Value-Conflict Mapping™ (VCM) To Define and Structure Innovation Strategy

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1 INTRODUCTION

Evolution of any technological or business product is driven by three large groups of impact factors:

- **Voice of market**: all demands and requirements which are comprised by existing and emerging demands, new trends, new developments, changes in a product's supersystem.
- **Voice of business**: each business organization is interested in growth as well as in the most effective and efficient production and delivery of its products and services.
- **Voice of technology**: internal drivers of technology evolution, new technological developments, emerging technologies, scientific discoveries, technology diversification.

Today virtually every organization, no matter what type of material products or immaterial services it delivers, relies heavily on underlying technologies to create new value: it can be either a new manufacturing technology for producing steel pipes or new telecommunication and data processing technologies used by an insurance company.

The dialectic approach to evolution states that each time, soon after a balance between these groups of factors is achieved, some factor will change and the only adequate response by a business system would be to innovate: either on a product or a business side (e.g. a new business model). It is well known in TRIZ that in order to create a breakthrough innovation, we need to eliminate a contradiction which blocks further evolution of a current system, which can be either a technical product, or a business service. However, emergence of contradictions is not limited to technical requirements and parameters only. There is always a large group of cross-disciplinary contradictions between these three voices. For example, a mass market demands ordinary lightweight bicycles for comfort and easier riding; but a company producing these bicycles is interested in reducing material costs which would be not possible to achieve if the bicycles would use lightweight composite materials which are still too expensive today. Thus a good known technical solution can not be used due to a limiting business constraint.

To correctly define future innovation strategy related to the customer's business, one needs to design a map which would establish and structure relationships between all types of contradictions to be able to identify those contradictions which should be resolved within short and long terms. To create such maps, we developed and introduced a technique called "Value-Conflict Mapping" which is presented below.

Value-Conflict Mapping has been developed in parallel and incorporates some basic ideas of OTSM-TRIZ and is based on a similar idea to networking contradictions. On the other side, it introduces an approach to mapping market demands to contradictions as well as mapping the contradictions to new demands.

In classical TRIZ, main research focus was traditionally placed on solving a specific inventive problem [1], and that is why major attention was paid by G. Altshuller and his associates to developing and enhancing ARIZ [2] and a system of Inventive Standards [3]. However in many cases, a starting point for an innovative project is to explore how our product or service can be improved and evolved on a broader scale before solving any specific problem. Even if we would like to focus on solving a specific but complex problem, we need a method that would assist us with managing the problem complexity and provide us with sufficient information to make right decisions what and how to change.

One of the first techniques for complex analysis of technical systems which was included to TRIZ was Function-Cost Analysis [4] (also known as Function-Attribute Analysis). Another approach is a direct application of the TRIZ Trends of Technology (or Business) Evolution to a selected product or service to breed new ideas of future generations of products and services [5,6]. All known modifications of these approaches have their advantages and disadvantages: they either deal with contradictions in implicit way, or do not provide linking between the three groups of impacting factors ("voices") mentioned above. For instance, while Function Analysis can be used to comprehensively map functional interactions in a system, it is limited to representing non-functional attributes (such as, for instance, aesthetic, emotional or business parameters) of the system, and asa consequence they are not included to the analysis. On the other hand, a disadvantage of the direct application of the TRIZ Trends of Evolution is that we might miss crucial information about existing and potential contradictions and thus we can only rely on our intuition to make a conclusion about the degree of future success of ideas proposed. In addition, evolution of a system can be blocked by many smaller, often "invisible" contradictions which we do not properly recognize. For that reason we need a tool which will help us to recognize, visualize, and map blocking contradictions thus we would clearly see what we have to do and use this information to define our innovation strategy.

The concept of a contradiction is a core element of TRIZ and should not be neglected during innovative projects. Today there is a range of existing and emerging techniques which help with identification and definition of contradictions for solving specific problems such as Problem Formulator [7], RCA+ [8]. Proper recognizing of driving and even minor contradictions ensures success of new innovative ideas since we get a better understanding why we need to introduce one or another change. Another important issue is to be capable of foreseeing contradictions which today are not noticeable but will play a major role in the future.

Modern technological and business systems are quite complex and involve large numbers of interrelated contradictions. Some research and developed techniques already deal with this issue within OTSM-TRIZ, which is extension to Classical TRIZ being developed by N. Khomenko and his colleagues [9,10].

Value-Conflict Mapping has been developed in parallel and incorporates some basic ideas of OTSM-TRIZ and is based on a similar idea to networking contradictions. On the other side, it introduces an approach to mapping market demands to contradictions as well as mapping the contradictions to new demands.

2 VALUE-CONFLICT MAPPING

Value-Conflict Mapping (VCM) was designed to help with extracting and linking technology, business and market contradictions. VCM proposes a process of direct mapping of existing key customer demands and market trends to relative values of properties or parameters of existing products or services, and then identifying the existing contradictions and revealing potential ("hidden") contradictions by a procedure of value inversion. Thus a central idea of VCM is to define how the existing technological or business products and systems contradict to business and market demands, trends, and requirements.

There might be three groups of contradictions:

1) Between two specific market demands put on the same system's part. For instance, an automotive light should have both high intensity of light (to better lit a road in the dark) and low intensity (to avoid blinding of other drivers). Most of contradictions in technical systems and products arise at the level of market demands or can be translated to them.
2) Between a market and a business demands. For example, a plane must be checked very thoroughly during airport parking to ensure safety of a flight. However it requires increasing the number of technicians and parking time which would negatively influence revenues of the airline.
3) Between two business demands. For example, a supermarket management considers bringing more employees to the supermarket floor to help customers with better product choice. However it requires increasing the number of sales assistants which would negatively impact profit margin of the supermarket.

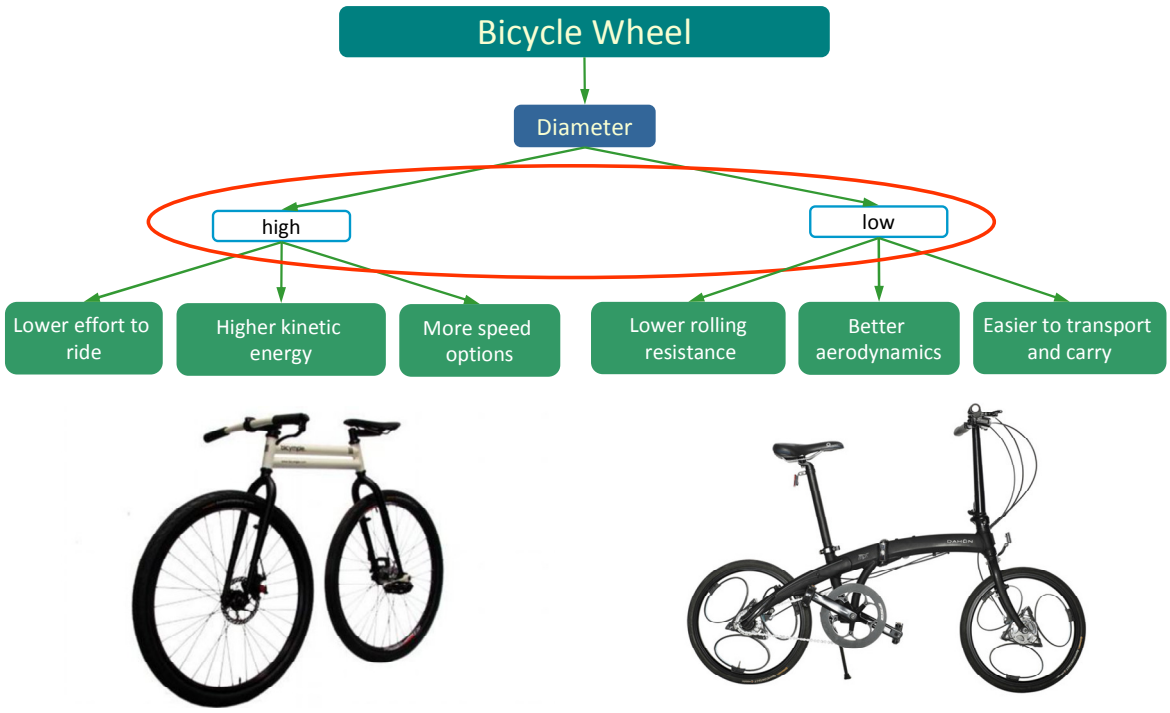

Figure 1: Example presenting contradictions which are caused by opposite values of a certain parameter in a system. A large bicycle wheel satisfies one set of demands once a small wheel satisfies a set of different demands.

3 VALUE-CONFLICT MAPPING PROCESS

General phases of the VCM process are depicted in Figure 2.

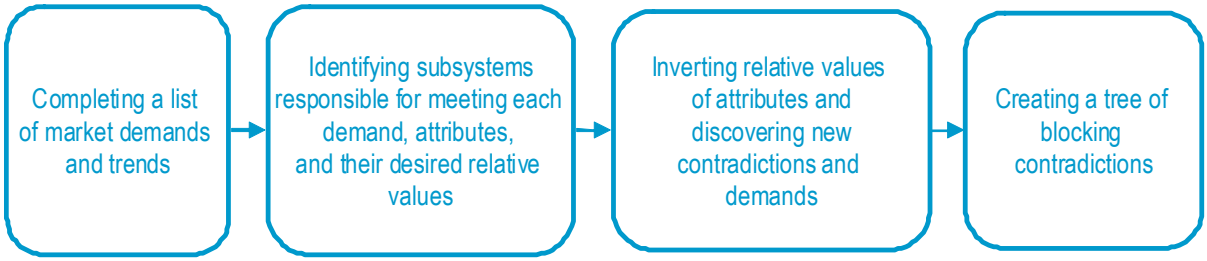

Figure 2: A general process of Value-Conflict Mapping

VCM is performed by completing a table which consists of the following columns (Table 1):

1) A market demand or a market trend.
2) A part of a system responsible for fulfilling the demand or the trend.
3) Attribute (property, attribute, feature) which is responsible for fulfilling the demand or the trend.
4) A desired relative value of the attribute.
5) Index of Current Satisfaction of each demand.
6) Business demand which is associated with the attribute.

MARKET DEMAND	SUBSYSTEM	ATTRIBUTE	RELATIVE VALUE	INDEX OF CURRENT SATISFACTION	BUSINESS DEMAND
A customer /market demand or a market trend which is becoming a demand	*A part of a system (subsystem) responsible for meeting the demand. Can be a whole system as well.*	*A property (parameter) which is responsible for meeting the demand. It is associated with a subsystem defined in the left column.*	*A desired relative value of a property/ parameter to fulfill the demand (e.g hard, soft, high, low, etc.)*	*Index with respect to desired demand satisfaction: "+": good "0": can be improved "-": not satisfactory*	*A business demand which contradicts a market or another business demand demand (if any)*

Table 1: A typical string in a VCM Table

To start VCM, we should first select a system which we are going to analyze. It can be a technical object, or a business product, or an organization. In other words, it can be any man-made system.

There are nine basic steps in the analytical part of the process:

1) Gathering information on market/customer demands and market trends. Often such information is readily available after thorough customer and market research independently of TRIZ and other innovation activities. Usually the list includes both functional and non-functional requirements and demands.
2) Each market demand or a trend is linked to a certain part (subsystem) of a system under consideration which is responsible for meeting that particular demand. Often, general demands can be divided to more specific demands. If there are several subsystems connected with the same demand, all of them are included to the analysis. In some cases, the entire system can be related to a particular demand (for instance, the overall weight of a system), although in this case it is recommended to extract most contributing subsystems.
3) An attribute (property, parameter, or feature) which is responsible for fulfilling a selected demand is identified. It can be weight, size, transparency, amount of information, number of sales people, amount of transactions, and so forth. It should not necessarily be a physical parameter, especially when we work with business or organizational systems.
4) A relative value of the attribute is identified: here with a "relative value" we mean a desired qualitative measure with respect to fulfilling a corresponding demand. For instance, to satisfy a certain demand the weight can be high or low, a number of employees can be small or large, and so on. At this stage we do not pay attention to any specific numeric values, only to their qualitative states.
5) After each attribute has been identified with its relative value, its Index of Current Satisfaction is estimated. There are three possible values: "satisfactory", "non-satisfactory", and "satisfactory but can be improved". The latter is used to indicate that there is a potential for improvement and this attribute should not be neglected.

#	MARKET DEMAND	SUBSYSTEM	ATTRIBUTE	VALUE	IS
	Short walking time	Shopping space	Area	Small	-
	Broad selection of goods	Goods	Diversity	Large	+
	Goods must be fresh	Goods	Expiration time	Long	0
	All goods are to have nutritional info	Packages	Information	Much	-
	Quick advice from the personnel	Personnel	Number	High	-
	High quality of advice	Personnel	Competence	High	-
	Fun shopping	Entertainment area	Size	Large	-
	Kids entertainment	Entertaining personnel	Number	High	-
	No waiting in lines	Personnel	Number	High	+
	Attractive pricing	Goods	Price	High	-
	Always available	Goods	Number	High	+
	Clear visualization "what where"	Signs	Size	Large	-
	Broad selection of discounted goods	Goods	Price	Low	-
	No crowds	Shopping space	Area	Large	+
	…	…	…	…	…

Table 2: Completing the first 5 steps of VCM

6) A relative value of each attribute is inverted to explore if we can discover missed or new market or business demands which can be added to the table.
7) If a desired relative value contradicts a certain business demand, this business demand is added to the column of business demands.
8) All contradictions in the resulting VCM table are grouped and graphically represented as a VCM tree.

An example of completing the first 5 steps of the VCM process is shown in Table 2. Only a fragment of the actual table is shown to simplify presentation. A case was to explore how a supermarket's product department could be improved.

As we can see table 2 already provides us with information about a number of contradictions: for instance, the area of a shopping space should be large to avoid overcrowding, and at the same time the area should be small to reduce walking distance, and as a consequence, shopping time. Next, this table should be added with new contradictions and new demands.

The output of VCM is a set of trees of contradictions related to different system's parts. These contradictions, in turn, can be further resolved with relevant TRIZ techniques. In case when a system's part experiences the largest number of contradictions, it is usually selected as a primary candidate for improvement. The required improvement is reached by increasing the overall degree of ideality of the system's part with the TRIZ trends of technology or business evolution.

4 INVERSION IN VCM

Value inversion plays important role in the VCM philosophy to discover new opportunities. We often take things for granted and do not think about "what if….". It is one of numerous effects of our psychological inertia: we used to accept things which surround us as they are; and we rarely think about what would happen if we consider the same things within the opposite context. For instance, we used to think that roads must be as wide as possible to accommodate more traffic. But what would happen if the roads would become extremely narrow? In such case we will obtain many positive effects: less noise, no large damage to the existing infrastructure, less building and maintenance costs, and so forth. But narrow roads will demand a complete rethinking of a concept of transportation. Still, making such statement explicit is important: inversion will force us to

register contradictions and eventually come up with new breakthrough ideas to resolve either small-scale or long-standing contradictions.

The process of inversion is performed in the following way. A string in a VCM table looks as follows (Index of Satisfaction is omitted):

Demand -> Subsystem -> Attribute -> Relative Value

Now we should replace the relative value with its "anti"-relative value and reconstruct the chain backwards:

Anti-Relative Value -> Attribute -> Subsystem –> New Demand

This new demand can be a market demand or a business demand. Let us consider the following example with a bicycle. A wheel should have a large diameter to provide easy riding. Thus the string should look as:

Easy Riding -> Wheel -> Diameter -> Large

Now we should invert the relative value "large" to the relative value "small" and ask the question: will there be any positive effects for a customer or business of a bicycle manufacturer? Certainly: the bicycle will become smaller and less bulky, thus the customers will be able to carry it with less efforts. A small bicycle means lower material and delivery costs for the bicycle manufacturer as well. Thus we can add the following lines:

Easy Riding -> Wheel -> Diameter -> Large

Easy Carrying -> Wheel -> Diameter -> Small

Easy Transportation -> Wheel -> Diameter -> Small

Easy Maintenance -> Wheel -> Diameter -> Small

As one can see, we can add new demands after inversion which makes a picture of contradictions more complete.

Apart from helping to identify other market and business demands, inversion helps to make many contradictions explicit which block further evolution of the same subsystem. It is important since in many cases the same subsystem might cause numerous contradictions and thus we should have as most complete picture of involved contradictions as possible to define the right priorities and areas where to concentrate most of our future innovative efforts.

The resulting fragment of the VCM tables for the supermarket is shown in Table 3.

#	MARKET DEMAND	SUBSYSTEM	ATTRIBUTE	VALUE	BUSINESS DEMAND
C1	Short walking time	Shopping space	Area	Small	
C1	No crowds	Shopping space	Area	Large	
C1		Shopping space	Area	Small	Low Rental costs
C1	Broad selection of goods	Shopping space	Area	Large	
C2	Products freshness	Goods	Expiration time	Short	
C2		Goods	Expiration time	Long	Avoid product loss
C2		Goods	Expiration time	Long	Low-cost storage
C3	Quick advice from the personnel	Personnel	Number	High	
C3		Personnel	Number	Low	Cost saving
C4	High quality of advice	Personnel	Competence	High	
C4		Personnel	Competence	Low	Cost saving
C5	Fun shopping	Entertainment area	Size	Large	
C5		Entertainment area	Size	Small	Rental costs
C6		Entertaining personnel	Number	High	
C6		Entertaining personnel	Number	Low	Cost saving
C7	No waiting in lines	Cashiers	Number	High	
C7		Cashiers	Number	Low	Cost saving
C8	Always available	Goods	Number	High	
C8		Goods	Number	Low	No product loss
C9		Goods	Price	High	Higher margin
C9	Attractive prices	Goods	Price	Low	
C9	Broad selection of discounted goods	Goods	Price	Low	

Table 3: Adding new customer and business demands to VCM (Supermarket case)

For instance, by inverting the relative value for "a number of personnel is high" to "low" would provide us with considerably lower labor costs which was added as a business demand. Similarly, a new market demand was added to the table illustrating the bicycle case (Table 4): by inverting the relative value of light intensity we added a new demand: low intensity of the light will help to avoid blinding of other riders. In the actual table on the bicycle case, more than 50 new market demands were added.

#	MARKET DEMAND	SUBSYSTEM	ATTRIBUTE	VALUE	BUSINESS DEMAND
C1	Smooth running	Tire	Elasticity	High	
C1		Tire	Elasticity	High	Higher revenues
C1	Long tire lifetime	Tire	Elasticity	Low	
C1	No need to replace tire	Tire	Elasticity	Low	
C2	No sail effect	Wheel	Hollowness	High	
C2	Higher stiffness	Wheel	Hollowness	Low	
C2		Wheel	Hollowness	Low	Cheaper to manufacture
C3	Easy to carry	Wheel	Diameter	Small	
C3	Easy to cycle	Wheel	Diameter	Large	
C3		Wheel	Diameter	Large	Easier transportation
C3	Easy maintenance	Wheel	Diameter	Large	
…	…	…	…	…	…
C54	Better visibility in the dark	Lamp	Light Intensity	High	
C54		Lamp	Light intensity	High	Better revenues
C54	Less blinding	Lamp	Light intensity	Low	
C54	Less energy spent	Lamp	Light intensity	Low	

Table 4: Adding new customer and business demands to VCM (Supermarket case)

5 VCM TREES

To provide a better visualization of results, so-called "VCM trees" are built after completion of the VCM process. Fragments of such trees are show in Figures 3 and 4. As we can see, on top of each tree we place subsystems which were included to the corresponding VCM tables.

The VCM trees can be useful to visually present the results of the VCM to a larger group of people, whose input might directly lead to new insights.

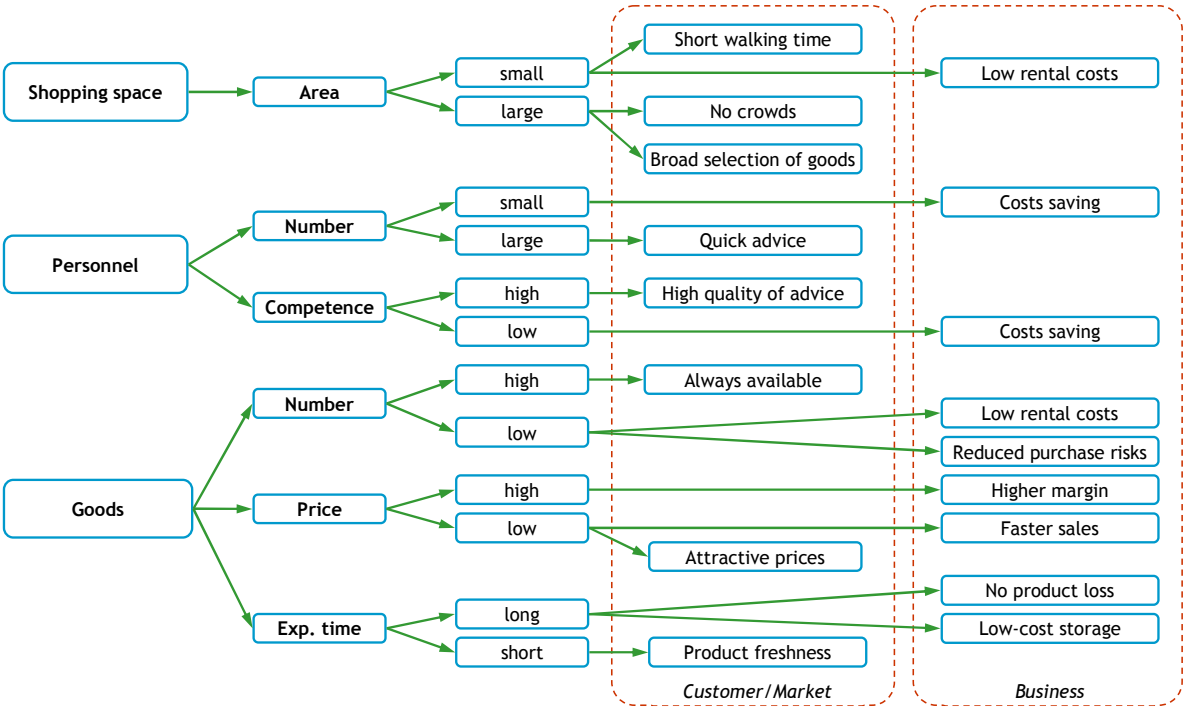

Figure 3: A fragment of a VCM tree after supermarket analysis.

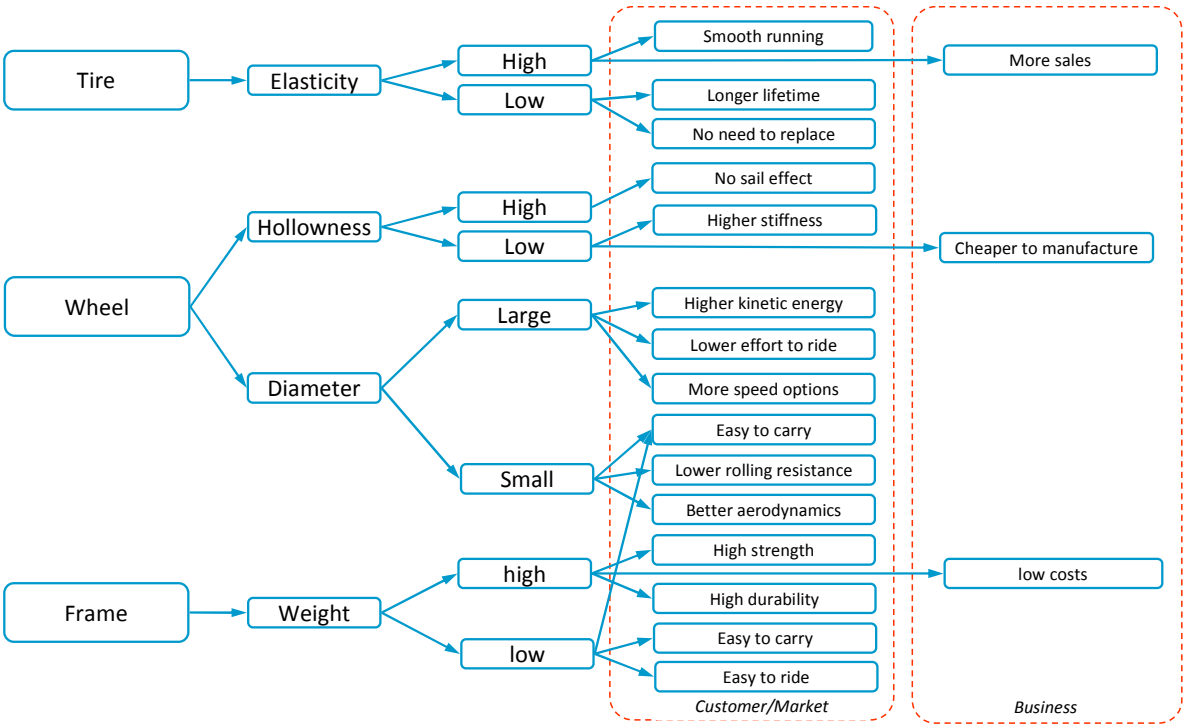

Figure 4: A fragment of a VCM tree after bicycle analysis.

Often the question arises, "Why can not we start doing VCM directly with building the VCM trees?" A goal of VCM is to systematically map market demands to relative values of system properties and not vice versa. A process will be more systematic and results will be more complete and consistent after we first complete the VCM tables and then visualize them in form of the VCM trees.

6 WORKING WITH VCM RESULTS

After the VCM Analytical Part is complete, there might be several ways of working with its results. For instance, most important contradictions can be identified with the ranking procedure and then resolved with classical TRIZ problem solving techniques, for instance, ARIZ.

However, in many cases the same subsystem is related to a multitude of contradictions, and solving one or another contradiction will only satisfy a part of demands, or it will generate new problems depending on a particular solution. As follows from our experience, a more effective strategy will be to use the TRIZ Trends of Evolution by applying them to a subsystem which causes most of contradictions. This procedure is known and thus we omit is presentation in this paper.

After the ideas generation session is finished, ideas and concepts obtained are ranked and landscaped to identify:

- most promising candidates for a short-term implementation and
- most promising candidates which would require more efforts for a long-term implementation.

Since a completed VCM process provides sufficient information and a broad overview of current and potential contradictions which can be used to formulate many different tasks, these results can be re-used in different projects.

7 SUMMARY

Summarizing, application of VCM provides the following:

- Mapping market demands to contradictions caused by a current system.
- A comprehensive overview of system parts (subsystems) causing contradictions.

- Identification of new or "hidden" contradictions and demands via the procedure of value inversion.
- Input for a multitude of projects on further system innovation.
- Information for defining and structuring innovation strategy with respect to a selected technological, business, or organizational system.

VCM can be used in various contexts and for analyzing various types of systems. For instance, VCM can be used to analyze technical systems and products without adding business demands: to collect information about contradictions at the level of market and technical demands only.

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