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Представяме Ви рециклирана прежда, която е направена изцяло от тениски, събрани благодарение на кампанията на Мария Юрукова за рециклиране на текстил “Плети с тениска”.

Рециклираната прежда е в разнообразни цветове, представлява трикотажна лента, изработена от рециклиран текстил с ширина приблизително 7-12 мм. Всяко едно кълбо е ръчно изработено от тениски по забравена традиционна технология за обработка на текстил.

Закупувайки си от продуктите, вие не само ще подкрепите кампанията, но и ще помогнете за намаляване на текстилните отпадъци.

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За Платформата “Кръг на Квадрат”
Платформата “Кръг на Квадрат” е естественото продължение на бранда “Плетчица” и проекта “Плети с тениска”.

“Кръг на Квадрат” обединява страстта ми към плетенето и интересите ми в екологията и психологията. Тук вие ще намерите ръчно правени продукти, изработени от естествени материали и рециклиран текстил. Във всеки от тях е вложена много любов и смисъл.

Чрез кампанията "Плети с тениска" се събират стари дрехи, предимно тениски, които се обработват. От рециклирання текстил се създават чудесни продукти за дома и офиса. Някои са изцяло изплетени, други - шити. Колекциите от текстил са изработени от материали, които са изцяло биоразградими и могат да бъдат почти 100 % рециклирани. Изключително екосъобразна и щадяща природа.
LEARN MANUFACTURING IN SEWING INDUSTRY IN BULGARIA

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Abstract:

Increased competition in the sewing industry requires demand and the introduction of innovations to improve efficiency and production quality without increasing costs. The paper discusses the principles of Lean Systems and their application in the sewing industry in Bulgaria. The value stream is mapped, according to the specifics of the production of sewing products - ready made garments and a new value stream model is presented in which pre-and post-production activities are optimized.

Key words: Lean Systems, sewing industry, value stream

Introduction

Lean Manufacturing, as known Lean Production, is created as production system by Toyota and due to this fact - known as the Toyota Production System (TPS). It was established in Japan between 1948 and 1975 by Taiichi Ohno and Eiji Toyoda. They called it Just-in-time manufacturing [1].

The introduction of the system is aimed to eliminate inefficiencies in production operations and waste. These are all components in any production process that do not add value. The process is so successful that the Toyota Production System has long been beyond the boundaries of Toyota and Japan and has entered manufacturing sectors all over the world.

Lean’s core principles influence concepts not only in industry, but also in sectors such as healthcare, the IT sector, services, and so on. When the principles are implemented correctly, Lean can lead to major improvements in efficiency, production time, productivity, material costs, waste, which in turn leads to lower costs and increased competitiveness.

Lean Manufacturing has been successful on a range of sizes - from large corporations to small businesses, and even micro-companies. It improves teamwork, inventory management, quality, reduces operating costs, deadlines, improves customer interaction, and so on.

The aim of the paper is to examine the principles of Lean systems and to analyse the possibilities for their application in sewing companies, producing in Bulgaria, taking into consideration the specifics of production.

Exposition

Each production is accompanied by its peculiarities. Introducing significant improvements is a laborious process. By using Lean Manufacturing’s capabilities to know basic principles and implement different tools to deliver Lean Manufacturing enables production to become an effective, well-functioning system.

By its creating Toyota Production System (TPS) is trying to prevent:

1. Muda - Japanese term for “waste”. Muda is all in the production process that creates waste or
limitations for creating a valuable product. These are all activities in the production that do not add any value.

TPS defines 8 types of waste (DOWNTIME):

- Defects - errors that require additional time, resources and remedies.
- Over-production - at the output of the process, the basic product is not available, and at the same time the workers are committed to produce products that are not so urgent at the moment.
- Waiting - the job must be stopped for some reason, the worker is overloaded and fails to pass on the required amount, or waiting for approval, or because the available materials are exhausted, etc.
- Not using talent - insufficient use of talents, skills, knowledge, inventiveness of people.
- Transportation - unnecessary transport, resulting in increased costs, waste of time and increased likelihood of damage and deterioration of product quality.
- Inventory excess - there is production and supply that is above actual customer demand.
- Motion waste - people, equipment or machines that do not add value to the product, service or process.
- Excess processing - it takes longer than necessary to process the product.

2. Mura - Japanese term for “irregularities in operations”. Mura is all that creates ineffective workflows and disturbs consistency. An example of Mura is if less than the planned number of items are produced for the day, and the next day more than necessary.

3. Muri - the Japanese term for “overloading of people and equipment”. These are all tasks or tasks that cause too much pressure on employees or machines. If an operator is burdened with too much work, this leads to his exhaustion and reduced efficiency of his actions, rather than part of it being delegated to someone else. When operating a machine that has been in the service for a longer period of time than is foreseen in its standard features, damage is possible.

When introducing TPS, it is intended to minimize or eliminate Muda, Mura and Muri.

In [2] the TPS management philosophy is analyzed and refined. The main principles of the Lean concept and its implementation in the organization are defined as a process consisting of the following five stages:

1. Value - Determine what value is added to the customer.
2. Value stream - Clarify which activities in the process create added value for the client and which does not.
3. Flow - Maintain smooth flow of the process all the time and eliminate losses that can cause delays.
4. Pull (Production Withdrawal) - Avoidance of production greater than demand.
5. Perfection - Continuous striving for improvement.

For the successful implementation of the system it is necessary to develop a strategy, which includes an analysis of each of the principles from the point of view of the particular production.

The value is created by the manufacturer but is always determined by the customer’s needs for the particular product. It is important to identify customers and determine the added value that products or services bring. The company must strive to eliminate the waste and the cost of its business processes so that the optimum price of the customer is achieved at the highest profit for the company.

The client is not willing to pay for resources and time that is not invested in the specific product. In other words, companies need to understand the value the client add to the products and services, which in turn can help them determine how much money the client is willing to pay. This helps to clearly see which units and operations generate “added value” for the client. This ensures a reduction in production costs, identifying the teams that usually carry out the essential part of the work, as well as the unnecessary units that can be removed. As a result, the final item price is approaching the value in terms of the client that he is willing to pay.

For example, when making sewing products, the client is willing to pay a price that includes the cost of materials delivery and manufacture of the product, within the desired timeframe. If the enterprise uses intermediates for delivery, this increases the final price. From the client’s point of view, these units and activities do not bring him added value and he is not willing to pay for them.

Value stream - Defining and outlining the path of creating value added for the client. Once the value is determined, the next step is mapping the “value stream”. This includes a description of all processes,
teams and accompanying activities involved in the stages of creating value added in products or services, all steps and operations from the delivery of raw materials for processing to delivery of the ready-made garment (RMG) to the client. This principle includes recording and analyzing the flow of information or materials needed to produce a particular product or service for the purpose of identifying waste and methods of improvement. Value stream covers the entire life cycle of the product. Mapping is a simple but effective way that identifies all actions that are put into the product or service at each stage. This process can be the design of the production process, the supply of materials, human resources employed in production, administration, customer service.

The idea is to make a short and clear “flow map” for the whole process. The goal is to identify all steps that do not create value and then find ways to remove or reduce them. Sometimes this principle is called re-engineering of the process. Ultimately, its application leads to a better understanding of the entire business operation. This is the ultimate end-to-end process that creates added value for the client.

After the first step - understanding the needs and desires of clients, the second is an analysis of how to be satisfied [3].

The value stream of a RMG, produced in a Bulgarian company, which is working on CMT-Cut, Make and Trim process, has the following form (Figure 1). In the mapped flow, the client is the part of the flow, who makes the orders for the RMG production.

**New flow** - create a new process by eliminating the unnecessary components. Removing functional barriers and identify ways to improve runtime to ensure that processes run smoothly from the time the order is received to delivery. The steps to create value are done in a strict sequence so that the product or service moves smoothly to the customer. The flow is critical to the removal of waste. Lean production depends on preventing interruptions in the production process and creating a harmonized and integrated set of processes where the activities move in a steady stream.

From the created value stream map of the sewing product, it is found that there are units and activities that do not have value for the client. Such are the intermediaries of materials delivery and logistics of finished products to the end buyer and they can be removed.

For the same sewing product, a new value stream has been developed (Figure 2). It does not have intermediaries. Deliveries are requested through an electronic system, directly from a manufacturer. The cost of remuneration of intermediaries and the time from request to delivery are reduced.

Once the waste is removed from the flow of the value, the next step is to ensure that the remaining steps run smoothly, i.e. the way clients receive their added value is direct - without interruptions, delays or losses. This is perhaps the biggest challenge to create cross-links in all departments to ensure flow of the process.

**Pull is the fourth principle of Lean production.** Respond to market demand by creating a pull system. Identify when and why clients are looking for products and services, and the process follows client needs whenever and wherever the client wants. This means starting a new job only when there is a search for it so that the products are made on a “just in time” basis, the materials are not stored and clients receive their

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**Figure 1. Value stream mapping of a ready-made garment**

**Figure 2. New value stream of a ready-made garment**
orders for weeks rather than months.

With improved flow, time to market (or time to client) can be significantly shortened. The client can download the product from the manufacturer if necessary.

As a result, it is not necessary for the sewing company to pre-manufacture the products or to store materials for them, thus saving money for both the manufacturer / supplier and the client. Another major risk of dropping out of the fashion for the garment [4] is avoided, resulting in substantial losses for all participants in the chain.

Lean manufacturing uses a pull system where nothing is bought or produced in advance until a search occurs. The pull relies on flexibility and good communication.

Perfection is the fifth principle of Lean production. Once “surpluses” have been identified, they have to be accepted not as a philosophy of processes but as “work philosophy”, strategy and vision. Which means Lean thinking and process improvement should become a core part of corporate culture.

The implementation of steps 1-4 is an important beginning, but the fifth step is probably the most important: turning Lean thinking and improving the process into corporate culture. For a good end result, constant effort and vigilance and improvement are required. Every employee should be involved in the implementation of the Lean system.

Perfection is accompanied by continuous improvement of the process. A radical reorganization in the company, following the way the client receives the product, would help to see more surpluses.

The implementation of Lean strategy guarantees not a high but imperative high quality of products and services. Achieving the desired results is not just a matter for managers, employees also have an active role in turning Lean companies into the lead.

In order to make the Lean production system more concrete and less abstract, it is important to know the tools for its implementation. From their proper use, depending on the specifics of production, depends on their efficiency.

CONCLUSION

Lean is not a static system and does not work equally for all companies. For its effective implementation, it is essential to take into account the specificities of production and of the company itself. The presented examples of the application of the basic principles have taken into account the fact that in Bulgaria the sewing industry works mainly of a CMT. Requests are made by a client, and the company itself has no great opportunities to change the technology of making products. In mapping the value stream, it has been found that stream optimization could be done by removing units and activities before and after production.

Reducing the value of the products could be achieved by strictly controlling the execution schedule, selecting resources and materials, selecting effective communications channels, both with the client and with the rest of the chain production and delivery.

Through the right tools and system implementation, seams can be produced with the highest quality, while increasing the revenue and productivity of the sewing company.

REFERENCES


EKSPOSHOSHES
İSTANBUL

İSTANBUL AYAKKABI SARACİYE VE MODA FUARI
7th ISTANBUL FOOTWEAR LEATHER GOODS FASHION FAIR

14-17 MAYIS - MAY - MAI 2019

online magazine for Textile, Clothing, Leather and Technology

online www.tok-bg.org
Abstract:
The fashion industry today is one of the most unsustainable global business sectors - contributing to the depletion of fossil energy, deforestation caused by drought and water use, pollution caused by chemical dyeing and unethical attitudes towards workers. These negative impacts lead to mega problems related to the economy, the environment and society. This article focuses on fashion design education as one of the aspects that support the paradigms of society, and the young people are drivers of trends. Fashion and sustainability are examined in their contemporary understanding of connectivity and the role of education in sustainable development. The focus is on the new educational paradigm - design for sustainable development. The challenges of fashion training for sustainable fashion design are presented. Finally, competencies in fashion design and development of sustainable design thinking are exposed.

Keywords: fashion industry, sustainability, fashion design, education.
програма за действие. Образованието остава важно за укрепване на устойчивото развитие и присъства в дневния ред за развитието на Европа и света и след 2015 г.

Програмата за устойчиво развитие- 2030 на ООН е амбициозна и универсална програма за премахване на бедността чрез устойчиво развитие. [20] В нея се подчертава, че образованието е от съществено значение за успеха на всичките 17 от нейните цели. Също, в глобалната програма за действие на Юнеско и петте определени стратегически области на действие са свързани с овладяване на младите хора. [15] Подчертана е тяхната важна роля в по-нататъшното развитие на практиката и научните изследвания в областа на устойчивото развитие през следващите години.

Първата книга на Юнеско за приложението на Глобалната програма за образование за устойчиво развитие пример, подчертава възможността „обучаемите да вземат информирани решения и отговорни действия за етична и екологична възможностите на устойчиво развитие през следващите години. Също, в глобалната програма за действие на Юнеско и петте определени стратегически области на действие са свързани с овладяване на младите хора.

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3. МОДА И УСТОЙЧИВОСТ

3.1. Предизвикателства

Модната индустрия, е с огромен икономически потенциал, но и един от основните замърсители на околната среда. Производството и потреблението на облекло е отговорно за няколко екологични и социални въздействия. Тези въздействия са свързани с отглеждането и извличането на суворини, условия на труд, запазване на културната идентичност и поддръжка на облеклото. [13]

Краткотрайността на жизния цикъл на модните продукти, предполага масово производството и неконтролирано потребление на продукти, с програмирано излизане от употреба на всеки шест месеца. [10] Давид Сантило и организацията „Форум за бъдещето“, подчертава някои от основните проблеми, причинени от тези отрасли, а именно: „Консумация на мода, консумация на вода; условия на труд; изразходваната енергия; въглеродни изкода от транспорта и тъкането; сложността на веригата за доставки и управление на отпадъците. [29]

Първоначално, модната индустрия се променя - потребителите са все по-осведомени въпросите на околната среда и започват да предпочитат продукти, разработени с екологични, и социално отговорни политики. В този смисъл марките се опитват да се адаптират към това променящо се общественото съзнание, което изисква изпълнение на околната среда и социална отговорност, и развитие на нови стратегии като използването на възобновяеми енергийни източници и нови технологии, които могат да подпомогнат управлението на околната среда. [10] Компаниите започват да реализират устойчивост в жизния цикъл на модните продукти в процеса на тяхното развитие.

Имайки предвид факторите, споменати по-горе, има необходимост от мерки, които могат да намалят отпадъците. Устойчивото развитие изисква отговорност към околната среда и предприемане на действия за свеждане до минимум на проблемите причинени на природата. Това развитие трябва да бъде част от бизнес-виждата на модната индустрия, всички участници във веригата търсене и предлагане на устойчиви продукти и използване на основни енергийни източници и нови технологии, които могат да подпомогнат управлението на околната среда. За да се постигне устойчивост на модната индустрия, всички участници във веригата трябва да работят в тази посока. За да се постигне устойчивост на модната индустрия, всички участници във веригата трябва да работят в тази посока. За да се постигне устойчивост на модната индустрия, всички участници във веригата трябва да работят в тази посока.
3.2 Устойчива модна индустрия

Модата е културно изразяване и комуникация на често предполага преходност, а значението на модата остава непроменено. Облеклото е материализован израз на модата, тя е контекстуалната визия в обществото. [2]

Устойчивостта, в контраст е свързана с дългосрочна перспектива. Линда Уелтерс, в своята работа „Модата на устойчивостта“, представя връзката между устойчивостта - както се разбира днес - и модата, и подчертава, че устойчивостта не е нова концепция в историята на модата. [22]

Концепцията за „устойчива мода“ е сравнительно нова - въпреки че идеята за устойчивост е съществувала от десетилетия насам. В началото на 90-те години дизайнът и иноваторите започват да изследват процесите в модата и да реализират идеята, че дрехите могат да бъдат направени по начин, който да е екологичен, социално отговорен и насърчаващ културното многообразие и иновациите. Същевременно, устойчивата мода предполага етика, тръгновост и повторна употреба на продуктите. Дефинирането на „устойчива мода“ в индустриален аспект е трудно. Но концепцията за устойчива мода се свързва с различни термини като органична, зелена, справедлива, устойчива, бавна, еко и т.н. [3], всеки от които се опитва да подчертява устойчив моден дизайн. Терминът „устойчив моден дизайн“ няма точно дефиниране.

Въпреки че дейността на съвременните дизайнери е съобразена с необходимите изисквания за по-устойчива производствена система, ролата на модния дизайнер в този контекст е по-сложна в сравнение с традиционните дизайн дейности.

4.1. Компетенции в модния дизайн за устойчивост

За да се преодолеят екологичните и социални проблеми на устойчивостта, трябва да бъдат създадени нови инструменти и методи за дизайн, които да се насочат специално към устойчивостта в модния дизайн.

Образованието е един от най-критичните елементи за усъвършенстване на устойчивото развитие и устойчивия дизайн. Тук трябва да се има предвид подобряване на качеството на основното образование, преориентиране на образованието към разбиране на устойчивостта, подобряване на обществената осведоменост и осигуряване на обучение в много сектори на обществото.
въпросите на устойчивостта и съответната среда ще даде възможност на хората да се занимават с проблемите на околната среда и развитието, включително етичното съзнание, ценностите и нагласите, уменията и поведението. (UNCED, 1992). [28]

По отношение на компетенциите на модните дизайнери съответстващи на устойчивото развитие, то със сигурност може да се изграждат във и извън формалното образование. Също, традиционния подход при проектирането трудно може да се справи с целта за устойчив дизайн. [27]

Типичното дизайнерско образование обикновено набляга върху проектирането на визуалния елемент на новите продукти, като подчертава значението на естетиката и художественото експериментиране, като се отделя малко внимание на интегрирането на устойчивостта. Всъщност, устойчивостта не се счита за съществена част от дизайн процеса или често се разглежда като самостоятелно проектиране/ Сега сме изправени пред факта, че тези подходи не са достатъчни, за да насърчат устойчивия начин на живот и че е необходим нов подход.

Дизайнерите могат да играят важна роля в този сценарий. Те са в състояние да вземат решения по отношение на материали и методи, използвани в производствения процес[1]. В този смисъл, дизайнът има потенциала, да създава продукти и процеси, култура за по-устойчиво производство, общество и бъдеще. В този контекст, ролята на модния дизайнер е да търси решения на предизвикателствата, които поставя устойчивостта. [13]

Ангажирането на модните дизайнери с устойчивостта изисква знания, умения и компетентности. Това на първо място означава познаване на стратегиите за устойчив дизайн: ако не знаете какви са стратегиите, те няма да променят процеса на проектиране, за да създадат повече устойчиви решения. [7,8]

4.2. Устойчиво дизайн мислене

Флетчер и Гросе (2012, стр. 157) твърдят, че „за да се развият идеите и практиките за устойчиво развитие на модния сектор, трябва да се разбири по-дълбоко и по-широко комуникационно и образователно движение за изграждане на грамотност сред населението за екологията и природните системи и техните взаимовръзки с човешките системи.“ [7,8] Образователните и изследователските институции могат да подкрепят прехода чрез вграждане на принципите на кръговата икономика в тяхното преподаване и създаване на доказателства за значението на концепцията за устойчивост.

Въвеждане на принципите на кръговата икономика възобновяващо ще подготви обучаемите с необходимите умения за системно мислене и нагласи. [5,6] По отношение на обучението по моден дизайн, има тенденция за системно въвеждане на изследвания от университети и изследователски институти в образователни и приложни инициативи и програми. [5,6,25, 29] Резултатите от тях се явяват доказателство за необходимостта за развитие на текстилната и шивашка промишленост, и модната индустрия в глобален аспект. [11,12] Сътрудничеството между изследователи, предприятия и други организации е от решаващо значение за справяне с проблемите на съвременното общество и също за разпространение на пилотни проекти и резултати.

Образованието по моден дизайн във ВСУ „Черноризец храбър“ предоставя нужната среда за обучение на нужните модни дизайнери. От една страна, визуалното оформление на изделието се разглежда като средство за вза̀действие и цели развиване и изграждане на умения по проектиране на оригинали дизайнърски обекла. Същевременно, дизайнът, проектирането за решаване на проблеми и адресно проектиране на костюми е процес и резултат към който „трябва да се подхожда като към създаване на елемент, имащ своето определено място и въздействие в обогатяването на едно цяло.” [9] Историята на развитието на това обучение и разбира се на модния дизайн в цялост, предполага въвеждане на знанията и уменията нужни на обществото и съответно на всеки обучаем. Задачи и проекти по темите „Еко“, „Зелена мода“, „Рециклиране“ и „Редизайн“ присъстват в програмите по различни дисциплини. Новото в обучението не е самата тема “Устойчивост”, а подхода да се развива дизайн мислене за устойчивост. Задача по дисциплината „Моделиране на облеклото“ представи като резултат на първата браншова конференция “Тенденции и иновации в текстилната и модната индустрия” в Пловдив – България. Десет проекти на студентите по темата „Нов живот“ утвърдиха последните тенденции в модата- устойчивост и иновации.
фиг.1 Представяне на ВСУ „Черноризец Храбър” и спец „Моден дизайн” в ТексТейлърЕкспо 2018

Студентите приложиха устойчивите техники: редизайн, рециклиране на текстил, безостатъчен и модулен дизайн за създаване на облекла и цялостни модни визии.

Резултатите доказаха, че фокуса на обучението трябва да е върху развитие на дизайн мислене за устойчивост.

ЗАКЛЮЧЕНИЕ

Модните и текстилните дизайнери трябва да преосмислят процесите на проектиране и да включат устойчивостта в начина, по който те проектират продуктите. Всички участници в реализирането на образователните практики, трябва да подхождат отговорно, защото в университета се оформя културата на дизайнерските практики.

Ролята на академичните среди във висшето образование, както и на класовите участници в икономиката и администрацията, трябва да бъде подкрепена по отношение на ключовите предизвикателства в областта на устойчивото развитие. Засилването на темповете по

фиг.2 Представяне на ВСУ „Черноризец Храбър” и спец „Моден дизайн” в ТексТейлърЕкспо 2018

изграждане на дизайнерски умения и дизайн мислене изисква разработване и прилагане на нови инструменти.

Образованието за устойчиво развитие трябва да е ориентирано към резултатите и съвместно към развитието на ключови компетенции в областта на устойчивостта.

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For information: http://itafmyanmar.org/
Abstract:

Modern technological means are increasingly used in the field of fashion and textile industry. At the design stage, the application of specialized computer software systems is a necessity. They help for more efficient, precise and quality design of the developed models. In practice specialized program products designed for specific needs, universal CAD systems, vector and raster programs, as well as open-source systems are used. The present study aims to analyze leading specialized software applications in the fashion and textile industry, paying particular attention to open-source 3D systems, where anatomical and anthropological parameters are assembled, making it possible to construct correctly the developed models.

Keywords: 3D, Open-source, Blender, MakeHuman, Clothes

Introduction

Contemporary conditions of technical progress directly affect the fashion and textile industry. This is explained in many stages of conceptual design, conventional and computer design, production, marketing, markets, etc. [1 - 4]. Sustainable design in this area is essential [5 - 8] as well as the specific regional features [9 - 11]. Engineering design practices [12], the development of digital innovations [13], 3D printed models [14 - 16], and other jewelry accessories complementary to the overall fashion vision are also crucial [17 - 20].

Exposition

The application of computer 3D design in the field of the fashion and textile industry requires a deep knowledge of the principle of the work of modern software systems. There are 2D vector and raster programs [21], CAD systems [22] and 3D polygonal mesh applications [23, 24]. While in its 2D design part, the design capacity is relatively straightforward (except for special integrated systems developed for specific needs), a certain class of CAD systems is involved extremely successfully in the development of accessories (jewelry, jewelry, rings, etc.). The solid based CAD system – SolidWorks - the leader in the field is fully optimized in the material calculations [25]. Through it, the process of material consumption, pricing, and environmental research has been optimized. Referring to the visual design, where developed models of dummies involving a particular textile design are presented, the application of open source systems such as 3D Blender and MakeHuman is fully justified [26, 27].

To implement the research objectives, a methodology has been developed which contains a fully optimized process between SolidWorks CAD system, 3D Blender, MakeHuman and additional programs and specialized Add-ons applications [28 - 31]. The anatomical and anthropological features and requirements are fully respected [32 - 35]. The methodology for optimizing the process of computer 3D design for the needs of the fashion and textile industry includes:

- SolidWorks 3D CAD:
- Solid modeling;
- Characteristics of the material;
- Pricing;
- FEM analysis;
- Eco design.

- **3D Blender:**
  - 3D Polygonal mesh modeling;
  - Simulations
  - Animation and render.

- **MakeHuman:**
  - Anatomical design;
  - 3D conventional design of clothing and accessories.

- **Additional programs, platforms and Add-ons:**
  - Specialized functions;
  - Optimized file formats

- **SolidWorks 3D CAD:**
  - 3D solid modeling;
  - Conventional design of clothing and accessories

- **3D Blender**
  - 3D Polygonal mesh modeling;
  - Simulations
  - Animation and render.

- **MakeHuman**
  - Anatomical design;
  - 3D conventional design of clothing and accessories;

- **Additional programs, platforms and Add-ons:**
  - Specialized functions;
  - Optimized file formats

The present work contains 3D human mannequins dressed in fashionable daily and summer clothing and accessories (jewelry—Female).

According to the preliminary plan, two CAD models of jewelry were originally developed (bracelet and ring) differing by type of material: gold, silver and titanium. In fig. 2 (a) is presented a 3D gold bracelet model and (b) a 3D gold ring.

Fig. 3 (a) visualizes the original gold color (according to the real, automatically generated) and (b) the physical properties of the material.

Visually, the methodology is shown in fig. 1

**Fig. 1. Methodology optimizing the process of computer 3D design for the needs of the fashion and textile industry**

To implement the developed model, the practical application of the methodology is set out in the following order:

1. Development of 3D solid bracelet and ring jewelry models in CAD environment (SolidWorks);
2. Characteristics of the material and pricing of the samples;
3. Exploring the robustness of the 3D geometry of the developed models using the FEM method (additional option, subject to other studies. SolidWorks);
4. Ecological aspects (an additional feature that is subject to other SolidWorks research);
5. Polygonal mesh anatomical 3D design of human mannequins using Blender software, MakeHuman;
6. Anatomical design of clothes (MakeHuman + 2D raster editing);
7. Assemble in a single 3D model of a mannequin + clothes and jewelry accessories (Blender);
8. Final render and presentation of the result.
Fig. 3. Gold material: Appearance (a) and Properties (b)

Fig. 4 (a) shows 3D silver model of bracelet and (b) 3D silver ring

Fig. 4. Silver bracelet (a) and silver ring (b)

Fig. 5 (a) shows the original silver color (in accordance with the real, automatically generated) and (b) the physical properties of the material.

Fig. 5. Silver materials: Appearance (a) and Properties (b)

Fig. 6 (a) shows 3D titanium model of bracelet and (b) 3D titanium ring

Fig. 6. Titanium bracelet (a) and titanium ring (b)
Actual weight of the 3D CAD models of bracelet and ring are shown on table 1 and table 2. For calculating are used the following options: MassProperties \ Options: Decimal Places: 3; Accuracy level: Higher. The original material data provided by SolidWorks system is based on: Material Financial Impact data is based on bulk raw material price computed from 1. MetalPrices.com (2012).Accessed May 15th, 2012, from http://www.metalprices.com/subscription/metros/au/au.asp.

**Table. 1. Mass Properties of Bracelet model**

<table>
<thead>
<tr>
<th>Bracelet</th>
<th>Density – grams per cubic millimeter</th>
<th>Mass – grams</th>
<th>Volume – cubic millimeters</th>
<th>Surface area – square millimeters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure Gold</td>
<td>0.019</td>
<td>79.423</td>
<td>4180.136</td>
<td>3482.965</td>
</tr>
<tr>
<td>Pure Silver</td>
<td>0.011</td>
<td>45.981</td>
<td>4180.136</td>
<td>3482.965</td>
</tr>
<tr>
<td>Titanium</td>
<td>0.005</td>
<td>19.229</td>
<td>4180.136</td>
<td>3482.965</td>
</tr>
</tbody>
</table>

**Table. 2. Mass Properties of Ring model**

<table>
<thead>
<tr>
<th>Ring</th>
<th>Density – grams per cubic millimeter</th>
<th>Mass – grams</th>
<th>Volume – cubic millimeters</th>
<th>Surface area – square millimeters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure Gold</td>
<td>0.019</td>
<td>3.165</td>
<td>166.605</td>
<td>647.412</td>
</tr>
<tr>
<td>Pure Silver</td>
<td>0.011</td>
<td>1.833</td>
<td>166.605</td>
<td>647.412</td>
</tr>
<tr>
<td>Titanium</td>
<td>0.005</td>
<td>0.766</td>
<td>166.605</td>
<td>647.412</td>
</tr>
</tbody>
</table>

The next stage is the development of two 3D human models (fig. 8) - of man and woman in MakeHuman software and virtual presented on the internet platforms p3D.in and ResearchGate. For the 3D model of a man, only parametric modeling, including anatomical model and daily clothing (standard from the database, visualization in Blender software). The 3D model of a woman dressed in summer clothing (MakeHuman software) and jewelery (developed in SolidWorks Final Stage) is visualized in Blender software, with the T-shirt going through a re-design process in Gimp software.

3D modeling of the anatomical figure of a man takes place in the open source MakeHuman software. There is a possibility to define different poses and armature (if necessary to move the model into a computer environment). In fig. 9 (a) the 3D model is in a neutral position without an armature (None), while in Fig. 9 (b) is in Rig state.
Fig. 9. Pose/Animate. Skeleton: Rig presets None (a) and Rig presets Default (b)

Parts of the anatomical features of the model in fig. 10 include: (a) Main, (b) Face and (c) Torso

The 3D male model has the following anatomical parameters (fig. 11): Age: 26, Muscle: 81.9%, Weight: 118.80% and Height: 189.5 cm.

In sequence (fig. 12), the modeling of the male model passes through the creation of the Eyelashes (a), Eyebrows (b) and Hair Short (c)

Fig. 12. Geometries: Eyelashes 01 (a), Eyebrows 012 (b) and Hair Short 04 (c)
Fig. 13 shows the materials and textures used for full 3D visualization.

![Images of materials and textures](image-url)

Fig. 13. In sequence: brown_eye.png (a), eyebrow012.png(b), eyelashes01.png (c) and short04_diffuse.png (d)

The used clothes for the man model are from the possible basic models in MakeHuman software, with no corrections made (fig. 14).

![Male Cloth](image-url)

(a) Male Cloth (Original): Diffuse (a) and Normal (b)

The shoes also come from the MakeHuman database (fig. 15).

![Male Shoes](image-url)

Fig. 15. Male Shoes: file shoes02_diffuse.png

Like the male figure, the female model is designed (fig. 16 (a)) the model is in a neutral position without armature (None) and (b) is in the Rig state).

![Female Pose](image-url)

(a) Pose/Animate. Skeleton: RigpresetsNone

(b) Rig presets Default

Fig. 16. Pose/Animate. Skeleton: RigpresetsNone (a) and Rig presets Default (b)

The 3D model of a woman has the following anatomical parameters (fig. 17): Age: 22, Muscle: 65.3%, Weight: 94.2% and Height: 179.3 cm.
Parts of the anatomical features of the model in fig. 18 include: (a) Main, (b) Face and (c) Torso.

In sequence (fig. 19) the modeling of a woman passes through the creation of: Eyelashes (a), Eyebrows (b) and Hair Bob (c).

The used women’s clothes are from the possible base models in MakeHuman software, and the blouse corrections are made using the Gimp software (fig. 21).
Fig. 21. Female Cloth (Re-design): Diffuse (a) and Normal (b)

The sneakers are from the MakeHuman database (fig. 22).

Fig. 22. Female Shoes: shoes05_diffuse.png

The last stage is the final scene that is assembled in the Blender software (Figure 23). The scene contains: fashion female model + cloth (MakeHuman + Gimp) and models of Bracelet and Ring (SolidWorks 3D CAD system).

The finished Fashion Female Model is presented in fig. 26 (X-Ray with wireframe) and fig. 27 (Blender render).
CONCLUSION

The present study contains a fully functioning methodology, including modern technological means. The main stages and moments in the implementation of the models have been identified. Detailing of certain technical specifications is provided in a series of other studies directly related to the current work. Through the developed methodology, the creation of 3D human mannequins with their apparel and accessories in a uniform overall composition is optimized and the obtained final results are used in the field of fashion and textile design. Also obtained CAD models of jewelry provide full information on the material used, the quantity and the quality, which helps the correct pricing. The final 3D results are visualized in the appropriate form, which contributes to the realization of aesthetic beauty in the presentation of the models.

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ЗА ОБЛЕКЛО И ТЕКСТИЛ

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3D technology is growing among apparel retailers and brands. However, many brands and retailers are relying on 3D alone to meet consumer demands which is leaving them frustrated. The real value is an end-to-end solution, not a feature, that will facilitate On-Demand Manufacturing or what some are calling the "Microfactory".

So, when did this idea that we need more than 3D in our manufacturing ecosystems to compete in this modern retail environment come to exist? Well, the idea of On-Demand Manufacturing is not new. What is new, is better and more accessible digital fabric printing machines and technology solutions that can connect the workflow from design to the cutting room floor.

The 3D message has been a loud one for the past several years. 3D solution providers have been banging their "3D drums" and the industry has followed. Some companies are already several years into 3D adoption in their workflows. For some, it has been much more recent. As a former manufacturer myself, I always ask, "Can we point to hard numbers on ROI from the 3D implementation?" I can certainly point to ROI from better costing, more efficient nesting and cutting, and building a connected supply chain.

Theoretically, being able to visualize a sample and communicate changes in 3D should save physical samples and lead to better, faster, and more accurate decisions. This makes perfect, logical sense. However, for many, this acceleration of the development process has not been realized. In some cases, 3D implementation has actually slowed their process down. Why would that happen? There are several reasons in my opinion:

1) 3D was viewed as some type of "Holy Grail" that would solve every problem. It would be the 3D implementation that would make us more profitable, better at design and development, and speed up our time to market. We forgot that 3D is a modern piece of a more complex workflow, much in the same way digital pattern making was 30 plus years ago. The retail market is extremely competitive and buying habits have changed. Companies will be challenged to maintain profit. Profitability will rely on better product control, cutting efficiency, fabric efficiency, technology (Customer Data meets AI), and yes, 3D solutions as a PART of the workflow not THE WORKFLOW.

2) The 3D solution adopted was too hard to learn. Many equate 3D solutions with an advanced version of Adobe Illustrator. In most cases, the user would need to have a background in technical design or even pattern making to effectively use most 3D solutions.

3) The "Who" question. Relating back to the difficulty to learn, for many companies the "who" within their organizations is the question. Is it the pattern maker? Well, the pattern maker does not really have the design skills. Is it the Designer? Well, the designer does not know (or want to deal with) patterns. It is actually a hybrid and a job title that does not currently exist. So, for management the question is do we re-purpose someone who already works here or do we take on new hires.

4) A 3D solution that was adopted was lacking connectivity to patterns so, although we could get a quick look in the design process, when we were happy with the image, it was back to Square One and then getting a pattern made. Whether a company directly manufactures or uses global suppliers, a pattern is needed to manufacture your order. To go a step further, brands are built and maintained because of loyal customers who trust the brand’s fit, quality, and consistency. This starts with great patterns, not the 3D image.

Many 3D adopters should have a "gut check" on the most basic of questions. Has the implementation of 3D in my organization saved sample time and money? Allowed a faster time to market? Contributed to a healthier bottom line? If the answer is yes, then value was perceived and realized. If the answer is no, then we must ask: does the

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Conference is financially supported by The Ministry of
Education, Science and Technological Development of the
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