Model of Intention: A concept to support models building in a complex system design project

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1. Introduction

A hybrid propulsion system for aircraft application represents a new paradigm for propulsion systems designers. Several new problems appear, and classical design methods must be challenged. Indeed, addition of new systems and new components inside the aircraft architecture imply the need for a multidisciplinary study, in order to support design and integration. For example, addition of a battery pack to a propulsion system requires functional analysis, performances estimation, energy management and operational strategies. More than these aspects, related to design, integration is also challenged: where to locate the battery pack, how to manage thermal effects, how to manage electromagnetic effects… To address these two parts, design and integration, early in the design, we propose to build a model of intention. This article is dedicated to the concept of model of intention in a complex system design project. This concept will be explained, justified, developed and tested in order to allow reader to have clear vision of what represents the model of intention.

The first part explains why model of intention has been proposed. This part starts from observation in design process, and proposes some ways to improve it, especially in term of model and simulation. A global process is described where model of intention has an important place. The second part proposes a zoom in model of intention process of global methodology. To support this theoretical description, two examples will be described, corresponding to two different cases of model of intention utilization. A third part proposes utilization of model of intention previously described. Opportunities, advantages or drawbacks are highlighted, completed by critics and improvement expected. A synthesis of global model of intention contribution is proposed as conclusion.

2. Model of intention in complex system design

2.1. Complex system design

All along this paper, design work on hybrid propulsion system for a copter-based unmanned aerial vehicle (UAV) is applied to illustrate concepts. Hybrid term is used as Vehicle in which "propulsion energy is available from two or more kinds or types of energy stores, sources or converters, and at least one of them can deliver electrical energy."[2]. A complex system is defined by White as "An open system with continually cooperating and competing elements." [1]. Hybrid propulsion system is clearly a complex system, with most interesting points are innovation, multidisciplinarity, interaction between environment and sub-systems, and potential interactions between sub-systems.

To design complex system, numerous methodologies exists, based on systems engineering practices, as presented in Beitz, INCOSE or NASA books[10][11][12]. De Tenorio has proposed a collaborative methodology to support innovative multiphysic system design [3]. The collaboration aspects highlighted in his works shows mandatory collaboration process for design. Completed by design models and optimization, several architectures and design can be analyzed with his approach. Liscouët proposes a methodology for energy management inside aircraft [4]. This methodology proposes collaboration essentially around model. The sizing methodology is based on a two phases process, sizing and simulation. In the methodology proposed in this paper, only simulation is used to design. These two approaches are inspiriting the proposed methodology for model, simulation and collaboration, and initiate the interactions and model request formulation. In the field of interactions between systems in a model based approach, Paredis et al. proposed to link models with specific sub-models corresponding to potential interaction based on physics [5]. This approach has motivated interaction analysis for complex system and for design phases. All the links proposed can have several granularities in order to accurately answer questions. The granularity decomposition is a main focus of Basset et al. methodology [7]. This last approach focus on industrial collaboration for an aerospace multidisciplinary design based project, with models decomposed on multiple level of modeling. Price et al. proposed in that way an analysis of possible lack of granularity model under different domain [8]. In comparison of all these works, the methodology proposed with this paper, and especially based on model of intention, tries to explore the relationship between design, models and simulations, with a focus on having the right model at the right design phase, using a collaboration process.

A numerous number of tools and associated methods exist already for model a system quickly, or completely. In one hand, system engineering design model are already used (SysML graphs, requirement management). On the other hand, and at the cross between systems analysis and physics, functional architecture modeler allows proposing more behavioral model, essentially often based on physics (modelica language, bond graph theory…). Out of these two aspects (pure system and system behavior), physics based with very specialized domain methods and tools are used for detailed design and integration (CFD…). The proposed methodology is based on Model Based System Engineering (MBSE), a domain that proposes a continuous model experience, from requirement to behavior. In that way, some solutions and methods are proposed, as example with Schamai and ModelicaML approach, which allows joining SysML with Modelica for requirements validation [6]. Requirements-Functional-Logical-Physical approaches summarized the final field of the methodology proposed. This decomposition contains all different steps mandatory for a successful product design. In addition of collaboration, model request and multidisciplinary, the RFLP decomposition offers a right frame. Belloncle et al. proposed an example of use of RFLP, applied to their specific study-case [9]. For the methodology proposed, RFLP is applied not as a process, but horizontally, in order to ensure that all different specificities of each term are confirmed. If a Requirement, that has allow developing Functional and Logical architecture is correct virtually, in design and integration (physical), it is correct to affirm that system is properly designed. In that way, the methodology proposed wants to challenge the link between, on one side pure design problem (requirements, functions) and on other side behavior on simulations (environment, sizing and integration). In that way, hypothesis has been selected to build a methodology:

- Base analysis on a Scenario: Notion of view, architect's questions and modeling strategy
- Base system design on Systems Engineering : MBSE extension with interactions analysis
- Develop virtual solution(s): Models and simulation for a simulator to design product.
- Enhance collaboration: Experts and system designer have not similar and global skills. With collaboration, it is possible to combine all aspects.
- Analyze interaction between systems: A choice to drive methodology, an access point to merge system and physical world.

To manage models and simulations, a role is introduced with simulation architect, the builder of model of intention. Simulation architect is represented as an alone person for theory, but he is destined to be a team. In order to support model and simulation for architect, and create a link between design and integration, model of intention is a concept proposed for simulation architect to manage models request.

2.2. Model of intention

Model of intention only concerns behavioral and environmental models. The necessity of model of intention comes from the will to transit from pure system models world to physical world. A question is, how to be able to request right model to an expert that has appropriate skills. In fact, model of intention is an alternative way to specify a model.

One of the major advantages of using a model of intention as a model specification is the bi directional benefices; for architects, that obtains a model to answer his question; for experts, that can propose advices of technologies via a model, with more freedom than a strong and inflexible specification contract. Another important point for model of intention is the simulation capability. To join the idea of offer more freedom to expert, model of intention can be run to analyze system under design. According to the study-case, a parametric model, based on power vs. mass, is proposed to represent functional/logical architectures. For the study-case, the model has been developed in Modelica, with OpenModelica tool [13]. This model, base for future model(s) of intention, includes some requirements (linked with power and mass) and includes a parametric mission block (Figure 1). All components, or blocks, that composed the model have exchange ports, and contain "simple" relations that define a behavior (factor, empiric results, table…). As example, electric motor is composed of 3 major parameters (Power density (Watt/Kg) and mass (Kg) to define max deliverable power of motor; Efficiency (%) that allow to determine real power delivered) and 4 ports (Power delivered (W); Power required (W); Mass (kg); Requirements (Boolean)).

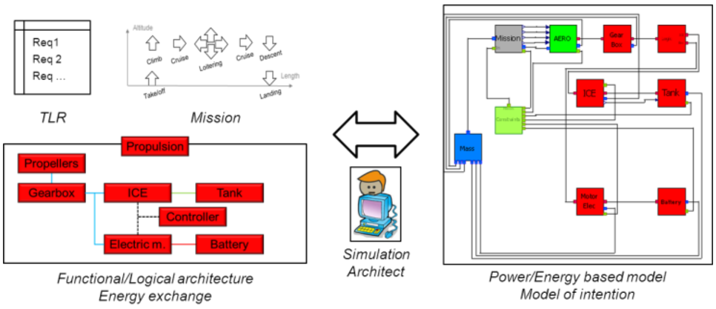


Figure 1: Inputs and Power vs. Mass model

After an analysis of the role wanted to be set to model of intention, we propose a definition: "Model of intention is a model based approach to request and specifies model(s) or simulation(s) for a specific scenario. Model of intention allows expert to propose adequate model(s), and to propose advices, technologies or technical solutions."

2.3. Methodology

2.3.1.Overview

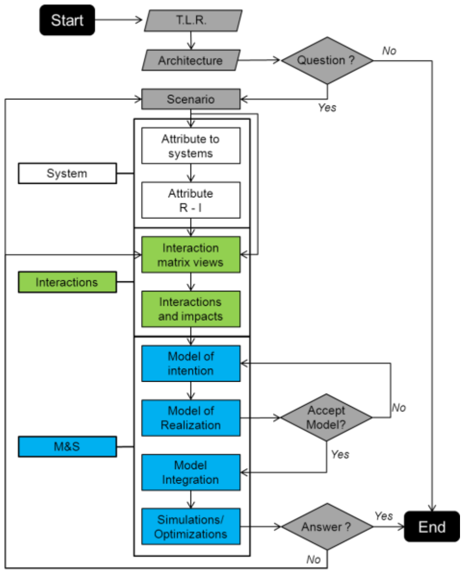


Figure 2: Global methodology

The methodology proposed is global, from a functional/logical architecture and top level requirements (TLR) to a virtual solution. As mentioned previously, scenario, based on an architect question is a mandatory step in the methodology. The heart of the approach is the interaction and impact analysis. It is the real bridge between world, because allows to inject physics into systems and conversely. In that way, the methodology is inspired by RFLP. It is proposed to flatten the RFLP sequencing, and consider more specifically a Requirement-Functional-Operational-Physical decomposition (RFOP). The L-Logical is not considered for the moment excepted inside architecture input. The O-Operational is added in order to consider mission and mode (for energy management), mandatory in a simulation process. The RFOP represents in fact different views to characterize systems. Added with interaction (I), FOP-RI decomposition is proposed.

2.3.2. A Three steps methodology

The methodology has three blocks. The first block, named system, is proposed with system engineering models. This step associates requirement, functions and system to attributes. An attribute is a characteristic of a system. An attribute is associated to a discipline, a domain which allows it to be filtered in views. Attribute is the base for interaction detection.

The second block is interaction one. An attribute can have two different functions: it can be a requirement (R - if a requirement is associated), it can be an impact source (I - Scenario) or both. The process of interaction detection is to link an impact source to a requirement following an interaction matrix. With this approach, it is possible to visualize directly first order impact of the characteristic of a system to another one. This concept of R-I is important to understand model of intention building.

The last block is M&S. This block contains model of intention as a link to follow to virtual solution and simulations. In that block, all analysis are used to support simulator building, used to follow scenario, and so the architect's question. The collaboration between simulation architect and expert is done around a model of intention and model of realization. When model of realization is accepted to satisfy scenario needs, integration in simulation chain and simulation runs can be done. Results obtained are selected then to satisfy scenario. If model of realization is accepted, but cannot answers scenario, there is a deeper problem, directly in link with scenario (first check) or with interactions analysis (second check).

3. Model of intention building process

3.1. Specific methodology for model of intention building

3.1.1.Overview

The model of intention building is a sub-process that implies some notions of ports, behavior and simulation. As previously mentioned, model of intention, as defined with proposed methodology, is composed of two distinguished parts, a document and a simulatable model. Model of intention is also a platform to exchange with experts: It contains requirements, architecture information, design hypothesis, and pre-design solution(s). In that way, it is an interface, initialized by simulation architect with interactions and impacts analysis.

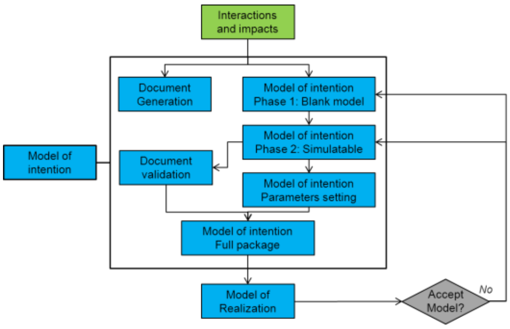


Figure 3: Model of intention sub-process (extension of Figure 2)

The sub-process proposed in Figure 3 described the model of intention block of global methodology (Figure 2). This process is separated in 2 major tasks corresponding to the 2 faces of model of intention full package: document and model phases. Interactions and impacts study is an input for model of intention. Model of realization is the output and is done by experts after they received the Full package. The accept model question represents dialog that must be done between simulation architect(s) and expert(s). At the end of the dialog, if model cannot be accepted, it is mandatory to determine where model of intention has to be updated. Of course, if model is accepted, process continues to model integration and simulations for virtual product consolidation. The final aim is to offer a robust model of intention to reduce at maximum misunderstanding and dialog loop.

3.1.2.Document generation and validation

The document is a part of model of intention. Full model collaboration hypothesis is for the moment, impossible. Another point, justifying a document, is advantages of having a trace of work. An improvement expected of the methodology is to be able to construct automatically this document in parallel of methodology application. As a template, 4 parts are proposed:

- Scenario: Contains question, mission, functional/logical architecture and hypothesis;
- I&I: Contains attributes, interactions detail and physics/behavior expected;

- M&S request: Contains model of intention explications, ports considered, behavior and hypothesis on model requested and models to be updated.
- Annexes: Information on previous design, previous virtual model, detail on geometry and all other useful information for model parameters and setting.

It is important to note that this document is oriented to support simulation architect works. Each part can be modified or removed to adapt the document to the contact. Contact can be system architects, system experts, domain experts, subcontractors or partners.

3.1.3.Model phase 1:Blank model

The model phase 1 derives directly of interactions and impacts analysis. As explains, interactions and impacts are based on attributes, kind of systems/subsystems characteristics that influence design, and so freedom of designers. The objective of that phase 1 is to be able to propose a blank model, i.e. a model of intention without any behavior, equations and physics. A blank model is just composed of:

- Inputs: What information we can bring to the future model of realization;
- Outputs: What information we want to be generated/calculated/estimated by the future model of realization.

A blank model has different type of ports that are defined to represent different type of information that ports deliver (flow, field, discrete values…). For the moment, 6 types have been defined. Work is in progress to adjust ports types for better model definition. The model of intention port attribution is defined with interactions and impacts analysis. To stick with attributes proposed for interactions and impacts, each port is associated to an attribute. This important point permits smooth transition in all methodology steps.

The hybrid propulsion system study-case is proposed with a model under Modelica language (Figure 1). Phase 1 is the integration of a blank model with right ports inside the global model (power vs. mass). Integration implies additional port addition, or creation of a new system block. Port type allows also detecting where information must be taken, in term of other system block model. In that way, it is important to add some new port to other systems implies in scenario and where interaction and impact has detect a need. An example of blank model of intention is proposed in Figure 4.

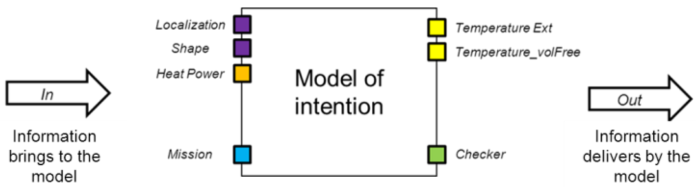


Figure 4: A blank model of intention with different port type (color) associated to attributes (name)

3.1.4.Model phase 2: Simulatable

The concept of "simulatable" model of intention is a pillar in model of intention concept. However, if a model is simulatable, it means that a behavior, as simple as possible, is including inside a model. The model power vs. mass, introduced in Figure 1, is composed of blocks. Each block is associated to a real system, and each block is a part of a simulation chain. If a block is deleted, simulations capability of the global model is compromised. So, if designers need to introduce new system, or want to add or refine a model, behavior must be taken into account to ensure simulation capability. Simulation architect is not an expert in domain, physics or particular system. In that way, it is quasi-impossible for him/her to propose a behavioral model. However, he/she can work with existing material just developed in previous steps of model of intention process.

Ports of model of intention, that represent information, have been defined. The objective is to be able to switch a blank model of intention to a simulatable one. To perform that switch action, it is necessary to link inputs to outputs. As mentioned previously, non-expertise does not allow simulation architect to build final model (i.e. model of realization). Several options have been highlighted to support simulation architect in its model of intention simulation capability addition:

- Factor: A simple relation with a factor can be proposed. As example, efficiency or a density can permit to link an input with an output. Value or range of potential value of this factor is then a hypothesis that must be challenged.
- Empiric results/tables: For a set of input, literature, experiences or tests can support construction of a table that delivers a set of output.

Whatever the solution for simulation capability chosen, model of intention must appear as clear as possible in term of hypothesis, in order that experts understand clearly what simulation architect has done. Simulation capability is a feature that requires being rigorous to avoid misunderstanding.

3.1.5.Model of intention parameters setting and full package

The last step in model of intention sub-process is the delivering of a full package to expert. Just before validation of full package, it is mandatory to set all parameters of model of intention. This step is important because expresses requirements, hypothesis and previous direction given to the design.

Since parameter setting is done, and document is validated, the full package can be transferred to expert as a specification for model of realization. It is important to remember that even if model of intention building is a large process, it represents only a platform that must be challenged by each parts, simulation architect and experts. Finally, model of intention is just the translation of an architect question to model and simulation world, supported by a scenario.

3.2. Hybrid propulsion system study case

3.2.1. First Application

Hybrid propulsion system for aeronautic is an innovative propulsion system solution. The study-case, presented in Figure 1, proposes a hybrid parallel architecture and a sizing mission. The model proposed corresponds to a base for model of intention, but can support first pre-design questions: Is it possible to perform the mission with a hybrid parallel solution, or, what is the best endurance possible, or what is the best payload to carry? These questions have been merged to propose to estimate endurance vs. payload with the power vs. mass model.

In order to answer this very first question, that could be fatal for the project, an optimization process based on evolutionary algorithm (NSGA2 [14]), and 2 objectives is proposed. 8 optimization variables are selected. A Pareto front is obtained, and mass decomposition of architecture is estimated, considering some strong hypothesis that must be challenged with an expert eye.

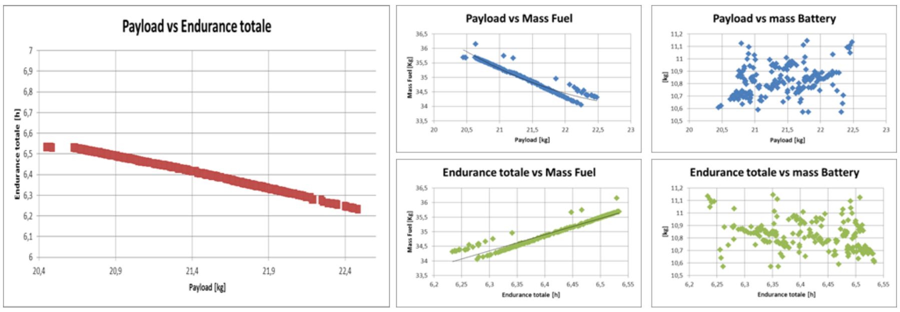


Figure 5: Endurance vs. Payload with power vs. mass model

3.2.2. Questions from architect

In order to illustrate the model of intention building, hybrid propulsion system design and integration, on the copter-based UAV, is challenged around two questions that represent two different types of model of intention:

- Question 1: Mass of batteries is a critical issue for UAV design. Is it possible to reduce uncertainties on battery mass estimation?

- Question 2: Thermal environment inside UAV is a critical issue. Is it possible to have an estimation of sub-systems temperatures during a mission?

The question 1 expresses the request of a model refinement, and a closer link with technologies. The objective is to obtain a model of realization that considers more accurately the link between mass of batteries and technologies or products-on-the-shelf. With the future model of realization, architect will have information (results of simulations) to estimate mass of batteries needed versus technology.

The question 2 expresses the request of new discipline consideration, thermal transfers. This discipline, mandatory to consider integration, provokes a lot of potential interactions that should be quantified. A new model is also necessary, the fuselage model which will integrate thermal behavior models, and support sub-systems temperature evaluation.

The objective of that demonstration is trying to detect and quantify where the model of intention sub-process can be generalized (Figure 3). For each scenario, works on system and interactions blocks of global methodology (Figure 2) are not presented in this paper due to the focus on model of intention.

3.2.3. Scenario 1: Batteries mass

This scenario represents an improvement of model prediction and behavior. The model for battery inside power vs. mass model considers technologies of battery only through 3 parameters: energy density (Wh/kg), time constant for charge (1/h) and for discharge (1/h). This model considers that mission is not satisfied when battery is empty although it is mandatory that it delivers energy. Since this instant, mission is compromised and the mass of battery (parameter) is not sufficient. Future model of realization must keep this approach, with a real link with technology.

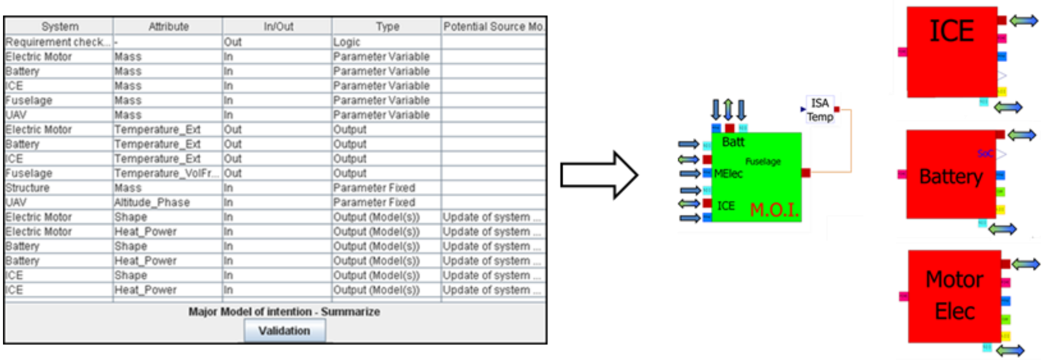
Interactions and impact process is not useful for model of intention building for this scenario, just because model inside power vs. mass model is the real model of intention. This is due to the fact that no additional port has been detected, and behavior is already inside. The parameter setting phase is already done with the first pre-design work presented in previous part. To complete a full package, document is built (not automatically for the moment). The full package is ready to be sent to expert.

The model of intention for scenario 1 was quiet easy to build, and illustrate the necessary work to create a global model for model of intention basement. For the hybrid propulsion system, or other energy analysis in aeronautic, mass and power model seems to be the simplest, quickest and more interesting model to develop initially.

3.2.4. Scenario 2: Thermal environment

This scenario represents close link between design and integration. The model requested is an environment model that allows estimating quickly temperature of sub-systems inside fuselage, in order to avoid sub-systems critical temperatures. In current power vs. mass model, there are no thermal effects considered. Interaction and impacts analysis, with a thermal filter/view, is mandatory for simulation architect to be able to propose a model of intention.

The scenario defined considers only 4 sub-systems that have a potential thermal influence. These sub-systems are Fuselage, Electric motor, ICE (Internal Combustion Engine) and Battery. Simulation architect has considered fuselage model has a host for thermal environment inside UAV model. Interactions and impacts are based on the fuselage and authorize to impact, or be impacted, by three other systems.



System	Attribute	In/Out	Type	Potential Source Mo...
Requirement check...	-	Out	Logic	
Electric Motor	Mass	In	Parameter Variable	
Battery	Mass	In	Parameter Variable	
ICE	Mass	In	Parameter Variable	
Fuselage	Mass	In	Parameter Variable	
UAV	Mass	In	Parameter Variable	
Electric Motor	Temperature_Ext	Out	Output	
Battery	Temperature_Ext	Out	Output	
ICE	Temperature_Ext	Out	Output	
Fuselage	Temperature_VolFr...	Out	Output	
Structure	Mass	In	Parameter Fixed	
UAV	Altitude_Phase	In	Parameter Fixed	
Electric Motor	Shape	In	Output (Model(s))	Update of system ...
Electric Motor	Heat_Power	In	Output (Model(s))	Update of system ...
Battery	Shape	In	Output (Model(s))	Update of system ...
Battery	Heat_Power	In	Output (Model(s))	Update of system ...
ICE	Shape	In	Output (Model(s))	Update of system ...
ICE	Heat_Power	In	Output (Model(s))	Update of system ...

Major Model of intention - Summarize

Validation

Figure 6: Phase 1: Port addition to system models (red port → temperature; light green → shape)

The blank fuselage model of intention is built following results of Interactions and impacts analysis (Figure 6). Several attributes are highlighted as input or output, with different type. Each type will not be detailed in this paper. However, it is interesting to note last column of Figure 6 table, which shows the necessity of update other systems model in addition of fuselage model. The phase 1 of model of intention is finally completed with addition of new port, and fuselage model, directly inside an alternative version (V2) of power vs. mass model.

The model phase 2, behavior addition, implies 4 system models. Simulation architect has considered as input the heat power attribute. This attribute is, by hypothesis, amount of power that is not directly used by a component (power lost). With efficiency, it is simple to consider a heat power. For the fuselage model, which represents a sort of hub for heat powers, it is impossible to extract a simple, or empiric, relation to determine all temperatures without entering inside a domain expert field. However, temperatures do not interfere with simulatability capability of model of intention because temperature values are not directly used inside the simulation chain, there are only observables.

The parameter setting phase is tricky, due to the possible lack of information on any parameters. Parameters linked with shape, which are basic form (cylinder, block…) and size, of each sub-system is not clearly set at this point of design. In that way, any hypotheses are done to allow simulations. Hypothesis is closer than possible of reality, but offer uncertainty risk for simulation results. As it will be explained later in this paper, hypotheses are clearly dangerous for designers and decisions they have to take.

In parallel of the elaboration of blank and simulatable model of intention, and even before with the Interactions and impacts analysis, the document was completed in order to be able to propose a full packaged model of intention.

4. Model of intention : a practical example

4.1. Scenario 1 and 2 model of intention collaboration

4.1.1. Scenario 1: Collaboration with battery system expert

This part relates a role play organized around model of intention full package corresponding to scenario 1, on uncertainty reduction for mass battery. The full package has been transferred to a battery system expert of a propulsion research team. This expert will try to satisfy the model request with the model of realization. At this point of methodology, collaboration is crucial between simulation architect and expert.

After analysis of model of intention scenario (document), it appears that the will is to propose a model that takes account of technologies parameters to size battery mass, to challenge hypothesis of model of intention (i.e. energy density, rate of charge and discharge). Expert has selected two batteries previously used in other project (battery A and B). He has selected these solutions because he has understand the need in this project, thanks to several simulations that has allowed him to detect maximal power and amount of energy desired. This point is interesting because it illustrates the freedom offer to expert to push some solutions more than other. Of course, in this simple case, no money or business problems interfere in confidence offer to expert by architect and simulation architect.

The model of realization is the vector to transmit expert's advices and pre-choices. In this case, expert has proposed a unique model, parametrizable to switch from one solution to another. The model is developed directly in Modelica, in order to avoid integration problems which are out of scope of model of intention.

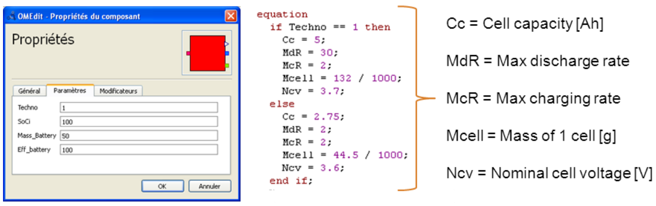


Figure 7: Model of realization contains solutions parameters

As a simulation architect to architect collaboration, model has been simulated. Due to the out of scope for this paper of decision aiding for architect, only a simple comparison on different models results, on a similar mission and for same battery mass, is proposed in Figure 8. Model of realization results highlight that model of intention hypothesis on battery are optimistic, because battery discharge is lower than with real solution. As a decision aiding, without optimization for the moment, technology B seems to be more interesting. However, simulation architect delivers these results, architect acts decision.

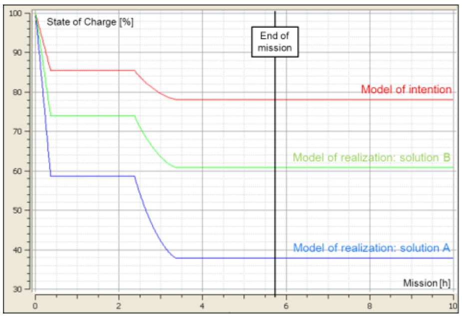


Figure 8: Comparison of simulation results on a similar mission and for same battery mass

4.1.2. Scenario 2: Collaboration with thermal domain expert

As for model of intention for scenario 1, an expert in thermal domain received the full package. For the necessity of this simple use-case, a member of propulsion team has played this role. After having received model of intention, he proposes a manner to model a solution. A Model based on thermal node is proposed. This approach delivers results expected, i.e. temperature of sub-systems considered (ICE, Electric motor and Battery). All information necessary for this model is inside the model of intention. As the model requested concerns environment (physics), the expert has not proposed different model of solution. Expert could however propose different manner of modeling. In the current study-case, a unique model of realization is delivered. Another important point is the necessity highlighted, in Interactions and impacts phase, of having heat power of the others considered systems. For the study-case, models of considered systems have been updated to propose an output port that delivers the heat power information and surface wetted (Figure 6). The heat power is directly calculated with efficiency parameter (hypothesis of power loss of a system is lost as thermal). The surface wetted is based on volume (energy/power density) and basic form.

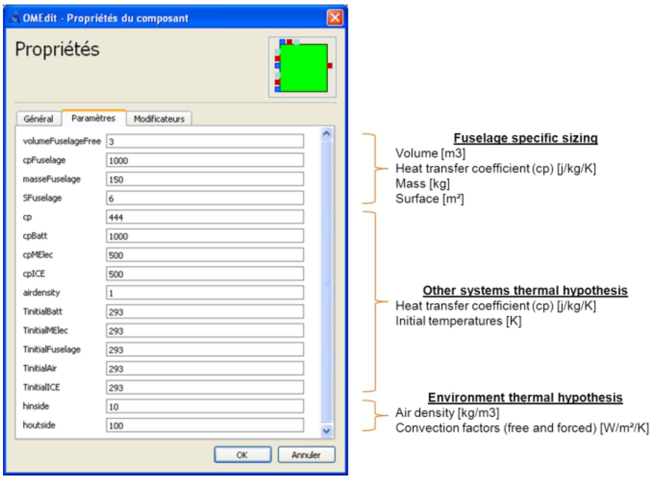


Figure 9: Model of realization parameters

4.2. Advantages and drawbacks

Several advantages and drawbacks have been identified (Figure 10). Any of them can be turned into next improvement or research fields (especially tools limitations).

Actors	+	-
Product Architects	– Simulation based decision aiding; – Interaction and impacts analysis to support innovative design; – Discharge of M&S technical request.	– No control of M&S; – Full confidence in Simulation architects. – Model architectures with SysML language; – Only functional requirements.

Simulation Architects	– Models are extracted rather than pushed; – Interface with design team and experts; – Assisted methodology for Model of intention (based on Java and XML); – Trace and justify model request; – Store models of realization; – Manage simulation results; – Discharge of requirements and architectures.	– No design decision; – Hypotheses to manage; – Simulatable Model of intention to build in Modelica language(power and energy); – Integration of model of realization in simulation chain.
Experts	– Clear and justified model request; – Platform to express modeling problems; – General Context presentation with Scenario; – Opportunities to push some technologies for system expert; – Opportunities to propose multiple qualities of models for domain experts.	– Models are extracted rather than pushed; – New models to build; – Adaptation necessary to simulation chain; – Less freed in modeling.

Figure 10: Model of intention advantages and drawbacks

5. Conclusion

The objective of model of intention is to facilitate the use of models for design and integration decision on a product project. Hidden behind this idea, there is a will to extract model from expert, more than current tendencies consisting in pushing models by expert. Model of intention is simply a concept to support model specification, in order to improve collaboration in a way to enhance innovation and creativity. Even if the architect is the project leader and decision maker, initiatives can also be provided from expert, and models allow them to express their ideas. Simulation architect with his virtual or Model and simulation vision is an interface to allow the model-based dialog. To summarize, model of intention is a bridge, a tool for simulation architect, to create collaboration in a virtual world, and to continue to innovate, to design and to integer a real product.

Numerous challenges are yet to manage, especially in a proper and generic definition of a model of intention. A setting up of proposed methodology in a real industrial context shall be explored. The link between design models of system engineering and real physical world, environment, design and integration seems to be mandatory in order to break conventional design method and open larger innovation and creativity in future product.

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