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STEERING THE VALUE CREATION IN AN AIRPLANE DESIGN PROJECT FROM THE BUSINESS STRATEGIES TO THE ARCHITECTURAL CONCEPTS

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ABSTRACT

The objectives of the designers have above all been the achievement of the aircraft mission and the certification rules. Today, the competition between airplane manufacturers leads to bring more added values to the stakeholders. Other types of values have then to be considered as higher level objectives like the ground operations and maintenance costs, the environmental impact, the image, the security and the autonomy. Therefore, the conceptual design must be driven in the perspective of value creation objectives from the first airplane specification sheet to a satisfactory dimensioned architecture. Consequently, the traceability of value contributions of design concepts to the entire airplane value should be better supported. An explicit enriched representation of the value model and the targeted stakeholders is then built. A strategical alignment transforms value targets into marketing business strategy and low level innovation strategies that drive design concepts development. This paper addresses all of these issues with a methodological proposal in four steps and based on a value based management of knowledge, design problems and design solutions.

Keywords: innovation management, value management, product planning, conceptual design, requirements management

1 INTRODUCTION TO THE AIRPLANE DEVELOPMENT ISSUE

1.1 Traditional technological based practices

The traditional management of new A/C development projects has mostly consisted in implementing *technological differentiation strategies* in the competitive market through A/C *mission improvement or new positioning*. These strategies are described by high level engineering objectives on *generic A/C mission characteristics* such as: the number of seats, the range, the minimum speed for take-off and landing, the maximum cruise speed, the stability degree and the specific consumption. From those technological requirements, different global or local *A/C architectures* are built and assessed by *reusing or improving past technological best practices*. These architectures represent namely geometrical shape, components structure, material type, technology type, relative position between components, surface quality and process of manufacturing and integration. Aerodynamic and mechanical calculation methods are used to define conceptual alternatives of globally sized A/C geometries that achieve the targeted technological performances. Engineering loops are then performed to optimize the targets achievement of the A/C concepts either by changing the A/C architectures or the requirements. As long as the market differentiation is based on the A/C mission performance, this traditional technology based design process seems to be efficient and fluent.

1.2 The value based management practices

The *value based approach* has risen with the evolution of the aviation environment. Indeed, it has evolved with the appearance of new types of customers (e.g. low cost, VIP airlines, leasing companies), the globalization of the market (e.g. new demands of the emergent countries), the change of the economical, social and legacy conditions (e.g. increase of the petroleum and raw material costs), the increase of the world-wide competition (e.g. introduction of new competitors), the change of the interactions with external systems (e.g. autonomous aircrafts), the transformation of the business model (e.g. increase of the level of services). The technology based design approach is consequently insufficient to address the needs of such changing external environment and define pertinent differentiation strategy among the competitors. This evolution of the aviation market leads to a deeper analysis of all the potential opportunities of *business value creation.* The challenge consists in identifying new business strategies that create or improve other types of values than the A/C mission or safety to the airlines (like the environmental impact, the image, the security, the autonomy and the service level), but also the manufacturer values (like the standardization, the image, the employee welfare and the environmental protection).

1.3 The needs of integrated practices

In the preliminary phase of a new product development project, A/C solutions architectures have to be defined both from an analysis of *proof of value* (their potential business value for the customers and the manufacturer) and of *proof of concept* (their technological feasibility). For instance, some A/C systems can create value only for some *specific airlines profiles*. Autonomous A/C with advanced technological systems would then target airlines operating in poorly supported or risky environment, whereas basic systems A/C with low operating costs would target low cost airline companies. There is a need of integration between the value and technological based practices in order to improve the probability of creating *high value to the so called project stakeholders*: the targeted airline companies, end-users and other actors of the airplane lifecycle. The current interactions between the business and design teams mainly occur in a *customer/supplier* transaction mode. The traditional situation consists in the delivery of a given business strategy to the design team, which returns its *technical feasibility* assessment and proposition on the basis of technological means or capacity. The business case and architectural solutions are then defined in an *iterative process* between the two teams. Such process mainly leads to *conflicting interactions* between the business and design teams: both of them mainly build their own view on the product strategy, and tend to maximize their *own objectives*, which are either the *technological performances*, or *the business value*. It often drives to non-optimal strategy and architectural concepts: the business case may be too ambitious and technically unfeasible (development cycle and cost objectives are not achieved!); the solutions may not be adapted to the market, and may not really create enough value. Such unsuccessful results come from the *lack of transparency* between the two disjoint processes: each of them is seen as a *black box* from one another.

2 STATE OF THE ART FROM BUSINESS STRATEGIES TO DESIGN CONCEPTS

2.1 The product planning stage

The *business or marketing strategy* [1][2][3] relates to the business objectives, activities and market positioning to achieve the corporate strategy [4]. It defines the way the organization practically acts on its market environment [5], and creates value for internal and external stakeholders. It leads namely to the identification of different *Strategical Business Units*, or the strategic organization activities in the market [1]. The business strategies have to be well defined from an efficient diagnostic of the external and internal environment through methods like: the 5 forces of Porter [6], the BCG matrix [7][4], the PESTEL method [7][8], the SWOT matrix [7][9] and the Porter Value Chain [6]. The general purpose of business strategies definition is the exploitation of the *external opportunities*, the reduction of the *external threats*, the development and use of the *internal strengths*, and the deletion of the *internal weaknesses* [1]. Various types of marketing strategies may be defined: external organization growth (by absorbing some of its competitors), internal costs reduction (by rationalizing its internal processes), competitors leaderships neutralization (by developing products or services with similar values or performances) and *marketing differentiation* [10]. The marketing differentiation strategy consists in breaking the market competition rules, setting up an uncontested market place from differentiating product or service features. Such strategy aims at creating much higher value than the competitors, increase the market shares and attract new customers profiles [11][2][3].

2.2 The conceptual design stage

From *Design Engineering* domain, the conceptual design stage begins by specifying *the new product requirements* [12][13] and ends by defining the *technical architectures* [14]. This process is composed of a succession of design problems formulations, and design solutions generations and analysis: the functional and structural representations of the product evolve in parallel [15]. Product architectures may be found in a *systematic* or *intuitive* way [15]: on the one hand, the design solutions may be generated from a systematic combination of local solutions from divided local design problems [12]; on the other hand, the solutions can be issued from random approaches based on designers creativity enhancement and exploitation [16]. The conceptual design is also seen as a permanent iteration between a *convergent* and *divergent* process: it is a divergent process as it has to widespread the exploration of design solutions from a design problem; it is convergent as it analyzes the explored solutions in order to select the best ones in regards to the specified problems [17]. The research works in this field help the designers in reformulating the stakeholders expectations into *explicit engineering problems*, in maximizing the product performances or quality [18] with respect to the given problems. At the beginning of the conceptual design, models of engineers preference or utility are frozen [19][20][21], and help them all along the process in analysing the design solutions.

2.3 The partial integration of product planning and conceptual design stages

On the contrary to the Product Planning, the Design Engineering methods that support the Conceptual Design are mainly dedicated to the Engineers: such methods support their designing tasks [22] and improve their well-being [23]. In an increasing competition, pure Engineering Design is not enough to deliver sufficient business value in a new product development process. Indeed, the designers should not be considered any more as isolated and must take into account other functions outputs in the organization, like the Marketing, Finance and Business Intelligence. In the literature, models of new product development process tend to integrate the product planning and conceptual design stages. Many models which primarily described the design engineering process add the product planning stage: the “Systematic Approach to the Design of Technical Systems and Products” [24] is now denoted “Systematic Approach to the Development and Design of Technical Systems and Products” [25]; Pahl and Beitz’s chapter “Process of planning and designing” [14] is now renamed “Product development process” [26]. Nevertheless, the integration between the product planning and the conceptual design is partially achieved in the current models of new product development process [27][28]. They mostly consist in making the most important and strategic decisions for value creation in the product planning stage, and in implementing are made simple design choices in the conceptual design stage. Consequently, the business and technological strategies are not optimal: the business strategy is often too ambitious and so technically unfeasible; the technical strategy and architectures may not create real perceived values and differentiation to the stakeholders.

2.4 Lack of systematic and integrated steering of knowledge, problems and solutions

CK Theory [29] is proposed to describe a global framework of the product development process based on parallel exploration of the design concepts and knowledge. It is a quite interesting design theory since it integrates well the product planning and conceptual design stages. This theory suggests a parallel exploration of concepts and knowledge in the both stages and in a fully integrated manner. It leads the convergence to reliable and high value business and technical strategies. Nevertheless, this theory stays at a very high level description and does not support the *practical tasks* to be performed by the business and design teams. Besides, new research works are implemented on the relationships between the *Intermediate Objects*, which are generated and used within an innovation project [30], and its success. The *Radical Innovation Design principles* [28][27] state that *several product artifacts*, such as the Knowledge, the Problems and the Solutions, must be collaboratively produced in the preliminary phase and by multidisciplinary teams (business managers, designers, engineers…) in order to ensure reliable and high proof of value and concept. There is a need of a methodology that systematically implements the CK Theory and the RID principles. A *systematic and integrated approach* should allow the business and design teams to systematically represent and steer their *knowledge acquisition*, their *problems formulation*, their *solutions definition* and their *generated values for the stakeholders*.

3 METHODOLOGICAL PROPOSAL FOR VALUE STRATEGIES AND ARCHITECTURES DEFINITION

3.1 A value based knowledge, problems and solutions model

Our *Concept-to-Value methodology* (CtV) is based on a generic model representing, on one hand, *the multidisciplinary knowledge, the problems and the solutions*, and, on the other hand, the *potential values* they generate for the stakeholders (see figure 1). This model describes the different

Intermediate Objects that are generated both in Product Planning and Conceptual Design stages, should be integrated and systematically assessed in terms of potential of value creation.

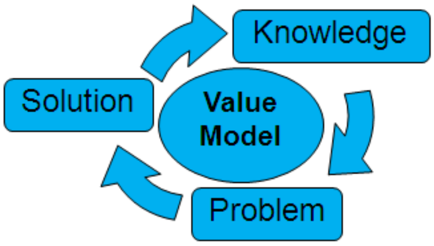

Figure 1. The V-KPS model of CtV methodology

This value based KPS model can be compared as three different rays (K, P and S) that are examined, filtered and refracted through special glasses (value model): K, P and S are examined through the value model in order to *elicit their potential of value creation*; K, P and S are filtered through the value model in order to *evaluate* and *select* the objects that create the highest values; K, P and S are refracted by the value model in order to *steer* their further development or generation.
The V-KPS model is to be usable in different industrial situations where the design and business teams must collaborate in a systematic and fully integrated way. It can be implemented in different sorts of project situations or objectives:

1. *1st type of project objective*: the starting point is an existing technology or a set of technological requirements to be analyzed. Knowledge has then to be acquired in an efficient manner both by the business and design teams in order to evaluate their values and propose new pertinent business, technological strategies and architectural solutions.
2. *2nd type of project objective*: it consists in innovating from a scratch. Knowledge must be acquired to specify integrated strategies, and to develop innovative and high value technologies.

3.2 A four step process for value-based steering of product planning and conceptual design stages

The CtV process deploys the V-KPS model *in four steps*:

1. Primary knowledge acquisition
2. Stakeholders and value drivers analysis
3. Value strategies analysis
4. Architectural solutions steering

First step: primary knowledge acquisition

The first step starts with the specification of an *initial project statement*. It describes the initial context and objectives of the innovation project:

1. The *product level* at which innovation has to be steered
2. The initial *business and technological constraints* to be taken into account
3. The *actors and knowledge fields* to involve
4. The *stakeholders* to be targeted and satisfied

These initial pieces of information permit to narrow the *scope of the project*, to define *a broad perimeter of the problem*, in which relevant business and technological strategies have to be defined, and to better orientate *knowledge acquisition requests*. The formulated requests are characterized on the basis of the V-K model:

1. *Objective*: requests on technological (e.g. current internal solutions with their advantages and inconveniences) or business environment (e.g. market competitors and characteristics, customers chain)
2. *Subject*: requested object (e.g. product, service, enabling product, process, business model, stakeholder, airline profile)
3. *Type*: type of request (e.g. function, performance or quality, structural parameter, scenario)
4. *Level*: level of request (ex: program level, A/C level, subsystem level, component level)
5. *Domain*: requested knowledge field (ex: business, structure, systems, systems installation)
6. *Method*: the way or the tool to be used to acquire and capture the information (ex: functional analysis, systemic analysis, problems and solutions networks)

Second step: stakeholders and value drivers analysis
With the first step, this one systematically implements the *investigation process* of RID [28][27]. It analyzes the *characterized knowledge* and generates three types of objects from the V-K model: the *stakeholders model*, the *value dimensions* and *the key value drivers*.
This step begins by describing the *identified global stakeholders* to be satisfied, which are generally the manufacturer, the customer (e.g. the airline companies), the end-users (e.g. the passengers) and the external environment (e.g. the airport, the certification organisms).
It deduces also from the characterized knowledge various *business and design parameters*. *Influence or contribution links* between them are derived in order to structure and integrate them. Different types of *relations* are extracted (e.g. causality, performance, functional, hierarchical and aggregation relationships) quantified through a *relative semi-quantitative scale* and captured within matrices (see table 1). Positive and negative matrix coefficients are set to represent both desired and undesired influences between the parameters [31][32].

Table 1. Example of direct influences between three parameters

Influence on / of	Parameter 1	Parameter 2	Parameter 3	Direct influence
Parameter 1	0	-2	0	2
Parameter 2	0	0	-1	1
Parameter 3	0	0	0	0
Direct dependence	0	2	1	0

Legend:

2	high & positive contribution
1	medium & positive contribution
0	no contribution
-1	medium & negative contribution
-2	high & negative contribution

The *value dimensions* correspond to the parameters that have no direct influences to other parameters. Indeed, they represent the highest level of satisfaction criteria of the stakeholders. A level of importance or weight is assigned for each value dimension and for each stakeholder.
The *value drivers* **c**orrespond to the parameters that have direct or indirect influences on the value dimensions. The *level of independence* of a value driver is higher as the level of its direct dependence is lower (see Table 1). The *level of influence* of a value driver on the value dimensions can be assessed for given stakeholders. It corresponds to a weighted sum of the absolute influences on the considered Value Dimensions (see formula 1).

$$TotalInfluence(d) = \sum_{l \in VD} weight_l \times abs\left(\sum_{n=N} \left(A^n(d,l) \right) \right) \qquad (1)$$
$$d \in vd$$

Where,
1. *vd* is the set of value drivers
2. *VD* is the set of value dimensions
3. $Weight_l$ is the importance level of the value dimension *l*
4. *A(i,j)* is the direct influences matrix
5. $A^n(i, j)$ represents different power levels of the parameters influences matrix *A(i,j)* and describes then all the indirect influences between the parameters
6. *abs()* is the absolute function
7. *N* is the maximum level of the series $A^n(i, j)$ before its convergence to the null matrix in the case there is no influences loop between the parameters

The *level of importance* of a value driver depends on the comparison between its *total positive* and *negative contributions* to the value dimensions. It can be assessed for given stakeholders. The *total* *positive* (see Formula 2) and *negative contributions* (see formula 3) of a driver correspond respectively to the weighted sum of its positive and negative contributions to the value dimensions.

$$TotalPositiveContribution(d) = \sum_{l \in PVD(d)} weight_l \times \left(\sum_{n=N} A^n(d,l) \right) \quad (2)$$

$$TotalNegativeContribution(d) = (-1) \times \sum_{l \in NVD(d)} weight_l \times \left(\sum_{n=N} A^n(d,l) \right) \quad (3)$$

$$d \in vd$$

Where,

1. *NVD(d)* is the set of value dimensions on which the driver *d* has negative contributions (i.e., $(\sum_{n=N} A^n(d,l)) \leq 0$ for all value dimensions $l \in NVD(d)$)
2. *PVD(d)* is the set of value dimensions on which the driver *d* has positive contributions (i.e. $(\sum_{n=N} A^n(d,l)) \geq 0$, for all Value Dimensions $l \in PVD(d)$)

The level of importance of a driver is higher as its total positive contribution is more important than its total negative one. Different *categories of importance level* can be used for its assessment:

1. *the importance level is high* (A) in the case of higher total positive contribution than the total negative contribution
2. *the importance level is medium* (B) in the case of equivalence between the total positive contribution and the total negative contribution
3. *the importance level is low* (C) in the case of higher total negative contribution than the total positive contribution

Inspired from the research works by Yannou et al. [33][34] on usages surfaces covering, the *level of completeness* of a set of value drivers corresponds to its *degree of covering* of the value dimensions. It is defined as the relative sum of the weights of the value dimensions that are positively influenced by the set of drivers (see formula 4).

$$CompletnessLevel = \frac{\sum_{l \in TPVD} weight_l}{\sum_{l \in VD} weight_l} \quad (4)$$

Where,

1. *TPVD* is the set of value dimensions on which the drivers have positive total contributions (i.e. $\sum_{d \in vd} (\sum_{n=N} A^n(d,l))) \geq 0$, for all value dimensions $l \in TPVD(d)$)

In a summary, this CtV process step consists in extracting value drivers for the stakeholders in a multi-objective view. Indeed, they should be the most independent, influencing and important. The value drivers corresponding to such criteria are defined as *strategical or key value drivers.*

Third step: value strategies analysis

This step systematically implements the *problem setting* phase of RID [28][27]. It builds and assesses different *value strategies* on the basis of the V-P model: *business and technological strategies* that should maximize the value for the stakeholders.

A strategy is *a set of choices or objectives* on stakeholders, value dimensions and drivers (see formula 5).

$$ValueStrategy = (S, VDT, vdt) \quad (5)$$

Where,

1. *S* is a set of global stakeholders
2. *VDT* is a set of choices or objectives (e.g. low, medium or high) on value dimensions

3. *vdt* is a set of choices or objectives (e.g. low, medium or high) on value drivers

The objectives of this step consist in defining value strategies from the strategical drivers, and in ensuring that they create enough value.

The *value contribution* of a strategy *s* to the value dimension *l* is given by formula (6). The *total level of value contribution* of a strategy corresponds to the weighted sum of all its contributions to the value dimensions (see formula 7).

$$StrategyContribution(l,s) = \sum_{d \in vd(s)} O_d \times \left(\sum_N A^n(d,l) \right) \quad l \in VD \tag{6}$$

$$TotalStrategyContribution(s) = \sum_{l \in VD} weight_l \times \left(\sum_{d \in vd(s)} O_d \times \left(\sum_N A^n(d,l) \right) \right) \tag{7}$$

Where,

1. *vd(s)* is the set of value drivers of the strategy *s*
2. O_d is the relative objective value between *-1* and *1* and assigned to the driver *d*:

2.1 O_d equal to *0* means that the value of the driver *d* in the strategy is equal to a reference value

2.2 O_d equal to *1* means that the value of the driver *d* in the strategy is much better than a reference value

2.3 O_d equal to *-1* means that the value of the driver *d* in the strategy is much worse than a reference value

The *level of completeness* of a strategy corresponds to the degree of covering of the value dimensions by the strategy. As the *completeness degree* of value drivers, it is defined as the relative sum of the weights of the value dimensions on which the strategy has positive contributions (see formula 8).

$$CompletnessSrategyDegree(s) = \frac{\sum_{l \in PVD(s)} weight_l}{\sum_{l \in VD} weight_l} \tag{8}$$

Where,

1. *PVD(s)* is the set of value dimensions on which the strategy *s* has positive contributions (i.e. $StrategyContribution(l,s) \geq 0$, for all value dimensions $l \in PVD(s)$)

In a summary, this step allows selecting the most interesting strategies that contribute the most to value creation and are the most complete.

Fourth step: architectural solutions steering

This step systematically deploys the *problem solving* phase of RID [28][27]. By implementing the V-S model, it steers the development of the *architectural solutions* in respect with the selected value strategies. The assessed *gap to strategy* of a solution corresponds to a weighted sum of absolute distances between the objectives of the strategy and the actual values of the solution (see formula 9).

$$GapToStrategy(s,o) = \sum_j weight_j \times abs(O_j - A_j) \tag{9}$$

Where,

1. *j* represents a value dimension or a driver
2. $weight_j$ is the relative weight of the value dimension *j* or a quantitative function of the importance level of the value driver *j*
3. O_j is the relative objective of the strategy *s* on the value dimension or driver *j*
4. A_j is the actual value of the solution *o* on the value dimension or driver *j*

4 CASE STUDY IMPLEMENTATION: DEFINITION OF STRATEGIES OF AERONAUTICAL SYSTEMS INSTALLATION

The CtV methodology is applied to identify new concepts of electrical and hydraulic systems installation on civil airplanes. The initial problem perimeter consists in challenging the current linear and sequential process of systems installation on the A/C final assembly line. Different strategies of systems installation have then to be found and analyzed with their value contributions for the stakeholders. The value strategies may impact the A/C structure, the systems architecture, the systems installation tools and process.
The case study is implemented by following the different steps of the CtV process.

The first step permits to:

1. formulate different knowledge requests
2. acquire and capture multidisciplinary knowledge using Trizacq tool (a European Consortium tool for Triz implementation)

Trizacq tool is used since it supports well technological analysis and innovation areas identification. It allows to formulate knowledge requests such as “what are the current faced design problems and solutions?” and “what are the past and potential future evolutions of the A/C structure and systems installation?”. The answers of these questions are captured in Trizacq tool namely with a problems-solutions causality diagram and a nine multi-screen representation.

The second step allows defining and structuring 86 problem parameters with the following characteristics:

1. subject: product (e.g. number of systems to install), enabling product (e.g. availability of ergonomics tool) and process (e.g. number of installation activities on the assembly line)
2. type: structural parameter (e.g. material of structural elements for systems installation), function (e.g. electrical protection of systems), performance/quality (e.g. time of systems installation)
3. level: A/C (e.g. A/C weight), subsystem (e.g. locations of installed systems), components (e.g. material of mechanical elements)
4. domain: business (e.g. A/C manufacturing ramp up), structure (e.g. material of mechanical elements), systems (e.g. systems weight), systems installation (e.g. number of activities on the assembly line)

The influences between the parameters are modeled in a direct influences matrix. 12 Value Dimensions with null influence level represent the stakeholders end values, namely for the manufacturer and airlines: A/C operational utility, operational cost, manufacturing cost and cycle, manufacturing ergonomics, safety, environmental protection, automation feasibility, engineering cost and cycle, and industrial risk. Various business strategies come then from the assignment of different qualitative or quantitative objectives on these dimensions.
30 independent Value Drivers among 74 are found and analyzed through their total influence and importance level. The figure 2 shows the disparate contributions of the independent drivers on the Value Dimensions. It points out a global completeness degree of 67%: 8 Value Dimensions out of 12 are positively contributed by all of the 30 independent drivers.

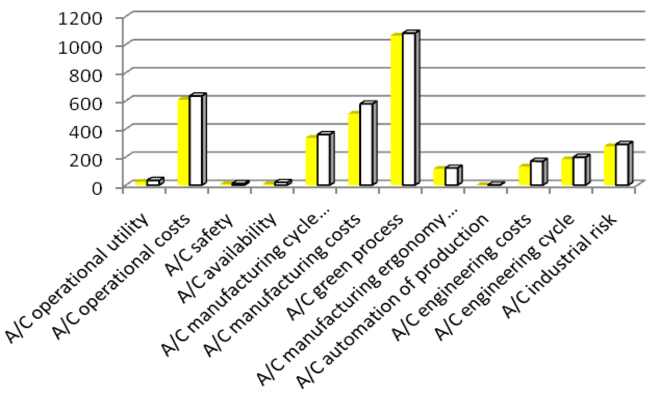

Figure 2. Contributions of independent (white) and most influencing drivers (yellow) to Value Dimensions

This figure represents as well the contributions of the 15 selected most influencing drivers: it demonstrates that the contributions of all the 30 independent drivers are well equivalent to the contributions of the 15 selected ones. Only two of the selected drivers have low importance level (C) and can not be defined as key drivers: number of micro-structural elements and number of innovative material elements for systems installation. Indeed, the analysis of their value contributions explains that they have bad impacts on manufacturing and engineering performances: this is due to a low level of maturity of such technologies in the use case context. Further research projects should reduce their negative impacts and reinforce their positive contributions: the decrease of the A/C weight and operational costs, but also the improvement of the A/C operational utility.

The third step permits to establish 7 value strategies of systems installation from the previously selected drivers. Their value contributions can be assessed either for each stakeholder (figures 3 and 4) or globally (figure 5). All of these figures describe the positive or negative total contributions of the 7 strategies to the manufacturer or airline Value Dimensions. Positive contributions mean that the strategy creates more value than it degrades in comparison with the current system installation concept. Negative contributions mean that it degrades value more than it creates.
The figure 3 represents in particular the total contributions of the strategies to the manufacturer Value Dimensions. One can observe a negative total contribution of the strategy 5 to the manufacturer: indeed, this strategy uses the two previously described value drivers (number of micro-structural elements and number of innovative material elements), which have low importance level for the manufacturer since their total negative contributions to this stakeholder is higher than their total positive contributions.
The figure 4 shows the total contributions of the strategies to the airline Value Dimensions. We can remark that the strategy 5 has positive total contribution to the airline values in the contrary to the manufacturer: the two used drivers that are low important for the manufacturer have high level of importance for the airline. Indeed, they lead to reduce the airline operational costs due to the decrease of the weight of the systems installation concepts.
The figure 5 describes that all the generated strategies globally contribute positively to the stakeholders values except the strategy 5: the weights of the airline Value Dimensions and the total positive contributions of the strategy to the latter are not sufficient to balance its negative total contributions to the manufacturer values.
This example shows well that only the key drivers with high level of importance for each stakeholder should be selected in the second step of the CtV process. It ensures the definition of pertinent individual and global value strategies for the stakeholders.

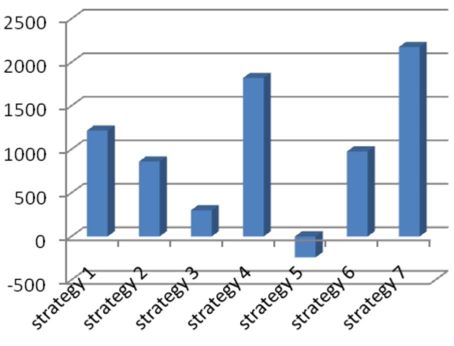

Figure 3. Value contributions of the strategies to the manufacturer

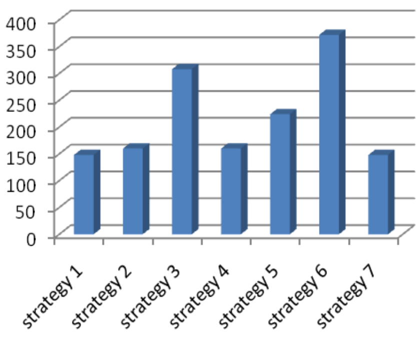

Figure 4. Value contributions of the strategies to the airline

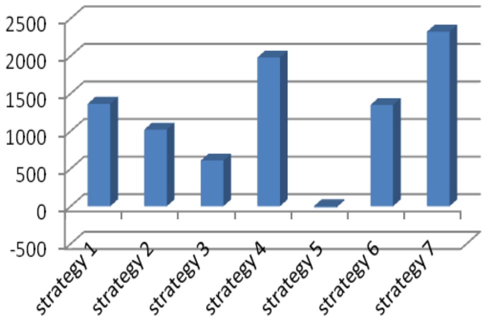

Figure 5. Value contributions of the strategies to the stakeholders

Finally, the figures below compare the level of completeness of the selected drivers with the levels of completeness of the strategies respectively for the airline, manufacturer and both of them.
The figure 6 explains that the level of completeness degree of the drivers for the airline is achieved by all the strategies.
The figure 7 shows that the completeness degree of the drivers for the manufacturer is obtained by only one strategy.
These observations are due to the thinner definition of the airline value dimensions and to the systematic positive contributions of the selected drivers to them.
The last figure represents the global completeness degrees of the value strategies and the drivers. It means that the third step of the CtV method is well done since the global completeness degree of the drivers is achieved by a strategy. But, it also suggests that the knowledge acquisition and value drivers analysis steps should be implemented again in order to increase this degree and so to better cover the stakeholders Value Dimensions. In this industrial case, the manufacturer values should really be better covered.

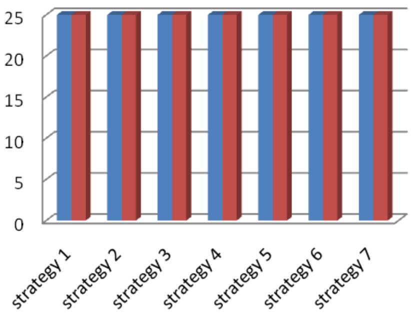

Figure 6. Completeness degrees of strategies (blue) and selected drivers (red) for the airline

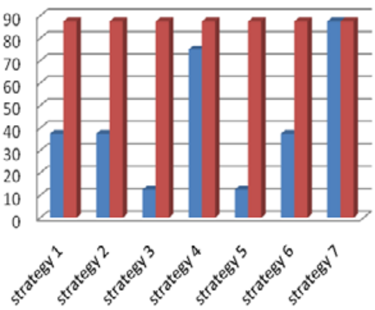

Figure 7. Completeness degrees of strategies (blue) and selected drivers (red) for the manufacturer

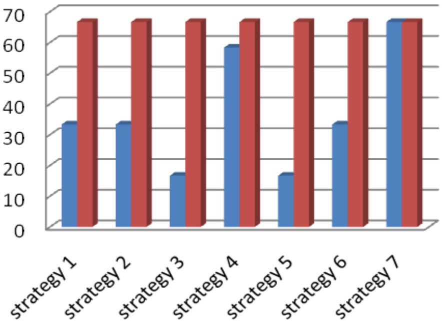

Figure 8. Global completeness degrees of strategies (blue) and selected drivers (red)

5 CONCLUSION

Our CtV methodology consists in supporting a systematic integration of product planning and conceptual design stages. It exploits a value-based KPS model for multidisciplinary knowledge capture and analysis, problems specification to define business and technological strategy, and for architectural solutions definition and evaluation. This model is steered in a four steps process and in a perspective of high value creation to all the stakeholders of an innovation project. The CtV methodology allows ensuring an agile management and alignment of the business strategies of an organization and the architectural solutions of its products to be introduced on the market. It supports the collaboration between the business teams, on one hand, that work on the product planning, and the design teams, on the other hand, that deploy the conceptual design. It permits then to increase and validate both the proof of value of solution architectures and the proof of concept of business strategies. This collaboration is enabled in a process of knowledge capturing, sharing and analysis, as well as in a process of common value strategies definition. Our intention of systematic and integrated steering of the conceptual design and product planning stages gives a new insight both for Innovation Marketing and Design Engineering domains.

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