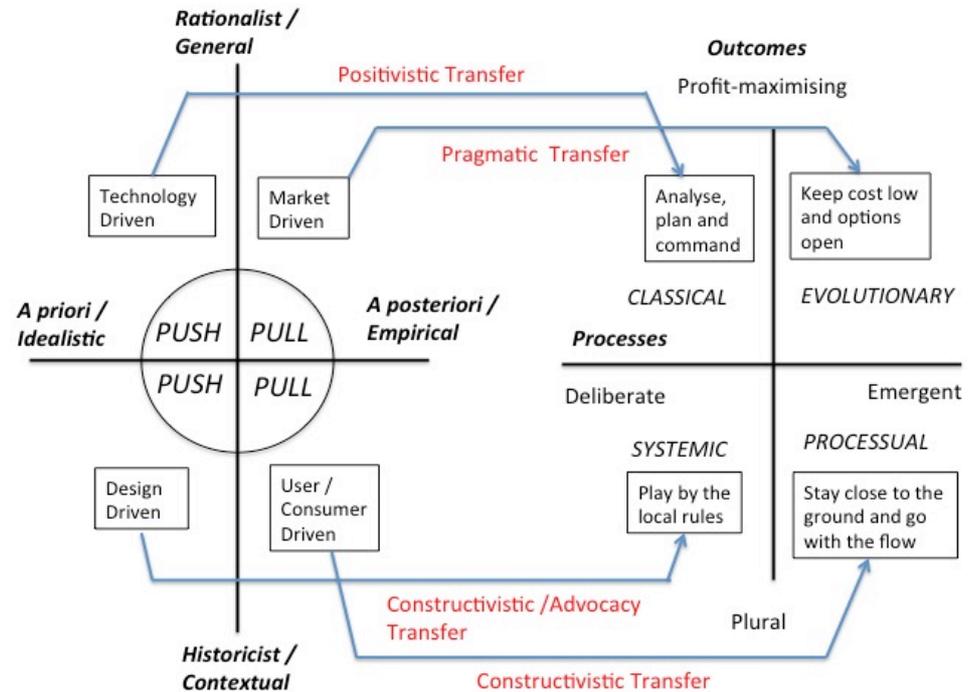


Figure 3: Alignment of innovation approaches with generic strategies through a worldview perspective.

3.1.1 A technology driven innovation approach based on a generic classical strategy

Besides sharing positivistic characteristics of “doing things in a top-down, structured and directive manner” between technology driven marketing and classical strategy approaches, “Good business model design and implementation, coupled with careful strategic analysis, are necessary for technological innovation to succeed commercially” (Teece, 2010, p184). His statement implies that every new technology driven product development effort should be coupled with the development of a planned business strategy, which defines its ‘go to market’ and when and how to “capture optimal economic value”.

3.1.2 A design driven innovation approach based on a generic systemic strategy.

The alignment between a design driven market approach and a systemic way of strategizing is commonly represented by its context dependency. People in organisations strategise and consumers make sense of a product or service according to their psychological profile, and of the deeply rooted cultural and densely interwoven social systems in which they are immersed (Whittington, 2001). Hereby, stakeholders should not be seen as decision-makers, who are simply detached calculative individuals, interacting in purely transactional and economic sense (Granovetter, 1985). Their actions are embedded in a network of social relations, involving their families, state, their educational and professional backgrounds, religion and ethnicity (Swedberg et al., 1987), (Whittington, 2001). Meanings are constructed and re-constructed in an on-going design-driven process through continuous interactions among firms, designers, users, and other stakeholders, both inside and outside a corporation (Brown & Duguid, 1991). The innovation of meaning, therefore, could be linked to a social-constructionist (Burr, 2010), or even re-constructionist approach,

where the continuous interaction of objects with subjects construct, representations of reality (Chan & Mauborgne, 2005)

3.1.3 *A user driven innovation approach based on a generic processual strategy*

The success rate of linking user-driven innovation a processual strategy through a constructivist transfer depends on how organisations transform themselves to become more consumer-centric, willing to introduce novel tools, instruments and procedures to systematically and continuously integrate users into their core business processes. However, one needs to acknowledge the imperfections of competitive markets as well as the limited and unpredictable cognitive and physical capabilities of human beings (Cyert & March, 1963) As a result organisations are rationally bounded. Similar developments can be observed when discussing innovation and design. Users, who are involved in co-creating products and services are unable to consider more than a handful factors at one time. Furthermore, by being biased in their interpretations, users tend to be limited in communicating their hidden needs, and are more inclined to adopt a reflective practice approach towards incremental innovation, creativity and problem solving.

3.1.4 *A market driven innovation approach based on a generic evolutionary strategy*

By adopting a post positivistic and pragmatic worldview, supporters of the evolutionary perspective believe that markets dictate how profit maximisation can be achieved. The differences with the other innovation and generic strategy alignments are that in this market driven innovation approach consumer behaviours are essential, but the consumer is perceived to be a passive rather than an active participator, not necessarily involved in creativity or co-creation activities. In this opportunistic way of strategizing companies need to continuously follow increasing complex consumer demands as well as exploit the technological capabilities they possess, or acquire new ones. Furthermore, companies are becoming less and less capable to predict the future, because of globalisation trends, changing economic, social and political climates.

3.2 RELATIONSHIPS AMONG GENERIC STRATEGIES AND MODELS OF DESIGN REASONING

Although typical processes and outcomes are different for strategizing and designing, different generic strategies, worldviews and models of design reasoning can be aligned with respect to intent. These alignments are invaluable for ergonomist, designers and business managers when creating better products systems and services (see figure 4). Furthermore, this contextualised generic strategy model provides a foundation for positioning ergonomic domains, interventions and specialisations relative to strategic management, strategic design and industrial design theories.

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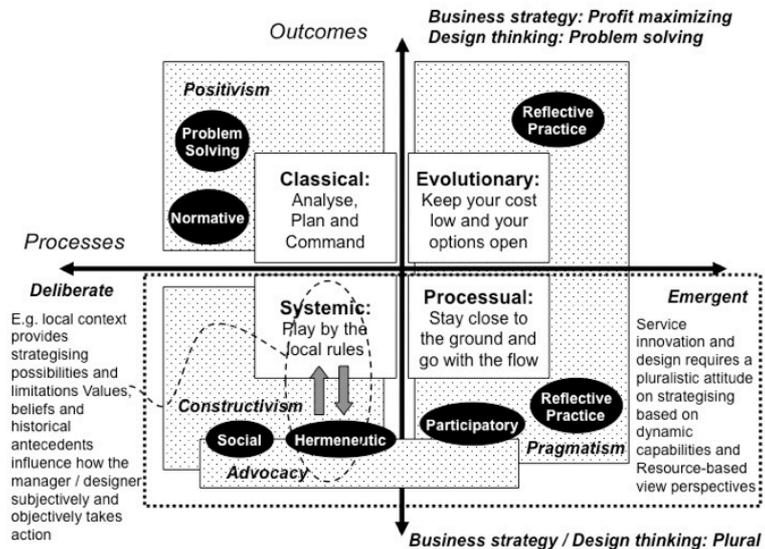


Figure 4. Extension of generic strategies to models of design reasoning based upon philosophical worldviews (adapted from Whittington, 2003, figure 2.1, p.10) (Liem, 2014, p.97).

A positivist worldview underpins the classical strategy approach, where focused and structured product planning and problem solving aims for profit maximisation in a systematic design process (Roozenburg & Eekels, 1995). The normative reasoning model is exemplified by how a strict and concrete program of requirements complements this problem-solving approach. Typically, PMT-matrices (Ansoff, 1968) and Style / Technology Maps (Cagan & Vogel, 2002) are examples of methods and tools, which supports a planned and structured approach towards PE and strategic design.

The evolutionary and processual strategic approaches are built upon a pragmatic worldview. Lacking a debate as to whether reality is objective or subjective, the emergent and in some cases opportunistic characteristics of these strategies determine how organizations behave to achieve their profit-making targets or goals. For instance, within corrective ergonomics, an evolutionary business strategy, complemented by a reflective way of designing, would suffice to incrementally improve ergonomic functionality of existing products. Transitioning from constructivist to a pragmatic worldview, reflective practices address design issues by engaging in conjectural conversations with the situation (Schön, 1995). In a processual strategic environment, participatory design approaches involve different stakeholders in a context-driven design and development process, where personal interests limit profit-maximizing and the development of an optimal design solution.

The systemic strategy is socially constructed and therefore the reality is co-constructed by different stakeholders and individuals in a social context (Lincoln & Guba, 1985). Although processes are planned and deliberate, multiple views, which are socially, historically, culturally, and contextually embedded in respective communities of practice may lead to pluralistic outcomes. The use of selected methods and tools, combined with personal experience and subjectivity, occupy a central place in strategizing and designing processes, which is based on hermeneutic and social reasoning. Reiterating the importance of systemic embeddedness, contexts, values, and functions are a key element for

prospective ergonomic activities, focussed on human well-being and involvement of different stakeholders

3.3 POSITIONING OF ERGONOMIC DOMAIN, SPECIALISATIONS AND INTERVENTIONS WITHIN MANAGEMENT AND MARKETING FRAMEWORKS

To gain a more reflective understanding of prospective ergonomics, it is important to discuss different ergonomic domains, interventions and specialisations in conjunction with selected theoretical frameworks. These selected frameworks are the "Push-Pull Innovation" and "Generic Strategy" framework.

However, in terms of positioning, only ergonomic interventions will be made explicit figures 5 and 6, as domains and specialisation are the same in all quadrants of the push-pull as well as Whittington's generic strategy framework (Whittington, 2001).

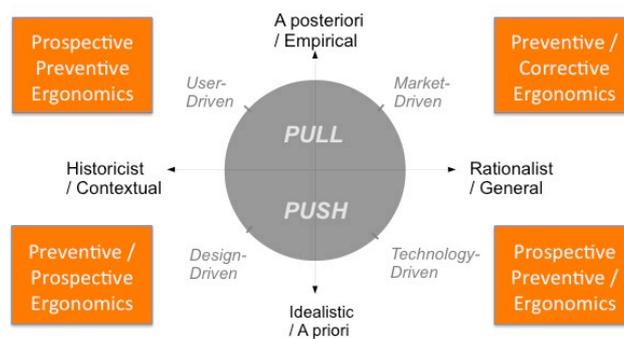


Figure 5. Ergonomic Domains, Interventions and Specialisations contextualised within Push-Pull Innovation Initiatives

As shown in the Push-Pull Innovation Framework (figure 5), corrective ergonomic interventions apply to the market-driven quadrant, to facilitate redesign or incremental innovation. Preventive ergonomic intervention targets context-based innovation and is present in all quadrants. Prospective ergonomic intervention is predominantly present in the technology driven, design-driven and user driven quadrants, because it aims to solve hidden needs and create new markets, products and services, either deliberate or emergent.

When juxtaposing interventions with generic management strategies, the evolutionary and processual approaches limit the scope to corrective or preventive ergonomics, because of their reactive and conservative attitude towards innovation (see figure 6). For example, in a processual innovation approach stakeholders may forgo the most promising prospective design solutions, because they have not been tested. These stakeholders perceive innovation as a gradual en emergent process of doing things, aimed at plural outcomes. The classical and systemic strategies stimulate more nuanced approaches within prospective ergonomics. PE intervention within the classical quadrant may lead to radical innovation focussed upon profit maximisation, whereas long-term pluralistic goals are a focal point within a systemic quadrant.

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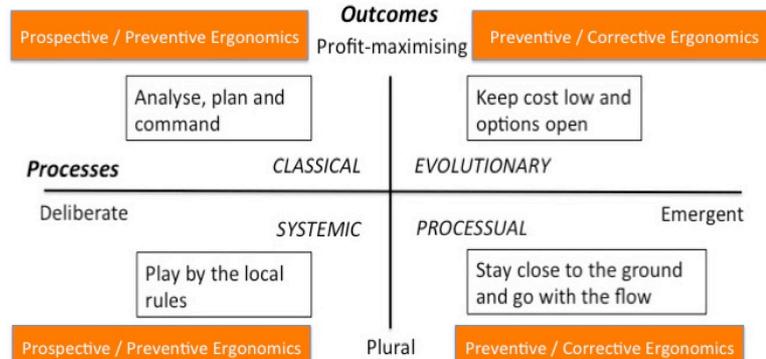


Figure 6. Ergonomic domains, interventions and specialisations contextualised within 4 strategy perspectives (Adapted from Whittington, 2001)

3.4 ALIGNING ERGONOMIC DOMAINS, SPECIALISATIONS AND INTERVENTIONS WITH PRESCRIPTIVE INNOVATION FRAMEWORKS

The following prescriptive frameworks have been selected, for positioning a company’s orientation towards PE and strategic design.

- Ansoff Product – Market Matrix (Ansoff, 1968)
- Value Creation Product /Service Positioning Map (Cagan and Vogel, 2002)
- Design Driven Innovation Framework; Meaning versus Technology (Norman and Verganti, 2011)

These prescriptive frameworks facilitate: (1) the identification of product opportunities, (2) the translation of consumer needs into actionable insights and defined attributes, (3) the integration of engineering, industrial design and marketing. The strategic orientation as depicted in these frameworks can be aligned with ergonomic domains, interventions and specialisations.

As shown in Ansoff Product–Market Matrix (figure 7), market penetration, product extensions are minimal, most likely limited to aesthetic modifications (face-lifts), and in no need of ergonomic intervention. Corrective ergonomic measures aim to improve the hardware and software of products to match existing or create new markets based on users physical and cognitive conditions.

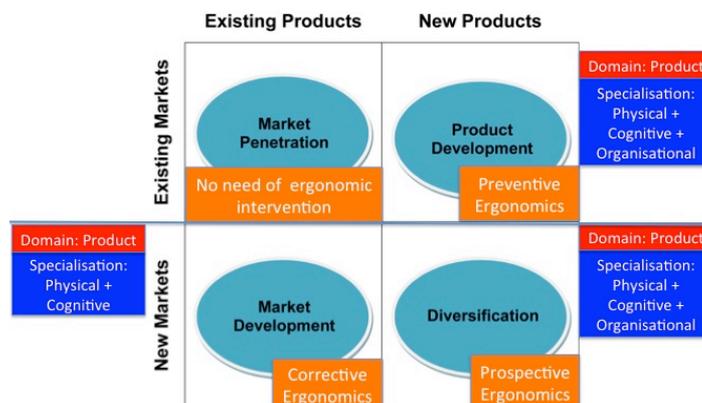


Figure 7. Ergonomic Domains, Interventions and Specialisations contextualised within Ansoff’s PMT-matrix (Adapted from Ansoff, 1968)

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An alternative to Ansoff’s PMT-matrix, Cagan and Vogel’s value creation product positioning map (see figure 8) aims to identify products of significant value, for a company to successfully differentiate itself from the competition. Ergonomic specialisations are mainly physical and cognitive in the high “Style” quadrants, and are extended, to organisational where high “Technology” and “Style” meets. Ergonomic intervention is limited to corrective or preventive if a product is designed based on existing technology. However, with respect to value creation in the high “Style” and high “Technology” quadrant, prospective ergonomic intervention facilitates the development of creative breakthrough ideas, contextualised around culture, workplace, family, etc.

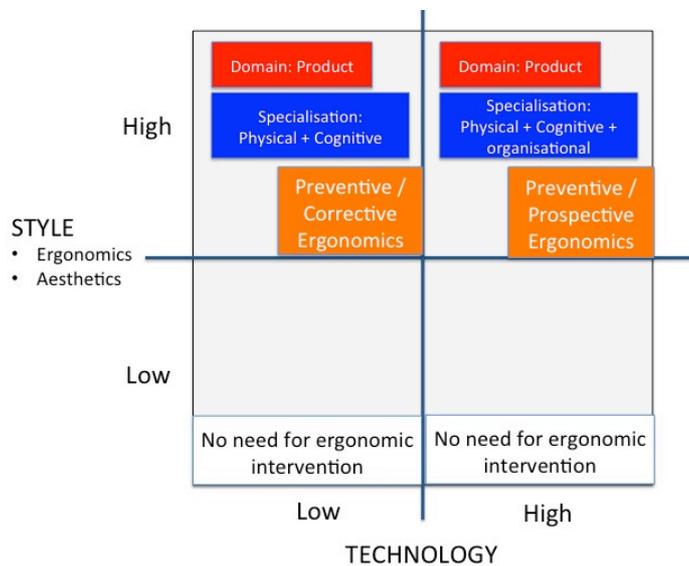


Figure 8. Ergonomic Domains, Interventions and Specialisations contextualised within the value creation product positioning map (Adapted from Cagan & Vogel, 2002)

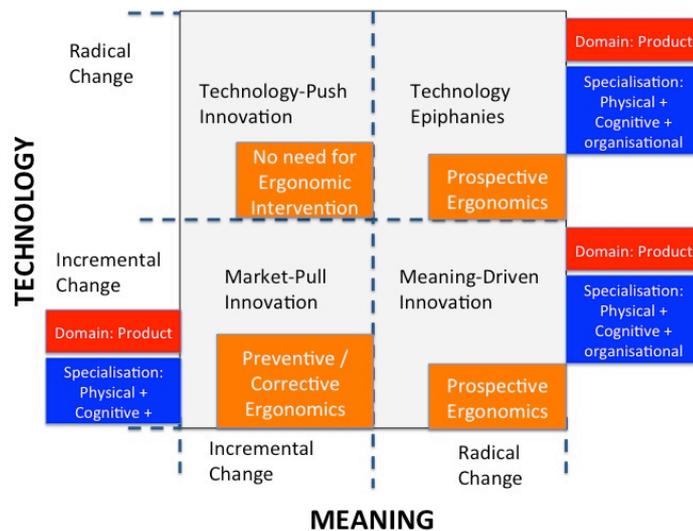


Figure 9. Ergonomic Domains, Interventions and Specialisations contextualised within design-driven innovation (Adapted from Verganti & Norman, 2011)

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A design driven framework (Norman & Verganti, 2011), where incremental and radical innovation is reflected against technology and meaning change is shown in figure 9. Technology push does not purposely introduce significant ergonomic interventions, although human behaviour may be influenced. For example, the digital camera, significantly changed users' behaviour in taking pictures, but the concept of capturing and storing events was not revolutionised. In "Market Pull Innovation", corrective or preventive ergonomics influence the design of products and services, which have been driven by users' needs. In Market Driven Innovation and Technology Epiphanies, a prospective ergonomic approach in the design of products and services may lead to the most innovative solutions. For example, the "Tupperware Party Direct Sale" concept instigated a cultural revolution in post-World War II America. It was not just about selling plastic kitchen containers to store food, but rather a manifestation of radically feminised ways of women's freedom. In both examples, no new technology was involved. Similarly, the Wii video game console manifests the use of new technologies in giving new meaning to gaming.

4 **A COMPARATIVE OVERVIEW BETWEEN ERGONOMIC AND DESIGN INTERVENTIONS**

After having evaluated selected theoretical frameworks from strategic management, strategic design and design reasoning, comparisons between ergonomic and design interventions are shown and structured according to "Orientation", "Methods and Techniques", "Practices" and "Value Creation" in table 2.

	Corrective / Preventive Ergonomics	Prospective Ergonomics	Strategic Design	Strategic Management
Orientations	Driven by external demands	Proactive / Speculative	Proactive	Proactive
	Focus on current state of affairs and incremental innovation	Focus on future products and services	Focus on future products and services	Focus on the future of the organisation
	Focus on user and usability issues with respect to product-service system innovation	Product-Service-System Innovation determined by STEEP factors	Product-Service-System Innovation determined by STEEP factors	Focus on organisational innovation
	Contribute to physical and cognitive human well-being	Contribute to social and/or business goals by people and for people.	Contribute to business goals	Contribute to business goals

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	Addresses an existing product or service,	Addresses a product or service, which does not exist yet	Applies to an existing and non-existing product or service	Applies to an existing and non-existing product or service
Methods and Techniques	User-centred	Human-centred (users, designers, suppliers, distributors)	Innovation Centred, Designer-centred	Centred around management practices
	Analytical Research Methods	Prescriptive, participative, reflective and prospective methods, to facilitate creativity	Prescriptive, analytical, participative and reflective methods	Use of deliberate and emergent processes, methods and tools
	Resource-based view	Resource-based view and dynamic capabilities approach	Systematic and prescriptive view towards product planning	Multiple schools of thought
Practices	Considers mainly the user in innovation projects	Considers interest of all stakeholders in innovation projects	Considers mainly the interest of the organisation	Considers mainly the interest of the organisation.
	Human activities are existing and observable	Human activities are prioritised and to be imagined	Human activities not always a priority	Human activities embedded in organisational aims
Value Creation	Long-term profitability	Long-term profitability	Long and short term profitability	Long and short term profitability
	Cost reduction through corrective ergonomics	Pluralistic goals in systemic contexts	Profit maximisation through increased sales of innovative products and services	Profit maximisation through increased sales of innovative products and services, and cost reduction

Table 2: Comparison of between prospective ergonomics and strategic design involving their respective roots; classical ergonomics and strategic management

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4.1 ORIENTATION

With respect to the development of future products and services, strategic design is centered around the growth and development of the profit-making organization, whereas in prospective ergonomics a balance between performance / productivity on one hand and human /social well-being is sought after. However, from both perspectives, the emphasis lie on the imagination of future user needs, and how to respond with creative design solutions in a Fuzzy –Front End of Innovation process. In corrective and preventive ergonomics, the main aim is to develop products and services for an existing context by taking into consideration explicit user needs.

4.2 PROCESSES AND METHODS

In strategic design projects, finding “what to develop” in the fuzzy-front-end is usually driven by the designer with the help of passive involvement of users and other stakeholders. Given this positivist viewpoint, product planning and goal finding approaches are complemented with structured processes and methods to propose and solve specific design problems. In PE, reflective and participatory methods and tools complement the structured and systematic processes for determining what to design and how to design it. The designer then acts as a facilitator to constructively extract stakeholders’ views and competencies to anticipate and create future user needs. He or she is then required to orchestrate a compilation of design methods and tools to be directly applied and / or to be introduced in a participatory manner. Concerning preventive or design ergonomic interventions, prescriptive analytical research and user-centred methods are being advocated to discover and understand user needs. However, in some projects, highly contextual constraints justify an evolutionary, reflective design approach, signified by on-the-spot model making and prototyping, sketching, and trial and fit activities.

4.3 PRACTICES

The difference between strategic design and PE with respect to practices is that the latter adopts a broader view towards stakeholders’ interests. Reported prospective ergonomic cases incorporate a strategic intent, and are positioned in the systemic quadrant. Unlike in pure strategic design projects, where processes and methods are carefully planned and profitmaking is prioritised, objectives and interests in PE projects are more nuanced, fuzzy or uncertain. In other words, prospective ergonomics acknowledges the individual interests and capabilities of different internal and external stakeholders at a micro level. This pluralistic approach is also reflected in innovation efforts, whereby the imagination and design of “human activities” through services, systems or products is being prioritised, sometimes contradictory to the strategic management aims of an organisation. Furthermore, in preventive or corrective ergonomics, human activities are existing and observable. In PE, the end user is an actor whom we must first invent, and thereafter create for.

4.4 VALUE CREATION

The nature of ergonomics, which focuses on human well-being, inherently promotes long-term profitability in organisations. The concept of achieving long-term profitability and at the same time human well-being can be achieved

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through socially responsible internal productivity measures within various units of the organisation, for example by eliminating hazardous and occupationally sound working processes, there may be lesser absenteeism, which leads to cost reduction. With respect to PE, value is created through the development of radically new products, systems and services, centred around the creation of human needs and imagination of new products and services. In strategic design, value generated through innovative products and service innovation is being complemented by cost reduction when adopting a broader strategic management perspective towards profit maximisation.

5 DISCUSSION

A comparative literature review of strategic design and PE was conducted to outline similarities and differences by juxtaposing theories, processes and methods from strategic management, philosophy, innovation and design (Liem, 2014; Liem & Brangier, 2012). Reference to RQ 1, strategic design focused on managing the fuzzy-front-end of innovation by using prescriptive product planning processes, methods and tools. PE was developed from macro-ergonomics to be more "forward looking in time" through the "intelligence analysis" of several factors; individual, social, cultural, political, economic, scientific, technological, environmental (Robert and Brangier, 2009), as well as by emphasising on context, user-experience and human-centeredness. Furthermore, persuasion and advocacy are typical characteristics of PE, which differentiate the two fields in the design of Product Service Systems (PSS).

With respect to RQ2 and RQ3, developments in strategic management, where firms tend to focus more on pluralistic objectives, combined with a user-experience centred view on consumerism, complements PE theories and practices. This broadened scope of PE gave rise to the design and development of intangible-dominant commodities, such as services (Miles, 1993). Vice-versa, service innovation and product service systems design, re-emphasised the importance of a systemic strategy approach (Whittington, 2001), where deliberate planning aims to anticipate complex future needs of different stakeholders. Furthermore, in the fuzzy-front-end of innovation, prospective ergonomic intervention encourages the use of human-centred innovation approaches, processes and methods (Nelson et al. 2014).

Reference to the value framework (Den Ouden, 2011) the scope of value creation within prospective ergonomics extends beyond the organisation. Within a systemic strategic context and targeting business eco-systems, value creation is pluralistic, addressing the interests of partakers. However, considering that people's economic behavior and capabilities are dynamic and embedded in a network of social relations, prospective ergonomic value is determined by how interactions among stakeholders fostered creativity during ideation processes (Hienert et al, 2011), as well as what individuals in an organization deem valuable. From a social value perspective, ergonomic intervention in the design of "Assistive Technologies", including functional needs, accessibility, social acceptability, but not forgetting cost-effectiveness and marketing, is a current topic (Plos et al. 2012). This topic aligns itself well with Whittington's systemic view on how to develop arrangements for an inclusive society. Focusing on the characteristics of systemic strategising through a prospective ergonomic lens, deliberate planning and the use of prescriptive methods is being exemplified by the EMFASIS framework (Plos et al., 2012). However, a "constructive turn" in inclusive design, promotes the targeting of pluralistic goals, which requires the

use of participative design methods in pre-defined contexts. Liz Sanders' work on the co-creation of patient care solutions as well as Rama Gheerawo's inclusive designs at Helen Hamlyn's Institute are clear examples of how prospective ergonomics has intervened in the planning and design of innovative products and service within the fuzzy-front-end of innovation.

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