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PLM Applications in The Sustainable Design Process

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Abstract

Product Lifecycle Management (PLM) systems are used as a set of business solutions and tools for the management of the entire lifecycle of a product, from its design to its disposal. Sustainability in design is becoming increasingly important. In this process, the rapid changes in customer preferences and the resulting short product life cycles make the design, production and retail areas of related industrial products such as the fashion industry where design elements are at the forefront more complex. This situation has led to the increasing value of the design process in industrial products such as the fashion industry. For this reason, PLM has been increasingly used in other sectors where sustainable design is gaining value. PLM systems, called "digital revolution", can be used in all processes, from trend analysis, preparation of designs, preparation of prototypes, definition of samples and collection details, from production to retail processes, integrated with 2D and 3D software.

Design is the initial procurement process that moves from upstream to downstream through the procurement process. It represents the start point where the creative idea starts. Decisions taken at this level can determine the success or failure of a product in the market. The design process is also important in observing, archiving, classifying and sharing customers' needs, requirements and trends in a collaborative production environment. To ensure that the product can be successful in the market, Trend Analysis and Storyboarding processes and the design process must be interconnected. In this study, the stages of the design process are examined and the usage areas of PLM applications in these stages are mentioned.

Keywords: Fashion design, PLM, Sustainability

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Introduction

As the other industries, design is so essential for developing fashionable apparel products in the fashion industry. Developing of product needs the effort of many people and departments. In the modern age, companies which engages about product development should have use Product Lifecycle Management (PLM) for better productivity and profitability values.

PLM is a process which is using at the all stages of company. It allows to create order, design, developing product, producing, marketing, suply chain, controlling in the company. There are so many software in the different industries that help all of these stages for using PLM. PLM has so important task all of these stages.

PLM is a very successful business strategy for managing the lifecycle of products. Many activities such as design, simulation methods, prototyping, quality control, integrated production, computer aided technologies such as CAD, CIM, documentation are carried out in an order thanks to PLM.

PLM is a digital set of values by which products are managed by digital computers, digital information and digital communication (Udroiu, 2016).

Main benefits of implementing a PLM system in companies are;

- Rapidly penetration to the market and market dominance
- More collaboration among different departments
- Better productivity
- Better product quality
- Decreasing of production costs and prototyping costs
- Ease of introducing new products
- Improving design
- Increasing of the potential sales
- Maximizing supply chain collaboration
- Reducing encironmental impact for product life
- Increasing the sustainability practices

PLM is a simple approach technique. It is ocured from simple production philosophy. Biggest difference of PLM from simple production philosophy is to increase efficiency at all stages. PLM focuses on using the power of information and computers to reduce inefficiencies that result from the design, manufacture, support and eventual disposal of a product (Negroponte, 1995).

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Product Lifecycle Management (PLM)

Product Lifecycle Management (PLM); It is a digital management system used for the management of processes such as product development, production, distribution and reaching the consumer throughout the life cycle of a product. PLM provides an attempt to consolidate these different views and functional uses of an item (Grieves, 2005). PLM is the integration of business systems to manage a product's life cycle. PLM is an application technology to all aspects of a product's life, from its design. The University of Michigan PLM Development Consortium's definition is: "Product Lifecycle Management (PLM) is an integrated, information driven approach to all aspects of a product's life from its design inception, through its manufacture, deployment and maintenance, and culminating in its removal from service and final disposal" (Stackpole, 2003). PLM briefly, is the integration of business systems to manage the lifecycle of a product. PLM drives the next generation of lean thinking by trading product information for wasted time, energy, and material across the entire enterprise and supply chain (Grieves, 2006).

Main elements in PLM are:

- PLM is about product data, and all information contained in the system.
- PLM deals with the entire life cycle of the product, from its inception to the end of its life.
- PLM is an approach that includes more than just software or processes.
- crossing PLM boundaries; It includes all approaches functionally, geographically and organizationally.
- PLM combines employee elements (applications or methods), processes and technology in action.
- PLM drives the next generation of lean thinking.

The product life cycle of fashion products is short compared to other products. For this reason, the stages in which PLM takes place occur faster according to other products. The PLM Lifecycle model is a good one. It reflects the fact that there are several distinct stages in the life of a product. It indicates that the stages are sequential and that the product-related knowledge core is required for effective development and use of the product over time. Product information should be developed and used in the product lifecycle and should not be segmented into stages.

There are many functional areas around the PLM system. These areas directly or indirectly affect the operation of the PLM system according to the product life cycle (Figure 1.). This visual model clearly shows the process between the stages.

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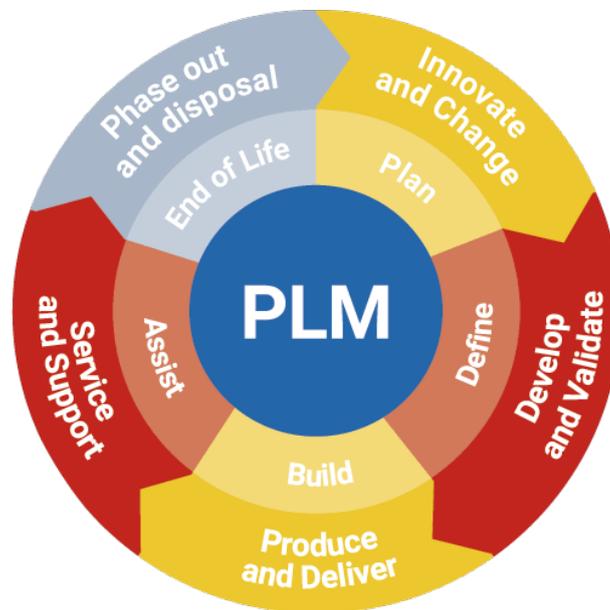


Figure 1. PLM Model around the informational core are the functional areas

Around the informational core are the functional areas that comprise a product's lifecycle. These functional areas are how organizations divide up the major categories of a product's life (Grieves, 2006):

- Planning
- Design
- Producing
- Technical support
- Dispose

Plan

In the production of a product, the first step of product development begins with needs analysis and planning. Questions are important to answers:

- What functions does the product have to perform?
- What are the requirements that the product must meet?

Design

The aesthetics of a product comes into play at this stage. While "form follows function" is the guiding principle of product design, function can allow for a wide variety of forms. Fashion product designers and industrial product designers put a lot of effort into the product design process and produce a wide variety of final design forms that can perform the same functions.

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Producing

After the product is designed, the manufacture of the product is the task of production engineering. The designs should be analyzed well and the process that creates the processes should be well established in order to produce the desired product. One important issue is that the design cannot be produced as designed. In some cases, the problem is so serious that it cannot be resolved by team conflicts and must be sent back to the design engineers. In the next phase, product engineering takes functional designs and prototypes and creates their final specifications. Then, product engineers add the information to the product lifecycle model. At the end of the phase, the components that make up the product are defined in a purely math-based model or CAD specification.

Technical Support

The sales and distribution function uses product information to tell the buyer and user of the product what the product's functions and features are, and ensure that the product performs in expected specifications. This part of the product lifecycle also provides valuable data about the product. This information is invaluable in determining how the product actually performs in use, whether the product has been designed properly. These data are important information about whether a product performs its guaranteed functions as specified.

Dispose

Disposal/Recycling is the last stage of the product's life cycle. Thus, the product completes its life. Knowledge of product design, manufacturing characteristics and composition is essential for sustainability. Information about whether the product can be recycled using processes designed when manufactured is important information for future product designs. The cycle starts over with the next release of the product based on this knowledge core.

USE OF PLM IN FASHION DESIGN

Good fashion PLM software gives the ability to collaborate and store critical feedback/data in one platform. It also helps to coordinate all involved in the process to improve and delegate resources (www.surefront.com).

Design is the key feature of a product's success. The design process is a very time-consuming task when the workflow is created manually. PLM solutions shorten this process. Fashion PLM helps the design team develop design ideas by simultaneously collaborating on a new design idea. PLM allows designs to be shared instantly with all stakeholders, allowing corrections to be made instantly (www.wfxondemand.com).

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Computer Aided Design (CAD)

Devices performing high-tech services in the apparel industry are commonly referred to as 'CAD/CAM'. In the apparel industry, CAD systems are mainly used in various processes such as garment design, pattern preparation, pattern grading, marker making and virtual garment simulation system (Öndoğan, Z., 2006).

These systems started out as simple drawing systems to aid the designer in producing faster and more accurate drawings, hence, the name computer aided design.

Initially, these systems were used as simple drawing systems to help the designer produce drawings faster and more accurately. Therefore, it was called Computer Aided Design (CAD). Today, the process has changed. Sketches and conceptual work of designers can be performed by CAD software with the help of CAD experts. Thus, the designers themselves sit in front of their computers and design their own designs and products directly on the CAD system. In the process when designers started to use CAD systems, 2D CAD systems now allow very successful work in 3D.

In order for PLM to fulfill its task in the design phase, the stages in the design process must be carried out with CAD and the data must be digitized.

Today, CAD (computer aided design) systems are used in the design and pre-production stages in the fashion and clothing industry. 2D CAD systems in fashion and apparel industry; It is used in the fields of technical pattern design and product data management, developed for the design of fashion styles, pattern making, editing and grading.

With the CAD systems developed for the design of fashion styles, model and pattern design, collection and catalog preparation can be carried out easily (Figure 2.). In these systems, after the pattern is drawn, it is colored and the pattern unit and fabric report are obtained (Şen and Öndoğan, 2004). In addition, story boards and presentation boards with designs made in these systems can be created. Thanks to these CAD software, it is possible for designers to reveal their creativity in a short time by choosing the right fashion design software. Weaving looms, dobbies and jacquards have also been integrated into these CAD software in recent years (Trivedi, 2015).

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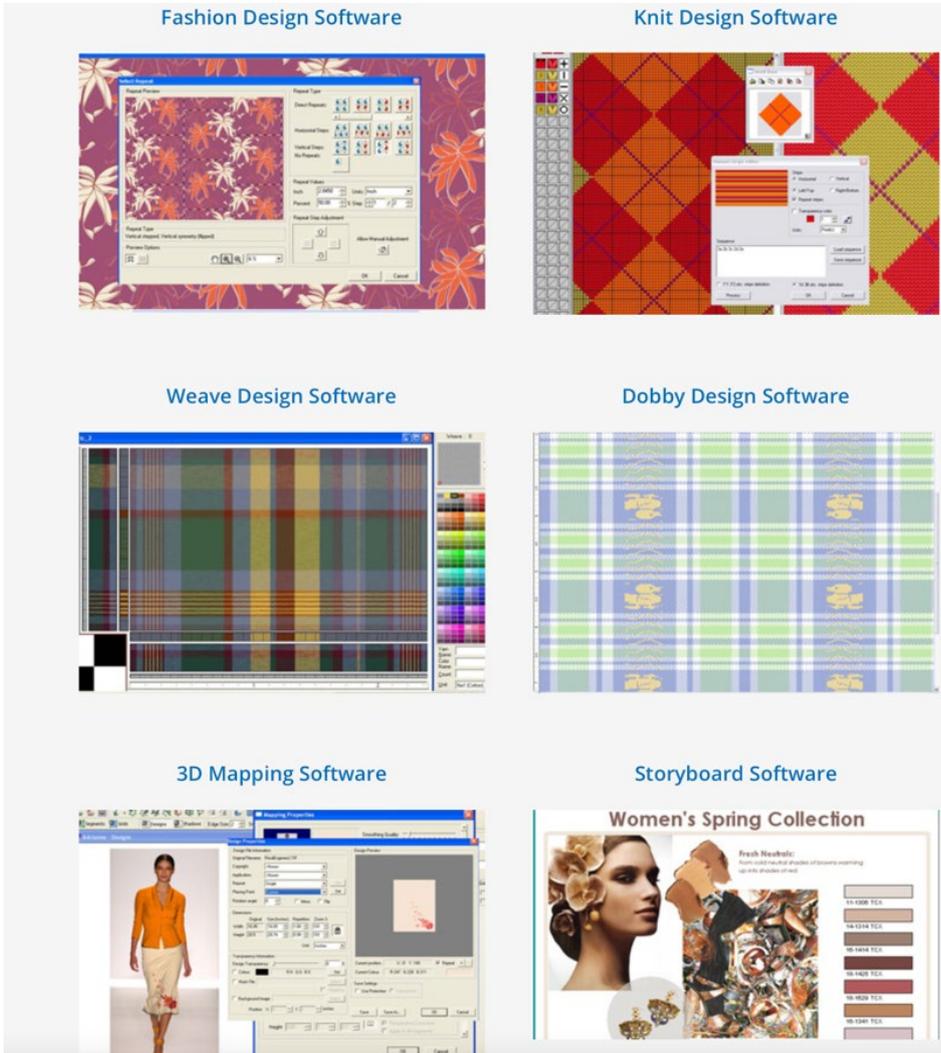


Figure 2. CAD systems in fashion design
<https://www.nedgraphics.com/fashion-design-software/>

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2D CAD systems developed for garment pattern preparation; It is used for preparing clothing patterns, model application, pattern grading and marker making. While these systems increase product quality, they also enable time, labor and material savings to be made. In Figure 3., examples of pattern and marker created in these systems are presented.



Figure 3. Examples of pattern and marker in 2D CAD systems

The purpose of virtual dressing systems, which are 3D CAD systems, is to garment design clothing models on virtual mannequins with the desired textile materials. Pattern pieces created in computer-aided pattern design systems are made three-dimensional with the help of these systems, and the necessary controls are carried out in terms of fit and aesthetics by dressing them on mannequins in the system. Taking advantage of 3D virtual clothing models significantly reduces both time-to-market and production costs of fashion products. 3D simulation allows designers to visualize the design and the draping effect without having to prepare prototype garments (Tama et al., 2016).

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Figure 4. Virtual dressing in 3D CAD systems
<https://masterkey.com.tr/masterkey/clo3d/>

CONCLUSION

Product Lifecycle Management (PLM) is both a company strategy and a specialized information system (IS). The PLM approach can be seen as a trend towards full integration of all software tools used in design and operational activities throughout a product's lifecycle (Garetti et al., 2005). Therefore, PLM software packages require PDM systems, synchronous and asynchronous, local and remote collaboration tools and, if necessary, a digital infrastructure that allows exchange between software programs (Segonds, et all. 2005).

Considering the collection preparation processes in the fashion and ready-made clothing sector, trend analysis is carried out first. Within the scope of trend analysis, storyboards are prepared in accordance with the target audience, themes and colors are determined.

There are processes such as determination of suitable materials and auxiliary materials, determination of patterns, preparation of portfolio for presentations. Considering the parameters such as fast production and increasing season numbers, these processes are quite time consuming and lead to material consumption. All stakeholders in the supply chain should use PLM effectively in their processes in order to contribute to sustainability efforts in the fashion industry and at the same time adapt to the rapid competition in the market.

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In the design process, with the effective use of CAD systems and PLM, collections can be evaluated with customers in a virtual environment without the need for fabrics to be knitted, woven, dyed, colored, patterned, and patterns prepared and sewn in the process of transforming designs into prototypes. Thus, while ecological sustainability is supported by the prevention of unnecessary waste, the savings in time, labor and materials provide a significant advantage to the sector in terms of economic sustainability.

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