Development of the Assembly Set for the Logistic Transport Solution

R. Sásik, M. Haluška, R. Madaj, M. Gregor, and P. Grznár

Abstract Reconfigurability has become as a new engineering technology which has a significantly impact on the changes in design. Reconfigurable manufacturing systems should be designed so that they can effectively respond to changes in the product requirements. Currently reconfigurable products will be a great benefit for customers and also a big challenge for designers of the manufacturing systems.

Keywords Assembly set • Logistic transport solution • Prototype • Rapid prototyping

1 Introduction

The aim of today's enterprises is to produce a different variants of the products that ensure their profitability. Due to the fact the enterprises must to focus on the customer requirements and low cost production. An acceptable alternative is the production of modular product components that can be easily and quickly mounted on the basis of the actual requirements of customer (personalized product). However the customers will much more prefer a product that can be easily reconfigured. Each configuration is represented by the specific product. But it is necessary to take into account the modular architecture of the product, which allows us to propose a reconfigurable product. Modularity of the product is a sufficient but not necessary condition for creating reconfigurable product. Reconfigurable product must be convertible from one shape to another or scalable.

According to the Koren [1] the basic characteristics of reconfigurable product can include:

- **Modularity** – Product modularity enables the change of product shape to fit the various customers and utilizations.
- **Integrability** – Integrability refers to defined module interfaces (mechanical, electrical, and information) for ease of product reconfiguration and customization.

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- **Customization** – Customization provides customers with just the product functions they need, and not features that they will not use.
- **Convertibility** – Convertibility enables products to be changed to fulfil various utilizations of the same product.
- **Scalability** – Scalability allows a product to be scaled up or down to fit to the user's body or applications.
- **Diagnosibility** – Diagnosibility means that a product is designed with embedded diagnostic functions, for easy service and maintenance.

Due to the rapidly changes customer requirements, manufacturers must have manufacturing system that will offer different levels of response to changing the customer demand but also reckon with new practices in the field of design [2].

2 Assembly Set of the Prototype

In laboratory ZIMS was designed and subsequently produced the first mounting assembly prototype of the logistic transport solution. The mission of the prototype is to integrate the advanced technologies and workplaces in the laboratory. It should be also noted that the product will be used to developing of different variants, which include production of product with different features. From the point of view, the product must be modular and should suggest also other modules, which will be easy integrable and implementable. Replacing of the components can affect the added value, which can product created.

Basic components of the assembly set include front axle, rear axle, shell, I. part of the logical box, II. part of the logical box and screws. In the mounting assemblies is also possible to incorporate chassis that is navigated through bluetooth chip and also chassis which is navigated through infrared communication interface.

2.1 Rapid Prototyping of the Designed Model

Assembly set was designed in Creo Paremetrics 2.0 and SketchUp 2013. Prepared digital parts of assembly for 3d printing should be as a solid object with closed surfaces. The functional model has scale 1:5. Digital model was exported to STL format for 3d printing. There was used 3d printer Stratasys Dimension SST 768 for rapid prototyping. The parameters of the 3d printer are:

- printed method FDM
- used material ABS+
- Thickness of the printed layer 0.25 mm
- System Dimensions: $914 \times 686 \times 1041$ mm – max. dimensions of the printed part

After printing was carried out surface finishing of each component which included cementing, sanding, polishing of outer surfaces and spattering with airbrush.

Assembly set is represented by the reconfigurable product which possesses of essential characteristics of the reconfigurability as modularity, integrability of new functions and convertibility. It is also possible to easy change and integrate individual components.

The next step of the development of the designed model is a manufacturing of the miniseries used vacuum casting. We have modified the model to scale 1:10 for vacuum casting. Master model was printed with 3d printer Formiga P100. This 3d printer uses laser sinthering method. It has smoother printed layer 0.1 mm. We had to prepatre printed 3d model by smoothing and spraying of surfacer.

In addition to developing of the transport solution model, we develop the model of the electric vehicle EDISON. It is static model nowadays, but we want to develop its own power drive.

3 Functional Analysis

There was also performed functional significance analysis of the individual system components from which is evidently clear that the most important link in the functional set is chassis that consists of logical components.

Simultaneously was also identified satisfaction fulfilment rate for each function which shows the direction of the further improving. Among the critical functions of the product can be assign control of movement direction, protection against external environment, reusability and quality of image recognition.

4 Figures

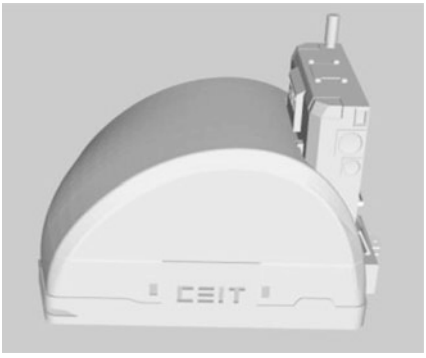

Fig. 1 Digital model of the assembly set

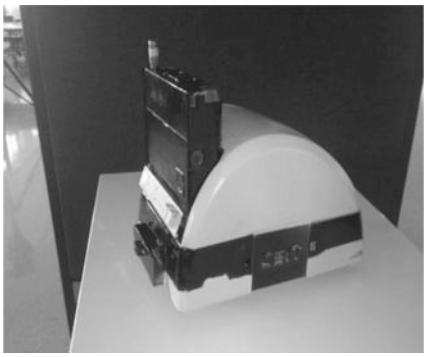

Fig. 2 Prototype of the assembly set

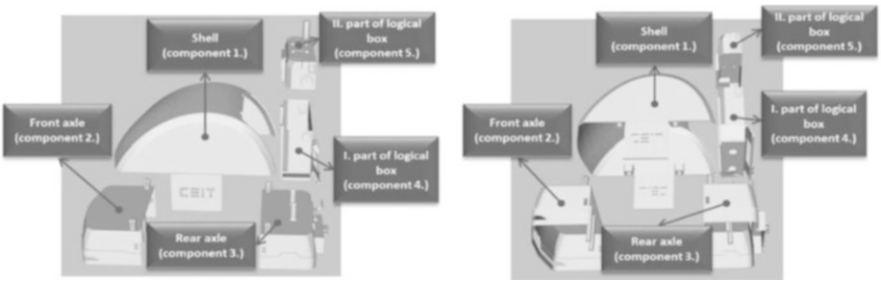

Fig. 3 Components of the assembly set

Fig. 4 Components scheme of the assembly set

Fig. 5 Surface finishing of the prototype

Fig. 6 Functional model produced by vacuum casting

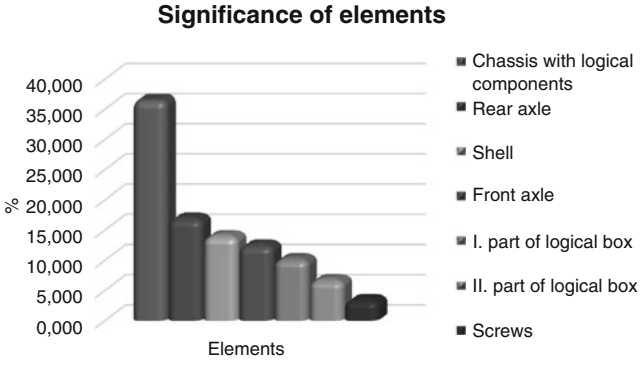

Fig. 7 Graphic representation of the significance of individual elements

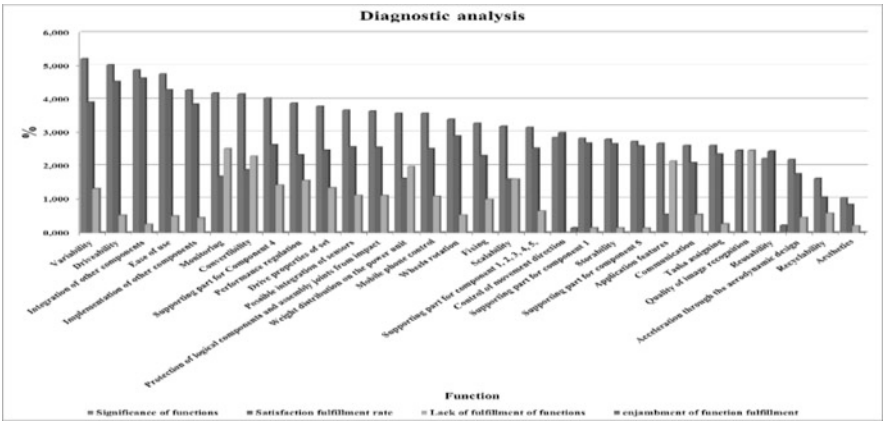

Fig. 8 Diagnostic analysis of functions

5 Conclusion

From the functional analysis is evident that product has still deficiencies in control but also in the level of possible reconfiguration. The product will be used not only for the integration of technologies in laboratory ZIMS but also for the direct development of the own logical platform and product variants.

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