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# Systematizing new value proposition through a TRIZ-based classification of functional features

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**Abstract**

In recent years, several TRIZ practitioners have focused their attention on the application of TRIZ concepts for new business strategy definition. Among the others, the Blue Ocean Strategy has attracted the largest consensus. Nevertheless, this methodological approach proves to be very elegant to describe past business innovation successes, while it provides just general directions if a new profile of "values" is requested for a given product or service. The present paper analyzes with a TRIZ perspective 32 case studies from the BOS literature and shows that more prescriptive guidelines can be identified from these experiences.



*Keywords:* New value proposition; functional features; TRIZ ideality; System operator;

## 1. Introduction

One of the main assumptions of TRIZ concerns the concept that repeatable patterns characterize the evolution of technical systems regardless the field of application. The Laws of Engineering Systems Evolution (LESE) [1-2] and the Inventive Standards [3] allow thus to envisage the viable evolutionary scenarios regarding any technical system; as a consequence TRIZ has represented the theoretical background for technological forecasting activities [4-5]. In the same context the authors have proposed a tool named Network of Evolutionary Trends (NET) [6-7], aimed at mapping the evolution of product platforms and the related employment of resources. The network illustrates the development followed by products in the marketplace and patented inventions, suggesting unprecedented evolution paths that cope with the LESE. Within business innovation the alternatives suggested by the NET have to be subsequently evaluated in terms of the expected appeal on the market. The last step can be supported by an estimation of the customer perceived value of the options depicted by each evolutionary branch.

On the other hand business experts are aware of social and economical macro-trends, that shape the core of knowledge for the decision making process, but codified and systematic tools for technological forecasting are not

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widespread. TRIZ has represented the first attempt to build a homogeneous set of trends viable to anticipate the development of technical systems. Thus, from this point of view, TRIZ tools can provide the missing link for systematic business innovation activities dealing with the development of successful products to enter the marketplace.

Within business innovation policies, a particular attention is given nowadays to the identification of systematic means to propose products and services characterized by a new value profile, rather than competing within the current features and performance levels of the reference industry, as formalized by Kim and Mauborgne with the Blue Ocean Strategy (BOS) [8-9]. The existing "new value proposition" strategies, and BOS is not an exception, lack of systematic paths to envisage innovative products and services, since they are very elegant to describe past successes, but they are not really prescriptive, i.e. they provide just fuzzy directions about the space where to look for new market opportunities.

Dealing with these deficiencies and with the general purpose of building a systematic approach for the development of successful products and services, the paper aims at supporting the identification of the attributes that determine customer perceived satisfaction. Further on, the measures to be attained in order to propose new valuable product platforms are suggested through a preliminary set of guidelines, arising through the analysis of the case studies described by BOS authors. The outcomes of such comprehensive task are viable to orientate the choice of the alternatives suggested by the NET.

The following section provides an overview about new product development techniques, focusing on those employing the concept of value and performs a critical review of BOS. Section 3 explains the methodology used to gain the preliminary guidelines by the characterization of products and services attributes in terms of useful functions, harmful effects and resources consumption, hereafter indicated as functional features. Section 4 highlights the outcomes of the performed survey of BOS' cases by listing the preliminary guidelines. Section 5 provides an overview of coherences and mismatches between the indications emerged and the evidences provided by different models and researches about the performed modifications of the functional features. Subsequently, Section 6 reports the conclusions and the proposed further research issues in order to strengthen the guidelines and the process for systematizing the development of successful products.

## 2. State of the art of new value proposition methodologies

The product conceptualization phase plays a fundamental role in the New Product Development (NPD) cycle since, in order to develop a successful product in competitive and globalised markets, customer requirements need to be carefully investigated during the front-end design and the product platform planning [10]. The companies have pursued product lifecycle re-engineering strategies, by taking into account a wide range of features, such as price, delivery lead-time, delivery conformance, performance, quality and reliability, sources of risk, environmental factors and life-cycle costs. Consequently different approaches have been developed, characterized by the priorities, concerning one or more of the previously listed features, assigned to perform the product development [11,12].

However it is well acknowledged in literature, that successful NPD initiatives strongly depend on the business opportunity identification stage. The objective of this task is to search for new areas of opportunities which typically swivel on the unsatisfied and unspoken needs of the customers. In the following paragraphs a literature review of tools and methods developed during the last years to assist the definition of product re-engineering strategy based on the new value proposition is presented in order to introduce the specific objectives of the present research. Section 2.1 illustrates a general overview of the methods developed with the aim of assisting the product planning task, focusing on the tools for the investigation of customer needs and the identification of the most impacting product attributes for the customers. Section 2.2 is specifically dedicated to the description of the tools suggested by the Blue Ocean Strategy (BOS) for the identification of business opportunities with superior customer value. In section 2.3 the research objectives are summarized according to the literature review.

### *2.1. General overview of methods for the definition of new products having superior value*

Several methods have been developed in the consumer research field, with the aim to capture the so called "Voice of Customer" (VOC); in [13] an extensive survey is presented. Many approaches such as those based on Free Elicitation, Laddering, Conjoint Analysis, etc., try to extrapolate the product attributes having major interests

for the user by interviewing techniques in which the customers are asked to identify the attributes they consider relevant in the perception of a product. Other methodologies (i.e., Empathic Design, Information Acceleration, etc.) are based on observing the consumer behaviour during the day life. The assumption behind these approaches is that designers can easily identify opportunities for products in response to perceived needs, by examining the consumer behavior.

According to Ulwick [14], even if all these methods help in gaining knowledge of consumers and their behavior, they cannot support the systematic identification of new product attributes, since asking the customers helps just to reveal the needs they are clearly aware, without shedding light on potentially novel valuable attributes.

Quality Function Deployment (QFD) has been applied to several domains such as robust design and business process re-engineering [10,15,16]. It allows to focus the design tasks on the customer requirements along the whole product development process from conceptual design to manufacturing. A market-driven design system to integrate QFD technique with marketing analysis was proposed in [17]. The suggested approach is focused on concentrating the design efforts on particular product features, which generate maximum benefits for customer satisfaction. More recently, Ulrich and Eppinger [18] provided a methodological approach for identifying customer needs and for establishing their relative importance, but they didn't provide any guidelines for ranking and selecting needs based on their perceived value.

In the above mentioned approach and several others available in literature, QFD is used as a method to relate the customer demands to the engineering requirements in the early stage of NPD, but it cannot provide any useful support in identifying the product attributes having superior value. Thus QFD is used, very often, together with the above cited methods for customer research in order to investigate the end-user needs and to translate them in product attributes.

By summarizing the above performed literature review, the following drawbacks and lacks of the considered methods arise:

- the identification of the product features creating superior value for the user is demanded to the VOC, but it cannot support the systematic identification of new product attributes since the consumers don't know exactly what they want;
- some of the described methods are useful to identify the impact that each product attribute has on the customer satisfaction, but they don't provide any useful indication on the measures to be undertaken in order to shift towards more valuable product platforms.

### *2.2. Overview of Blue Ocean Strategy*

From the business point of view, most of the well-established strategies mainly focus on the ways to achieve competitive leadership and advantage, with a crucial role played by the relationship between the performance and the prices of the manufactured products or the delivered services. On the contrary, the strategy fine-tuned by Kim and Mauborgne aims at looking for new business opportunities, through the definition of an innovative set of features for a company's industry, allowing to create new market space due to a novel value proposition. In this way BOS intends to break the quality/cost trade-off through value innovation, thus "killing" the competition with industry rivals and creating a new business model through the investigation of communalities of different groups of costumers and non-customers. The so built uncontested marketplace is symbolized by a blue ocean in contrast with severe competition, the red ocean infested by bloody sharks.

The reasons of BOS' success, witnessed by acknowledgements [19], awards [20], quick adoption by the companies looking for innovation tools [21], are to be traced, beyond the suggestive picture of the blue ocean [19,22], in the attempt to develop and systemize ideas and theories regarding a dynamic market characterized by breakthroughs opposed to incremental improvements [23] and pushed by the interplay among needs (functional, emotional, aesthetical, etc.), consumers and firms [24]. The advantages of pursuing a blue ocean are pointed out by Kim and Mauborgne through the evidences arising from numerous breakthrough case studies belonging to manifold sectors [20]. The widespread applicability of the strategy in the business context has pushed its diffusion. In the literature the case studies regarding the fruitful application of BOS' framework, guidelines and tools, as well strong recommendations for their implementation, range from big companies to SMEs, from the tertiary sector to institutions; the involved industrial fields encompass manufacturing, apparel and footwear, energy and

sustainability, pharmaceutics and biotechnology, education, communications, logistics, transportation, insurance, financial activities, healthcare, entertainment, tourism, agriculture, husbandry, constructions, real estate.

The application of the strategy has been carried out with the direct implementation of BOS fundamentals, as well as employing the suggested tools described in the book [9]. Among them, the strategy canvas represents the conceptual framework aimed at summarizing the ideas to perform a successful strategic "move". In the strategy canvas the value curves stand for the graphical representation of the relative performances of products or services, across the relevant factors of competition for the companies and their value propositions in their pertinent business industry.

*BOS issues in terms of selecting the relevant attributes and applying the Four Actions Framework*

In the BOS a new curve is built by proper modifications of the current product/service attribute performances and by the introduction of previously ignored properties. The innovative bundle of attributes and performances is obtained by the Four Actions Framework and summarized by the Eliminate Reduce Raise Create (ERRC) Grid. While it is relatively simple to investigate the current relevant product features to be properly removed, worsened or enhanced, by benchmarking the competition, the proposition of new valuable product attributes represents a severe challenge [25]. Within BOS such task can be eased by the Six Path Framework, which represents a set of indications that help in finding new ideas that are viable to break the established market boundaries.

Nevertheless, it has been argued that the strategy canvas represents just a useful visual tool to represent the ideas underpinning the BOS "*move"*, whilst it misses proper guidelines in order to select successful value propositions among multiple alternatives [26]. As a consequence, assessing a strategy canvas results in a difficult matter [22,27]. Several scholars [28-30] have attempted to make the process of building the strategy canvas more robust, taking into account the extent of importance levels attributed to competition factors in terms of customer perceived value. However, these measures can be adopted just after the relevant business features have been identified and defined, so when the range of possible choices has already been consistently reduced and the actions to be applied have just to be prioritized.

A relevant matter consists in the proper actions to be applied to the various product attributes. From Kim and Mauborgne's description of Four Actions Framework it emerges that the attributes to be investigated are those related to buyer's perceived value:

- the eliminate action concerns factors the pertinent industry has long competed on and that don't represent anymore a source of competitive advantage in terms of customer value;
- the reduce action is related to product/service attributes that are overdesigned and that could be provided at much lower performance without affecting perceived value;
- the raise action consists in increasing the performance of certain attributes well above the current industry standard, breaking the compromise with other features of the value curve;
- the create action aims at introducing brand new sources of value for customers.

Thus, the company's strategy should be reoriented acting on those features that directly affect the buyer's perception, whereas a performance increase for a certain attribute represents a growth in customer's value. However, already Ziesak [30] has highlighted how Kim and Mauborgne themselves use price in their value curves and how a high score of this attribute results in a low value for customers. Thus the employment of attributes generating dissatisfaction may result misleading especially with *reduce* and *raise* actions. The non-prescriptive formulation of the rules has resulted in several applications performed by BOS practitioners that show an incorrect use of the Four Actions Framework. These include the use of features that are not valued by customers [31,32] and mainly inherent to internal business processes, as well as attributes that have a reverse impact on buyers' perception and satisfaction [33].

Another issue related to BOS tools concerns the need to apply all the four actions in order to create a *blue ocean*, as recalled by Kim and Mauborgne in the chapter that introduces the ERRC Grid. However, it is arguable to assess such statement as a constraint, since even in classical BOS application cases, it is not straightforward to clearly individuate factors submitted to all the four actions: examples can be drawn by Siegemund [34], who examined Southwest Airlines, and Formule 1's value curve without any newly created attribute, as represented by Kim and Mauborgne [35] and subsequently by Narasimhalu [29].

*BOS' reliability*

Kim and Mauborgne have illustrated a set of case studies from a wide range of industrial sectors, in order to show the strength and the positive outcomes of their strategy. However it has been argued that is not possible to determine whether the examples have contributed to the formulation of the theory or if they have been chosen because they fit the strategy. As well as it is also unclear how exactly the method was developed [36], issues arise in terms of BOS' reliability and applicability.

*The need for an enhanced formalism*

As a consequence of the whole bundle of observations, the BOS' tools result to be pretty descriptive, useful to motivate the success of product and processes ex post, but don't provide systematic paths to identify the new product/service profile. The authors describe in this paper the preliminary results of a research encompassing multifaceted aspects of product development and lifecycle carried out in order to provide BOS' tools and value proposition strategies an enhanced formalism in the correct identification of the attributes and subsequently in the actions to be performed.

### *2.3. Objectives of the research*

The aim of the paper is therefore to provide a first contribution in order to systematize the individuation and the classification of the attributes subjected to the application of the Four Actions Framework. The guidelines emerging from the present research originate from the statistical analysis of the features, that are switched in the successful examples exposed in literature by Kim and Mauborgne.

## 3. Methodological approach of the research

### *3.1. Investigating preliminary guidelines aimed at systematizing a new value proposition*

The guidelines aimed at supporting the definition of value profiles for products and services thus lean upon the investigation of acknowledged successes in the market, carried out in order to verify the existence of any regularity arisen in the reconfiguration of the product attributes. The performed research encompasses various phases, starting from the individuation of the pertinent case studies for the investigation, to a statistical analysis about the functional features of the product/service attributes, whose modifications have led to new value propositions. The following paragraphs will describe more in detail these steps, summarized in Table 1.

*Individuating and selecting the case studies*

The aim of this step is to select a representative group of acknowledged products or services that, as documented by literature, have gained uncontested success in the marketplace, due to breakthroughs in the value profiles with reference to their industries of expertise. Such cases are then identified as successful implementations of a new value proposition strategy.

The case studies described by Kim and Mauborgne in the works that have led to the formulation of the BOS [9, 35,37], have been thus collected and examined in order to create the set of examples. The described products and services have been further investigated through scientific and technical literature, thus allowing to select those responding to the criteria of acknowledged success and characterization, through features both significantly enhanced and dropped to a lower level. This investigation has led to the identification of 32 case studies, that represent a wide set of product and services. The detailed list, as well as the references that don't pertain Kim and Mauborgne's literature will be provided in an extended version of the paper,

*Comparing the value curves and classifying the actions applied to the attributes according to the ERCC model*

The transformations, occurred from the traditional to the novel value curves for each case study, are substantiated by the attributes subjected by the actions foreseen within the ERRC framework. Thus, the task of this step is the individuation of product/service attributes that have been firstly introduced, eliminated by the set of competing factors, subjected to a drastic modification of their performance level. Such attributes are therefore classified according to the Eliminate, Raise, Reduce and Create actions.

| Step | Objective | Task | Tools | Outputs |
|---|---|---|---|---|
| 1 | To create a set of case studies to be investigated in order to extrapolate further guidelines | Individuating and selecting the case studies | Scientific and technical literature | A set of case studies acknowledged in the literature as successful New Value Proposition applications |
| 2 | To identify and characterize the shifts occurred to the value curves of successful products or services with respect to well-established standards | Comparing the value curves and classifying the actions applied to the attributes according to the Four Action Framework | Strategy canvas, value curve, Four Action Framework | Classification scheme of the product attributes in terms of the Eliminate Reduce Raise Create (ERRC) actions |
| 3 | To provide an insight about the retrieved attributes in terms by considering the elements that enable customer value at a functional level | Classifying the attributes in terms of the functional features | TRIZ functional analysis and Ideality; classification employed to rank Evaluation Parameters | Classification scheme of the attributes in terms of the Functional Features of the system |
| 4 | To characterize the evolution of the product profiles by the occurred modifications of the customer perceived value | Correlating the Four Actions and the functional features | Statistical analysis | Guidelines to perform an enriched value proposition strategy, based on Four Action Framework and TRIZ Ideality terms |

Table 1: Steps followed to extrapolate the guidelines.

In some cases, the literature about the BOS already individuates and explains the actions applied to the various product/service features. The authors have therefore defined all the attributes in terms of desired outputs, whose increase implies a growth in the customer perceived satisfaction. This leads to avoid misleading identifications of the actions applied. At the same time a particular attention has been paid in order to list attributes without mutual interrelations and dependences, as well as communalities in the contribution to more general valuable aspects for the customers. Thus, the sets of competing factors include just decoupled evaluation parameters that play an independent role in the generation of customer perceived value.

In order to systematically classify the actions of the ERRC framework, further ambiguities have been solved resorting to the Elements-Name of the feature-Value (ENV) model [38]. The properties which first characterize the value curves are the novel Elements of the strategy canvas and are distinguished by the action Create. The features which are not proposed in the strategy canvas, or don't represent anymore a factor of competition, are assumed as removed Elements and thus subjected to the action Eliminate. In the cases in which the modification of the attributes is outlined as a shift in the Value of the feature of a certain Element, the classification deals with the actions Raise or Reduce, depending on the enhanced or reduced perceived satisfaction for the customer.

*Classifying the attributes in terms of the functional features*

The guidelines that the paper aims to extrapolate are based on the classification of the attributes into three main categories (functional features), representing the terms that characterize the ideality (in TRIZ terms) from the viewpoint of the end user of the system under investigation. Thus, the scope of this step is to distinguish the attributes among outcomes of the useful functions (UF), measures to attenuate or avoid the inconvenience due to harmful effects (HF) and efforts aimed at mitigating the impact of resources' consumption (RES). Due to such definition of the functional features' classes, the increase of each attribute results in a growth of customer perceived value.

The classification and subsequent categorization (through clusters that will be indicated as sub-functional features) comply with a previously proposed classification for the Evaluation Parameters of a technical system [39]. As well as the Evaluation Parameters represent the requirements to be satisfied by a technical system, the attributes related to a strategy canvas represent the core of the requirements to be fulfilled in order to foreshadow a successful value proposition. However, while the features of technical systems are considered at a functional level, the attributes have to be classified by the user point of view in order to cope with an approach swiveling on customer value. Consequently the classification has been slightly customized in order to be employed within the application field. The authors have thus categorized the useful functions into threshold achievement (THR), versatility and adaptability under changing conditions (VER), robustness and repeatability of the outputs (ROB), controllability (CTRL); the harmful functions are classified according to the item subjected to the negative effect (system itself, SYS; super system, SUP; object of the Main Useful Function, OBJ); the resources are subdivided in space (SPA), time (TIME), materials (MAT), information (INF), energy (ENE), direct costs (COS).

Table 2 provides an example of classification of the attributes in terms of both functional and sub-functional features, as well as the indication of the actions to which they are subjected. In order to clarify the classification process, the authors have firstly consulted sources about the case study described in Table 2 (as well as for the other successful products and services) from BOS literature and other domains, so to obtain information about its original value profile. Subsequently the attributes subjected to any ERRC action, that have therefore determined the novel value curve, have been classified through the TRIZ related functional and sub-functional features by more research fellows, as explained in Section 4.

| Case | Action | Attribute | Functional feature | Sub-functional feature |
|---|---|---|---|---|
| NetJets | CREATE | Time saving for aircraft administration | RES | TIME |
| | CREATE | Ease of aircraft management | RES | INF |
| | CREATE | Savings on deadhead costs | RES | COS |
| | RAISE | Purchase cheapness | RES | COS |
| | REDUCE | Travel flexibility | UF | VER |
| | REDUCE | Flight speed | RES | TIME |

Table 2: Exemplary classification of the attributes subjected to the actions in a successful new value proposition.

*Correlating the Four Actions and the functional features*

The goal of this step is to delineate the proper guidelines by assessing the results of a statistical analysis. Once the attributes are classified according to the above defined criteria and the proper actions are identified, their mutual correlations are counted. By observing the statistical outcomes of the most occurring and the rarest crossover correspondences among attributes' classes and actions, the extrapolated guidelines provide indications about the most viable measures for building successful new value curves and about what to avoid at the greatest extent in order to prevent from failing propositions.

Another TRIZ model, the System Operator, has been adopted to strengthen the systematic procedure for the creation of new value curves.

Often referred as Multi-screen Schema in classical TRIZ literature, the System Operator is a key model of the TRIZ body of knowledge. It constitutes an effective means for avoiding psychological inertia in several steps of the problem solving process, and the essence of reasoning of a creative person [40].

Given its flexibility of use, the System Operator can be thus employed for mapping a wide range of situations, circumstances and working conditions otherwise neglected, consequently allowing to scout for enhancement opportunities. The application of the System Operator proposed in the paper is aimed at individuating unprecedented sources of value for the end user of manufactured products or delivered services. In order to customize the tool and so to highlight the valuable aspects considered by customers, temporal dimensions can be suitably articulated following a lifecycle perspective. It is hereby proposed to adopt a standard subdivision into the followings: purchasing and access activities; operations and conditions preceding the employment of the system; the utilization time; the period elapsing before further exploitations; the phases related to the definitive termination of the functions, the disposal, the dismantling.

## 4. Outcomes of the research

This section describes the outcomes of the survey performed about the classification of the attributes subjected to modifications within BOS' cases.

### *4.1. Overview of the research and of the employed tools*

The analysis of the previously listed 32 case studies has led to the identification of 288 product attributes that underwent the Four Actions of BOS.

The classification of these attributes has been carried out by more research fellows, in order to evaluate the robustness and the repeatability of the clustering criteria defined in section 3.1. The number of attributes, whose classification has been considered disputable, resulted appreciably low. At the first level of classification, thus considering the functional features only, 273 attributes were classified in the same way by all the fellows, resulting in an overlap equal to 94.5%.

As mentioned in chapter 3.1, the classified attributes have been further clustered at a more detailed (sub-functional) level. The number of attributes that resulted with a convergent sub-functional classification from all the fellows is 232, equal to:

- a 80.6% overlap taking into account the total number of attributes;
- a 85,0% overlap with reference to the set of attributes having a concordant classification for the functional features.

The controversial clustered attributes haven't been considered for the preliminary investigation of the guidelines. In other terms, at both the functional and sub-functional level, only the attributes having convergent and undisputed classification, have been employed as the overlay of the subsequent statistical analysis.

The distribution of the applied Four Actions can oppositely be referred to the grand total of the attributes:

- Create: 82 (28.5%);
- Raise: 107 (37.2%);
- Reduce: 58 (20.1%);
- Eliminate: 41 (14.2%).

Therefore the first conclusion which can be drawn by this study is that the actions aimed at increasing the user's perceived value (Create and Raise) represent about two thirds of the total. They are thus strongly predominant if compared with the number of measures that entail a drop in the customer satisfaction (Reduce and Eliminate).

### *4.2. Statistical evidences according to the first level of classification*

According to the level of classification related to the functional features, the attributes are distributed as summarized in Table 3:

| | OCCURENCES | OVERALL % |
|---|---|---|
| USEFUL FUNCTIONS | 157 | 57.5% |
| HARMFUL FUNCTIONS | 29 | 10.6% |
| RESOURCES | 87 | 31.9% |
| TOTAL | 273 | 100.0% |

Table 3: Distribution of the attributes according to the functional features.

Such distribution shows that a wide majority of attributes pertains outcomes related to useful functions, while the number of those related to the mitigation of negative effects and resources' consumption, is considerably smaller.

The data demonstrate that the biggest attention is focused on the desired effects for the user, that are the terms standing on the numerator of TRIZ ideality formula.

The occurrences of the functional features along the Four Actions are summarized in Table 4, while their percentage distribution is summarized in Table 5.

| | UF | HF | RES | TOTAL |
|---|---|---|---|---|
| CREATE | 45 | 7 | 23 | 75 |
| RAISE | 40 | 15 | 47 | 102 |
| REDUCE | 41 | 5 | 11 | 57 |
| ELIMINATE | 31 | 2 | 6 | 39 |
| TOTAL | 157 | 29 | 87 | |

Table 4: Occurrences of the functional features along the Four Actions.

| | UF | HF | RES | TOTAL |
|---|---|---|---|---|
| CREATE | 60.0% | 9.3% | 30.7% | 100.0% |
| RAISE | 39.2% | 14.7% | 46.1% | 100.0% |
| REDUCE | 71.9% | 8.8% | 19.3% | 100.0% |
| ELIMINATE | 79.5% | 5.1% | 15.4% | 100.0% |

Table 5: Percentage distribution of the functional features within each action.

In order to obtain useful information for the definition of the preliminary guidelines aimed at supporting the identification of new value curves, analysis criteria have to be defined for evaluating the extent of the impact played by the Four Actions on each class of functional features.

Beyond the previously depicted data, the authors believe that a possible way to evaluate this impact could be the evaluation of the difference between the percentage distribution of the functional features within each action, and that expected, alike in the general framework.

According to this assumption, the differences between the values summarized in each row of the Table 5 and percentages depicted in Table 3 have been calculated. The values reported in Table 6 express the percentage gaps for each functional feature within the actions, dividing the previously calculated differences by the expected distribution of Table 3.

| . | UF gap | HF gap | RES gap |
|---|---|---|---|
| CREATE | 4% | -12% | -4% |
| RAISE | -32% | 38% | 45% |
| REDUCE | 25% | -17% | -39% |
| ELIMINATE | 38% | -52% | -52% |

Table 6: Percentage gaps between the real and expected distribution of the attributes within each action according to the functional features.

The analysis of the general distribution of the attributes and of the percentage gaps brings the following relevant indications:

- *no particular preference is hereby remarked in the implementation of new attributes, hence the outcomes of Useful functions (UF) and the mitigated inconveniences due to harmful effects (HF) or resources' consumption (RES) follow a distribution within the Create action that is pretty similar to their global distribution;*
- *within the Raise action it is observed that the meaningful mitigations of the inconveniences due to HF and to the consumption of resources (RES) seem to be recommendable; conversely enhancements, although relevant, of the performances related to attributes classified as Useful Functions, don't show likewise benefits for the end user;*
- *the main trend related to the Reduce action is the drop of the performances defined as UF; on the other hand, the increase of needed resources is scarcely diffused and it could result as strongly inconvenient;*
- *the Eliminate action tends to be applied mainly to the UF attributes and meaningfully seldom to the features classified as HF and RES; therefore it seems to be extremely risky to introduce harmful effects previously absent or to foresee the employment of new kinds of resources; thus, when some outcomes of the system have to be jeopardized, in order to allow a new value proposition, the preliminary observations strongly advise to address the removal of attributes consistent to useful functions.*

### *4.3. Statistical evidences according to the second level of classification*

In order to obtain useful indications from the analysis of the second level classification of the attributes, a similar analysis has been performed in analogy with the distribution of UF, HF and RES sub-functional features. For the determination of the percentage gaps the calculation has been carried out with reference to the distribution of the sub-functional features within the related cluster at the first level of classification. Tables 7, 8 and 9 report the percentage gaps of the sub-functional features concerning UF, HF and RES attributes respectively.

| | THR | ROB | VER | CTRL |
|---|---|---|---|---|
| CREATE | 1% | -3% | -11% | 21% |
| RAISE | -3% | 171% | -33% | 8% |
| REDUCE | 19% | -100% | -5% | -34% |
| ELIMINATE | -17% | -100% | 58% | -4% |

*Table 7: Percentage gaps between the real and expected distribution of the attributes within each action according to the UF sub-functional features.*

The analysis of the depicted values brings to the identification of some relevant trends related to UF sub-functional features:

- *it is worth to mention the emphasis that seems to be given to the creation of attributes related to the controllability of the system;*
- *a tendency is observed to consistently raise the capability to provide the same desired outcomes under varying inputs (robustness);*
- *the Reduce action is preferably addressed to diminish the value of UF attributes that are ranked into Threshold achievement;*
- *the features that are eliminated or that don't represent anymore competition issues, deal significantly with the versatility and the adaptability of the system, i.e. blue ocean can be found through specialization.*

Through the outcomes of Table 8, further preliminary guidelines can be drawn out; however the small amount of HF attributes doesn't allow to assess their reliability at all:

- *at a first glance, the attributes that are firstly introduced in the new value curve and that pertain undesired effects and drawbacks, are mainly associated to those that play an impact on the external environment (SUP);*

- *significant enhancements in terms of attenuating undesired effects affecting the object of the system, are quite diffused in building new value curves;*
- *worsened outcomes in terms of drawbacks against the super-system seem to be the most accepted;*
- *as a consequence of redefining the sets of values for a product or a service, the introduction of harmful functions that seems to be tolerated at best, is related with the impacts on the system itself; on the contrary, relying on the observations, any bad consequence on the object of the system, not being already present in the reference industry, has to be discouraged.*

| | OBJ | SYS | SUP |
|---|---|---|---|
| CREATE | -31% | -100% | 95% |
| RAISE | 24% | 24% | -54% |
| REDUCE | 4% | -100% | 30% |
| ELIMINATE | -100% | 333% | 62% |

Table 8: Percentage gaps between the real and expected distribution of the attributes within each action according to the HF sub-functional features.

| | SPA | TIME | MAT | ENE | INF | COS |
|---|---|---|---|---|---|---|
| CREATE | -100% | 7% | 42% | -100% | 70% | -41% |
| RAISE | 80% | -2% | -100% | 80% | -28% | 18% |
| REDUCE | -100% | 23% | -100% | -100% | -26% | 27% |
| ELIMINATE | -100% | -44% | 800% | -100% | 35% | -53% |

Table 9:1 Percentage gaps between the real and expected distribution of the attributes within each action according to the RES sub-functional features.

According to the values presented in Table 9 the following preliminary indications can be outlined about RES sub-functional features:

- *benefits can arise by introducing new features centred on the reduction of employed resources in terms of required information, know how, practice of use, materials; on the contrary, starting to compete on the price and on the need of energy doesn't result to be advantageous at the same extent;*
- *positive feedbacks come out by attenuating the user needs in terms of energy and space;*
- *the increase of time requirements and direct costs, on which the competition is already based, seems to be the least impacting;*
- *the introduction of novel requirements for the system employment, if necessary, should be best based on materials or information; at the current stage of the survey, analogous measures related to other kinds of resources have to be discouraged.*

## 5. Discussion about the guidelines and other evolution hypoteses

This section is aimed at discussing the most noticeable congruencies and mismatches between the preliminary guidelines, obtained through the statistical analyses described in section 4, and the indications pertaining different evolution hypotheses in the field of innovation and business. However, it is worth to notice that the parallel drawn is affected by the circumstance that most development theories concern the evolution observed by product platforms, while by means of BOS the competing systems that are compared can be significantly different and pooled only by the common accomplishment of certain user needs.

The main evidence arising from the research is the growing role played, within the renewal of product value profiles, by resources safeguard, and more generally by the measures performed to attenuate undesired aspects of a product/service. Indeed, both RES and HF functional features come out more frequently in the groups of attributes subjected to the actions Create and Raise; on the contrary, the functional features classified as UF constitute the bulk of the attributes having reference to the actions Reduce and Eliminate.

Within the LESE, the Law of Uneven Development of the Parts of a System assesses that the priority assigned to certain performances, and specifically to the Main Useful Function (MUF), lead to the unequal evolution of the elements of the system itself and consequently to the birth of contradictions. If such conflicts are overcome in the last phase of the system development, the system faces the enhancement of the aspects that had been jeopardized by the growth of the main function. It is not possible to directly link the law with the recalled main evidence of the research carried out, since the improvements can concern secondary useful functions, as well as harmful effects and resources requirements. Nevertheless the terms that constitute the denominator of the ideality formula are relevant just during the last steps of the evolution of the technical system. The Law of Increasing the Degree of Ideality foresees two different mechanisms, in agreement with the wave model of resources consumption [2]. The first type of ideality growth involves the enhancement of the MUF with minor increase of the consumed resources; the second half of the S-curve is characterized by a drop of the required resources, still preserving the outcomes related to the MUF.

Within the Wave Model by Salamatov [2] the mechanism of reduction of resources required by the system happens after the maturity stage. With a greater affinity with the indications arisen by the statistical analysis, the obsolescence phase, depicted in the final part of the S-Curve of Evolution, observes a relevant drop in the resources employment and a less consistent decrease of useful functions, in terms of their number or extent. The same model pertaining an akin set of stages characterizing the S-Curve is outlined also by Lapidot [41], that employs the concept of “costs” instead of “resources”, by considering the overall expenditures and undesired outcomes, thus including also the harmful functions.

Still in the context of product innovation, a study about awarded original engineering systems reveals how the determinants for their success lie in the enhancements brought to interaction with the user and the environment [42]. These kinds of improvements, that can be ranked among the attributes related to resources and harmful effects, overbear the benefits generated by additional functions.

Some analogies with the assessed relevance of resources and drawbacks of mature products can be tracked also in the field of business and industrial management. Utterback and Abernathy, already in the 70s [43], depicted a product development model constituted by three different stages, foreseeing:

- a first performance maximization, addressed to fulfil the needs of the user and characterized by high products innovation;
- a massive competition aimed at pushing the sales at the greatest extent, from which a dominant design emerges; such phase shows remarkable process innovation and is stimulated by technological progress;
- the minimization of the costs for highly standardized products, competing thus on the resources requested to the user.

This model constitutes the basis for more recent frameworks within industry lifecycle evolution, assessing the shift of emphasis from products to processes and services. Thus the evolution involves at a greater extent those aspects that are less connected with the main performance of the system and more linked with efforts played by the customers in order to gain certain outcomes. A survey of these models is provided by Cusumano et al. [44].

## 6. Conclusions and future developments of the research

The paper is a first attempt to systematize the procedure for building a successful new value proposition strategy. The preliminary attempts have been addressed to overcome formal ambiguities related to the successful strategies developed within BOS. After showing some fuzzy aspects of this technique, the authors propose a classification of product and service attributes that have been subjected to consistent modifications in BOS literature examples of new value propositions. The Four Actions Framework and the functional features characterizing the TRIZ ideality formulation from the user‘s viewpoint, together with proposed subcategories, have been chosen as the taxonomy of the classification. The statistical analysis of the attributes categories has led to the identification of relevant

recommendations that represent a first attempt towards the synthesis of more systematic guidelines aimed at supporting new value proposition tasks. Moreover, it has been showed that the System Operator can provide useful suggestions to investigate the viable directions for the definition of product and service value profiles. A step forward in order to implement the guidelines with TRIZ tools is foreseen by linking the outcomes of the present survey with the Network of Evolutionary Trends [6]. Indeed, among the alternatives offered by the evolution trends depicted through the NET, the guidelines should guide the designer in choosing the most promising branch to develop a successful product to enter the marketplace.

According to the discussion performed in Section 4, the statistical analysis has highlighted, in the renewal of product platform, a trend assessing an increasing emphasis on resources and harmful functions and a substantial reduction of the useful outputs that the industry has long competed on. This trend is confirmed also by other indications coming from various scientific domains. Nevertheless, in order to integrate and validate such preliminary guidelines and the other suggestions emerging from the statistical analysis, it is worth to apply the employed classification framework also to other successful examples of new value proposition not belonging to BOS literature. As well, with the objective of substantiating the recommendations about the measures to be avoided, an examination of unsuccessful value proposition examples could provide a better understanding of the motivations that have led to products' and services' failures.

The guidelines emerging from the investigation of the Create action should be the most relevant, being the proposition of pretty new product attributes appreciated in the marketplace the most severe challenge for the strategies based on value. Unfortunately, the statistical analysis of the attributes firstly introduced in the domain industry hasn't brought any unmistakable hint. In order to fill this gap and strengthen the definition of the guidelines, it could be appropriate to provide other taxonomies for classifying the attributes.

Even if the guidelines that were defined by the functional classification of the attributes provide suitable suggestions on what should be done to define a new value curve, criteria giving a prioritization in the selection of the most suitable recommendations are still lacking. Therefore further development of the research should go towards the definition of such additional criteria.

With this purpose, the use of the System Operator itself, suggests to investigate the elements and the product lifecycle phases affected by the novel attributes, thus establishing the mutual relationships with the operative time and space of the MUF of the system. In other terms it is viable to identify whether the new benefits are perceived during, before or after the display of the main performance of the system, as well as to observe the hierarchical level of the product or service involved in order to provide the advantages originated by the attributes under investigation.

Some other research has been carried out in order to link the new valuable attributes to seeded and yet unrevealed needs. Although a theoretical background [45] has been built to relate needs theories (especially Maslow's model and its evolutions) with the attributes created by applying the BOS or the attractive requirements described by the Kano model [46], practical indications to systematize the new value proposition process are still lacking. Working on a similar background, studies have been carried out to deepen the perception of functional and emotional features of products and services, fulfilling users' requirements and nevertheless related to human needs [47]. As well, Cagan and Vogel [48] have advanced proposals to accomplish new value proposition strategies based on the interplay of functional and emotional product features. These hints, beyond representing a critical support for the BOS' path "Look across functional or emotional appeal to buyers", can constitute a further field of research for strengthening the guidelines, by taking into account the human needs that are stimulated by the new attributes and the forms of customer perceived value.

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**List of acronyms**

BOS: Blue Ocean Strategy
COS: Direct costs attribute

CTRL: Controllability attribute
ENE: Energy attribute
ENV: Elements-Name of the feature-Value
ERRC: Eliminate Reduce Raise Create
HF: Harmful Functions
INF: Information, know-how attribute
LESE: Laws of Engineering Systems Evolution
MAT: Material attribute
MUF: Main Useful Function
NET: Network of Evolutionary Trends
NPD: New Product Development
OBJ: Object attribute
QFD: Quality Function Deployment
RES: Resources
ROB: Robustness attribute
SPA: Space attribute
SUP: Environment (super-system) attribute
SYS: System attribute
THR: Threshold achievement
TIME: Time attribute
TRIZ: Theory for Inventive Problem Solving
UF: Useful Functions
VER: Versatility attribute
VOC: Voice of Customer

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