Designing for Human Factors in the Technology-Intensive Domain of Fighter Aircraft

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ABSTRACT

This paper aims at describing how to design for human factors in the technology-intensive domain of fighter aircraft. Similar to space industry, the fighter aircraft industry has to manage technology-intensive development where the end user often has implicit or explicit human factors requirements or expectations that has to be managed though design. This paper describes the specifics of the domain of fighter aircraft development with examples of what is special and design concepts to handle it. Specifically useful human factors' considerations are highlighted and recommended approaches for managing human factors in development of fighter aircraft are described.

Keywords: Design, Development, Fighter Aircraft, Human Factors, Technology-Intensive

INTRODUCTION

This paper is about how to design for human factors in the technology-intensive domain of fighter aircraft. Similar to space industry, the fighter aircraft industry has to manage technology-intensive development where the end user often has implicit or explicit human factors requirements or expectations that has to be managed through design. And similar to challenges within the space domain of how to manage complex technology innovation and development (Szajnfarber & Weigel, 2012; van der Veen, Giannoulas, Guglielmi, Uunk, & Schubert, 2012) the fighter aircraft domain has to manage innovation. However, also domain specific constraints have to be considered when designing for human factors.

Due to natural limits in education and training or other ways of changing the user's characteristics, the long time evolution of technology to support the fighter pilot is central for future use of the fighter aircraft developed today, to become significantly better. A fighter aircraft has state of the art technology and subsystems that are designed to provide the pilot with large amounts of information and are ready to execute the pilot's commands swiftly and precisely. In addition, the pilot is highly capable, selected

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among the best and educated and trained over a long period of time. Frequently, there is a bottleneck between the competent system and the competent user, when large amounts of important information should be sent between the two in fast interaction. The question of how to manage human factors issues is therefore central to the development of fighter aircraft.

The objective of this paper is to highlight important aspects of human factors and how they could be managed in the domain of fighter aircraft development. First, the domain of fighter aircraft development is introduced to readers who are not familiar with its characteristics, followed by a section describing what is special about a fighter pilot, a fighter aircraft, and the flight environment and some design concepts used in the domain. The latter part of the paper concerns human factors and how human factors can be managed during development. Here, methods and techniques for human factors, as well as development, are discussed in the domain context of fighter aircraft development.

The Domain of Fighter Aircraft Development

The domain of fighter aircraft development is special in many ways. For instance, it is extremely important to design for performance. As for many other domains, there is a professional user, not a consumer using the product for pleasure. As many other professional users, pilots have defined purposes regarding their use of a system. The context of a military system is that it will be used by professional military in extreme situations where failure could be devastating. For military pilots, it is extremely important to perform better than opponents and to be able to make fast decisions and execute them accurately. Therefore, the most important parameter for successful fighter aircraft design is performance, together with safety. Only a highly performing system, which is safe for the user, can meet the demands from the fighter aircraft domain. It is less important, for instance, for the system to be inspiring or fun to use, even if motivation is also important for support in a fighter aircraft.

As stated above, safety is also very important. Safety critical systems in a fighter aircraft have to be robust and work all of the time. Despite redundancy being built in when possible, it has to be extremely rare for a subsystem to malfunction. Additionally, tactical systems that are not directly linked to flight safety have to work because of the potential hostile and threatening situation that the fighter aircraft has to perform in.

User involvement is important in the development of many systems, but perhaps even more important in the development of fighter aircraft than in many other systems. One reason for this is that the cockpit, its use, and corresponding experiences are not very easily available compared to other domains. The designer of a car is probably also a driver of a similar car to and from work, or the designer of a telephone probably makes some calls occasionally on a similar phone, etc. Since it takes a long time to become an experienced pilot and a long time to become an experienced designer with technical and methodological skills, it is not always possible to find these competences combined in one designer. When that is the case, it quite often the own fighter aircraft experience is based on yesterday's systems rather than the systems of today. Therefore it is often wise to include current users in all phases of the design of a fighter aircraft.

In addition to user involvement, it is desirable to have continuous broader customer involvement. For a consumer product it is common that the customer and the user are the same person, but in the domain of fighter aircraft there are actually various kinds of users and customers (often different roles and individuals within large organisations). It is important that the human factors development manages this wide spectrum of needs and expectations.

Due to the length of time a fighter aircraft is going to be in service, and partly due to the long development loops, it is very important to study not just current conditions regarding state-of-the-art technology, tactics and use of today etc., but rather future conditions, even if they are not fully known now, since they are