I. INTRODUCTION

The papers presented in this special issue follow on the presentations made at the 9th Le Travail Humain Workshop, aiming at capturing some of the most significant recent contributions of Ergonomics in Aviation.

The goals of the introductory section are twofold. First, this section provides the reader with a short survey of Human Factors in Aviation. Second, it puts the four papers of this issue in the context of new Ergonomics challenges.

II. PAST AND PRESENT IN AVIATION HUMAN FACTORS

In the 90’s, the focus on Aviation industry took over from the nuclear industry to symbolize the high technology overhang of the new millennium. From the last decade, Aviation has provided rich and complex fields, civil, military, professional or amateur, that sustained most of the recent advances in Ergonomics theories and practices.

Among characteristics of the Civil Aviation professional system, three are extremely important for Ergonomics. First, Aviation is a complex and world-wide system, with a high-speed changing Western-based technology. Hence, it is chronically challenging to a variety of professions, and end-user national and corporate cultures. Second, it is a system under extreme commercial competition, with almost total commercial deregulation. Third and finally, Aviation has become an ultra-safe system, among the best in the world along with the nuclear industry, and railways in some countries.

Among characteristics of the Military Aviation system, one may note the significant contribution to Ergonomics of the design of real-time intelligent decision-support systems.

Ergonomics concerns have varied over time in Aviation (Sarter & Amalberti, 2000).

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Le Travail Humain, tome 64, n° 3/2001, 193-196
Until the 90’s, most Ergonomics and Human Factors research in Aviation focused on human relationships inside the cockpit (the technical crew). Significant advances were made in selection and fatigue management. Charles Billings’ NASA team was pioneering a new style of course focusing on the improvement of team co-operation, so called Crew Resource Management (Billings, 1997; Wiener, Kanki, & Helmreich, 1993).

Till the 90’s, Human Factors research in Aviation widened their horizons, going beyond the cockpit to focus on the specific problems of air-traffic controllers, mechanics, cabin crew and dispatchers, and their reciprocal interactions. The change not only concerned the profession, but also the scope of Ergonomics, putting more and more emphasis on design, cultural adaptation, and on on-going automation-related problems.

Automation remains one of the emblematic areas where the Aviation Human Factors community has made the most contribution to theory and practice in Ergonomics. Advanced automated aircraft were introduced in the late 80’s. They rapidly caused serious problems of adaptation. A first well known series of problems resulted from early dramatic and highly-publicized accidents (e.g., Airbus A320 at Habsheim (1988), and at Mont-Saint-Odile (1992), in France). Beyond these catastrophic events, automation in Aviation has represented for a long time a sort of lab room for studying social conflicts, and social mechanisms of adaptation to technical revolutions. As is usual in Ergonomics, changing the tool has an immediate effect on changing the job, and reshaping performance and Human Factors. From the very beginning, unions were very negative about the introduction of automated aircraft and related changes in their job. Downsizing professional teams (the cockpit team went from triads to dyads), imposing growing demand on system performance (including commercial performance), requiring significant swapping in crews tasks and accountability (manual flight no longer the recommended procedure), put the Aviation system under high stress. Automation was long considered to be the tool for making these changes a reality, and hence it crystallized workers’ dissatisfaction.

Negative effects of automation tend to fade with time and adaptation. Automation in Aviation is by now recognized as part of the system, and nobody would mind the future going back to manual “old folks” systems. Initial problems with worker transitions from classic systems to automated systems came to the end. Only the intrinsic effect of complexity on worker decision making, planning and situation awareness continued to be under the spotlight, specifically in the design of Aircraft and Air-Management Systems.

The last important lesson that Ergonomics learnt from Aviation is realism and humility. Ergonomics has been extremely good in identifying the potential for failure, and activity analysis has been a remarkable tool to use. However, when confronted with the reality of risk, Ergonomics has not clearly modeled the very risk associated with identified flaws. Most did not result in an accident, because of early prevention through barriers or training. Some resulted in one accident, but not more, probably due to the rapid “immunization” of the sociotechnical system. These dramatic
but rare accidents have finally resulted in profiling Ergonomics as a whistle blowing matter, and confirming manufacturers in their way of dealing with safety. Indeed, the general model that applies to design still indicates that it does not provide solutions to avoid all risk at the design level, and therefore maximum safety is achieved only after a few years of in-service experience, and related modifications.

III. ABOUT THE ISSUE AND THE PAPERS

The four papers selected for this special issue are good illustration of the new questions arising in the Aviation field.

Along with design problems, the institutional incorporation of educated staff in Ergonomics, and of advanced methods into the Aviation design business, is one of the most important challenges under the present spotlight of authorities. Quite paradoxically, Aviation has been both a great user of Ergonomics values, and a poor user of academic Ergonomics, hiring almost no students, and applying very few academic recommended methods (or when doing so, twisting their instructions). Again, this lasting situation is about to fade with time. Its complexity is such that manufacturers recognize the need for importation of useful new methods and expertise.

It is now up to ergonomists to prove that they have more than criticisms in their toolbox, and that solutions are available; the challenge is even greater. We are not starting from scratch; naïve—or common sense— Ergonomics has already put the design on a good footing. Doing more supposes improvements compatible with habits, and already successful demonstrated solutions for design. All ideas are encapsulated into the “make evolutions, not revolutions” philosophy. J. Long and P. Timmer’s, F. Reuzeau’s, and S. Shorrock, B. Kirwan, H. Mac-Hendrick, and R. Kennedy’s papers are all pointing to important solutions that are worth watching.

J. Long et al.’s paper starts from the basic question of how much Cognitive Ergonomics research practices about acquiring and validating design knowledge require the specification of design problems, such that this knowledge can be shown to solve these problems. Operational problems are rejected as appropriate expressions for the acquisition, but not for the application, of such knowledge. There is a need, then, to develop a specification of design problems for research, problems that nevertheless have a relationship with operational problems. This paper describes and illustrates a framework for expressing such Cognitive Ergonomic design problems, using an air traffic management-like micro-world. The illustration includes both framework models and their operationalization as data. The paper concludes that, because they are less complex, micro-worlds may be a better initial development environment for specifying design problems for Cognitive Ergonomics research, than either operational or macro-worlds.

F. Reuzeau’s paper presents a thorough theoretical and empirical contribution to the application of Participatory Ergonomics in the design
of complex systems. The participation of end-users in design has long been a claim in Ergonomics. The reality is that designers still fear from the involvement of end-users, and try to postpone this until the very last stage of design. F. Reuzeau’s paper is one of the first attempts to fill in the gap. S. Shorrock et al.’s paper is proposing a portfolio of methods to assess safety in design. The field is the design of Air-Traffic Management system. The paper gives extremely useful insights into the combination of methods that are compatible with the timeline of industrial design, and even more with the human resource available to do the Ergonomics job. It offers a balanced scientific acceptability, easiness in implementation, and effectiveness in result (added value as compared to naïve Ergonomics).

The last paper, from H.-J. Hoermann, addresses another class of problem, related to the effect of culture on the process of personnel accreditation. The paper focuses on the characterization of the evaluation of professional competencies in different cultures. This problem is of specific importance within Europe where all countries are expected to comply to the same policies, protocols and laws, with a comparable level of safety and effectiveness.

REFERENCES
(Short-list of recommended recent books to go beyond the issue)