ECONOMIC EFFICIENCY IN THREE-DIMENSIONAL GARMENT MODELING: A CASE STUDY OF 3DS MAX AND MARVELOUS DESIGNER SOFTWARE

Dilshodbek Yusupov
dilshodbekyusupov1992@gmail.com
Kimyo International University in Tahskents

Abstract: This article analyzes the impact of three-dimensional garment modeling technologies on economic efficiency in the sewing and fashion industries. In particular, it highlights the possibilities of accelerating the product design process, reducing the number of experimental samples, optimizing raw material consumption, and evaluating design decisions in a digital environment through the use of Autodesk 3ds Max and Marvelous Designer software. The article provides a scientific and practical justification for the role of 3D modeling in reducing production costs, increasing labor productivity, and creating competitive products.

Keywords: 3D modeling, garment design, economic efficiency, 3ds Max, Marvelous Designer, digital technology, virtual garment, sewing industry, design optimization

Introduction

Today, the use of digital technologies in the sewing and fashion industries is considered one of the key factors in improving product quality, reducing production costs, and accelerating the design process. In the traditional garment design process, preparing a sketch, developing patterns, sewing a trial sample from fabric, testing it on a mannequin or human body, correcting errors, and producing repeated samples require considerable time and material resources.

Three-dimensional modeling technologies make it possible to carry out a large part of these processes in a virtual environment. In this case, the garment's form, silhouette, volume, fabric drape, fit to the body, color, and texture solutions are initially evaluated on a computer. As a result, the product intended for production is analyzed in advance, and errors are identified at an early stage.

In particular, 3ds Max and Marvelous Designer play an important role in creating garments in 3D form, visualizing them, and presenting them realistically. While Marvelous Designer is mainly focused on garment construction, patterns, seam lines, and fabric simulation, 3ds Max is widely used for modeling ready-made 3D objects, staging scenes, applying materials, setting lighting, and producing high-quality renders.

Three-dimensional garment modeling is the process of creating the form, construction, volumetric structure, and material properties of clothing in a virtual environment. This technology strengthens creative and technical interaction among the designer, pattern maker, technologist, and manufacturer.

In traditional design, the sketch created by the designer is converted into a pattern by the pattern maker, after which a trial sample is sewn. In this process, certain design shortcomings may be identified only after the sample has been produced. In 3D modeling, however, the design solution can be reviewed directly on the screen. The garment's fit on the body, length, width, folds, fabric drape, and behavior in motion are evaluated virtually.

This process optimizes the pre-production preparation stage. Three-dimensional technologies are of particular economic importance in the creation of complex-cut garments, stage costumes, sportswear, special-purpose clothing, and fashion collections.

Marvelous Designer is one of the convenient software programs for virtual garment construction and fabric simulation. In the program, the user creates 2D pattern pieces, connects them

through seam lines, and observes the garment’s appearance on a 3D avatar body. Since this process is close to the pattern-making and sample-sewing stages used in traditional garment production, it is practically convenient for specialists in the sewing industry (Figure 1).

The economic efficiency achieved through Marvelous Designer is manifested in the following areas:

First, it reduces the number of trial samples. In the traditional method, one garment model may be sewn several times. Each trial sample requires fabric, thread, accessories, labor time, and equipment resources. In virtual modeling, initial errors are identified on the computer. This reduces the number of unnecessary samples.

Second, it helps optimize fabric consumption. In the program, the dimensions, placement, and structural form of pattern pieces are checked in advance. This contributes to the efficient use of materials, the reduction of excess waste, and the lowering of production costs.

Third, it enables rapid comparison of design options. Different versions of one garment model in terms of length, color, material, silhouette, and decorative elements can be tested within a short period of time. As a result, the designer works on more variations without increasing material costs.

Fourth, it facilitates remote presentation and approval processes. The customer or manufacturer can view the virtual appearance of the product before it is physically sewn. This reduces the risk of incorrect orders, reworking, and unnecessary expenses.

3ds Max is a professional software program widely used mainly in the fields of 3D modeling, visualization, animation, and rendering. In garment design, 3ds Max is particularly important for presenting a finished clothing model in high-quality visual form, creating advertising materials, developing virtual runway shows, catalogs, animated scenes, and 3D characters (Figure 2).

A garment model created in Marvelous Designer can be exported to 3ds Max, where detailed work can be carried out on material quality, color, lighting, camera angle, and scene composition. This enables the garment to be presented effectively not only from a technical perspective, but also from aesthetic and marketing points of view.

Figure 1. Interface of the Marvelous Designer software

The impact of 3ds Max on economic efficiency can be observed in the following aspects:

First, it reduces product advertising costs. Traditional advertising requires sewing a finished garment, hiring a model and photographer, using a studio and lighting equipment, and organizing a photo-shooting process. With the help of 3ds Max, however, digital renders of the garment, catalog images, and virtual scenes can be created.

Second, it makes it possible to present the product to the market before production. This helps to form preliminary orders, study customer feedback, and determine the production volume according to market demand.

Third, it clearly demonstrates complex design ideas. Some garments may include complex forms, decorative elements, volumetric constructions, or unconventional material solutions. 3ds Max enables such models to be represented in a realistic visual form.

Fourth, it creates opportunities for developing virtual collections and digital portfolios. This is economically beneficial, especially for fashion designers, higher education institutions, manufacturing enterprises, and start-up projects.

In three-dimensional garment modeling, Marvelous Designer and 3ds Max are considered complementary tools. While Marvelous Designer serves to create the constructive and physical properties of a garment, 3ds Max enhances and finalizes its visual appearance.

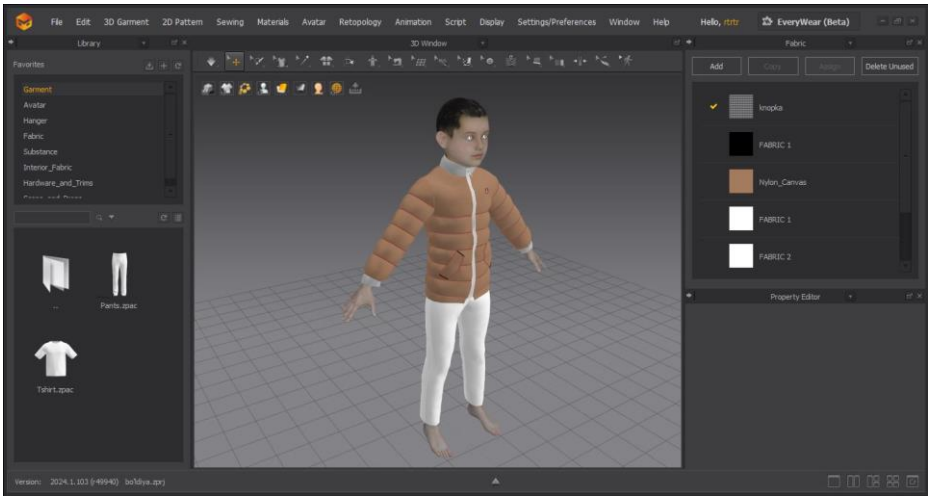

Figure 2. Interface of the 3ds Max software

The practical process can be organized as follows:

1. An avatar is selected or imported in Marvelous Designer.
2. 2D pattern pieces are created.
3. Seam lines are defined.
4. Fabric type, density, elasticity, and bending properties are adjusted.
5. The garment is simulated in 3D form.
6. The finished model is exported in OBJ, FBX, or another suitable format.
7. In 3ds Max, materials, textures, lighting, and camera settings are applied to the model.
8. The final render, catalog image, animation, or virtual presentation is prepared.

Such integration digitizes the entire process, from design to marketing. As a result, an enterprise can evaluate the product from technical, aesthetic, and commercial perspectives before putting it into production.

Economic efficiency in three-dimensional garment modeling is assessed through several key factors.

1. Time Saving

3D modeling significantly accelerates the product development process. In the traditional method, the development of a new model consists of several stages, each requiring manual corrections. In a digital environment, however, modifying the model, changing its color, editing its construction, and reviewing it can be carried out quickly.

2. Reduction of Material Costs

Virtual samples reduce the number of trial samples sewn from real fabric. This provides considerable economic benefit, especially for garments made from expensive fabrics, imported materials, or complex accessories.

3. Increase in Labor Productivity

The designer and pattern maker can work on the same digital model. In this process, information exchange becomes faster, misunderstandings are reduced, and production-ready documentation is formed more accurately.

4. Early Detection of Errors

Constructive problems in the garment, fitting deficiencies, excessive tension, or improper fabric drape can be identified at the virtual stage. Eliminating errors before production is one of the most important economic advantages for an enterprise.

5. Expansion of Marketing and Sales Opportunities

Based on 3D models, it is possible to create electronic catalogs, images for online stores, virtual exhibitions, animated videos, and digital advertising materials. This helps promote the product in the market more rapidly.

6. Environmental Efficiency

The reduction of material waste, the elimination of unnecessary samples, and the digitization of pre-production stages are also environmentally beneficial. This is directly related to the modern concept of "sustainable fashion."

Opportunities for Application in the Educational Process

Teaching 3ds Max and Marvelous Designer in the fields of sewing, costume design, fashion design, and light industry technology improves students' professional competencies. A student not only draws a garment on paper, but also creates it in a 3D environment, observes constructive errors, analyzes fabric properties, and presents the finished product in a realistic visual form.

This brings the educational process closer to production. A specialist who has mastered digital technologies becomes more competitive in the labor market. Such skills are especially important in the fields of fashion design, stage costumes, special-purpose clothing, sportswear, and virtual fashion.

Problems and Proposals

There are also certain challenges in implementing 3D modeling software. These include the cost of software, the need for powerful computer equipment, insufficient training of specialists, and the incomplete formation of digital culture in manufacturing enterprises.

To overcome these problems, the following proposals may be put forward:

- strengthening 3D modeling courses in sewing and design programs;
- organizing practical training sessions on Marvelous Designer and 3ds Max software;
- expanding cooperation between higher education institutions and manufacturing enterprises;
- establishing a digital portfolio system for students;
- organizing 3D design services for small enterprises on an outsourcing basis;
- introducing virtual samples, virtual exhibitions, and digital catalogs into practice.

Conclusion

Three-dimensional garment modeling is an important technological direction that increases economic efficiency in the modern sewing and fashion industries. While Marvelous Designer enables garment construction, pattern development, seam lines, and fabric simulation to be carried out in a virtual environment, 3ds Max serves as an effective tool for high-quality visualization of the finished model and for creating advertising and presentation materials.

By using these programs, it is possible to reduce the number of trial samples, decrease material consumption, save time, increase labor productivity, and bring products to the market more quickly.

In addition, 3D technologies are also of great importance in the educational process, as they develop the digital competencies of future designers and engineers.

Therefore, three-dimensional garment modeling not only improves design quality, but also increases the economic, technological, and environmental efficiency of the production process. For this reason, the widespread implementation of 3ds Max and Marvelous Designer in the sewing industry and fashion education system is one of the urgent tasks of the present day.

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