Applying Value Analysis and Value Engineering to Develop a Popular Wheel Clamp

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Abstract— The work describes the basics of value analysis and value engineering and presents detailed overview of its distinct stages applicable to any merchandise with the aim of boosting its value. Besides, the paper examines the case of delivering a new popular wheel clamp on the market. The research discovers that one can accomplish it through improving the design of a specific model of the device in the framework of value analysis and value engineering. The enhancement consists in reduction of the number of components, implementation of the fool-proof technology, and taking advantage of the leverage. The activity gives rise to the improved design of an affordable wheel clamp.

Keywords— "Value Analysis and Value Engineering (VA/VE), Distinct Stages of VA/VE, Improved Design, Product Life Expectancy Domain, Function Analysis System Technique (FAST"

I. INTRODUCTION

Traditionally, the methodology of value analysis, as well as value engineering, (VA/VE) aims at boosting the value of a merchandise through identifying components for which one can either increase the benefits of their roles or lower their costs. However, the need for such the change is often not evident since VA/VE efforts are costly whereas the competitive forces of the market could subdue the expected pay off drastically. Nevertheless, the likely explanation of the worsening political stability globally is the decline of the value of the human life automatization of a production process caused. Creation of numerous job places in the service industry could improve such the state of affairs. Therefore, in the long run it is worthwhile to substitute existing goods with more popular ones and make their use too challenging for machines since they resolve quality issues much worse than human beings do. To lower the risk, it is appropriate to start such the program with substitution of products which quality could impact a strategy of a military operation. Among such the goods there is a wheel clamp since such the operation assumes frequent repairs. Hence, in view of worsening of political stability on the global scale, creating a wheel clamp free from broadly-known defects and with the improved design has a value.

Figure 1 depicts steps the methodology assumes. This work sheds light on the elements of VA/VE and use the production

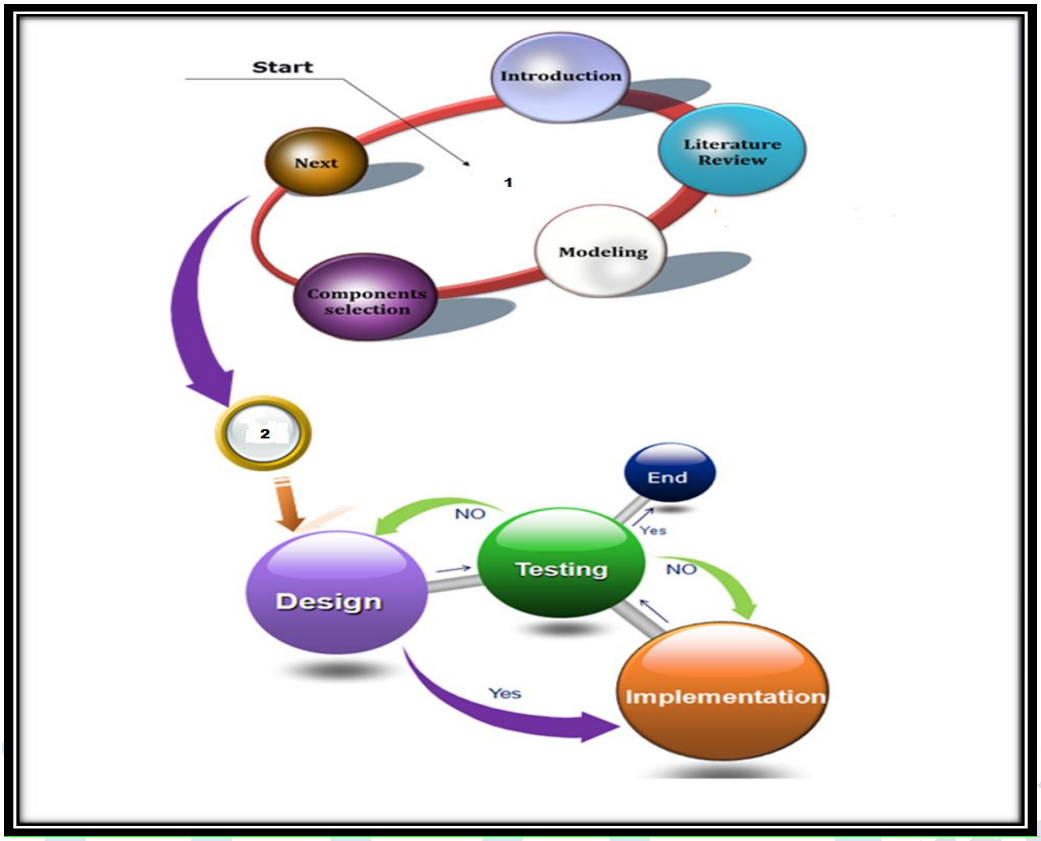

Fig 1: project steps

of wheel clamps to demonstrate the pros of the methodology. The following subsection contains the review of the research in the area of VA/VE.

Key words: “Early Sex, Factors, Young Schooling Children, Kigali-Rwanda”.

II. LITERATURE REVIEW

In the forties of the past century, Lawrence D. Miles worked at General Electric and frequently faced the lack of all kinds of input of the production process due to the Second World War. Looking for substitutions, he came up with numerous innovations. The researcher realized that one can handle material constraints through generating innovations linked to accumulating value of the merchandise. Understanding that the function analysis provides a convenient framework for such the linkage, he was capable of developing the methodology of innovation generation based on it and broadly known as VA/VE. Lawrence D. Miles scrutinized the behavior of consumers and figured out that they pay attention to the functions of the merchandise and the relation of its appearance as well as its other qualities to the notion of the good taste. Therefore, developing VA/VE he put emphasis on studying the roles of different product components. The framework of this methodology assumes seeking design enhancements and switching to more inexpensive materials as well as new ideas of performing needed functions. To facilitate concentrating attention on the component roles, Lawrence D. Miles offered to avoid passive voice in the descriptions of values the functions generate and to use in these depictions nouns that assume measurable amounts or quantities. Besides, according to him, it is worthwhile to analyze different options of delivering values of the roles. These findings contributed to formation of the function analysis that promotes the

team work and individual efforts aimed at comprehending new ideas of delivering values. The major concerns of such the activities relate to boosting sales figures, cutting resource expenses, and enhancing product quality. One can achieve success through paying attention to benefit imbalances in merchandise or a procedure on the design stage [1]. VA/VE resulted in increased comfort of people since they enjoy inexpensive products that deliver numerous functions [2]–[4].

Nowadays, VA/VE promotes satisfying needs of customers from the poor nations since they require less expensive products with some specific features beneficial thanks to local peculiarities. Besides, in the developing world there are suppliers that offer resources at unfairly low prices. It turns out that the technological advantage of the developed countries cannot outperform the difference in prices. Such the state of affairs results in increased competition that alters sales figures drastically. Besides, the access to the Internet became ubiquitous. It boosted the evolution of technologies to the great extent. Consequently, the merchandise lives shrank greatly.

As for the rich nations, the companies cater to not only customer needs but also to the societal ones. Besides, they have to pay attention to environmental considerations [5].

III. DEVICES AND METHODS

VA/VE is a system of activities a set of experts from different fields of knowledge performs. The pursuits aim at recognizing tasks of the merchandise or assistance, determining value of those tasks and coming up with viable substitutes. The main components of the methodology include an analysis the specialists in various areas conduct striving to boost the amount of benefit, determining tasks of the merchandise or the assistance in hand as well as the related expenditures, and finding better ways of performing the tasks along with better ideas.

The length of the product life depends on the interplay between its characteristics that are the following: worth, range of capabilities, and excellence. Actually, this interaction results in the domain that determines the product life expectancy (see Figure 2). The change described above corresponds to switching from maximal possible excellence to the maximal permissible one. One can achieve it through limiting expenditures on quality.

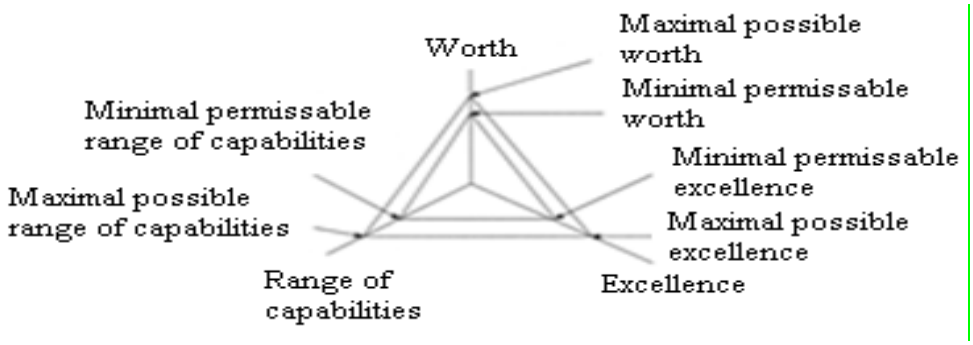

Fig 2. The product life expectancy domain

Implementing VA/VE consists of three steps: pre-workshop, workshop, and post-workshop. Although it is possible to boost product value on any stage, to avoid conflicts of team members' interests one should do it prior to allocating assets. The thinking out step allows creating a schedule of activities needed during the workshop. At this stage, it is compulsory to figure out the ultimate goal of the study as well as the stuff one has to accomplish to be ready for initiating the workshop.

According to the VA/VE technique, the workshop step assumes a list of mandatory activities known as the Job Plan. Adhering to the plan facilitates collaboration of team members. Specifically, studies performed on each phase of the course of actions promote making choices that result in at least a draft of some notion. Besides, it is likely that project planners will be able to estimate current limits of the undertaking and the capacity attainable in principle. It is worthwhile to achieve extremely valuable limits. As for established workshop goals, teams achieve them only on rare occasions. The experts engaged in the activities contemplate the feasibility of achieving the current limits as well as their contribution to the goals pursued. Clarifying the aim with the help of studying limits and Function Analysis System Technique (FAST) sketch promotes associative thinking that leads to specific predilections that result in acceptable solutions.

One cannot alter the order of activity phases in the above mentioned list (see Figure 3) since each step is the prerequisite for the following one. However, it is often worthwhile to go back to one of prior phases after completing activities that cause acquiring knowledge in some intermediate one. Figure 4 depicts the succession of project exercises. The plan starts with the information stage, which assumes gathering relevant data that facilitate

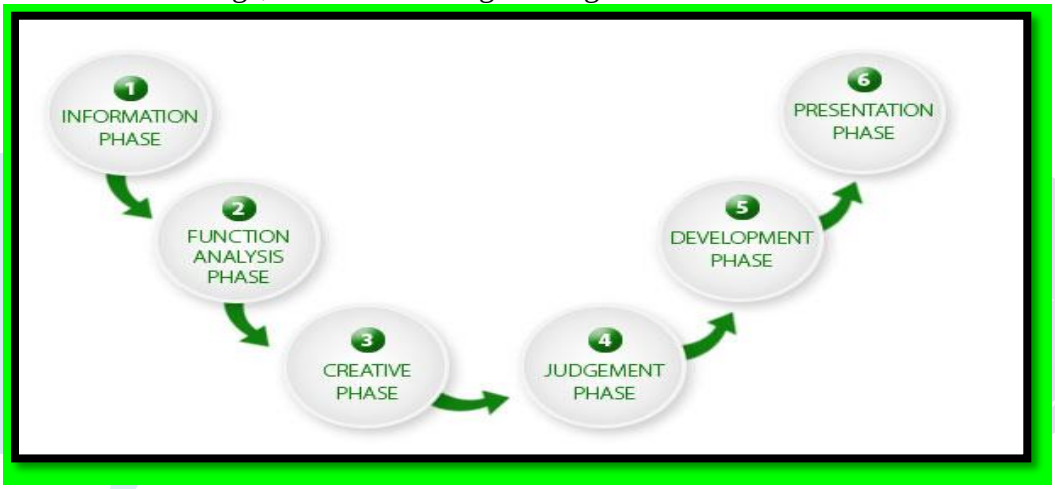

Fig 3: Activities of the Workshop Step

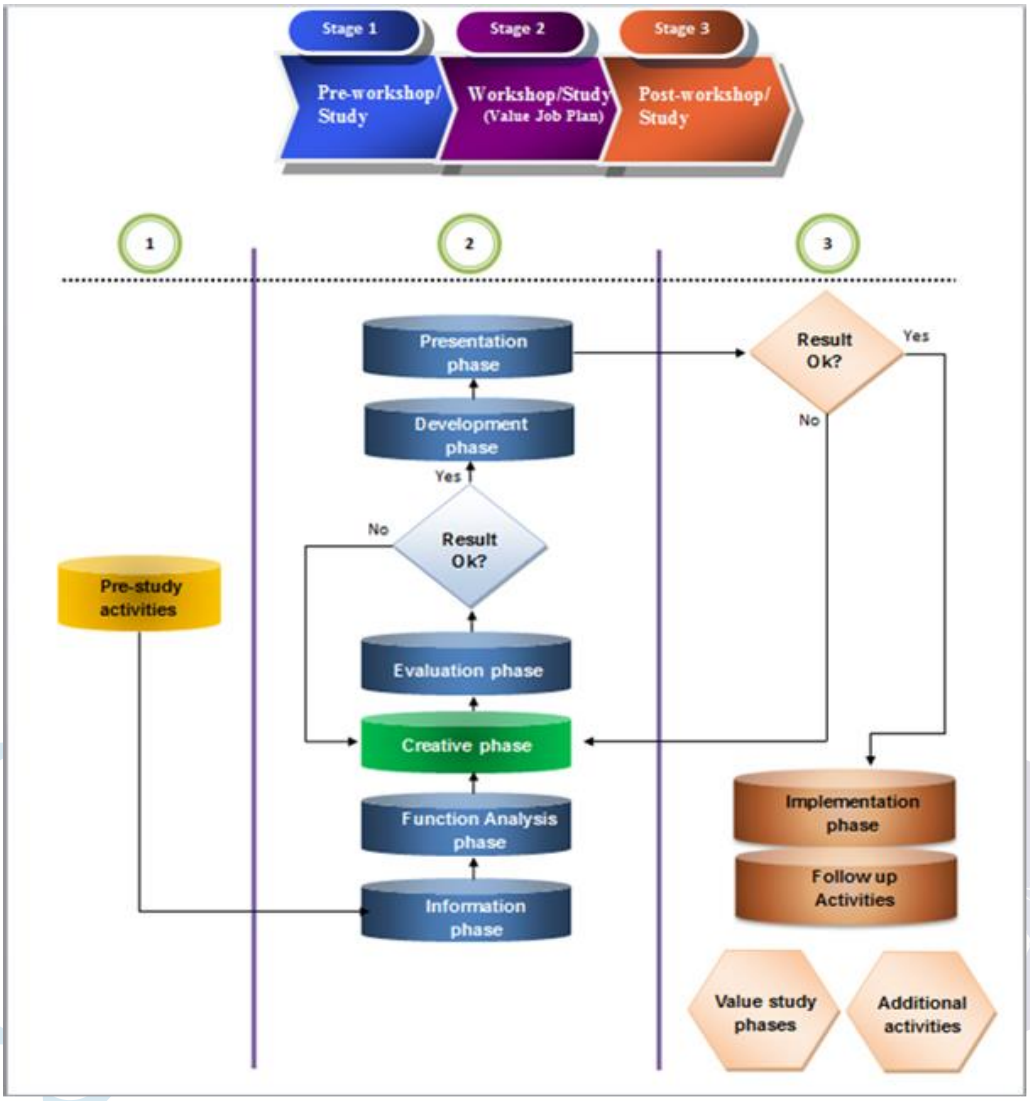

Fig 4**:** Project exercises.

determining all device functions and categories of customers whose needs it satisfies. The team uses the accumulated data to analyze components that have the potential for improvement. It can request additional information related to the aim and limits achievable in principle. With appropriate input, the team has to deliver the most suitable preferences. Actually, this phase is one of those that exert great influence on the ultimate outcome. It intends to clarify the status quo of the overall VA/VE activity and specifications that impacted exercise preferences. During this phase the team obtains data needed to identify the range of available options of value improvement. Being aware of the main direction of the activities and the specifications it satisfies is obligatory for generating a set of viable alternatives used in subsequent analysis.

The methodology in hand relies on a few approaches to doing the job. They deliver great contribution to the overall quality of the VA/VE. According to Larry Miles, conducting VA/VE at the information phase one should identify the object of the study, its intended functions, and the necessary conditions for successful performing those activities. During subsequent phases, it is worthwhile to use this input for determining viable substitutions for the object and the amounts of the respective expenditures.

Analyzing functions follows gathering information. At this stage, the team figures out tasks performing which the device facilitates. During this activity the team describes the

devices in terms of functions and compares their requirements with the benefits they deliver during the product life. Subsequently, the team finds the most appropriate way of conducting tasks. Amazingly, the approach often differs from the one established previously. At this stage of the Job Plan, it is imperative to determine device components that conduct distinct functions and understand the methodology of arriving at such the conclusion. Experience suggests that during this activity it is convenient to use the FAST sketch. FAST provides convenient framework for settling issues that could arise when experts from different fields work as a team. FAST often gives rise to breakthrough in scrutinizing the potential of carrying out tasks of the device. The technique unites attempts of groups of experts paying attention to correspondence between them. It facilitates avoidance of the prejudice and often gives rise to the resonant effect. Identifying issues leads to modeling in the FAST framework on the part of the team. The FAST sketch presents the device in the form of one block that includes everything.

It facilitates the teamwork aimed at maximal possible improvement of carrying out the intended function. The team analyzes the wheel clamp block according to the VA/VE course of actions that assumes philosophical scrutiny of the intended task. The sketch of reasons divides the tasks of the device into parts that have great potential for finding better ways of carrying out the task. The drawing sheds light on reasons and the ways of performing functions. It illustrates function interdependence that leads to performing the intended task. The sketch allows considering different variants of clustering functions.

Two main tasks are the critical one and the supporting function. The essential function provides preliminary description of the intended task. As for the supporting ones, they facilitate happening on the part of the critical function. Among them there are the optional ones. For instance, one can view inferior basic task as preparation for performing the critical one. Similarly, free auxiliary tasks boost performance of executing the critical one. Figure 5 summarizes the concept of a FAST sketch.

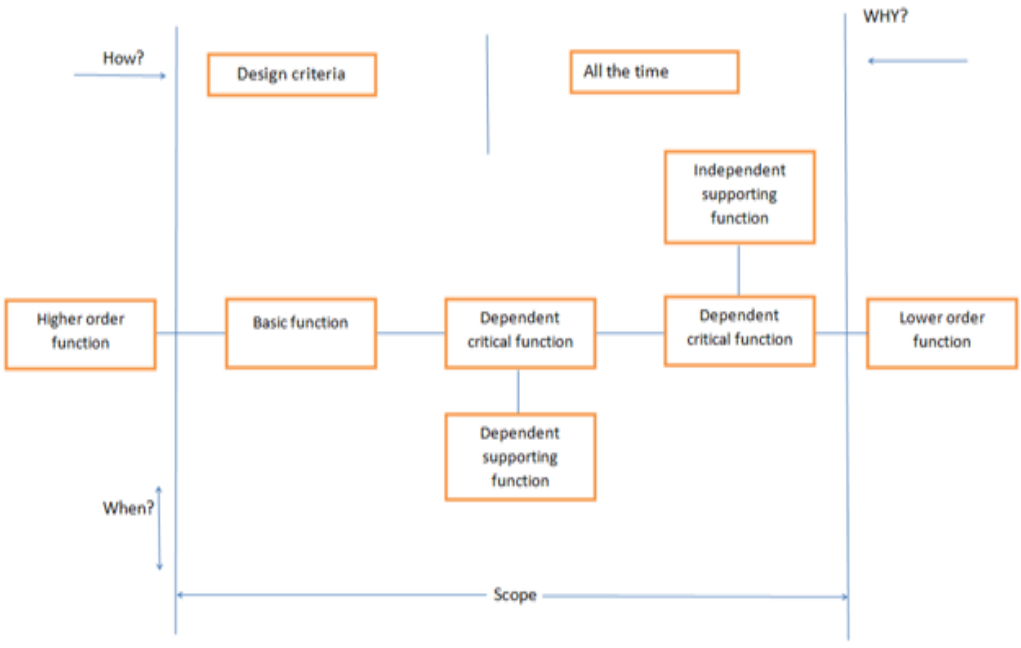

Fig 5: A typical FAST sketch

Creative work follows analyzing functions. At this phase, the team looks for the methods of delivering intended tasks of the device. Specifically, it discusses various alternatives that allow achieving the desired outcome. The next phase is evaluation. It

discards alternatives that are inferior to the current version of the device and precedes the development. On the development stage, the team works on chosen alternatives to convert them into programs susceptible to evaluation. Subsequently, during the presentation phase, team explains their subtleties to people with decision rights shedding light on their pros and cons with regard to implementation. A new product serves as an input of post workshop pursuits. As for the implementation ones, they aim at realizing the chosen programs and making sure that they produce estimated value to the full extent possible. Finally, follow up pursuits analyze the process of creation value in the case in hand to improve the VA/VE technique.

People use wheel clamps to prevent cars from moving. The simplicity of the task resulted in numerous types of this device. The most convenient model is Pyramid Clamplok Universal Wheel Clamp. Nevertheless, there are a great number of instructions that explain how to remove it from the wheel without keys on the net. Therefore, it is worthwhile to choose a Stop-lock hg 400-00-wheel clamp as the prototype of a new model since it contains a shield that obstructs the access to the wheel screws. However, it has a drawback that consists in the damage to the wheel tire the device use causes. In what follows we describe the research that allows getting rid of this flaw.

IV. TESTS CONDUCTED

Figures 6 and 7 explain tasks the device performs and indicate what physical properties boost the value of the clamp to a great extent.

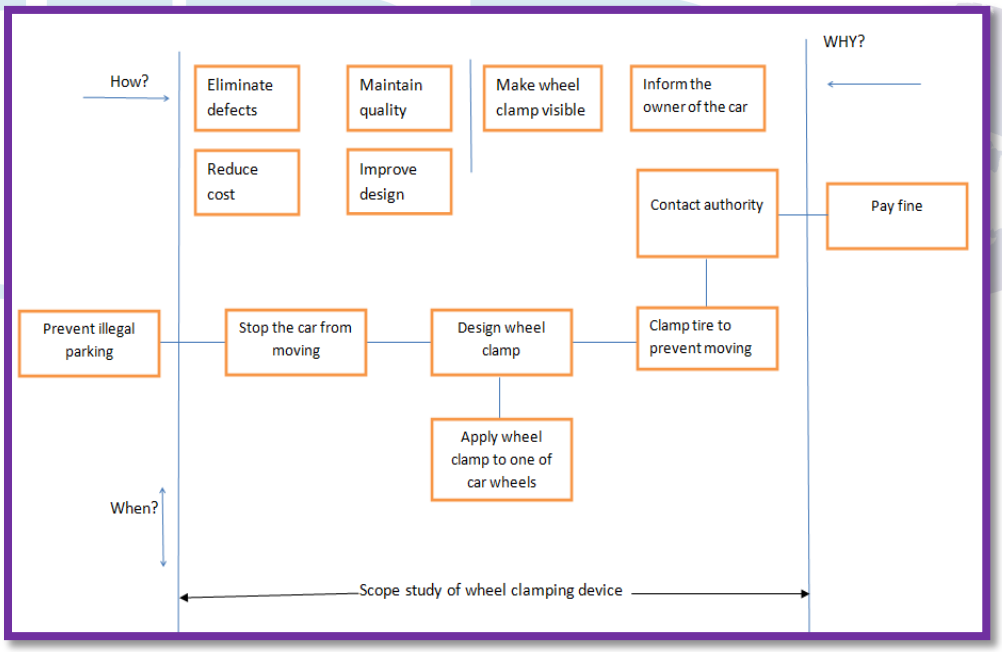

Fig 6: The FAST sketch for the case in hand.

Discussion in a group facilitates creativity and Table 1 lists possible substitutes to the existing principle

TABLE 1
SUBSTITUTES FOUND DURING THE DISCUSSION

Creating a new wheel clamp			
Sub. no	Substitute's title	Task	Type of a tool

1	Automated vehicle latch apparatus	Make it impossible to open the vehicle with the central latch	Electronic
2	Magnetic wheel clamp	Exert force due to magnetic field on the rim to prevent rotation of the wheel	Electrical and mechanical
3	Improving existing models	Exert mechanical force on the tire to prevent rotation	Mechanincal

of performing the task on the part of the device found during the exchange of ideas. Unfortunately, the first alternative is not feasible since the current state of technology does not allow determining the radio frequency of the central lock of a vehicle. As for the second option, the magnitude of the required force is larger than the one in the case of the third alternative. Besides, one has to apply it to the solid part of the wheel. Hence, the force due to magnetic field can damage the rim. Therefore, the third alternative is the best one.

The new wheel clamp contains two limbs and the shield that safeguards the lock. Limbs bear mechanisms that allow adjusting the device to any tire available on the market. Two rods have bounces that permit them to be connected with the main bolt in the middle of the rod and to reach the limb mechanism disc. Their parts that contact the tires have conical shapes. It allows avoiding damaging

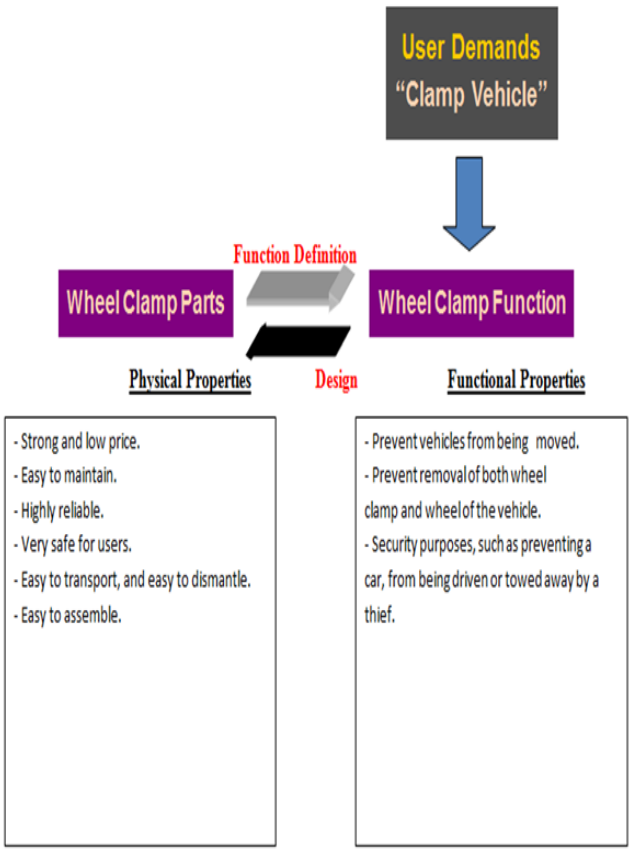

Fig 7: Functions and physical properties of the device.

the covering. One can tune the device through shifting the upper limb with respect to the disc. The arm contains a latch. It secures the grip and one can close it with a key. The pros of the clamp are the following. It takes less than 20 seconds to immobilize a vehicle if one chooses to use the device. It is convenient to carry it since its mass equals only 6kgs. Besides, it is extremely difficult to open the latch if there are no keys. In addition, one can use the device with any vehicle. Finally, the shape of the device part that contacts the tire guarantees that the clamp does not damage the wheel covering.

V. RESULTS AND DISCUSSION

The activities of this project adhere to the framework of the VA / VE methodology. One of specifics of this undertaking consists in putting the largest emphasis on gathering information. The reason is the broadness of the spectrum of fields in which various team members are experts. The team identifies options that are promising from the perspective of enhancing value of the device and studies them further. The last activity consists in determining pros and cons of the alternatives with subsequent analysis of the best one. The chosen opportunity allows improving the product life expectancy, use easiness, and maintenance simplicity through delivering appropriate design. These specifications require the use of steel as a raw material. To reduce the time of attaching the device to a wheel, the team cuts down on the number of its components drastically. In addition, the crew takes advantage of the leverage. Besides, the clamp is foolproof which allows mounting it on the wheel through applying the method of trials and errors on the part of a novice.

VA / VE relies on sensible arguments and studying tasks to deliver links that boost performance. The argumentation is quantitative and resembles hypothesis testing broadly used in statistics as well as problem solving in the framework of linear programming that facilitates decision making.

The new model of the device is better than its prototype due to the following. It suits to any vehicle whereas its precursor can immobilize cars only with wheel diameter that belongs to the rather narrow range. Besides, contrary to the forerunner, using the device does not entail damaging the wheel covering.

VA / VE leaves room only for manufacturers' adjustments delivering drafts that make the likelihood of misunderstanding negligibly small. They are the following. Figures 8-11 provide dimensions of respectively the limb mechanism, bottom arm, the top one, and the disk in accordance with the GD&T rule ANSI Y14.5M Tolerances.

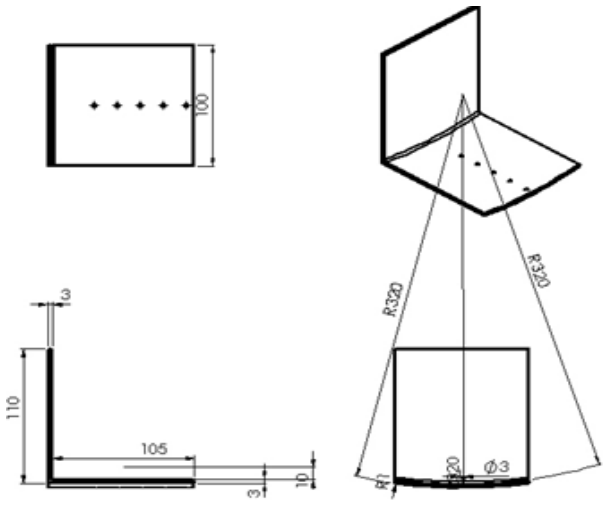

Fig 8: Dimensions of the limb mechanism.

As for Figures 12 and 13, they are assembly sketches that inform about the design idea. Particularly, these drawings depict the relative disposition of the device components in the state of its deployment.

The main tasks of parts depicted on Figures 8–13 are the following. Both limbs and their mechanisms make sure that the user can perform the duties staying on the floor and facilitate fastening the device to the wheel

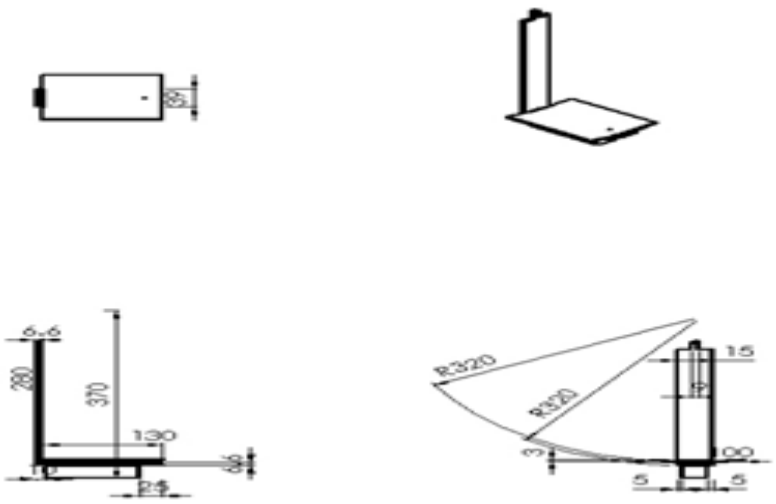

Fig 9: Dimensions of the bottom limb.

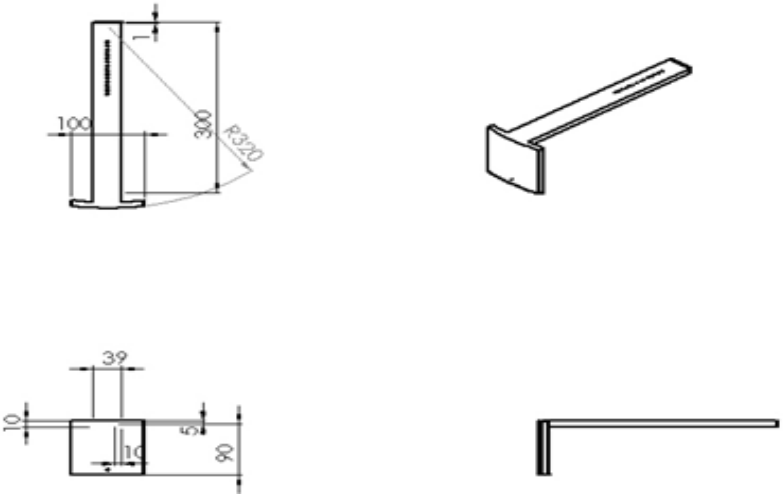

Fig 10: Dimensions of the top arm.

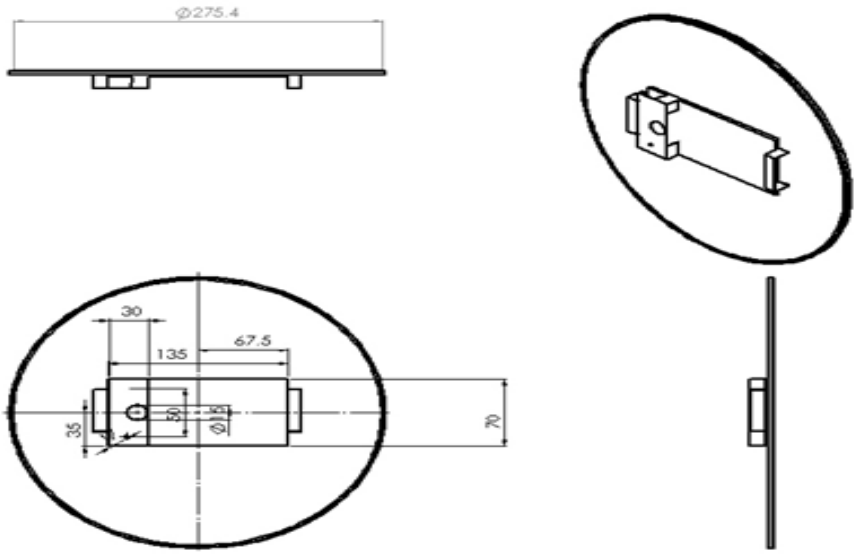

Fig 11: Dimensions of the latch shield.

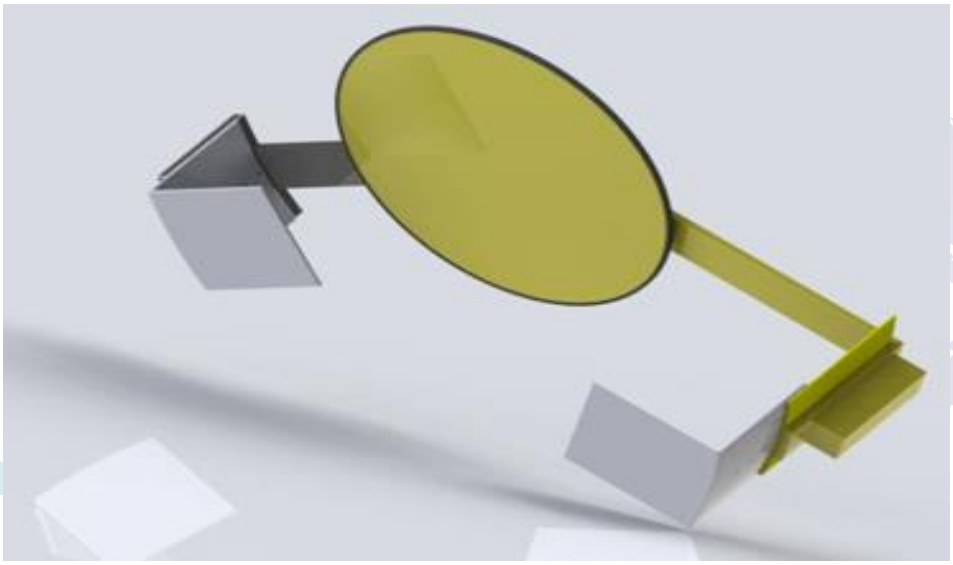

Fig 12: The rear view of the device.

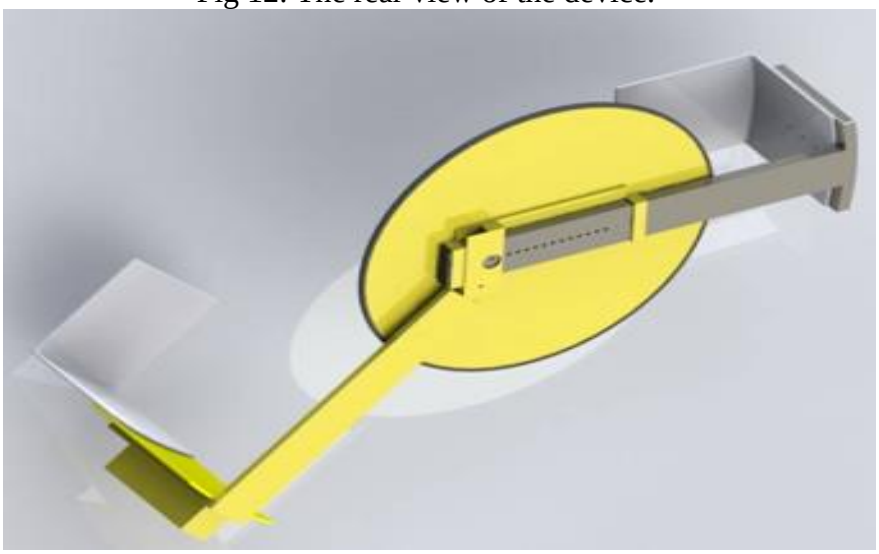

Fig13: The front view of the wheel clamp.

quickly. Construction of joints delivers the ease in handling them. The design of the bottom limb boosts the strength of the device grip. Besides, producing this arm does not require much skill and this limb is more inexpensive than the top one is. A set of holes on the upper limb allow tuning the device to the wheel roughly whereas bolts that fasten the limbs to the disk facilitate adjusting the device finely. The disk obstructs the access to the wheel screws and the wrongdoer cannot remove the component together with the clamp. Finally, the latch serves to prevent unauthorized removal of the device.

VI. CONCLUSION

Unfortunately, technical progress entails increased relying on automatization in the production process. However, human beings exhibit better performance in solving intellectual problems than machines do. Therefore, cutting expenditures on quality can result in new job places in the service industry. Due to worsening political stability around the globe it is worthwhile to start such the initiative with products which military personal use during a battle. The wheel clamp is one of such the devices because one can use it to immobilize damaged vehicle prior to conducting the reconstruction. The aim of this undertaking consists in delivering a new popular wheel clamp on the market through taking advantage of VA / VE on the part of team of experts. Information gathering revealed that there are numerous models of this device on the shop shelves. However, the most convenient one is not acceptable since there are numerous online descriptions of how to remove the device from the wheel without the use of a key. Therefore, the team decided to improve the popular model that contains the disk that impedes access to the screws of the wheel. The renovation removes the essential drawback that consists in damaging the wheel covering on the part of the device. The group delivers valid arguments that promote figuring out the best alternative and comes up with the improved design.

In the context of military operation, poor quality of notable portion of the devices has a value. We are going to determine which characteristics of the wheel clamp are the most beneficial under such the circumstances.

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