The Transformation of the Modelling & Simulation of Systems for the Training of the CAF: Design Requirements and New Functionalities

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Abstract. The rapid evolution of the technologies applied in modelling and simulation (M&S) of the operational activities of military systems has made simulation platforms fundamental. In the case of the combat air forces (CAF), the simulators mission so far has been the initial and advanced training of pilots in offensive and defensive air operations. A high operational hybridization between the real and the virtual has been achieved, incorporating the pilot's tactical-operational behaviour in air operations that reproduce circumstances of extreme hostility and lethality, adjusted to the effort that the aircraft would experience in a real flight, and applying the latest digital technologies. Yet the development effort has focused exclusively on comprehensive training solutions. However, the strategic development vector of M&S systems for CAF presents a much more ambitious spectrum, which transcends training and can become the core of the operational and logistic structures of the military forces in the future. This paper analyzes the main aspects that have conditioned the transition from the approach of the human-computer interaction (HCI) to the design of the user experience (UX), as well as the design requirements necessary for the development of the organizational architecture LVC-AI of M&S systems for CAF, and new functionalities beyond training systems. In this line, two examples of strategic development of these new functionalities in the field of logistics and in the operational field are developed. First, the case of obtaining, applying and managing logistic support intelligence related to the simulated effort of simulated hostile air operations and adverse weather conditions. Second, the case of the transformation of the LVC simulation platform into a real cabin on the ground, transforming the fighter aircraft into a remote pilot aircraft (RPA) capable of operating alternately in a conventional or remote way.

Keywords: Modelling and simulation · Digital transformation · LVC simulation · Intelligent system · Technology trends · Communications · Training

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M. Botto-Tobar et al. (Eds.): ICAT 2019, CCIS 1193, pp. 325–339, 2020.
https://doi.org/10.1007/978-3-030-42517-3_25

1 Introduction

The modelling and simulation (M&S) systems have become a fundamental tool for combat preparation in the armed forces, as well as for the planning and execution of their missions. The simulated platforms contribute decisively to improve and homogenize the degree of preparation of the combatants, reducing the cost and the environmental impact of their activities. Live, virtual and constructive simulation (LVC) is a taxonomy widely used to classify simulation platforms based on the degree of human participation and the degree of realism of the team. The systems simulate confrontations with enemy forces in adverse climatic environments and take into account allied and neutral forces, but in circumstances of hostile conflict that never or almost never occur in reality training.

In the case of the Combat Air Forces (CAF), the mission of the simulators developed so far has been mainly the initial and advanced training of pilots in offensive and defensive air operations. Fighter aircraft simulation systems have developed an operational hybridization of the real and the virtual, incorporating the pilot's tactical-operational behaviour in advanced air operations that reproduce circumstances of extreme hostility and lethality adjusted to the effort that the plane would supposedly experience on a real flight. There is a strategic development vector to promote an Integrated Training Solution (ITS) by applying the latest technologies and digital equipment, developing new training concepts for combat pilots and contributing to the improvement of offensive and defensive operational air capabilities.

LVC simulation platforms are socio-technical systems because of the permanent multidirectional interaction between people, not just users, and technologies. These people represent the stakeholders of all the communities involved in operations, training, testing, planning, analysis, experimentation, logistics, procurement and research and development. Therefore, the M&S must develop dynamically in relation to all the elements of the system of development and integration of the affected military capabilities and throughout their life cycle. The most appropriate integrated organizational architectures that allow the implementation of new hyper-connected and intelligent systems should be created.

During this decade, the objective in the development of M&S systems has been to create LVC and Artificial Intelligence systems capable of assembling models and simulations quickly, allowing the creation of operationally valid LVC environments for initial training and real missions, allowing a closest interaction between military operations and all the elements and structures of defence and security organizations. These M&S environments should be built with a scalable concept based on linkable components that interact in the integrated architecture to be developed.

The digital transformation of simulation platforms implies a complete organizational, cultural and strategic reinvention, which in the defence sector affects both military structures and companies that participate in it. The corresponding strategic development requires the M&S activities to evolve rapidly, thus creating an operationally valid LVC environment, which, beyond serving training processes, facilitate the development of doctrines and tactics, as well as the formulation of operational plans and the evaluation of situations of war. This promotes a closer interaction between operational commands, logistics and acquisition communities, and the industry responsible for the research and development processes of new aerospace weapons systems. These new M&S environments should be built from linkable components that interoperate in an integrated architecture, facilitating flexibility and rapid capacity to generate innovations. In this way, a strong M&S capability will allow the armed forces in general and the CAF in particular to meet operational and support objectives effectively in the various activities of military services, combat commands, and logistics organizations and of acquisitions.

2 Material and Method

2.1 Objectives, Methodology and Contents

This work aims to reflect the most significant conceptual elements of what the evolutionary transformation of the M&S training systems of the Combat Air Forces represents. It studies the requirements of the new hyper-connected and intelligent organizational architectures LVC-IA, as well as the new functionalities that, beyond the training activities, can be developed in the new systems within the foreseeable digital technological evolution.

In relation to the methodology, the research has been developed under a systemic conception through a systematized deductive process (Top-Down) guided by empirical evidence of the experience and operational research and logistics of the author, as well as in the evolution of his maturity professional in the air forces (Bottom-Up). The literature reviewed has been used to synthesize the essential concepts and approaches on the problem investigated, reviewing all this with a level of detail that is considered sufficient, seeking its original aspects to ensure objectivity and avoid interpretative biases.

To achieve the objectives, the work has been structured in two sections, after which the conclusions are presented. First, there is a conceptual reflection on the current situation of the simulation systems of the CAF, as well as the design requirements necessary to evolve the architecture of the M&S systems of the training systems. Second, the new potential functionalities that are generated are analysed through two examples within the strategic development of hyper-connected and intelligent CAF simulation platforms. The case of obtaining, applying and managing logistic support intelligence related to the simulated operations effort simulated hostile aerial and adverse weather conditions, as well as the case of the transformation of the LVC simulation platform into a real cabin on the ground, turning the fighter aircraft into an RPA capable of operating alternately in a conventional or remote way.

2.2 The Current Situation of the Simulation Systems for the Training of the CAF

Meaningful Learning, Technologies and Simulation Systems

Meaningful learning is the process according to which a new knowledge or new information is related to the cognitive structure of the person who learns, in a non-arbitrary and substantive or non-literal way. In this way, the student tends to compare and match the new knowledge acquired with the existing one, through a non-imposed process, where motivation or predisposition play a very important role. Thus, the cognitive phenomenon and the construction of meaning are carried out to achieve the above using virtual environments or simulators. It seeks to facilitate that connection of knowledge due to the diversity of scenarios that can be managed, the application of unusual cases to solve, standardize and give uniformity to the training of experiences in defined groups, develop the problem-based learning and self-learning [1]. It is the type of learning in which the new information is related to what is already possessed, readjusting and reconstructing both information during this process, where technology plays an important role so that there is repetition or even practicing for several occasions if what is intended is to mechanize a procedure [2].

It is impossible to acquire large amounts of knowledge if there is no meaningful learning and for this to occur there must be two fundamental conditions. On the one hand, the main objective of all teachers is to have a predisposition to learn and on the other, obtain the motivation of the one who is learning and through the support of technology; it is considered possible to achieve this. The virtual reality is a simulation of a process, environment or situation and allows the interest of the students to be aroused by means of the handling of different scenarios with images, situations or sounds, making it possible to capture a better attention on what it tries to teach. On the other hand, the presentation of a relevant and significant material, that is to say with a logical meaning where there are adequate anchoring ideas in the subject that allow its relationship with the new material. This can be strengthened by using technology, such as augmented virtual reality and the support of simulators, which are tools that can make a student feel motivated to learn something due to its simple relevance and as a way to achieve autonomous learning [3].

In order to achieve the above, it is important that the right tools are learned, that is, that the student develops in increasingly complex real situations by doing and practicing and learning the necessary skills in safe and controlled environments, through the use of simulators or virtual environments to achieve more relevant or meaningful learning [4, 5]. This has strongly promoted cognitive psychology and meaningful learning, supported by educational technology, where the objective is for the instructor to know a goal that should be achieved by the students. Using the necessary tools such as e-learning and combined learning supported by simulators, the student discovers for himself what he would like to learn, practice and develop his skills, that is, the student himself involved in a technological user to develop the responsibility of his own learning, encouraging research habits [6]. This is precisely where technology emerges as an advanced organizer, to save the gap between what is already known and what is required to be known. Therefore, this offers the simulators the advantages derived from being able to represent the process of a phenomenon or a step-by-step explanation of a procedure, activity or task, through images that show in time the complex learning process [7, 8]. In this line of thinking, the development of Ramírez's research [9] on how these methodologies involve greater efficiency in the preparation of the armed forces is very enriching. His research is driven by the concern to improve and achieve meaningful learning particularly in its application in the performance and operations of flight crews, for its development with the highest level of effectiveness, efficiency and safety possible [10].

The Simulation in the Pilot's Current Training in the CAF

The world of aviation is the frame of reference for the development of simulation media. The new disruptive technologies have allowed us to evolve into a completely new "virtual" world that not only complements the "real" world, but also becomes part of it in many professional activities and especially in everything related to aviation, applying the advancer mathematical Models [11]. Proof of this is the usual use of the expression "LVC training" (Live, Virtual and Constructive) [12].

Increasing the training of forces using simulators is a means to save budget [13]. Flight hours in a hunting simulator are not enough to train a pilot, but increasing those hours reduces overall costs, while allowing the pilot to gain in safety and skill, before training in a real fighter aircraft. It can be easy to quantify the fuel savings, maintenance of the weapon systems and personnel. This example not only provides us with an idea of the cost reduction, but also provides one more advantage, which is the greater flexibility-availability of the simulator in its use, compared to the restrictions on the number of flight hours on real aircraft. All of which is an increasingly limiting factor in the training capacity of all air forces, including for joint military space operations in which this limitation is very large [14].

As already mentioned, in the air forces a good part of the simulation efforts are focused on the CAF, trying to take advantage of the advantages offered by the simulators to the pilots for the acquisition of certain operational capabilities without the need to put the aircraft in the air. As we said, it is not only about saving costs, but also about improving the effectiveness of training by promoting the use of the simulator in certain practices focused on navigation and flight, and thus being able to spend more time on the real plane to exercise the operational aspects. Technology for training CAF teams has evolved through a convergence of advances in simulation technology for individual and collective training, methods for analyzing teamwork and designing training solutions, and intelligent tutoring technologies [15].

However, the fidelity of the simulator with respect to the aircraft it represents can be so high, that in the real flight it allows the learning of some of the capabilities offered by the weapons system to be ignored, especially in the field of navigation and flight. This even supports the firing of weapons, which allows the pilot to be trained in the launching of weapons without really firing them before being sent on a mission, After Action Review (AAR) [16].

Another characteristic of current flight simulators is the high degree of inhibition that the crewmember can achieve during simulated missions, that is, to get involved in them as if they were real. Two aspects, a physical one and a cognitive or psychological one mark this level of the pilot's immersion. The first refers to the exact replica of the cockpit instruments, the representation of the visual and sound environment and the movement or accelerations of the aircraft. The psychological one refers to the work in the cabin of the crew and the decision-making processes that would be adopted almost identically to that of a real mission [17].

The capabilities of M&S systems are used to support operational tests and systems analysis, taking into account the complexity of new air operations, multi-domain operations, and operations in highly controversial areas, where they cannot be done in live environments [18].

The Eurofighter simulator in the Spanish Air Force, called ASTA (Aircrew Synthetic Training Aids), is undoubtedly the most advanced in all of the air forces of the EU countries. This simulator is a key tool for training assigned fighter crews to the platform of the aforementioned air weapons system, both in its provision for instruction missions, preparation for the first flight, preparation of air and ground missions, release of weapons and fire, training for real missions, etc. In this regard, the dossier on simulation published in May 2015 by the Aeronautics and Astronautics Magazine of the Spanish Air Force [19] is of marked interest. Based on the experience gained during the first 10 years since the start-up of the ASTA, at the end of 2005 and with more than 10,000 h of training, the result of training in a synthetic environment of a combat pilot is analyzed through empirical research carried out in this simulator, and analyses the factors that integrate it. The final result that is obtained is as follows: types of training vs. mission flow, procedures, techniques, tactics, complete simulation of the "rehearsal mission", realism and stress in the mission flow, interactions with the rest of the elements, presence of human entities in the operating scenario, connection and interaction with other simulators, etc. [20–22].

3 Results: The Design Requirements in the Transformation of the Architecture of the M&S Systems of the CAF

3.1 From Human-Computer Interaction (HCI) to User Experience Design (UX)

Human-computer interaction (HCI) is a discipline related to the design, evaluation and implementation of interactive computer systems for human use and the study of the main phenomena that surround them. HCI surfaced in the 80s with the advent of personal computing. For the first time ever, sophisticated electronic systems were available to general consumers for uses such as word processors, games units and accounting aids. Consequently, as computers were no longer room-sized, expensive tools exclusively built for experts in specialized environments, the need to create human-computer interaction that was also easy and efficient for less experienced users became increasingly vital. Applied studies have been evolving for decades until today and have configured a multidisciplinary science that includes multiple fields that are encompassed in the following three disciplines: *Computer Science*, *Cognitive Science* and *Human Factors Engineering* [23]. The evolution of the systems has generated the multimodal human-computer interaction (MMHCI) concept, in which the fusion of MMHCI about related technologies has been progressively expanding [24].

Figure 1 presents in a generic way the interrelationships of the elements that are present in HCI [25]. Computer systems exist within a broader social, organizational and work environment (U1). Within this context, there are applications for which we wish to use computer systems (U2). However, the process of putting computers to work means that human, technical and labour aspects of the application situation have to adjust to each other through human learning, system adaptability or other strategies (U3). On the other hand, in addition to the use and the social context of computers, on the human side it is also necessary to take into account the processing of human information (H1), communication (H2) and the physical characteristics (H3) of users. On the computer side, a variety of technologies have been developed to support interaction with humans: the input and output devices connect the human and the machine (C1), which are used in a series of techniques to organize a dialogue (C2) and which are also used in turn to implement larger design elements, such as the interface metaphor (C3). By delving into the substrates of the machine that support the dialogue, the dialogue can make extensive use of computer graphics techniques (C4). Complex dialogues lead to considerations about the system architecture necessary to support features such as interconnectable computer application programs, windows, real-time response, network communications, corporate and multi-user interfaces, and multitasking of dialog objects (C5). Finally, there is the development process that incorporates the design (D1) of the dialogues, the techniques and the human-computer tools to implement them (D2), the techniques to evaluate them (D3), and a series of classic designs that are considered referents for the study (D4). Each of these components of the development process is linked with the others in a relationship of mutual and reciprocal influence through which the choices made in one area impact the choices and the options available in the others.

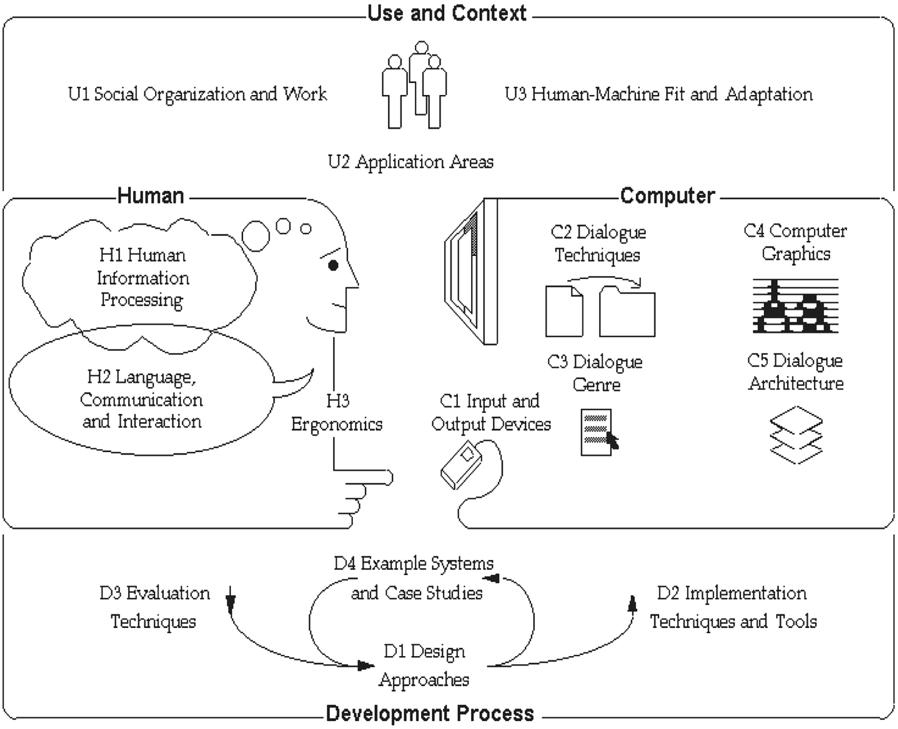
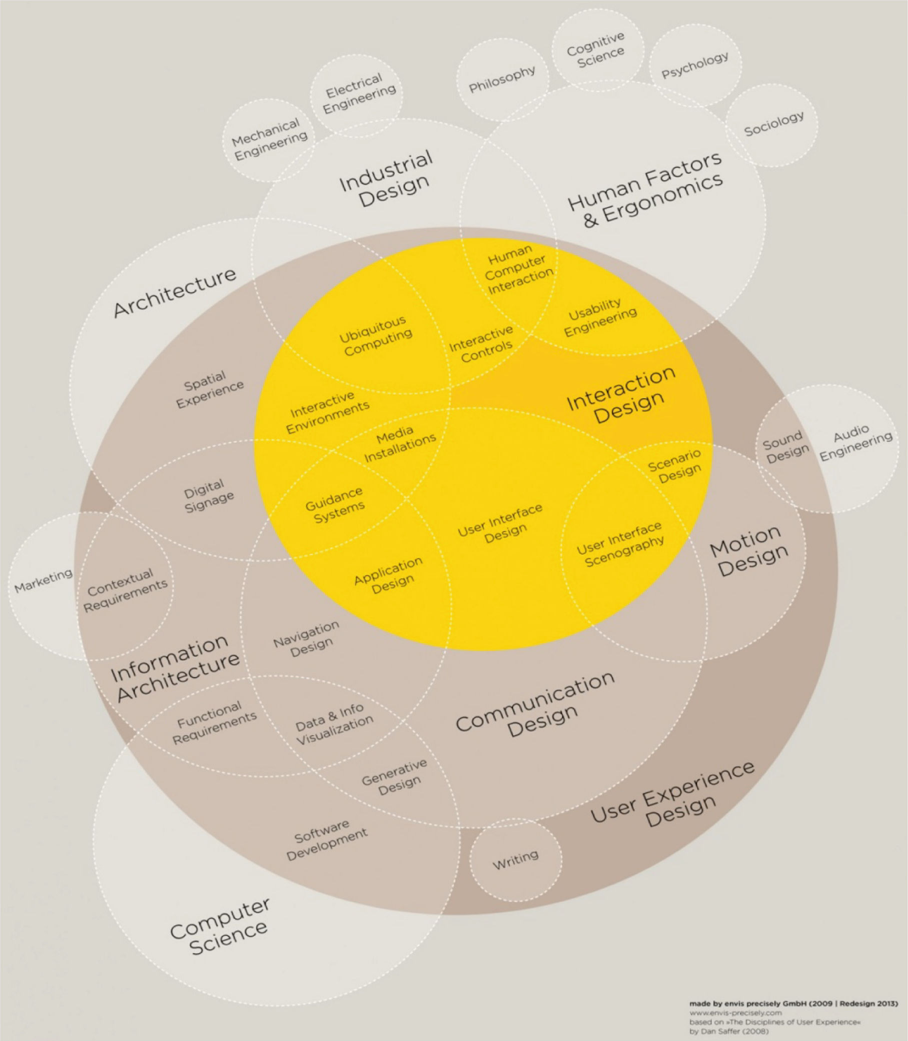


Fig. 1. Human-computer interaction: interrelationships of the elements present in HCI [25].

The evolution of these concepts gave rise to the user experience design (UX) methodology that is commonly used today [26]. The UX design is the design process used by the teams to create products that generate significant and relevant experiences for users, by involving them fully in the design of the entire product acquisition and integration process, including brand aspects, design, usability and function. User experience design is often used interchangeably with terms such as user interface design and usability. However, usability and user interface design are important aspects of the UX design, but they are subsets. A UX designer cares about the complete process of acquiring and integrating a product, including aspects of the brand, design, usability and function.

Products that provide an excellent user experience are designed by taking into account not only the consumption or use of the product, but also the entire process of acquisition, possession and even troubleshooting. Similarly, UX designers not only focus on creating products that are usable, but also towards other aspects such as user experience, efficiency and fun (Fig. 2).



made by envis precisely GmbH (2009 | Redesign 2013)
www.envis-precisely.com
based on »The Disciplines of User Experience«
by Dan Saffer (2008)

Fig. 2. The disciplines of user experiences design (UX) [27].

The UX designer considers the “why”, “what” and “how” to use the product, “Why” involves the motivations of the users to adopt a product, whether they relate to a task they want to do with it or with values and points of view that users associate with the ownership and use of the product. “What” addresses the things that people can do with a product and its functionality. Finally, “how” relates to the design of functionality in an accessible and pleasant way. UX designers start with the “why” before determining “what” and then, finally, “how” to create products with which users can form meaningful experiences.

Using this new designs concept, one has to ensure that the “substance” of the product arrives through an existing device and offers a smooth experience. Since the UX design covers the entire user’s journey, it is a multidisciplinary field: UX designers come from a variety of environments such as visual design, program programming, psychology, and interaction design. Designing for human users also means that one has to work with greater scope regarding accessibility and adapt to the physical limitations of many potential users. Typical tasks of a UX designer vary, but often include user research, profile creation, design of wired structures and interactive prototypes, as well as design proof. These tasks can vary greatly from one organization to another, but they always require designers to defend users and keep user needs at the centre of all design and development efforts. That is also the reason why most UX designers work in some form of user-cantered work process and continue to channel their best informed efforts until they address all relevant issues and user needs optimally [28].

3.2 The Design Requirements of the Architecture of the M&S Systems of the CAF

The aggregate representation of the fundamental elements of an LVC Organization includes hardware, software, networks, databases and user interfaces, policies, agreements, certifications, accreditations and commercial standards. The LVC integration architecture (LVC-IA) is intrinsically an organizational architecture given the “system of systems” environment it must support. LVC-IA links M&S technology to structures and people who need and use the information obtained through simulation. To achieve this, an LVC-IA training for CAF must meet three essential requirements: [29].

- **Integration** through simulation equipment, interoperability tools and support staff. The integration creates network-centric links to collect, retrieve and exchange data between live instrumentation, virtual simulators and constructive simulations, as well as between specific, joint and combined military command systems. Integration also unites data management, exercise management, exercise collaboration and the updating of training support systems.
- **Interoperability** through common protocols, specifications, standards and interfaces to standardize LVC components and tools for mission testing and training, testing, acquisition, analysis, experimentation and logistics planning.
- **Compostability** through common and reusable components and tools, such as post-action review, adapters, correlated terrain databases, multilevel security for multinational players and hardware and software requirements. Tolk [30] qualified its meaning by focusing on the need for conceptual alignment. The M&S community understands interoperability quite well as the ability to exchange information and use the data exchanged in the receiving system. Interoperability can be designed in a system or service after its definition and implementation.

The successful interoperation of the LVC component solutions requires the integrability of the infrastructures, the interoperability of the systems and the composability of the models [31]. LVC architectures must comprehensively address all three aspects in well-aligned systemic approaches. First of all, the most complex aspects related to Integration were technically solved with great solvency, and today they are not a problem in the development of M&S systems. Second, composability is different from interoperability. Composability is the consistent representation of truth in all participating systems. It extends the ideas of interoperability by adding the pragmatic level to cover what happens within the receiving system based on the received information. In contrast to interoperability, composability cannot be engineered into a system after the fact. Composability requires often significant changes to the simulation. Third, interoperability refers to methodologies to interoperate different systems distributed in a network system.

The development of the Levels of Conceptual Interoperability Model (LCIM) identified seven layers of interoperability among participating systems as a method to describe technical interoperability and the complexity of interoperations [32]. Zeigler's Modeling & Simulation theory extended it to the three basic levels of interoperability: pragmatic, semantic and syntactic [33]. The pragmatic level focuses on the receiver's interpretation of messages in the context of application relative to the sender's intent. The semantic level concerns definitions and attributes of terms and how they are combined to provide shared meaning to messages. The syntactic level focuses on a structure of messages and adherence to the rules governing that structure. The linguistic interoperability concept supports simultaneous testing environment at multiple levels (Fig. 3).

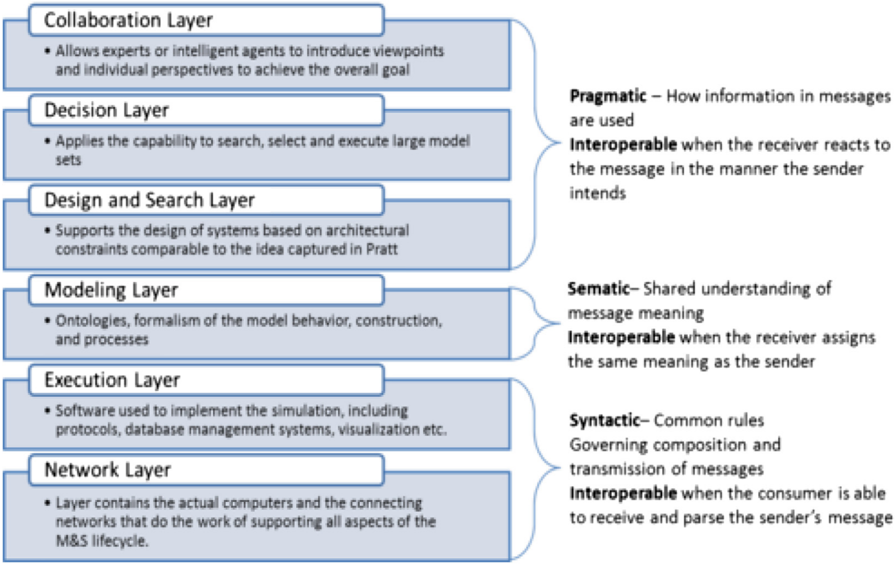


Fig. 3. LCIM: Zeigler's architecture for M&S [35].

The LCIM associates the lower layers with the problems of simulation interoperability, while the higher layers are related to the problems of reuse and composition of models. Simulation systems are based on models and their assumptions and restrictions. If two simulation systems are combined, these assumptions and restrictions have to be aligned accordingly to ensure significant results. Then, the interoperability levels that have been identified in the M&S area allow us to guide the way in which information is exchanged in general.

The Zeigler Architecture provides an architecture description language or conceptual model through which to analyze M&S systems. The LCIM provides a conceptual model as a means to discuss integration, interoperability and composability; the three linguistic elements relate the LCIM to the conceptual model of Zeigler. Architectural and structural complexity is an area of research in systems theory to measure cohesion and coupling and is based on the metrics commonly used in software development projects.

The M&S theory proposed by Zeigler, together with Kim and Praehofer, continues to provide a current conceptual framework and a valid computational approach associated with methodological problems in M&S [33] completely adequate for the development of simulation systems for the CAF.

4 Discussions: The New Functionalities to Be Generated Within the Strategic Development of the Intelligent and Hyper Connected CAF Simulation Platforms

Based on the extensive professional experience of the author of this work, as an Officer of the Spanish Air Force, and on the basis of the analysis of the EU Air Forces, it is possible to propose two new functionalities as an example that, among many others, could be developed within the LVC-IA of simulation systems for the CAF. (a) Obtaining, applying and managing logistics support intelligence related to simulated effort from simulated hostile air operations, and (b) Transformation the LVC simulation platform into a real cockpit on the ground, thus, turning the fighter jet into an RPA.

Both initiatives could be developed within the EU framework through R&D industrial projects proposed within the European Defence Industrial Development Programme (EDIDP).

Finally, the development of new functionalities and the expansion of simulation systems that integrate new distributive technologies, previously require cost-benefit analysis in detail, similar to any new technology integration, and before its large-scale implementation and use of limited resources susceptible to alternative uses [34].

4.1 Obtaining, Applying and Managing Logistics Support Intelligence Related to Simulated Effort from Simulated Hostile Air Operations

The mission that has been the focus on the development of state-of-the-art combat aircraft simulators at an international level is that of the initial and advanced training of combat pilots in both offensive and defensive military air operations under hostile environments and adverse weather conditions. However, these simulators are considered to be able to perform the logistical intelligence generation derived from simulated missions, but of high complexity and risk, as an added mission. Combat aircraft simulation systems have developed a real and virtual operational hybridization, incorporating the tactical-operational behaviour of the pilot in advanced air operations that reproduce circumstances of extreme hostility and lethality, through the effort that the aircraft would supposedly experience in real flight. The idea is to study and design other systems that are able to analyze the behaviour of the aircraft, in addition to the logistical and virtual support effort of all the elements of the airframe. These include, the engine, systems and armament, but based on simulated air operations of high hostility and lethality, which in the real world, would only occur in the event of serious conflicts.

The approach to obtaining logistical intelligence from combat pilot training simulators is completely new. With the exception of conclusions on logistical effort and costs that can be obtained in some very few real missions, combat aircraft flights are usually training flights in flight circumstances that are uncompromising in operational terms and with no adverse meteorology. It means having a system for generating alternative scenarios, in different air operations, both offensive and defensive, and according to the real behaviour of the pilots, and for estimating in each scenario the logistic effort of all the elements of the aircraft, systems and armament.

4.2 Transformation the LVC Simulation Platform into a Real Cockpit on the Ground, Turning the Fighter Jet into an RPA

The achievements obtained in the immersion of the pilots in their training on simulators, offers another interesting source of enrichment and profitability. That is to say, by transforming them into real cockpits on the ground, thus, converting the combat aircraft into a Remotely Piloted Aircraft (RPA), capable of operating alternatively in a conventional way or remotely in a cabin environment for the pilot, in exactly the same way. Operational empowerment is evident for high-risk attack missions in conflict situations, as it does not endanger the pilot's life, thus enhancing his operational aggressiveness. The aircraft significantly boosts its manoeuvrability, which is traditionally restricted by the physical resistance of the pilots on board. However, RPA also would carry out other important reconnaissance missions such as acting as intelligence platforms using radar, imaging systems, interception of communications, etc.

In this manner, with a transformation and empowerment investment that would have to be estimated, but which would probably be infinitely smaller than developing or acquiring new RPA, the aim would be to ensure that traditional combat aviation could also operate alternatively as RPA. Therefore, the strategy of transforming pilot training simulators into a real cockpit on the ground means the strengthening and greater profitability of traditional combat aircraft fleets. By giving them a new role to operate alternatively as RPA, they can also develop the missions that international military aerospace doctrine assigns to these latter aircraft, without the need to assume the large investments implied by their specific acquisition.

5 Conclusions

During the present decade, there has been a strong development of M&S systems in the field of training of the armed forces in general and of CAF in particular, which has been based on the application of the technological field of simulation to learning significant. Likewise, there has been a strong conceptual evolution from the human-computer interaction (HCI) models, which integrated three essential disciplines (computer science, cognitive science and human factor engineering), to the user experience design (UX). This is the methodology that best responds to the current requirements of the M&S systems of the CAF training, which today incorporate, through a real and virtual operational hybridization, the pilot's tactical-operational behaviour in advanced air operations that reproduce circumstances of extreme hostility and lethality.

There is a strategic development vector to promote an integrated training solution by applying the latest digital technologies, with advanced equipment, developing new training concepts for combat pilots and contributing to the improvement of offensive and defensive operational air capabilities.

For this purpose, it is necessary to develop a LVC-IA integrated organizational architecture, based in solid conceptual models that guarantee the levels of integration, interoperability and composability, allowing a closer interaction between military operations and all the organisms present in the defence systems. These M&S environments should be built with a scalable concept based on linkable components that interoperate in that integrated architecture.

The continuous digital transformation of the simulation platforms implies a complete organizational, cultural and strategic reinvention, which in the defence sector affects both the military structures and the companies that participate in it. The corresponding strategic development requires the M&S activities to evolve rapidly, to create an operationally valid LVC environment, which, beyond serving the training processes, facilitate the development of doctrines and tactics, the formulation of operational plans and the evaluation of war situations. Thus promoting an interaction approach between operational commands, logistics and acquisition communities, and the industry responsible for the research and development processes of new aerospace weapons systems. These new M&S environments should be built from linkable components that interoperate in an integrated architecture, facilitating flexibility and the rapid capacity to generate innovations.

In this strategic development of M&S systems for CAF, it is necessary to propose new functionalities even beyond the training systems. Two of them have been proposed. The first one, in the case of obtaining, applying and managing logistic support intelligence related to the simulated effort of simulated hostile flight operations and adverse weather conditions. Secondly, in the case of the transformation of the LVC simulation platform into a real cockpit environment on the ground, turning the fighter plane into a remote pilot plane (RPA) capable of operating alternately in a conventional or remote way.

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