1. Context and Objective

Prospective Ergonomics (PE) aims at detecting current human needs and anticipating or constructing future ones in order to design future products, services or processes that will satisfy these needs (Brangier & Robert, 2014; Robert & Brangier, 2012). It entails a significant enlargement and enrichment of the mission of ergonomics. Thus the role of ergonomists is no longer limited to correcting artefacts in order to protect human health and safety and to increase human performance and satisfaction. It is no longer limited to help designing artefacts that have already been identified or defined by others in order to satisfy the needs of a customer or respond to the request of a contractor. From now on, the role of ergonomists extends to activities of prospecting, creation and innovation that are not limited to what ergonomists are used to do for correction and design. PE can operate in a market-pull environment where the human needs stimulate and drive the development of technology as well as in the technology-push environment where one looks for useful applications of the available technology, or for ways to improve the current technology through more functionalities, connectivity, efficiency, flexibility, usability, etc. A major difference between traditional ergonomics and PE lies in the fact that in PE ergonomists are pro-active and in the position of initiating, defining and conducting design projects and soliciting the collaboration of other professionals (e.g., engineers, designers, marketers) instead of being reactive to others and being invited to join a team and take up a project that is more or less already defined. The rationale behind the creation of PE which is expected to be determinant for the future of ergonomics ensues from one major goal: actively participate to the definition and organization of the future in order to improve or change the world. It is also based on four main observations:

- the rise of the recognition of the great importance of creativity and innovation in organizations and in different disciplines such as design, engineering, management, and marketing with which ergonomics either already has narrow links or should develop ones; notice that creativity and innovation have always been at the core of the design profession;
- the ever increasing number of demands addressed to ergonomists for undertaking innovation projects that deal with the future;
- the strong interest of young ergonomists whose academic backgrounds are in engineering, design, computer science, human-computer interaction, or interaction design for academic training and projects including creativity, design, innovation, and entrepreneurship;
- the natural interest of ergonomists for human activities and the different devices that support them. Ergonomists often intervene on the ground and are close to human operators, their activities, their environment, and their devices so that they are often witnesses of irritants, errors, incidents, accidents, malfunctions, poor performance, poor user experience that could lead to the creation of new products, services, and processes.

To be able to accomplish its mission about the future, PE must know who the future users (of future artefacts to create) will be, what tasks they will do, how they will do them, what technology or tools they will use, what technological ecosystem will be in place, what political, social, economical or environmental contexts will prevail (e.g., new laws and regulations, habits, values), what principal challenges or problems they will face, etc. The answers to these questions call for the development or adoption from other disciplines of new approaches, methods, techniques, and tools in ergonomics, or new ways of using the existing ones to apprehend the future. This communication will present some recommendations and methods for detecting, anticipating and defining human needs, and for generating ideas of future products, services or processes that will satisfy them. Its objective is to draw the attention of our community on the design of future artefacts from a human factors point of view and to propose some approaches and methods that can help to do it.
2. Data, Recommendations and Methods for Prospective Ergonomics

- Resort to different mathematical, social, demographic, and economical models to analyse and monitor major human trends. One can find high-quality literature from international organizations (e.g., World Health Organization), Universities, research institutes, national organizations for statistics, and researchers (e.g., Randers, 2012). This literature is a well of information on numerous topics concerning the conditions and behaviours of Human: overweight, obesity, aging, (im)migration, mobility, epidemic, unemployment, women on the job market, use of technology, networking, richness/poverty, etc.
- Follow a human-centered approach and an iterative approach. It is difficult to imagine PE looking for or constructing future human needs without involving users in the design process. Since future users already exist for most of the projects, they can take part to surveys, interviews, observations in the field, task analysis, usability tests, performance and satisfaction evaluations, etc. Do not expect to have it right the first time. Iterations enable the design team to refine and test different design concepts.
- Know the people you will involve in your projects of innovation. Find the innovators among the end-users and the experts who want radical change. They are visionaries and look for a quantitative leap forward. Work with demanding and sophisticated customers because they will help find ways to improve existing artefacts. Work with experts and get them to imagine the future and build scenarios. Work with support staff in the case of patients: clinician, nurse, technician, parent, caregiver.
- Know the task. Task analysis is part of almost any ergonomic intervention, whether it is for correction, design or prospecting. It allows the analyst to know the structure of goals and sub-goals of the person performing the task, and the different means and used to attain them. The top goals of the task rarely change, on the other hand the means used to reach them are likely to change with new technology, work organization, regulations, etc. These means are good candidates for improvements or radical changes.
- Analyse existing problems (this is part of task analysis). It includes errors, incidents, low use rates, poor performance, low satisfaction, poor user experience, customers’ complaints and requests, etc. Such an analysis is likely to bring good ideas for improving existing artefacts or create better ones.
- Understand how the users appropriate their artefacts. Understanding the back-and-forth relation between the artefact and the user enables the analyst to understand the various adaptations, misuses, sub-uses, usage deflections, or innovative usages of the artefact. These can be an important source of innovation.
- Analyze the successes and the failures of products and services comparable to the ones we wish to create or belonging to the same technological ecosystems. So one will learn about their strengths and weaknesses relative to their functionalities, performance, connectivity, usability, aesthetics, sales, etc.
- Stimulate creativity in projects of innovation. In the literature, one can find numerous creativity methods to collect verbal data (e.g., brainstorming, analogy, critical thinking, forward looking interview, improbable encounter, story-telling), non-verbal data (e.g., brainwriting, drawing), or a combination of both (e.g., role playing, problem-solving). Furthermore, one can use various techniques of constraint management (Bonnardel, 2006) or social development of future needs (Brangier et al., 2009) that stimulate creativity.
- Use powerful methods such as scenarios and personas which are frequently used for interface design and evaluation. Since scenarios are stories about people doing activities in a context with certain artefacts, they help to imagine, organize and anticipate the future. Personas are fictional archetypes of future users represented through both textual descriptions and photos (Brangier & Bornet, 2011). Both methods help to imagine and embody the future.
- Build mocks-up and prototypes of future artefacts and use system simulation, possibly in immersive environments, to visualize, manipulate, and evaluate them.

References