

# SUSTAINABLE PRODUCT DEVELOPMENT FOR CAR LIFTING EQUIPMENT USING VIRTUAL REALITY

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## Abstract

Sustainable development is an integral concept for achieving quality of limits, interdependence, fundamentals and equity. Virtual reality means existing or resulting in essence or effect though not in actual fact, form, or name. Machine design is always interesting for most people, it is also becoming more and more popular now a days. Showing the performance of a machine design during the design phase is possible to do using 3D Max and ANSYS software.

Car lifting equipment is a device to lift a car for several workshop purposes as replace oil, fix car's break, overhaul engine, periodical maintenance and many others. Conventional car lifting equipment design needs a lot of cost, time, and materials because it needs doing the real test to understand the performance of the car lifting equipment design. The primary target of this research is to search and decide which mechanism is the most suitable for this machine and also the virtual reality to show it's performance during the design phase.

In this research, sustainable product development using virtual reality with 3D Max and ANSYS software is used rather than conventional design. The goal of this research is to show the performance of the machine during the design phase using 3D Max and ANSYS software.

Finally, car lifting equipment has been designed in this research using 3D Max and ANSYS software as a solution of sustainable product development. Designing car lifting equipment using 3D Max and ANSYS virtual reality software can reduce materials, cost and time of product development. Virtual reality using 3D Max and ANSYS software is a sustainable technology for sustainable product development in the car lifting equipment design.

**Keywords: Sustainable Product Development, Virtual Reality, Car Lifting Equipment.**

## 1. Introduction

Time to market has been generally admitted to be one of the most important keys for success in manufacturing companies and product design. Combination of factors such as ever changing market needs and expectations, rough competition and emerging technologies among others, challenges industrial companies to continuously increase the rate of a new products to the market. The marketplace provides numerous incentives for

the more rapid introduction of new products to market (Carrilo and Franza, 2006).

To develop a successful product, customer requirements need to be carefully considered during product design (Lin, et al., 2006). Quality function deployment (QFD) has widely been used to translate customer requirements to technical design requirements (Prasad, 1998). QFD helps us to interpret and organize the various groups of requirements, the output being the set of product specifications.

Besides that, current socio-economic trends towards developing more eco-friendly products

within a sustainable growth scenario, add a new complexity to the manufacturing companies mostly but not only, to the product designers. Sustainable product development approaches used in industry to date mainly focus on reducing the environmental impacts of products (Maxwell and Vorst, 2003).

Sustainable technology is a part of the broader concept of sustainable product development (Weenen, 2002) and virtual reality means existing or resulting in essence or effect though not in actual fact, form, or name (Anggono, 2006). Understanding the mechanical design is very hard to do because it is very hard to visualize the mechanical design product and the performance of the mechanical product during design phase. Product Design is always interesting to most of the people. It is also becoming more and more popular now a days. To predict the performance of the mechanical product during design phase is possible to do using 3DMAX and Finite Element Method technology (ANSYS Software). Virtual reality technology using 3DMAX and ANSYS software can perform the performance of the mechanical product during the design phase (Anggono, 2004).

Currently, many type of car lifting equipment which is placed in workshops. This equipment usually designed both manual and electronic, working processes of this equipment are various such as using hydraulic jack or mechanical.

These machines are various and quite same with ordinary jack, but the form and the working process are quite different and more complicated. The various car lifting equipments is shown in figure 1.



Figure 1. Car lifting equipment  
Source: [www.mohawk.com](http://www.mohawk.com)

Car lifting equipment is equipment that usually used in workshop and becomes one of the most important equipment. To search and decide the most suitable mechanism, specification and design must be determined before, which is

affected by six factors. First, price, whether the equipment are expensive or not. Second, lifting capacity, in this case the capacity is the weight of the cars. Third, the car lifting equipment size, whether the equipment are big or small. Fourth, material, the strength of material that used for basic material for the machine. Fifth, the car lifting equipment working mechanism, the easiness of the machine working mechanism that the users do not need assistant to help him to operate the machine. Last, maintenance, the practical maintenance will be easy the users to take care the machine.

## 2. Theoretical Background

Virtual Reality is “a set of image and sounds produced by a computer, which seem to represent a place or a situation that a person can experience or take part”. With the existence of this new virtual reality system, we are able to understand more the working mechanism of the machine. Moreover, we know that virtual reality can simulate the working process of machine from the beginning until the end of the process.

Virtual reality is a simulation from the reality or imagined environment model which give visual experiencing tree dimensions, such as length, width, and depth. Also, it provides more information in term of visual interactive experience that becomes the real condition or animation completely, with its sound that can provide feedback. The basic form of virtual reality is three dimension images, which can be explored interactively by personal computer. The popular product that usually used for giving virtual reality effect in personal computer are Bryce, Extreme 3D, Ray Dream Studio, 3D Studio Max, and True Space.

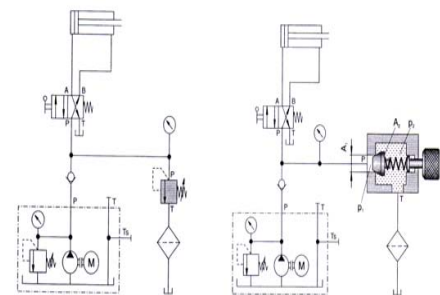


Figure 2. Hydraulic scheme

Fluids in closed area can be used to transfer energy from one place to another place. After that, to make circular or linear movement we need some capacity. The advantage of this hydraulic system are become the characteristic of incompressible fluids (relatively) with different height of density. A hydraulic system which based on fluids can work in higher pressure and can be used to make huge forces.

Concept development is a design process way which choosing worked object as market needs. Basically, designing are oriented to activities, such as manufacturing body, choosing material and whatever which needed to make the product function well and properly

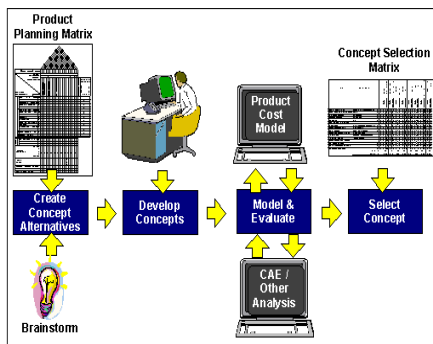


Figure 3. Concept development scheme

Source: <http://www.rqriley.com/index.html>

### 3. Research Methodology

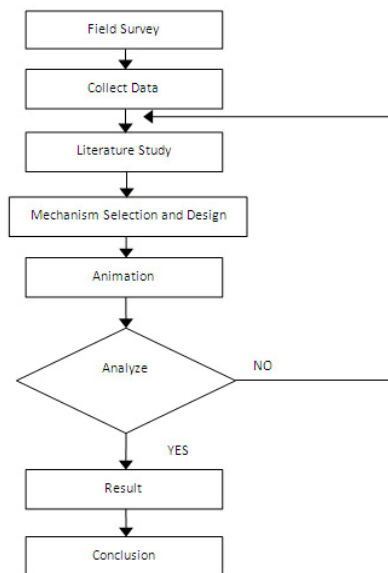


Figure 4. Research methodology

### 4. Result and Discussion

Designing this car lifting equipment, manufacturing process can be done manually which means mechanical design process which involve in designing car lifting equipment car are more oriented to product development process.

A good Development Concept will give huge impact to the final result of all product development process which will be done. In this step, the requirements from the market are identified, specified from the product is determined, chosen from the product is determined. This step is the basic of all product development process which will be done. If we do not pay attention to this step properly, it will lead to a bad effect in all of product development process, which affects the final result. Thus, the final results obtained are not perfect.

Identifying the customer needs can be done by researching the problems which occurred in nowadays condition. After that, it is being developed into a new design concept from the product which newly manufactured. In this case, the product being manufacture are car lifting equipment. By having identify customer needs process, the product which created will give extra satisfactions and ease to the users. Besides that, the users will easier in choosing existing mechanism process or to find new mechanism process from car lifting equipment. The list which obtained from identifying customer needs process will summarize in a list called list of requirements.

Based on the customer needs which are listed in list of requirements, we can do determining the target specification from designing process of car lifting equipment. Basically, this establish target specification step is similar with identify customer needs step. However, in this step, the current requirements are matched with technical constraint and available fund which is owned.

Methods which can be applied in establish target specifications step is function analysis method. In function analysis method, the first step to do is concentrating to the achievement that will be done in designing process and not how to achieve it.

Table 1. List of Requirements Cars Lifting Equipment

REQUIREMENTS	SPECIFICATIONS
Lifting Capacity	2 Tons
Lifting Height	1,6 Meters
Stiffness	Have enough stiffness and enable to hold car's weight
Robust Design	Simple Design: Easy to build with easy process and simple components and also can be used in limited (small) area.
Economical	Cheaper, compared with universal car lifting equipment
Cleaning Process	Easy, does not need specific cleaning equipment
Repair	Does not need heavy repair and lots of time
Work piece Installing System	There is a manual book, so the installation is easy and able to move easily
Last long material Characteristics	Anti-Corrosion to chemical fluids and oxidation

The activity in generate product concepts step are providing alternatives which enable us to do the process. After that, we choose the alternative that we want to use, where the chosen mechanism is the best mechanism which fulfills the requirements and technical specifications is needed.

In choosing handling equipment material, we also need to pay attention in constructing this car lifting equipment, because handling equipment material types which is used can affect the strength of frame and stick as main facility which facilitate the motion of the equipment. Pugh's concept selection method is the best concept selection method to choose the product concept for car lifting equipment.

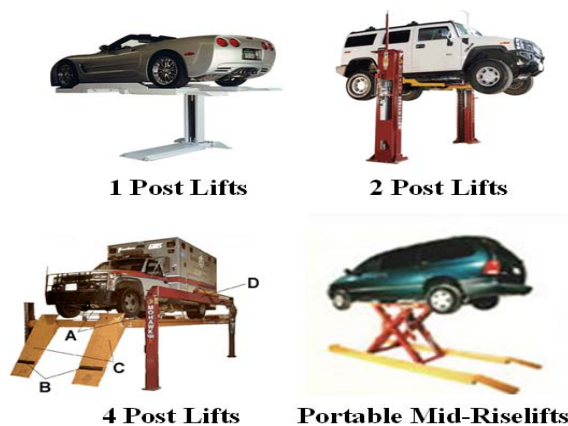


Figure 5. Product Concept  
Source: [www.mohawk.com](http://www.mohawk.com)

Usually this scoring (concept selection) is in B (better) alphabet form and awarded to the closely match scoring with the criteria above. S (same) is given if the thing which is used for that equipment available in the market. W (worse) is given if the thing or equipment is unmatched with above criteria.

Table 2. Concept selection for cars lifting equipment design

	1post lifts	2post lifts	4post lifts	Portable mid-rise lifts	autor.
Capacity	W	B	B	S	B
Lift speed	S	S	S	W	B
Motor	S	S	S	S	S
Lifting Height	S	B	B	W	B
Safety lock	B	B	B	B	S
Mechanical Safety Locks	B	B	B	B	W
Lifting Mechanism	S	S	S	B	B
Lift Weight	W	W	W	B	W
Concrete Floor Requirements	S	S	S	B	S
Lifting Mechanism Cost	S	S	S	B	W
Sum of B	2	4	4	6	4
Sum of W	2	1	1	2	3
Sum of S	7	6	6	4	5
B-W	0	3	3	4	1

Based on the data above, the price consideration and price which is offered in the market, portable mid-rise lifts design is highly suggested since it is more profitable. This is happened since it is easy to use and maintain, portable to move, cheaper than other model, and have lifting strength which is needed by daily car.

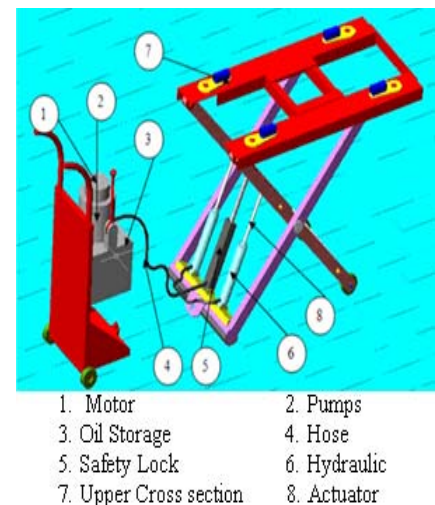


Figure 6. Car Lifting Equipment Design



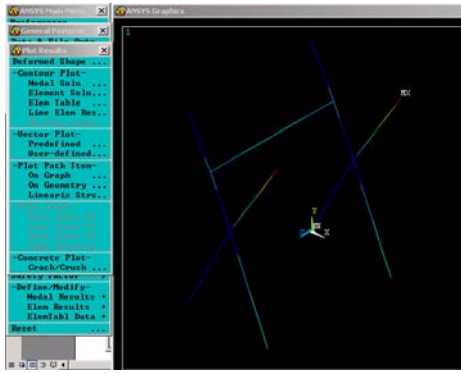


Figure 7. Car Lifting Equipment structural calculation using ANSYS software

Based in the ANSYS FEA result car lifting equipment design is safe. The criteria based on Von Mises stress calculation for structural application (figure 7).

To understand the mechanism of the car lifting equipment design, 3DMAX virtual animation software can be perform the simulation of the car lifting equipment design during the design phase. The simulation the car lifting equipment design using 3DMAX virtual animation software can be seen in figure 8

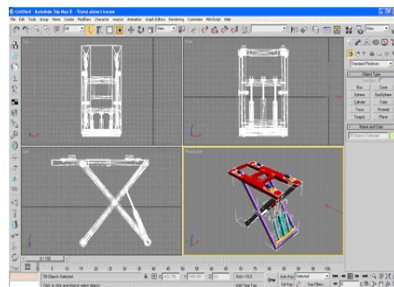


Figure 8. Design in 3DMAX software

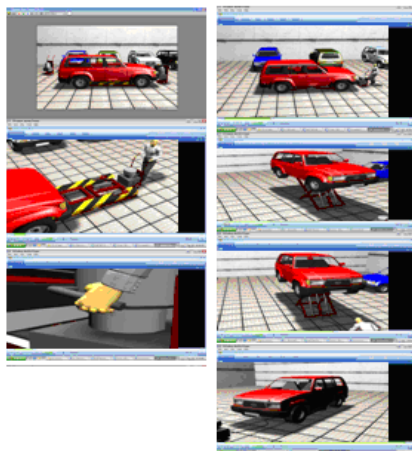


Figure 9. Animation result using 3DMAX

By using virtual reality, could be concluded that the shape and dimension of the semi automatic binding machine will be better displayed. Using 3DMAX virtual animation software, how this machine works could be better visualized, even before this machine being made.

## 5. Conclusion

Designing car lifting equipment using 3D Max and ANSYS virtual reality software can reduce materials, cost and time of product development. Virtual reality using 3D Max and ANSYS software is a sustainable technology for sustainable product development in the car lifting equipment design. Finally, car lifting equipment has been designed in this research using 3D Max and ANSYS software as a solution of sustainable product development.

## References

- [1]. Anggono, Willyanto. (2004) Peningkatan Unjuk Kerja Desain Flexible Shield untuk Pompa Sabun dengan Menggunakan Metode Elemen Hingga, Jurnal Teknik Mesin, 6, 57-64.
- [2]. Anggono, W. (2006) Analisa Pengaruh Radius Heads Terhadap Besar Tegangan Maksimum pada Air Receiver Tank Horizontal dengan Menggunakan Metode Elemen Hingga. Proc. National Seminar on Application and Research in Industrial Technology 2006 (Yogyakarta) April 27, pp 78-86.
- [3]. ANSYS, Inc. (2002) ANSYS 7.0 Documentation, USA.
- [4]. Budinski, K.G. and Budinski M.K. (2002) Engineering Materials Properties and Selection, Prentice Hall, USA pp 3-67.
- [5]. Budynas, Richard G. (1999). Advanced strength and applied stress analysis. Singapore : McGraw-Hill Book Company.
- [6]. Byheth S.H., Broman G., Holmberg J., Lundqvist U., dan Robert K.H. A Method for Sustainable product Development in Small and Medium Sized Enterprises. , 2004.
- [7]. Carrillo, Janice E. and Richard M. Franza, (2006), Investing in product development and production capabilities: The crucial

linkage between time-to-market and ramp-up time, *European Journal of Operational Research*, 171, 536–556.

- [8]. Lin, Ming-Chyuan, Chen-Cheng Wang and Tzu-Chang Chen, (2006) A Strategy for Managing Customer-oriented Product Design, Volume 14 Number 3
- [9]. Maxwell, D. and R. van der Vorst, (2003), Developing sustainable products and services, *Journal of Cleaner Production*, 11, 883–895
- [10]. Nugroho, R.M. Mochamad T I. (2007). Perencanaan dan pembuatan virtual reality mesin pengangkat mobil (Car lifting equipment) dalam bengkel “X”, Tugas Akhir S1 Jurusan Teknik Mesin Universitas Kristen Petra.
- [11]. Prasad, B. (1998). Review of QFD and Related Deployment Techniques, *Journal of Manufacturing Systems*, 17(3), 221–234.
- [12]. Pugh, S. (1991). *Total Design: Integrated Methods for Successful Product Engineering*, Addison-Wesley Publishing Company, Inc., USA pp 8-59.
- [13]. Pugh, S. (1996). *Creating Innovative Products Using Total Design*, Addison-Wesley Publishing Company, Inc., USA pp 7-61.
- [14]. Sackett, P.J, and Bryan, M.G. (1998), “Framework for the development of a product data management strategy.” *International Journal of Operations Management*, Vol. 18 No. 2, pp 168.79.
- [15]. Ullman, David G. (2003). *The mechanical design process*. New York : McGraw-Hill Book Company.
- [16]. Weenen, J C van. (2002) Concept, context, and co-operation for sustainable technology. *Proc. International Seminar on Design and Manufacture for sustainable development 2002 (Liverpool)* june 27-28, pp 3-12.