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PACKAGING MODEL IN GRAPHIC INDUSTRY

Diana Milcic
Faculty of Graphic Arts, University of Zagreb
Getaldiceva 2, Zagreb
Croatia

Adisa Vucina
Faculty of Mechanical Engineering and computing, University of Mostar
Matice hrvatske bb, Mostar
Bosnia and Herzegovina

Davor Donevski
Faculty of Graphic Arts
University of Zagreb
Getaldiceva 2, Zagreb
Croatia

ABSTRACT
Concurrent engineering methodology includes the product development model and the production process development model. These models use concurrent engineering as their overriding philosophy, strengthened by the use of a systematic design process. Process design model generally consists of three different models: the manufacturing process development model, the test method development model, and the packaging development model. This model has five development phases: project planning, conceptual design, design, production preparation, and production/service. Between each of these five development phases, there is a management milestone, which is an approval point for the management team to assess the progress of the project. Each of the phases are broken into steps. The process development model starts with a kick-off meeting in conjunction with the product development model. This meeting is used to develop a broad overview of the development methodology and the expectations of the product. Next, the teams begin their own tasks, but communicate their progress regularly. Finally, production/service, the last phase of both the product and the process development models is the phase in which the product is manufactured, tested, packaged, and distributed to customers.
Keywords: concurrent engineering, packaging model

1. INTRODUCTION
Process development model in concurrent engineering generally consists of three different models: the manufacturing process development model, the test method development model, and the packaging development model [1]. Three models each have five development phases: project planning, conceptual design, design, production preparation, and production/service (Fig.1).

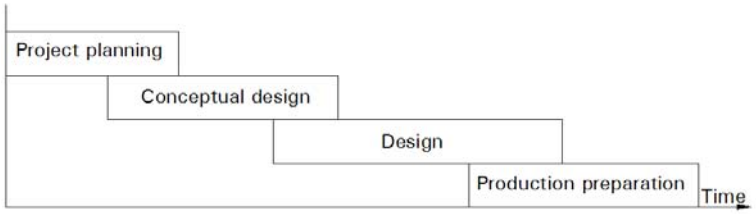

Figure 1. The packaging development model

Between each of these five development phases, there is a management milestone, which is an approval point for the management team to assess the progress of the project. Each of the phases are broken into steps. The process development model starts with a kick-off meeting in conjunction with the product development model. This meeting is used to develop a broad overview of the development methodology and the expectations of the product. Next, the teams begin their own tasks, but communicate their progress regularly. Finally, production/service, the last phase of both the product and the process development is the phase in which the product is manufactured, tested, packaged, and distributed to customers [1]. This paper will present a packaging development model in graphic industry.

2. PHASES OF PACKAGING DEVELOPMENT MODEL

2.1. The project planning phase

The project planning phase for the manufacturing process, testing, and packaging models are combined, as the designs from these models must be integrated and are interdependent [2]. In this step, the designers and manufacturing personnel clearly define what the project will require from a manufacturing point of view. Figure 2. shows the steps of this phase.

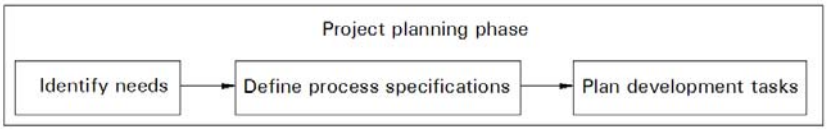

Figure 2. The project planning phase for the packaging development model

The first step of this phase is the most important step in the project planning phase, since the decisions made in this step guide the development team through the rest of the development process. There are many questions that must be answered in this step. The first of these that will be important for the team to ascertain is the amount of design work that will be required to pack the new product. The level of work required has been categorized as follows: a new line with new technology, a new line using the same technology, major changes to an existing line, or minor changes to an existing line; new requirements from product designers, special product considerations from a manufacturing point of view etc. Packaging can incorporate many design features depending on the requirements of the product, handling, storage and distribution. The simplest and least expensive box design styles are a limited family of regular slotted containers, RSC. Their characteristic is that all of their flaps are of same length. The side flaps meet at the center when the box is closed, and the end flaps do not meet unless the box is a perfect square. If the product is very heavy, it might be required that side flaps overlap forming a double layer. It the product requires an even weight distribution, end flaps would have to be made longer in order to meet at the center. In any case, whether the box is made as an RSC or SC, slotted designs can only be made with straight cuts and creases. If there are any requirements for angled cuts or creases or cutouts such as those for carrying openings, the box has to be made by diecutting. As this can operation can be performed on rotary or flatbed machinery, outputs have to be taken into consideration. Flatbed machines are generally slower, but are more accurate and inflict less damage to the material. An important consideration in the design phase is how the product will be packed. Some products are loaded vertically, while others have to be loaded horizontally. The required design style depends on the erect-fill-close equipment. Finally, the mission statement must be defined, which is used to guide the team through this development effort and keeps the project's aims clear and certain. Process specifications broadly define what is expected from the manufacturing line and its processes. These specifications should have target values associated with them. For example, what is the needed manufacturing cycle time, required daily output of product from the lines, space requirements, product movement, energy required, waste produced (type and amount), end-of-life considerations, target cost of packaging line, etc. Many of these target values will be very rough, but iteration is possible and expected. For example, while dimensioning the transit case, apart from the packaged product size, some important considerations have to be taken into account. Some products require to be packed tight inside the container, while others are allowed to move. In addition, if it is

not a single item, items might require to be separated by insertions. In some cases it is required that the edges are reinforced by various insertions, either made from fibreboard or expanded polystyrene. The inclusion of these features adds to the final box dimensions. Depending on the required box dimension, i.e. layout size, the appropriate sheet size, the one resulting with least waste has to be chosen. Concerning waste management, paper is a natural material made from renewable source and easily recycled. Waste can be minimized by the use of the appropriate sheet sizes and can be recycled. Although the quality of recycled paper reduces with each cycle, it is a very versatile material and recycled paperboard and corrugated fibreboard grades are in wide use. As more information is gathered and knowledge formed about the product and the processes needed to produce this product, the target values can become more concrete. From these process specifications, the team members can look for the means to meet the requirements. The final step in this design phase is to plan and schedule the process development tasks. In this step a rough budget should be defined for the design, modification, and build of the manufacturing lines. Also, a preliminary schedule or timetable should be defined with key time constraints outlined, which will then be expanded later by the various team members. The key questions that need to be answered in this step are: when is the completed manufacturing line needed, how can available resources be integrated and used and what are the unique aspects of this process development project? The most important question which should be answered on approval milestone at the end of this phase is whether the company successfully manufactures the new product, or if not, what alternate plans have been considered.

2.2. The conceptual design phase

The model for the development of the packaging methods and/or line is shown in Figure 3. The line layout design step may or may not be needed based on whether the packaging will be part of the manufacturing process line, or will be a standalone line. In the packaging requirements step, the team needs to determine how the product will be packaged, stored, and shipped to the customer. There are many issues that need to be addressed in this design step. First, what type of environment is this product going into: retail, wholesale, or to another company for inclusion in one of their products? How is the product to be shipped: truck, air, train, or ship? Are there any special environmental conditions that the product requires? Is the product to be shipped to different sites, having different packaging requirements? How will the packaging material be disposed of: is it recyclable, reclaimable? Do end users have different requirements: language, colour, materials? Are there some disposal, reuse or reclamation requirements of packaging material? [1]. In graphic industry corrugated fibreboard is commonly used as transport box material. The first consideration when choosing the material is type of flute. A-flute is not in common use today due to its poor flat crush performance. C-flute has smaller height than the A-flute and therefore yields better flat crush performance, but poorer edge compression and box compression. B-flute has the smaller height and has the best flat crush performance, but poor edge and box compression performance. In flute selection, the key questions are the packaged product weight, required level of product protection and storage and distribution requirements. If the product is particularly heavy, it might require B flute due to its flat crush resistance. If the product is fragile and requires more cushioning during the transport, higher C flute is recommended.

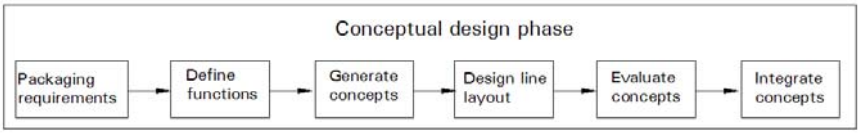

Figure 3. The conceptual design phase for the packaging development model

If the boxes are transported or stored in high stacks, resulting in great load, and the product itself does not support it (for example tin cans), C flute can provide the required box compression properties. In addition to flute type, required box strength has to be predicted with respect to the transport and storage conditions. A variety of empirical, semiempirical and mathematical models are used to predict the box compression strength [Da N] or [kg] based on the edge compression test of the material and the box dimensions. In addition to that, safety factors accounting for packaging operations (line

speeds), exposure to vibrations or high humidity (all reducing the box compression strength) have to be accounted for. When the required box compression strength and type of flute are known, the material with the appropriate grammage of liners and the corrugated medium can be selected. Visual impression is also of critical importance. If required, the outer liner can be bleached to enhance appearance.The conceptual design phase is one of the most time-consuming phases; however, this time is well spent, as changes later in the process are minimized, leading to reduced development time and costs.

2.3. The design phase

In the design phase, the development team generates the final design of the packaging equipment and/or line. In this phase, the integrated concepts generated in the last phase will be designed in detail and in some cases with the use of prototypes will take on a physical form for testing. The final design of the line(s) should contain all information necessary for the acquisition or fabrication and installation of all equipment. The model for the packaging is shown in Figure 4.

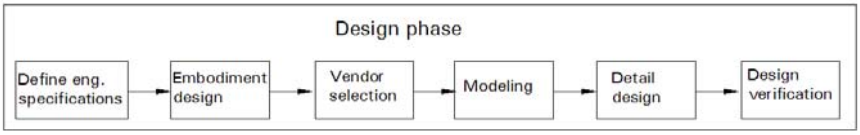

Figure 4. The design phase of the packaging development model

2.4 The production preparation phase

The production preparation phase includes the procurement, installation, and testing of the packaging line, and is used to ensure that the quality product can be packaged in this facility. This phase consists often design steps: procurement, installation, equipment integration, training, pilot packaging, validation, and release to packaging. The phase ends with the production approval milestone (Fig.5).

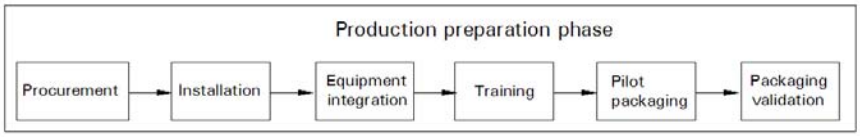

Figure 5. The production preparation phase of the packaging development model

3. SUMMARY

Packaging model consist of four design phases, which includes project planning, conceptual design, design, and production preparation. Each design phase follows the same general layout in which teams and support members are assigned to be responsible for various design steps. These teams then carry out the design step resulting in decisions and outputs for that step which are recorded in a database. The decisions made within each phase begin very broad, but with time and iteration within the phase, the decisions become more detailed until a final milestone report for that phase is completed and ready for management approval. The production and service are the culmination of all the other phases, the one in which the product is produced and shipped to the customer. It concludes the development of the product and its manufacture and packaging.

4. REFERENCES

[1] Skalak, S.C.: Implementing Concurrent Engineering in Small Companies, Marcel Dekker, Basel, Switzerland, 2002.

[2] Phair, J.: Integrating Manufacturing and Process Design into a Concurrent Engineering Model, Master Thesis, University of Virginia, 1999.