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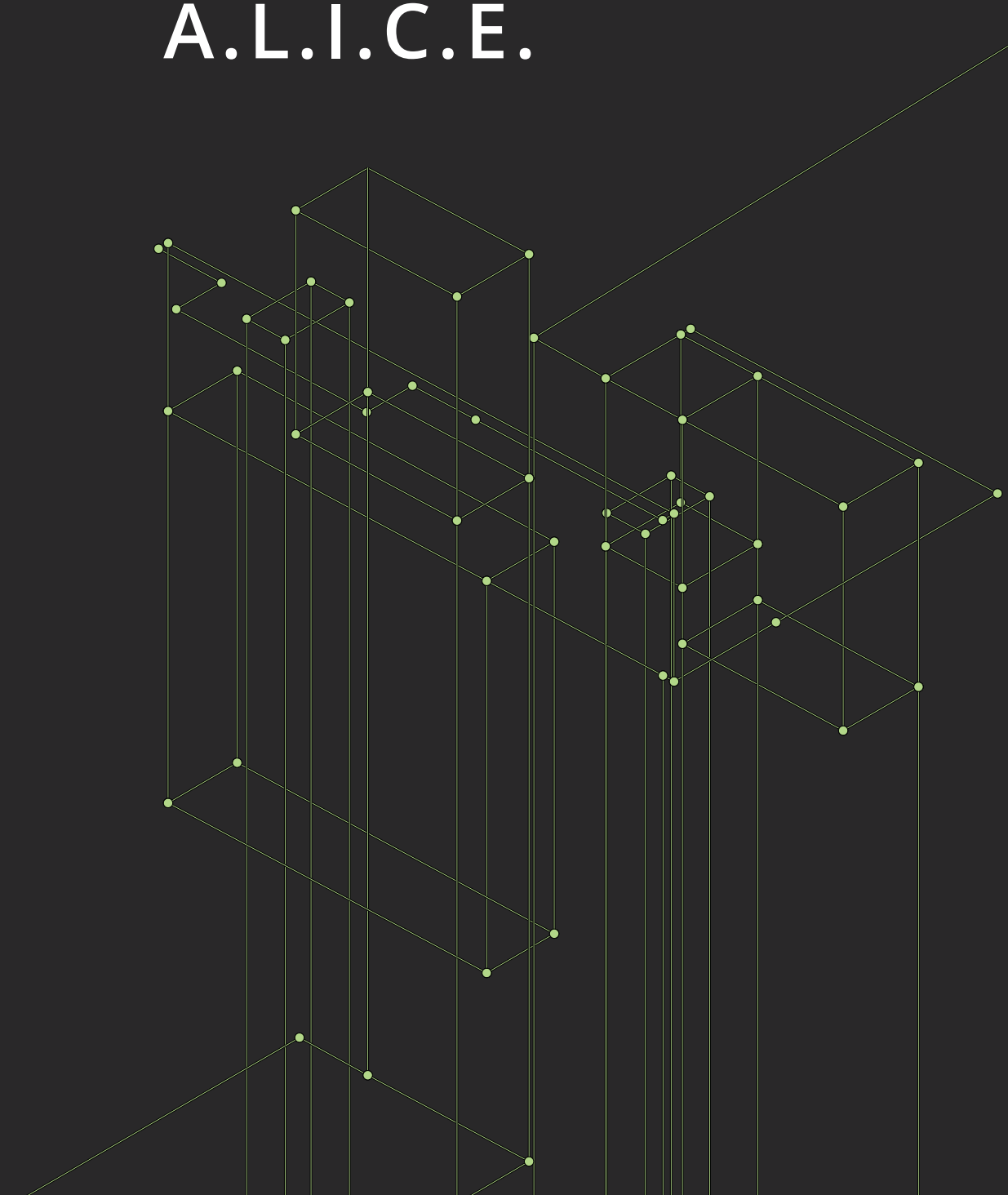

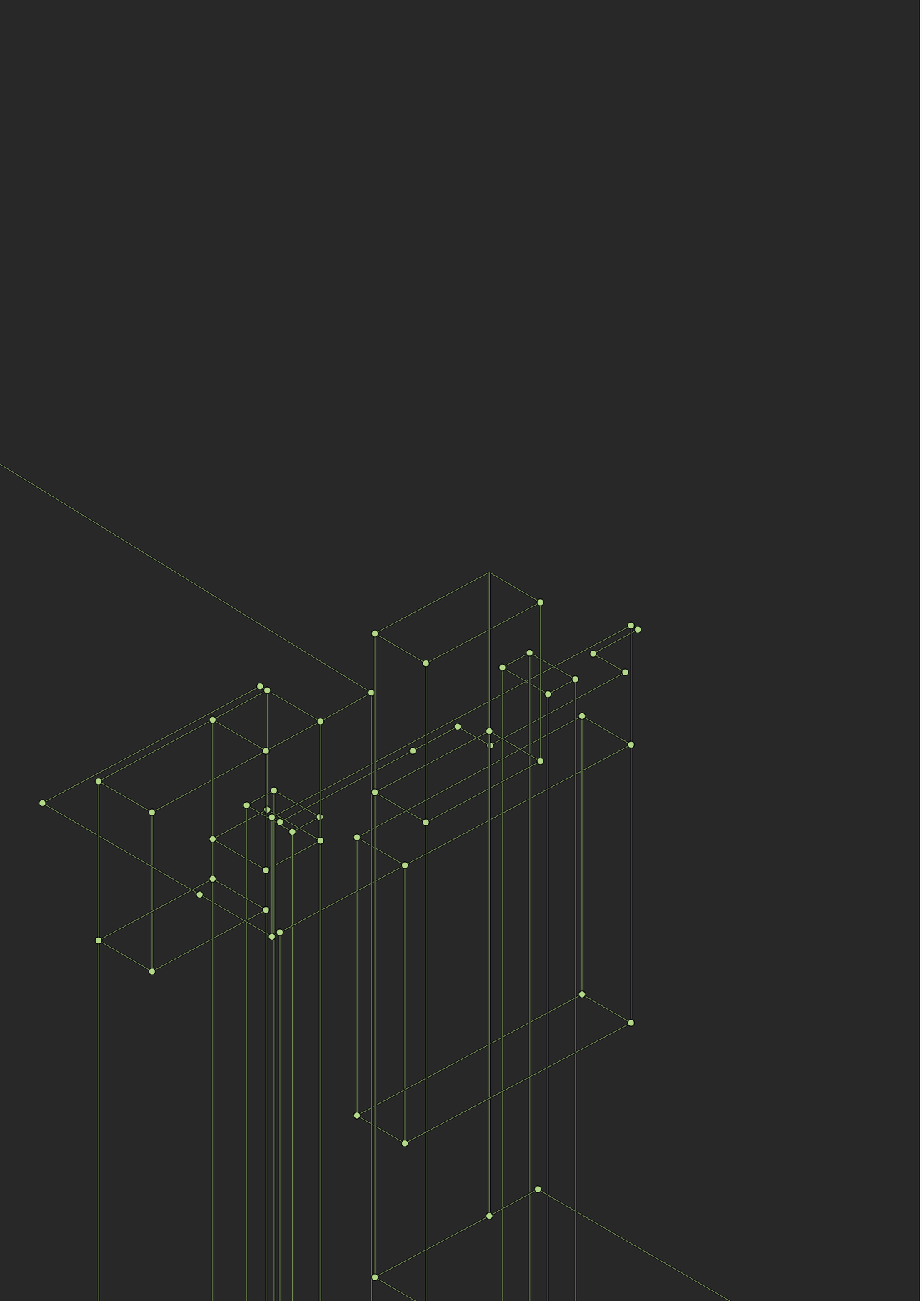

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Green is the new black - blue is the new green

–

Prof. Nada Rožmanec Matičič
Faculty of Design,
Ljubljana, Slovenia

Corresponding author: nada.maticic@fd.si

CONSUMERISM AND SUSTAINBILITY

The A.L.I.C.E. (Architecture |Landscape | Interiors | Culture | Emotions) platform, association of international design educational institutions, was established in 2010 by the former Academy of design, today Faculty of design Ljubljana to form a stable and reliable network of partners working on common projects with the aim to raise design awareness in the partner countries.

The principal goal of the platform consist of the exchange of knowledge, sharing good practices, presenting different teaching approaches, ideas and new professional knowledge. The platform is dedicated to professors, mentors, tutors, as well as students.

FIGURE 1. Outdoor green wall https://www.geoplastglobal.com/en/solutions/green/outdoor-green-wall/

What is the goal here?
To ensure sustainable consumption and production patterns.

Why?
Economic and social progress over the last century has been accompanied by environmental degradation that is endangering the very systems on which our future development and very survival depend. COVID-19 offers an opportunity to develop recovery plans that will reverse current trends and shift our consumption and production patterns to a more sustainable course. A successful transition will mean improvements in resource efficiency, consideration of the entire life cycle of economic activities, and active engagement in multilateral environmental agreements.

What needs to change?
There are many aspects of consumption that with simple changes can have a big impact on society as a whole. For example, the global material footprint – an indicator of the pressure put on the environment to support economic growth and to satisfy the material needs of people – grew by 17.4 per cent to 85.9 billion metric tons in 2017 as compared to 2010. Reducing food loss and waste can contribute to environmental sustainability by lowering production costs and increasing the efficiency of food systems. Currently, we lose 13.8 per cent after harvesting and during transport, storage and processing alone, amounting to a cost of over $400 billion a year. We are also polluting water faster than nature can recycle and purify water in rivers and lakes.

How can I help as a business?
It's in businesses' interest to find new solutions that enable sustainable consumption and production patterns. A better understanding of environmental and social impacts of products and services is needed, both of product life cycles and how these are affected by use within lifestyles. Identifying "hot spots" within the value chain where interventions have the greatest potential to improve the environmental and social impact of the system as a whole is a crucial first step. Innovation and design solutions can both enable and inspire individuals to lead more sustainable lifestyles, reducing impacts and improving well-being.

FIGURE 2. A stream of visual concepts for all things color, print + pattern related https://www.patterncurator.com/

FIGURE 3. Green For Every Day Of The Year
https://maggieoverbystudios.com/2015/03/18/green-for-every-day-of-the-year/

FIGURE 4. Polder Sofa by Vitra, Designed by Hella Jongerius, made of natural materials. https://hauslondon.com/collections/sofas/products/polder-sofa-by-hella-jongerius-for-vitra

How can I help as a consumer?
There are two main ways to help: 1. Reducing your waste and 2. Being thoughtful about what you buy and choosing a sustainable option whenever possible. Ensure you don't throw away food, and reduce your consumption of plastic—one of the main pollutants of the ocean. Carrying a reusable bag, refusing to use plastic straws, and recycling plastic bottles are good ways to do your part every day. Making informed purchases also helps. For example, the textile industry today is the second largest polluter of clean water after agriculture, and many fashion companies exploit textile workers in the developing world. If you can buy from sustainable and local sources you can make a difference as well as exercising pressure on businesses to adopt sustainable practices." (United Nations,2022)

FIGURE 5. Importance of puzzle
https://spielgaben.com/

FIGURE 6. Natural green wall
https://en.naturalgreenwalls.com/portfolio/green-solution-house/

GOAL 12 TARGETS

12.1
Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries.

12.2
By 2030, achieve the sustainable management and efficient use of natural resources.

12.3
By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses.

12.4
By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment.

12.5
By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse.

12.6
Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle.

12.7
Promote public procurement practices that are sustainable, in accordance with national policies and priorities.

12.8
By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature.

12.A
Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production.

12.B
Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products.

12.C
Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities.”
(United Nations,2022)

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The Study Of The Influencing Factors To Evaluate The Designer's Skill

Otgonchimeg Baljinnyam
Department of design
School of Industrial Technology
Mongolian University of Science and Technology
Ulaanbaatar, Mongolia

ABSTRACT
Each profession identifies and evaluates a person's performance based on the specific skills needed to perform their profession. The School of Industrial Technology (SIT) is one of the prestigious branch schools of Mongolian University of Science and Technology (MUST). Main objective of the Department of Design at SIT is developing and realizing of a new understanding of visual communication and graphic design concepts in Mongolia. The department is delivering the higher education in two majors 1)Graphic design, and 2) Visual communication design. A designer has the skills to attract a target audience through graphic design, create images to identify products, develop design work, design images using software packages, and select layouts, fonts, colors, and marking lines after discussing with clients. In order to determine which professional skills of graphic design graduates are most valued by employers, a survey was conducted among senior designers and managers of 64 organizations who provided a job position for our graduates. Based on the results of the survey, graphic designers according to the factors that assess professionalism.

The results of the study turned out to be convincing, since the concordance coefficient of analysts estimates with the concordance coefficient $\chi 2 = 7.96 > (7.81473)$, $W = 0.14$ was found and tested by the Pearson criteria. In the conclusion, the result can be used to evaluate thedesigner's skill. The skills of graphic designers are ranked as implementation, brainstorming, design development and problem research.

KEY WORDS
Design / Management / Design Management

1. BACKGROUND

One of the key indicators of curriculum improvement is the process of constantly developing training programs that meet the needs of employers. It is argued that the results of the training program will determine the skills of future graduates in accordance with the requirements of employers. In the practice of international evaluation of higher education, there are two main directions for assessing learning outcomes. It includes: 1) Method of direct estimation, and 2) Indirect estimation method.
While the direct assessment method focuses on what students need to learn, what skills they need to acquire and how well they learn during the course, the indirect assessment method usually focuses on how well the graduates learned the material, and how effective the training was. and whether the training has achieved its goals. Both direct and indirect assessment methods are important for identifying, weighing, and providing feedback on the strengths and weaknesses of a training program. However, indirect methods are widely used for program-level analysis, quality, performance, and progress.
In order to determine the results of the training program or the skills acquired by graduates, a survey was conducted reflecting the requirements of employers. The design process has been defined through five steps: 1.Define the problem, 2. Learn, 3. Brainstorming, 4. Design development, 5. Implementation.

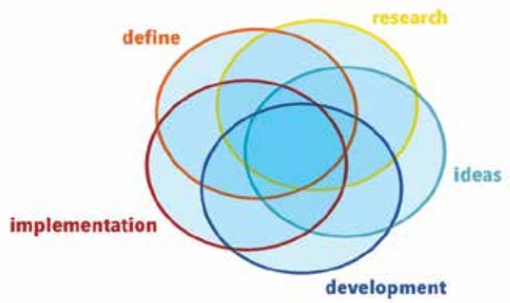

FIGURE 1: The design process, model of aiga.org

The design process is a method for designers to explore possible solutions to defined problems. All steps can be approached individually, yet together form a cohesive whole. As one executes each step, a shared space becomes evident in the center. The most unique and appropriate solutions will be influenced by all the steps in the design process.

2. METHODOLOGY

To assess the skills of a graphic designer, the design stages were divided into research sections, draft design, prototyping, and production sections, and a survey of employers was conducted. To find out which graphic designer skills are most valued by employers, the design phases are divided into four phases: Problem Research, Generate Ideas, Design Development, and Implementation.
Employers were asked to rate which of these steps were important.

The survey involved 59 graphic design companies and 5 marketing departments. The assessment was carried out on a 3-point system: -3 points if the skill is most needed, -2 points if the skill is necessary, and -1 point if the skill is

$$K = \frac{k_i * R_i}{\sum_i^n R_i}$$

K - rank coefficient:
k_i - sum of ki-rank coefficients
R_i - number of I rank [1]

To validate this result, the following formula was used to calculate the ranking factor.
The rating ratings of the questionnaires are found according to the above formula and are ranked as follows.
When processing the results of the survey, the rank coefficients were determined and tested by the Person criteria.

3. FACTORIAL RESEARCH TO DETERMINE THE SKILLS OF A GRAPHIC DESIGNER

The comprehensive competence of any specialist is determined by the totality of his abilities and skills. The ability is innate and varies depending on the stage of individual development. Professional skills are constantly evolving as a result of the knowledge creation process.

To find out which graphic designer skills are most valued by employers, the design phases are divided into four phases: Problem Research, Generate Ideas, Design Development, and Implementation. Employers were asked to rate which of these steps were important.

The results of the study turned out to be convincing, since the concordance coefficient of analysts' estimates with the concordance coefficient $\chi 2 = 7.96 > (7.81473)$, $W = 0.14$ was found and tested by the Pearson criterion.

NO.	DESIGN STAGES	AVERAGE SCORE
1	Problem Research	2.3
2	Brainstorming	2.6
3	Design Development	2.8
4	Implementation	2.4

TABLE 1: Average Survey Score

NO.	DESIGN STAGES	ORDER	FINAL INDICATORS
1	Implementation	1	50.5
2	Brainstorming	2	42.5
3	Design Development	3	42
4	Problem Research	4	40

TABLE 2. Poll Ratings

4. CONCLUSION

A survey was conducted with senior executives of the partner organization to evaluate four factors used to evaluate the skills of a graphic designer. According to the results of the survey, the skills of graphic designers are ranked as follows: 1. Implementation , 2. Brainstorming, 3. Design Development, 4. Problem Research. The results of this study are considered plausible as the concordance coefficient is $\chi 2 = 7,96 > (7.81473)$, $W = 0.14$.

It is important to keep in mind that collaborating organizations may first evaluate product performance when evaluating design skills, which can reinforce the tendency to use copied ideas in design work. Curriculum reform in graphic design should reflect the fact that 60% of employers say there is a need to improve the research skills of graduates.

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The concept of the Interior design For the “UV erdene” Theatre in the National center Of mongolian Cultural heritage

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Enkhjargal Battushig
Mongolian University of Science and Technology
Ulaanbaatar, Mongolia

Corresponding author: enkhjargal_b@must.edu.mn

ABSTRACT
The designer usually perceives the visual appearance of the building interior in a realistic way during the design process. Unfortunately, this only emphasises the role of the visual appearance of a building, while the acoustics often remain disregarded. Controlling the room acoustics is not integrated into most architects’ workflows—due to the lack of tools.

It is important to consider auralization in the interior design of the public and residential areas. In this research, we aimed to solve the design solution of the hall for the Mongolian traditional art performance. It is circular shape of hall with a 9-meter high ceiling with an area of 123 square meters. In terms of acoustics, the circular shape and high ceilings cause a lot of soundconcentration and echoes.

The Analysis of auralization problems in public and residential buildings has been seen in the Ulaanbaatar city planning, and citizen has continued to the victims. Furthermore, we need to work to understand the significance and value of this type of research.

KEYWORDS:
Sound insulation / Architectural acoustic / Theatre / Concert hall /

1. BACKGROUND

The process of acoustic design should include the following important properties: choice of dimensions and forms of the premises, subject to general requirements for the volumetric planning of the halls; verification of the reliability of the global assessment of the acoustics of the hall by statistical theory;calculation of the frequency characteristics of the reveration time of the hall to identify compliance with its volumetric optimum (Figure 1) and carry out the necessary correction of the project in terms of the structures of fences; graphic analysis of the drawings of the hall with the necessary correction of the project in terms of the form and outlines of its fences; development of measures to improve the diffusality of the sound field in the hall; calculation of local acoustic criteria for compliance with the zones of optimums with an additional, if necessary, correction of the project; assessment of the noise regime of the hall with the development of the necessary measures to improve it; and an assessment of the electroacoustic regime of the hall with the development of the necessary measures.

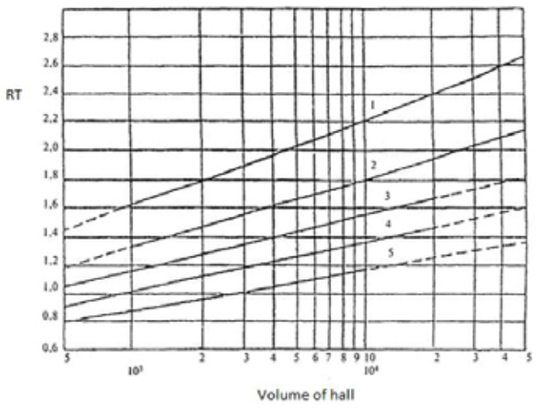

FIGURE 1. Recommended reveratiom time at medium frequencies (500 - 1000 Hz) for halls for various purposes depending on their volume

Numbers in the Figure 1 is represent the following meanings.
1 - halls for oratorios and organ music;
2 - halls for symphonic music;
3 - halls for chamber music, halls of opera houses:
4 - halls for multi-purpose purposes, halls of music and drama theatres, sports halls;
5 - lecture halls, meeting rooms, drama theatre halls, and cinema halls.
A comparative study of theatres covered the Mongolian Opera and Ballet theatre, State Academic Theater of Drama, Central Palace of Culture of Mongolian Trade Union, and Conservatory of Mongolia.

Object 1.
State Academic Theater of Drama. The Great Hall of the State Academic Theater of Drama has been operating for 80 years since 1931, and it was studied one of a research object.
Object 2.
Mongolian Opera and Ballet theatre. The concert hall of theMongolian Opera and Dance Theater, 78-year-old building that has been operating since 1942.
Object 3.
Central Palace of Culture of Mongolian Trade Union.Research has been conducted in the halls of the Central Palace of Culture of the Mongolian Trade Union, which has been operating since 1975.Calculations were made in the Great Hall and the Small Hall.
Object 4.
Mongolian Opera and Ballet theater.Since 1937, Ulaanbaatar city, Sukhbaatar district, 6th district, Mongolian Conservatory concert hall were selected forth research study.

	1	2	3	4
The length of the axis of the hall	39.07	81.4	30	23.07
Ceiling height	12.66	17.33	15.43	8
Total Volume	7837.72	4600	7837.72	1513
Total number of seats	610	510	300	239
Total sound absorption area	1149.54	32230	1363.53	1648.98

TABLE 1. Objects details and acoustical data

2. RESOURCE AND EXPERIMENT

Building details and acoustical data
Location: Ulaanbaatar Khan-Uul District 21st District National Cultural Heritage Center
Name of the object: National Center of Cultural Heritage
Hall for acoustic calculation: Ov Erdene Theater
Main building structure: Reinforced concrete frame
Capacity: 77 seats
Purpose of the hall: multi-purpose / universal / elementary theatre (a multi-purpose hall that can be converted into a traditional art performance, film screening, digital media art exhibition, video and audio recording studio)
Hall area: 123.5 square meters
Stage area: 29.76 square meters
Ceiling area: 166.06 square meters
Door area: 9.57 square meters
Total volume: 1217.5 cubic meters

FREQUENCY	UNOCCUPIED (SECONDS)	OCCUPIED (SECONDS)
125	1.37	1.29
250	1.39	1.29
500	0.92	0.88
1000	0.91	0.79

TABLE 2. Acoustical data

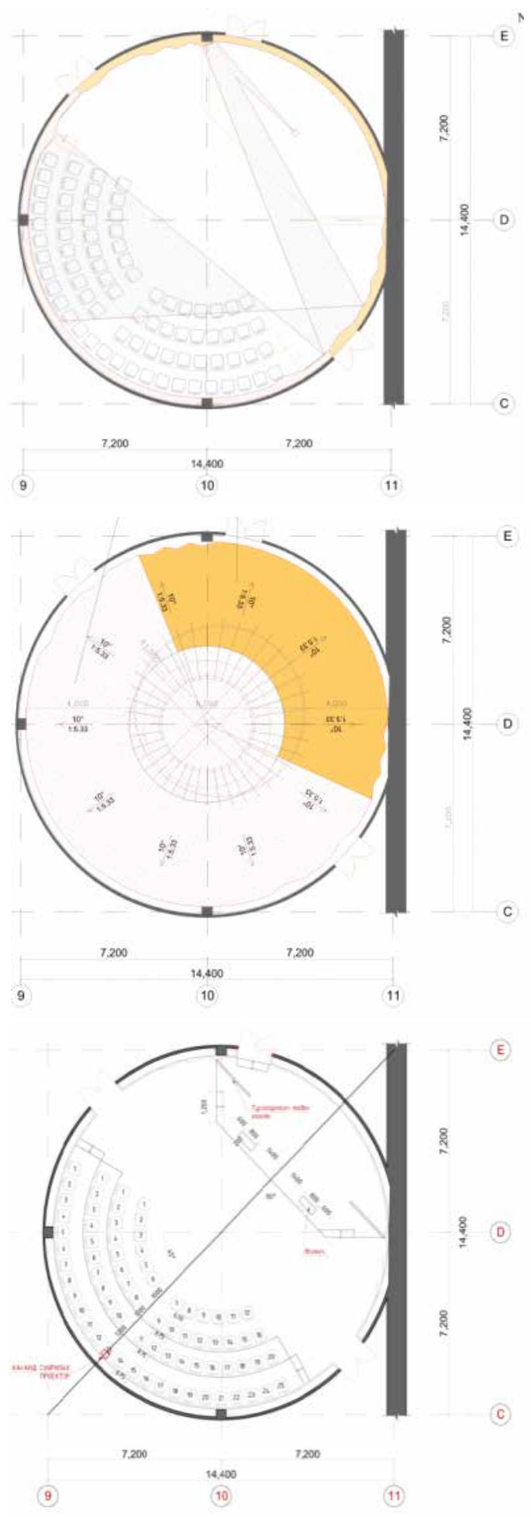

FIGURE 2. Hall's main floor view drawing , Geometric acoustics drawing

The first reflection from the wall and ceiling is aimed at checking whether the first reflection reaches the listener's seat area with an acceptable delay of 20-25m/s for speech and 30-35m/s for music. In the 4th row of seats, the sound delay does not exceed the acceptable limit, so the inclined position of the walls and ceiling of the hall is considered sufficient.

ROWS OF SEAT	L ОТР	L ПР	DIFFERENCE	SOUND DELAY
1	17	9.33	7.67	22.56
2	17.22	10.4	6.82	20.06
3	17.65	11.23	6.42	18.88
4	18.27	12.32	5.95	17.50

TABLE 3. Geometer Acoustical data

3. RESULTS AND DISCUSSIONS

The sound isolation and acoustics of any room, hall, or hall intended for sound reproduction are directly related to the building structure, building architecture, and interior design. Therefore, when deciding the construction planning in this area, it is necessary to carefully study and calculate from the sound technology point of view. In the city of Ulaanbaatar, activities in this direction are carried out in public and private and non-purpose environments. However, there is a need for us to determine how many of them have a standard sound, identify problems, and find ways to improve them. (Table 1)

Choosing the following types of wall structure is effective in terms of sound insulation. In the existing or 100mm thick plaster wall, it is calculated that the entire wall will be filled with insulation material. Check the filling in several places by punching the parts. Sound loss occurs if certain areas are not filled.The permissible reverberation time for a 1500 m3 hall with low music volume should be 1.2 seconds at 500-100 Hz. (Table 2)

Therefore, based on the above conditions, the calculation is made on the conditions with filling and without filling as possible. (Figure 2) From the result, the standard was reached. The wall covering material was chosen for the above two reasons, based on geometrical acoustics and reverberation time. If the material is to be changed, select

the sound absorption coefficient of the material accordingly.

The width of the wooden slats is 20-25mm, the thickness is 10-12mm, and the distance between them is 150mm. Instead of wooden slats, it is permissible to use specially formed aluminium alloys. (Table 3) Spectator seats have air-permeable coating, the seat and backrest are made of thin (perforated, porlon-like) material. In order to match the adequate penetration of the sound field, the shape and proportions of the hall were adjusted, and the height of the ceiling slope was adjusted in relation to the radius of the hall. (Figure 4)

Since, there is a risk of sound concentration in certain areas in a circular hall, the crystal surface is divided into hall mates, and a surface for understanding and absorbing sound waves is designed. The geometry of the sound beam relative to the crystal surface is described in each figure. From cut-off to geometric acoustics, since the radius of action of direct sound is 12 meters (sounding music), it covers all the seats of the audience, so planning an absorbing surface on the ceiling in an area of 168 square meters. (Figure 2)

Plan the ceiling above the stage with plasterboard as a transparent surface. Covering room ventilation with sound deadening and heat-resistant insulation. (Figure 4)

FIGURE 3. Hall interior 3D visual renders
(viewed from audience seating and viewed from the stage)

FIGURE 4. Construction process

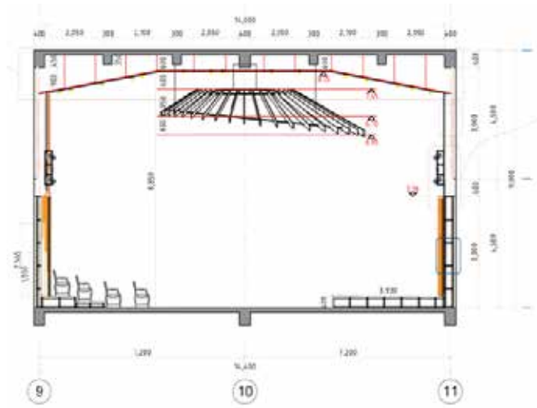

FIGURE 5. Hall interior (viewed from the stage)

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Integrating Sustainable Competencies and Thinking model into Design Management Curricula: The Best European Academia Practices

Assoc. Prof. Jordan Berginc, PhD
Studio of Entrepreneurship,
Faculty of design, Ljubljana, Slovenia

Correspoding author: jordan.berginc@fd.si

ABSTRACT
Designers all around the globe are critically challenged and address sustainable development problems in different ways and models. Based on designers' sustainable competencies and sustainable thinking system, they have engaged the competencies model which basically origin from a higher-education level and has an impact on their successful design practices. This paper is presenting a comparison of some promising European Design management curricula on sustainable competencies models which result in a higher level of "Future sustainable social design driven models" among designers and design managers. The paper's comparative analyses concern the theory and practice of sustainable design by emphasizing core competencies for sustainable development. Based on comparison analysis, the paper recommends some important education models and strategies to adapt sustainable development core competencies to higher - education curricula.

KEYWORDS
Sustainable competences, Sustainable thinking, Design management process and strategy, higher education Curriculum

1. INTRODUCTION

The term "design management" has become popular in the late 60', mostly in developing countries. In corporate terms, the design has become a part of strategic orientation in management practices and opposite, the management has become a part of the design orientation thinking process. That's how design management took a practical side of the business in a broader manner. After the establishment of the DMI - Design management institute in the USA, design management has converted to a corporate or business language where managers introduce design thinking and designers have become more familiar with the market and user experiences which are integrated into the product development process. After 90' the design management theory developed into an integral part of the most important design and business 1conferences worldwide. Academic and instructional writing on design management has significantly increased, with articles on the subject appearing in major publications and magazines such as The Economist, The Forbes, Inc magazine, Harvard Business Review, Business Week, Design Management Academic Journal, and many other popular Design and business magazines in EU countries, especially in Scandinavian countries. Design management has two specific goals: to familiarize managers with the design process and designers with management activities and roles.
Today, design management is widespread in many study programs at the graduate as well as postgraduate levels all over the world. Design management and design thinking study subjects can be found at more than 230 universities around the globe. Design management is intertwined on an interdisciplinary, multidisciplinary, and transdisciplinary level toward the sustainability concept. It is a meaningful balance of sciences and disciplines that give weight to the basic competence requirements of a design manager, as dictated primarily by practice in the entrepreneurial and corporate environment. Design managers are taking on an increasingly complex role on internal and external corporate levels.

Generally, the Design Management program curriculum is much more popular at the graduate level. Very often the structure of DM curricula looks like a typical MBA program, focusing in addition on design management and design thinking skills. Study courses offer strategic management skills, operations management, entrepreneurship, communication skills, financial management, marketing applied management skills, organization and human resource management, management of (social) creativity, innovation and change skills, and sustainability models. Design management studies are increasingly recognizing social, cultural, and arts in emerging creative cultural industries.

2. DESIGN MANAGEMENT COMPETENCES

This paper investigates the competencies model to be important for the potential career of design managers on the market. The term competence, as is used variously to mean activities, tasks, capabilities, skills, attitudes, and/or knowledge. Le Deist and Winterton (2005) proposed a typology of competence that is highly cited in research on human resource development: the holistic competence model (HCM). By HCM cognitive competence (CC) is the possession of work- related knowledge and the ability to apply it effectively; functional competence (FC) is the ability to perform work-based tasks effectively; social competence (SC) is relational and communication skills and abilities; and meta-competence (MC) refers to personal and professional values and attitude. The HCM is holistic in that the occupational dimension (CC and FC) corresponds to the task-oriented functional approach, while the personal dimension (SC and MC) relates to the
person-oriented behavioral approach (Kang et al., 2015).

The quality of design management experiences dictates the tendency towards the divergent types of education of design managers, who upon completion of their academic or university education have to demonstrate competencies both in the creative spectrum, where their ability to lead agile and creatively and solve problems have to be demonstrated and on the other hand competences in the field of management and leadership that meets the expectations of corporate hierarchies (Mootee, 2013). The more that design is used as a means to gain competitive advantage and as a strategic tool in the corporate environment, the more the roles, competencies, and
responsibilities of designers expand (Borja de Mozota, 2002).

At this stage, it is very important to distinguish between the competencies of design managers and design leaders. Their competencies often overlap in some studies and are separate in others. (Kang, et al, 2015). The interdependence between design managers and design leaders has been argued in statements such as "design management needs design leadership in order to know where to go and design leadership needs design management to know how to get there" (Joziasse, 2011b, p. 399). Finally, the roles of

Cognitive competence		**Meta-competence**	
Strategic level	*Business knowledge (Briggs et al., 1998; Green et al., 2004; Han & Bromilow, 2010)* *Envisioning the future, strategic thinking (Turner & Topalian, 2002; McCullaph, 2008)*	*Attention to detail (outcome quality), proactive attitude, empathy (Han and Bromilow, 2010)*	
Tactical level	*Knowledge of human dynamics and process (Briggs et al., 1998; Green et al., 2004)*		
Operational level	*Expert knowledge of design (Green et al., 2004)*		
Functional competence		**Social competence**	
Strategic level	*New design competences (strategic, business, intangible) (Maciver, 2012)* *Business and strategic skills (Miller & Moultrie, 2013b)*	**Strategic level**	*Directing and nurturing creative design environment (Turner & Topalian, 2002; McCullaph, 2008)*
Tactical level	*Management skills (Green et al., 2004)*	**Tactical level**	*Negotiation skills (Green et al., 2004)* *Interpersonal skills (Miller & Moultrie, 2013b)*
Operational level	*Design skills (Briggs et al., 1998; Miller & Moultrie, 2013b)* *Old design competences (functional, design, tangible) (Maciver, 2012)*	**Operational level**	*Presentation, communication skills (Han and Bromilow, 2010)*

FIGURE 1. Conceptual framework of design manager competences modified from the HCM - holistic

the design manager and design leader tend to coincide and share characteristics. This implies that their functions may not be clearly divided according to the levels of management activity (strategic, tactical, or operational) or hierarchies
(Figure 2 below).

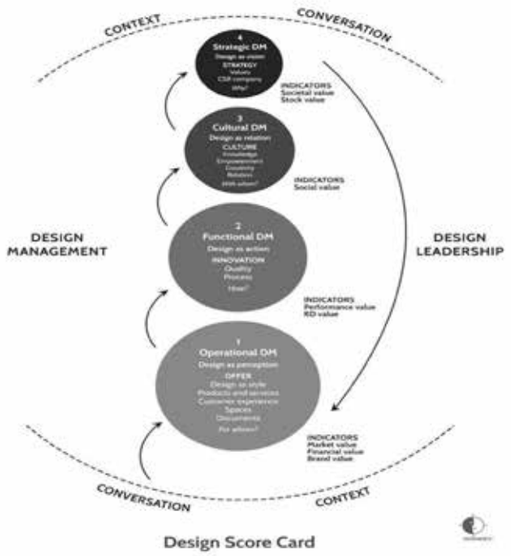

FIGURE 2 The four level of design management designance Borja de Mozota, B. and Wolff, F. (2019) competence model (Kang et al., 2015)

3. DESIGN MANAGEMENT MODELS

The development of this period resulted in efforts to establish key models showing how managers understand the value of design in their companies around three levels of design integration (the Danish Design Council's Design Ladder, 2002, and the Designence model, 2006).
Designence value model for design management has another advantage. It shows a system view and a visionary view of the values created by designers. It represents design as knowledge for many management and society decisions. Designers are more than just problem solvers: they are actors of the dynamics in knowledge building: "The activity of design consists in the transformation of an input representation into an output representation." In an activity that functions by way of representations, knowledge plays a central role. Designing is a cognitive activity (Visser, 2006).

However, the designers often become middle-level design managers later in their careers and middle-level design managers could be engaged in both design management and design leadership, just as generic middle managers do in their general activities (Kang et al., 2015). Moreover, Borja de Mozota (2003) proposed five levels of design managers' responsibilities and tasks according to job titles and roles, which are comparable with those of generic managers

LEVEL	DESIGN MANAGER TITLE
1	STRATEGIC DESIGN MANAGER
2	DESIGN ORGANIZATION MANAGER
3	DESIGN STAFF MANAGER
4	DESIGN PROJECT MANAGER
5	DESIGNER

TABLE 1 Designer by hierarchical level (Mozota, 2003)

(Table 1).
Kefallonitis' (2007) review of design management education highlights the importance of linking academic theory to business practice and calls for a common framework based on greater collaboration between academia and the design business.

Available from:
https://www.researchgate.net/publication/269607433_Design_management_education_and_ work-based_learning [accessed Jan 18 2023].

Practitioners both designers and managers think and act as design and management diverging domains. Observation in design schools and design consultancies shows that Design Management has a limited "MBA" focus. It is true that designers in order to do their jobs have:
- to enter an organization whether a design agency or a company as in house- designer
- to start their organization and act as entrepreneurs, open their design consultancy, work as freelance designers or editors, or even launch their manufacturing or retail business. Design – just like many other human activities such as medicine, architecture, etc.. has to admit that its activity cannot exist without a minimum of business knowledge. Design is an industry that has to mix creative activity with business skills just like other creative industries such as film, theater, or music Borja de Mozota, 2006).

4. TRENDS IN DESIGN MANAGEMENT CURRICULUM

As already mentioned, more than 200 programs around the globe are currently running design management courses. Most popular within EU countries are SDA Bocconi University, Royal College of Art, University of Arts London, Politecnico de Milano, Aalto university, The Glasgow school of art, Design Academy Eindhoven, The Royal Danish academy of fine arts, University of Europe, Macromedia University of Applied Sciences, Arden University, Poli. design, ICN Business school, IADE, Wismar University, Media design Hochschule, International University of Barcelona, Paris College of Art, and many others in different countries.
A general overview of all curricula programs can be divided into two types:

1. those delivered within design/engineering schools aiming to focus on the distinctive nature of design practice; and those delivered by business/management and
2. other schools or institutions, aimed to introduce non-designers and arts to the benefits of
design practices.

A major part of curricula offers design thinking courses and practices in various combinations with different study courses, depending on the major program.

5. CONCLUSIONS

Some authors suggest that future study programs of Design Management education in design school programs, should not stay as a specialty at the master's level degree, but as a mandatory program at BA level to manage earlier one's career and better understand of the users problems or client companies (Cooper et al., 2012).

The main competencies of design management and design thinking attitude in business manner mean the ability to deepen and solve problems, the ability to manage teamwork, leadership skills, entrepreneurial skills, the ability to put design contents in all corporate documents and strategies, the ability to effectively communicate on an internal and external level with clients/customers and users, brand management, ability to prototype and make user-ended innovation, knowledge of the project management, controlling a social media strategy, doing research to market fit phase, manage UX process in collaboration with the marketing department, hire different professionals to upgrade the product, communicate a vision, purpose, values, and goals with all stakeholders, brand management, ability to negotiate and mediate different projects and
similarly management skills to raise design management culture to a higher level.

Competencies in design management curricula are partly adapted to the request of the target group of students. Art programs put greater emphasis on managing the creative process, while engineering and management programs place emphasis on business design and management competencies. Both groups of graduates must demonstrate all acquired competencies and talents on the market in combination with competitors. Most design management programs introduce hands-on workshops, corporate case studies, and business-related projects into their curriculum. Some are focused on the industrial design development process. Both directions are popular - the
corporate direction and the direction toward creative cultural industries.

In the future, Design management curricula will be more based on the research field of the best
design thinking and design project practices, no matter in which field. Further on, design management successfully challenges the sustainability process at the corporate and societal levels. Sustainable design has a bright future because of its multidisciplinary nature.

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Sustainability of the Textile Industry

Snežana Urošević
University of Belgrade,
Technical Faculty in Bor,
Bor, Serbia

Milovana Vuković
University of Belgrade,
Technical Faculty in Bor,
Bor, Serbia

Corresponding author: surosevic@tfbor.bg.ac.rs

ABSTRACT
The textile industry is considered one of the biggest polluters of the environment, and textiles themselves represent a growing environmental threat. Until now, the development of the textile industry has been focused on the development of technology, increasing the productivity of production as well as creating a product that will be competitive on the market, especially with an emphasis on the low price of the final product, while less attention was paid to environmental protection. All the processes required for the production of the final textile product, from raw material production to various chemical and mechanical processes, have a different impact on the environment. In order to achieve sustainability in the textile industry, it is necessary to strive for cleaner production, which implies reducing the amount of produced waste. The principles of sustainability need to be incorporated in all segments from the production of raw materials, through production to the recycling and reuse of a product. All industries, including the textile industry, are now on the way to viewing their waste stream as a strategic raw material, and the circular model is the best long-term solution for providing raw materials for textile production. Driving this transformation of the unused value of textile waste is a rapidly emerging technology that will require the creation of new textile recycling jobs and skills.

KEYWORDS
Textile Industry / Sustainable Development / Circular Economy / Textile / Recycling

1. INTRODUCTION

The textile industry is one of the most polluting and resource-consuming industries in the world, right behind oil in terms of environmental impact (MATTEN, MOON, 2020). This is mainly driven by environmentally unfavourable production practices that involve large-scale ecosystem destruction, i.e. the wide use of chemicals in the production and processing of textiles and clothing, the emission of harmful greenhouse gases and other effluents resulting from the dumping of thousands of tons of textiles every year on landfills or incineration (LATAPÍ AGUDELO et al., 2019).

In addition, to meet the competitive pressures of the current textile industry, production is largely concentrated in low-cost areas where there are no strict pollution controls or regulations, along with a disregard for social aspects such as proper labor standards, health and safety, etc. (ZINENKO et al., 2015). Moreover, the textile industry is one of the worst in terms of promoting materialism, which is increased by running a classical market economy system (ETEOKLEOUS et al., 2016) providing the basis for the

emergence of a throwaway society based on economies of scale, planned obsolescence of products, short product life cycles and consequently increasing consumer demand for new products and services (WEHRMEYER et al., 2019). This has largely resulted in facing the challenges of sustainability and promotion by which producers continue to produce and consumers continue to buy, calling for increased intervention by designing sustainable development by understanding increased effects such as economic, limited resources, pollution, social impacts; for a high degree of efficiency of material and resource needs; and the need to move from a linear to a circular economy (WINDSOR, 2021).

A textile industry based on circularity will not only optimize the consumption of resources, but will also minimize the high environmental costs identified by the textile industry and initiate certain measures to mitigate them (DUFF, WEBSTER, 2022). Textile recycling is considered to be one of the greatest advancements that have occurred since the loom started the industrial revolution (WALKER, 2018).
As with any industry that has been shaken by the transition, traces are also visible in the textile sector (WIESMATH, 2020). The aim of this paper is to show that the domestic workforce can become stronger, while entities investing in the circularity of the textile industry can now take advantage of the developing industry (SILLANPÄÄ-NCIBI, 2019), and waste can often be considered a valuable resource (AHMED, 2020).

Nowadays, when due to global challenges in terms of environmental protection, sustainable development is becoming the basic goal of humanity, it is essential to review the current ways of production and design of textiles and clothing. Sustainable development requires a complete restructuring of the fashion industry with the aim of establishing a balance between environmental, social and economic aspects in order to realize the concept of sustainable fashion. In that process, the fashion designer plays an important role, whereby he has different strategies at his disposal to realize a sustainable design (JOCIĆ, 2022).

2. CIRCULAR ECONOMY IN THE TEXTILE INDUSTRY

The disastrous consequences that fast fashion has on the environment, climate and society are due to the uncontrolled consumption, wastage and pollution of non-renewable resources. In order to reduce those consequences, it is necessary for the textile industry to be part of the circular economy, where as such it will have the ability to produce the lifetime of garments, keeping resources in a closed circle. By realizing the goals of sustainable development, the circular textile industry strives to increase the recycling and reuse of textiles, and to reduce pollution and waste to a minimum during the production of textile fibers. In recent times, the need to reduce the harmful impact of the textile industry on the environment has gained even more importance. By drawing a clear line of general relations between man and nature, the modern consumer society went from following and approving the rapid change of fashion trends to suddenly reducing its interests to the satisfaction of basic existential needs.

The transition from a linear to a circular model in the fashion industry requires knowledge, awareness and engagement of all market participants: producers, designers of technology and products, and consumers (KOSZEVSKA et al., 2020). The result is garments designed from materials that can be recycled in several circles, supporting every aspect of the circular model. Thus, high-quality and durable clothing is a necessary prerequisite for the sustainability of the fashion sector (ELLEN MCARTHUR FOUNDATION, 2017).

A good model for the fashion sector indicates a four-level system:
- the first level - designing for longevity, puts the consumer in focus, its goal is to extend the phase of product use,
- the second level - designing for service, focuses on new business models for expanding or intensifying the use of products of brands and companies,
- the third level - design for reuse, includes the challenges that manufacturers face when introducing new models, which aim to extend the life of the product by returning it to its original state,
- the fourth level-design for material recovery, is based on material recycling, using waste for the production of new fibers and yarns (RSA, 2016).

The four-level model, in addition to engaging the key market participants needed to implement the transformation towards circularity, also points to the creation of mutual cooperation between designers, researchers, industries, companies, users and policy makers (RSA, 2016). Thus, achieving a circular model requires cyclical and regenerative ecological innovations in the way society legislates, produces and consumes (MACHADO et al., 2019).

3. CIRCULARITY OF THE TEXTILE INDUSTRY IN SERBIA

The textile industry of Serbia represents one of the largest and most complicated types of industrial production and as such it requires sustainable ecological, technical-technological, economic and social development in the synergy of all aspects of life, which indicates the need for active correlation between production, sustainable development of the textile and clothing industry and protection environment, which today is the foundation of generating new concepts of balanced work and sustainable development.
The real position of this sector can best be seen in comparison with the times of socialist Yugoslavia, for example in relation to the number of employees, whose participation in the textile industry is only slightly above 10% of all employees in production, in relation to socialist times, when that sector employed close to 40% of workers. For a labor-intensive branch, this is too low and shows little importance in the modern economy of Serbia, especially when considering the importance of the textile industry for the female workforce and for the economy of underdeveloped regions.

The amount of clothing purchased in Serbia is 80,000 tons per year and is often of questionable quality and composition. In order for clothes to be affordable, they are made of cheap materials, primarily plastic (polyester) and have a short lifespan. Such clothes harm the environment just like plastic bottles and bags. The fast fashion system has its motto “week after week” and drives people to buy new clothes at lower prices so “as we buy, so we throw away”. It is estimated that around 235 billion tons of clothing end up in landfills worldwide every year (https://www.politika.rs/sr/clanak/467963/Beograd/Spora-moda-i-pogubni-uticaj-tekstilnog-otpada).

The Agency’s report shows that out of the total amount of recycled waste in Serbia (455,457 tons), only 60 t of textile waste is recycled out of this total available raw material. The remaining amount of submitted textile waste (81,405 tons out of a total of 2,947,496 tons) goes to landfills or is burned (VLADA SRBIJE, 2022). Realizing the value of these lost assets is the basis of a highly profitable textile circular economy (QUEIROZ, 2021).

Second, the possibilities of improving the current textile waste collection rate may indicate that we are approaching a circular economy model that, if managed well, brings opportunities for the labor market in the textile sector, as well as for the fight against climate change (ZHURAVLEVA, 2021). This optimism brings an exciting time for the textile sector, as we begin to focus on what needs to change, much greater collection and recycling, which will undoubtedly lead to job creation.

One of the goals of the paper is to show the employment opportunities for workers who would work in normal jobs in the textile sector of Serbia, and workers who would work in jobs for the reuse/recycling of textile products, due to the fact that related industries are moving from a linear to a circular business model. This transition to a circular economy requires the adoption of new technology, but more importantly, to improve opportunities for decent work, sustainable industrial policies and actions will need to be comprehensive, integrated and inclusive (MUTHU, 2018). A textile industry based on circularity will not only optimize the consumption of resources, but will also minimize the high environmental costs identified by the textile industry and initiate certain measures to mitigate them (Muthu, (DUFF, WEBSTER, 2022).

Analyzing companies in Serbia that deal with textile waste disposal, including activities related to recycling, the data show that only 6 companies collect cotton waste textiles, as well as various types of textiles from production. Textile recycling produces industrial cloths that are used for cleaning and wiping hands, parts, machines and floors in various branches of industry. Also, yarn can be obtained for reuse, and recycled textiles are used to fill mattresses, furniture, etc. Polyester textiles can be used after treatment to create fibers for use in new products (WARASTHE, 2022). However, knowing that an incredible 100 billion pieces of clothing are produced annually worldwide (KAZANCOGLU, 2020), none of the surveyed companies have the capacity to recycle high-quality fibers that will be used in the production of recycled clothing. The reasons for this are that clothing is currently not designed to allow recycling, while another problem is that recycled materials can cost more than non-recycled ones (SANDVIK, 2018). Circularity and the job creation that goes with it will depend on improving the collection and exchange of data (CIRCLE ECONOMY). That’s why it’s no surprise that Serbia is just on its way to creating such data.

The consumption of clothes, shoes and textiles for households in the EU takes away 1.3 tons of raw materials and more than 100 cubic meters of water per inhabitant, according to the European Environment Agency (EEA, 2021). The EEA also stated that the production of clothing, footwear and textiles for households for Europeans is the cause of emissions, estimated at 654 kilograms of CO2 equivalent per EU resident, so textiles are the fifth largest source of CO2 emissions associated with private consumption. About three quarters of that issue is realized outside the EU. However, the annual report of the Environmental Protection Agency of Serbia shows that textiles, as part of municipal waste, were generated during 2020 in the amount of 81,405 tons, where only 61 tons refer to the separate collection of textile waste, and 60 tons were given to recycling. In relation to the total amount of municipal waste, textiles make up only 2.8% (VLADA SRBIJE, 2022).

Textile waste (which includes clothes and textiles), as
a part of biodegradable waste, has a negative impact on the environment by being dumped in landfills [16]. The entire amount of textile waste cannot be considered as biodegradable waste, because only natural textiles are biodegradable, but textile clothing can be reused (CITYLIFE, 2019). Textile waste is thus one of the biggest and growing

problems in the Republic of Serbia. There is no special infrastructure for the separate collection of this waste (VLADA SRBIJE, 2022).

The textile industry of Serbia employs 61.9 thousand workers (2.8% of total employment), while the majority of employees are in the production of clothing (36.2 thousand). In the textile industry in 2021, there were 1.9 thousand active companies and 6.2 thousand entrepreneurs, which is a total of close to 8.1 thousand [18]. The given data refer only to the production of textiles and clothing and do not refer to the recycling of textiles.

The analysis of the given data sources clearly shows the potential for creating new jobs in the transition of the circular economy (DISSANAYAKE, WEERASINGHE, 2022). This transition is gaining strength, as public concern puts the facts about textile waste, its disposal and complex production processes in the center of attention (LÖVIN, BAYLAN, 2020). The textile industry is now on its way to seeing its waste as a strategic raw material, and the circular model as the best long-term solution for providing raw materials for textile production. Powering this reshaping of the unused value of textile waste is a revolutionary technology that is fast approaching. This is certainly a huge opportunity, along with the potential for huge business growth. Once the production process is up and running, this renewed industry will require the creation of new jobs and skills related to the preparation of these textiles for recycling.

Operating textile recycling facilities do not currently confirm that the technologies for recycling textiles into a remanufactured textile product are ready to be competitive in cost and quality with the original resource-based textile product (JUANGA, LABAYEN, 2022). The survey, which included 22 Serbian companies - from yarn manufacturers and fabric manufacturers to large retail brands, shows the necessity of implementing a circular economy.

Currently, on a global level, 500 billion dollars are lost every year due to insufficient use of clothing and lack of recycling (GOLDSMITH, 2012). Data show that around 150 tons of textile waste ends up in landfills in Serbia every day (RISTESKI, SREBRENKOSKA, 2020). The need for the textile industry to behave differently is clear. We need to change the way money is invested and spent; we need to buy brands whose values reflect our personal image; and we need to change the way we attribute value to what we buy and wear (SANDIN, PETERS, 2018).

On the other hand, the main driver of the economy in the textile industry of Serbia is the employee, who should have an attitude towards an eco-oriented ethos (SUSHMA, ZEBA, 2018). In other words, to have safe and healthy working conditions, regular payment of personal income, employment without overtime, that it is not conditioned by discrimination or forced labor, and that all legal conditions are applied to his employment (BARTL, PIRIBAUER, 2019). The opening of new jobs means that employees can count on safe work, social and health benefits, and the workplace to be the center of everyday life, because in addition to salary, it also provides a wide range of social services (education, training, hot meals, health insurance, care for children, subsidized vacations, etc. (DIMITRIJEVIĆ, 2020).
The research conducted at the above-mentioned companies in Serbia shows that employees consider organizational commitment, with the aforementioned conditions for its existence, “Extremely or very important”, while almost half of the employees in the textile sector say that they would definitely or probably change their work habits as would reduce the impact on the environment.

4. CONCLUSION

In a situation where modern business moves from a linear to a circular business model, stakeholders in the textile industry will face various challenges: technological, structural and personnel.

The circular economy of Serbia should represent a regenerative economic system in which production resources, waste, waste emissions and energy outflow are significantly reduced by slowing down, rounding off and extending energy and material cycles in production. In fact, the basic premise of the circular economy must be to achieve sustainable development on a global scale (so that the model is as profitable as a linear one), but also to allow consumers to enjoy products without consuming natural resources and endangering the environment, all of which can be achieved through extended lifespan products, but also maintenance, servicing and recycling.

In order to create a quality, efficient, reliable and independent textile and clothing industry in Serbia, it is necessary first of all to create a raw material base that would meet the needs of the largest part of the national sector of the textile and clothing industry, of the concept of efficient and cost-effective waste processing, which implies sustainable ecological, technical-technological, economic and social development in the synergy of all aspects of life, and indicates the need for correlation between the production of sustainable development of the textile and clothing industry and environmental protection.

To place job creation in the context of a circular economy textile model, we need to address environmental issues, including worker safety and community impact. Paying attention to the environment is a pillar of the circular economy theory.

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The importance of urban green spaces in residential areas

Petra Kocjančič, MA
Faculty of Design,
Ljubljana, Slovenia

Corresponding author: petra.kocjancic@fd.si

ABSTRACT
Many of the benefits the residential neighbourhoods acquire from green open spaces are determined by social aspects. Our needs related to health and well-being, satisfaction and experiencing open areas are satisfied in urban green space. People's needs are the starting points that nonetheless value the social aspects of green spaces. These are very diverse and include both basic and special needs, which are related to ensuring social interactions in the sense of spending free time, gathering, socializing and opportunities for creative engagement, rest, recreation, relaxation in the natural environment, aesthetic pleasure, variety of space and experience, as well as assuming identity in the way of identification with space. Numerous studies show the important role of urban green spaces for the residents, as they represent an environment where socialization and networking for different age groups can take place.

KEYWORDS
Sustainable / Settlement / Urbanism / Open spaces / Green space / Communities / Lifestyles / Quality of living / Ljubljana

1. GREEN OPEN SPACE

In residential neighbourhoods, green space has several functions, namely referring to structure, design, restoration, representation, hygiene, society, as well as the function of rest and recreation. Open and green spaces largely influence the very identity of the neighbourhood. They are distinguished by their purpose, which can also be diverse. There are different types: private, public and semi-public green spaces.

Greenery is an important element in design, as we use it to connect lines, limit spaces, create variety between different spaces, create contrasts (vertical - horizontal, hard - soft, round - angular, light - dark), direct views, obscure views, connect lines of objects with each other, we divide the space, create different environments, indicate different programmes, separate different functional surfaces from each other. In the case of green spaces we must take into account the characteristics of the plants, as diverse plantings must not interfere with the use of the space. We need to consider the fact that the mere amount of plants alone does not suggest quality. The plants represent added value, considering that the vegetation defines an open space, increases pleasantness and variety, as well as visual qualities. Through the seasons, plants change their appearance, grow and develop, indicating a time dimension in space. Colours, shapes, textures, smells, noises... all this offers the observer a variety of experiences. In green spaces, people feel good, establish contacts with each other,

etc. Different plantings create different environments, they offer us protection from the sun, wind, rain and unwanted views.

A green environment reduces the perception of crowded space in densely populated areas. Therefore, planting trees and other natural elements in residential environments is a beneficial practice that improves the quality of living. Green environment reduces the perception of crowdedness in densely populated areas. Therefore, planting trees and other natural elements in residential environments is a beneficial practice that improves the quality of living (Polič 1996).

Doležal (1991) states that green areas in cities appear in a wide variety of forms. We distinguish them according to their purpose, and this comes in many forms. It defines green areas next to residential buildings as a special typology of green public areas. The above-mentioned green spaces are divided into individual gardens, green areas next to low multi-apartment blocks and green spaces next to tall multi-apartment buildings.

2. ROLE OF OPEN SPACES

Some time ago, the very concept of residential neighbourhoods was based on ideas about greenery and health, with the modern technical equipment of these neighbourhoods, with traffic safety, with the rationality and economy of construction. Emphasis was also placed on open spaces and their importance for play, sports and recreation.
Open and green spaces play an important role in terms of spending free time, recreation, gathering, socializing, where supply, accessibility, etc. are of key importance.
Open spaces in residential areas represent an important part of the physical structure and speak of the importance and conditions for living and working. These spaces represent common interests, they unite the residents and influence their attitude towards the settlement. Open space in neighbourhoods is also a place for various activities such as recreation, play, conversation, etc. (Polič 1996).

A large part of people living in cities will also live in apartments in multi-storey buildings in the future, which in the best case are equipped with balconies. Since the balconies are small and only intended for sitting, the residents have to get alternate spaces. For the owner of the garden, it can be a game or a walk, which requires larger areas, for the one who does not even have a balcony, it is also sitting outdoors (Lendhold 1970).

Open green space is of inestimable importance for humans from a sociological, psychological and biological point of view. Such space must enable a variety of experiences and activities for different age groups. Playgrounds and play areas are the most important for children, young people need sports fields and areas where they can hang out separately from adults, and for the elderly it is important to be able to walk, sit, talk and relax in peace.

FIGURES ABOVE: Conceptual examples of the renovation of one of residential areas in the city of Ljubljana

3. CHALLENGES OF OPEN SPACES IN RESIDENTIAL NEIGHBOURHOODS

Green spaces are represented in many forms. We mostly talk about poorly maintained spaces, which reduce the general quality of living, because green spaces are not used due to a number of facts. Most of the premises are unkempt, not maintained, and their programme of use is weak. Traces of unwanted use are visible in some places. Urban equipment is old, damaged, in some places it is not there at all. Green areas appear only in the form of grass areas and trees, other plantings cannot be detected.

Problems related to maintenance and arrangement are related to the ownership itself, to the arrangement of relationships between different uses and to the possibility of public investments. If the ownership and basic function are difficult to determine, open spaces are exposed to various pressures of unwanted use and construction. These areas also include open spaces of residential neighbourhoods. There are still many multi-apartment buildings, the owners of which are still not registered, and the functional land is not divided, which means that it does not belong to anyone. This means that no one is obliged to maintain these surfaces, and the managers of the facilities do not attach any greater importance to this, because there is no suitable financial support for this purpose either (Gazvoda 2001).

The arrangement of the surroundings is also conditioned by the type of apartment or how long the residents have been using this apartment. If it is a permanent residence, the attachment to the environment is certainly greater than if it is a temporary form of residence. The consequences of a bad attitude towards the environment are most visible in areas where the concentration of people is greater and thus there is greater anonymity. Developing a sense of belonging and responsibility would therefore be absolutely necessary. People should be involved in the very process of creating a residential environment.

The planning strategies in the past, especially zoning, have led neighbourhoods to such a position that they are closed, have unmaintained surroundings, and there are insufficient surfaces for parked cars in view of today's needs (Zupančič Strojan et.al. 2002). The number of cars is increasing day by day, and thus parking lots occupy most of the open areas that are not intended for this purpose, and at the same time, they take away space from people as users of the space.

Neighbourhoods without the maintenance of open green spaces become less attractive and there are common initiatives for redevelopment, mostly in built-up areas. The interest of investors today is primarily profit. Thus, new buildings, which grow like mushrooms after the rain, no longer meet these criteria and quality. The buildings are increasingly dense, there are almost no green, open, common spaces left.

FIGURES ABOVE: Examples of inappropriately maintained surroundings in various residential neighborhoods in the city of Ljubljana

CONCLUSIONS

The true value of the quality of the outdoor space of our cities and towns was demonstrated quite well during the Covid 19 pandemic, which greatly affected our living conditions and habits. Home balconies, terraces, atriums and house gardens have already proved to be very valuable. In particular, properly accessible and well-arranged green public areas proved to be very important because, despite the restriction of contact, they enabled us to move outdoors and consequently maintain a healthy lifestyle. The fact that the conditions for the use of green open spaces in various settlements and municipalities in Slovenia are unequal has become more acute, and as a result, the conditions for the daily physical activity of the inhabitants are much more modest than would be necessary, considering the spatial characteristics. The proximity of the natural environment alone does not guarantee adequate possibilities for use, especially for children and people with disabili-

ties who need special arrangements regarding equipment, safety and, above all, accessibility. (Šuklje Erjavec 2021).

Renovation of open green spaces in certain residential areas is necessary. In the first phase, it would be necessary to determine the purpose of the open areas, taking into account the population structure. The renovation programme should be supplemented with planned maintenance and management. The given directions and proven design approaches from both domestic and foreign practice can serve as a basis and as a suitable solution.

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Upcycling of clothes - a step towards circular fashion

Assoc. Prof. Damjana Celcar, PhD
Faculty of Design
Ljubljana, Slovenia

Corresponding author: damjana.celcar@fd.si

ABSTRACT
Frequent changes in fashion trends and the affordability of fashion products, which promote both a rapid change of clothing and a mass production and consumption, lead to market saturation and accumulation of textiles and garments. Consequently, all this affects negatively both the environment and the society. As the quantities of discarded and redundant textiles and clothing increase day by day, so we are nowadays facing the problem of growing textile waste all over the world. Therefore, textile and fashion industry is searching for new circular solutions to reduce their environmental impact. Upcycling and reuse of used or waste textile products and clothing is an important design approach for circular fashion that significantly contributes to reducing the amount of discarded waste and helps reducing greenhouse gas emissions, prolongs product life, affects saving of raw materials and natural resources, helps to create new (local) jobs and promotes craft careers, etc. This paper summarises the results of several years' long projects of upcycling and redesigning of discarded or waste textile product and clothing of the Fashion and Textile Design Department of the Faculty of Design, Slovenia, which prove that used or discarded items of clothing and textiles can be very well renewed and redesigned into new products with a higher added value.

KEYWORDS
Upcycling / Reusing / Redesigning / Textile waste / Clothing / Sustainable fashion / Circular fashion

1. INTRODUCTION

The textile and fashion industry is considered one of the world's most polluting industrie with a great impact on the environment in all process phases: in the production or processing of raw materials, in the consumption of water, chemicals and energy, as well as in the end use or consumption. Frequent changes in fashion trends and the affordability of textiles and fashion products, which encourage rapid change of clothing and mass production and consumption, lead to market oversaturation, which is reflected in the accumulation of textile waste and the negative impact on the environment and society. (Nieboer et al, 2021, Celcar, 2020). The production and consumption of textile products continue to grow and so does their impact on climate, on water and energy consumption and on the environment. Global textiles production almost doubled between 2000 and 2015, and the consumption of clothing and footwear is expected to increase by 63% by 2030, from 62 million tonnes now to 102 million tonnes in 2030 (European Comission, 2022; Ellen MacArthur Foundation, 2017). As the quantities of textiles and clothes produced and purchased increase, so does the problem of textile waste. It is known that less than half of used clothing is collected sep-

arately for reuse, and only 1% is recycled into new clothing due to the heterogeneous composition of the material (Ellen MacArthur Foundation, 2017). In 21th century, textile and fashion consumption in the world has increased dramatically as a result of various factors (Coskun & Basaran, 2019). In Europe the consumption of clothing and footwear per person decreased in 2020, relative to 2019, while the consumption of household textiles slightly increased. Average textile consumption per person amounted to 6.0 kg of clothing, 6.1 kg of household textiles and 2.7 kg of shoes in 2020. For 2020, the total textile consumption was 15 kg per person per year, and excluding industrial/technical textiles and carpets (European Environment Agency, 2022). In Slovenia, too, we are facing the problem of textile waste, as a recent study (Research on the project Obleka naredi človeka, 2021) showed that approximately 25,000 tons of clothing (12.3 kg per capita) was discarded in 2019. The research also showed that the most common reason for discarding clothes is uselessness: missing buttons, holes, stains that cannot be removed, poor quality of clothing materials etc. (Nieboer et al, 2021).

Despite the fact that many clothes are discarded in textile bins, exchanged at clothing exchanges, donated to humanitarian causes and sold in second-hand shops, many still end up in municipal waste containers, landfills or incinerators. Therefore, it is important that young fashion designers, clothing manufacturers and the rest of the public are aware of the current problems in the textile and clothing industry and know the various possibilities for solving them. Different solutions are offered by sustainable and circular approaches, e. g. upcycling of textiles and clothing. The study of fashion and textile design at the Faculty of Design from Slovenia has been aimed at strengthening sustainable content and approaches for many years, therefore, many sustainable projects have been created during this time, including different sustainable approaches and solutions, from designing for longevity, upcycling, reusing and redesign, zero-waste designing, multifunctionality and using ecological and recycled materials as well as considering handwork, crafts, new technologies, ethics, transparency, etc.

2. UPCYCLING - A DESIGN APPROACH AND A STEP TOWARDS CIRCULAR FASHION

More and more fashion designers are turning to the concept of upcycling. Over the last decade the term “upcycling” has been coined and worked into the discourse of sustainability efforts. It first appeared in William McDonough’s book, Cradle to Cradle (McDonough & Braungart, 2002). The term has a number of definitions and practices and it has mainly been used in connection with fashion and textiles. Upcycling can be defined as a recycling approach where “waste”- textile and clothing leftovers that would usually end up in landfill or incineration - is used to create products with a higher retail value than traditional recycled products (Aus et al, 2021). Traditionally textile waste recycling refers to the reprocessing of textile waste (mechanically or chemically) for use in both new textile products and non-textile products (Sandin & Peters, 2018; Aus et al, 2021). Upcycling is generally understood as a design-based circular fashion approach, where used, pre- or post-consumer textile waste materials or products and items of clothing are repurposed, repaired, mended, reused, redesigned, refurbished, upgraded and remanufactured into new products in a creative way that increases their added value (Aus et al, 2021; Singh et al, 2019). This contrasts with recycling, where value is often at least partially lost. Upcycling, understood as repurposing and mending, has long been a part of human life. However, recent years have seen a revival of the upcycling trend, driven by multiple factors, such as growing concern for the environment in general and specifically for resource availability and waste volumes. There is also growing environmental awareness about the urgency with which we need to address environmental challenges and increase understanding about governance mechanisms for sustainability, requiring engagement of different actors in the transition to a more resource-efficient society. The revival and increase in interest in the circular economy as a concept and practice is attracting the attention of mainstream companies, start-up SMEs and creative industries. Upcycling is regarded as a strategy that aims to reduce environmental impacts by combining circular material flows with slower throughput of products and materials and slower cycles of consumption. Publications and research show that upcycling increases quality and lifetimes of materials and products, reduces wastes, creates employment opportunities, and encourages sustainable consumer behavior. Despite such benefits and increasing interest, upcycling is largely considered as a niche practice (Singh et al, 2019).

We could say that upcycling is a growing “trend” and, above all, a process where we allow old or used clothes and textile products to be upgraded through the process and finishing. The end result is a new product with a new feature that has a higher added value than the product we started the process with. We make various textile manipulations, reconstruction techniques, patchwork, knotting, knitting and other textile techniques to process and turn one piece of garment / textile product into another. Processed clothing and textile product can also be upgraded with accessories such as buttons, zippers, various sequins and applications or upgraded with embroidery, printing, various dyeing techniques can be used, for example natural dyes, clothes can be added a new look by painting or by using new technologies such as laser cutting.

3. CASE STUDY - UPCYCLING FASHION DESIGN PROJECTS OF FACULTY OF DESIGN

Being aware of the problems of the textile industry, fast fashion, mass production and consumption, we at the Faculty of Design, Department of Fashion and Textile Design undertake creative projects of upcycling − reusing and redesigning of pre-and post-consumer waste material, such as textile leftovers, textiles, clothing and others. Doing so, we want to encourage young fashion designers and creators to take a creative approach to transforming or redesigning waste material and clothing into new products with higher added value. Figures 1 and 2 show the results of upcycling projects of the Faculty of Design, where pre-consumer waste, such as textile leftovers and other industrial waste materials of companies were used for developing new clothing creations, while Figure 3 shows a sustainable knitwear collection made from pre- and post-consumer waste materials, such as yarns, knits, fabrics and ribbons sourced from various textile companies. Figures 4 and 5 show the results of creative upcycling of discarded or used men’s shirts and men’s suits (post-consumer waste), while Figures 6 and 7 show the results of upcycling discarded and used jeans clothing (post-consumer waste).

Using textile leftovers from Odeja d.o.o. (Škofja Loka, Slovenia), a company that produces blankets and bed textiles (pillows, bed linen etc.), third year fashion and textile design students of the Faculty of Design developed unique dresses that reflect a circular approach in design. Under the mentorship of Associate Professor Matea Benedetti and with the professional help of Lidija Rotar, students used different textile leftovers of the company for the lower part of the dress, while the upper part of the dress was developed on the basis of constructing a corset made from white cotton fabric, Figure 1.

FIGURE 1. Unique dresses developed of textile leftovers of the company Odeja d.o.o. (photo: Valeria Arkhypova)

FIGURE 2. Clothing forms and creations made of waste materials of the car tire company Goodyear Dunlop Sava Tires (photo: Domen Lo)

Using industrial waste material from Goodyear Dunlop Sava Tires from Kranj (Slovenia), a company that produces car tires, students designed forms, developed technological processes of treatment of waste material, search for new methods of construction and developed harmonious visual compositions of new structures under mentorship of Associate Professors Matea Benedetti and Tanja Devetak. Figure 2 shows the clothing forms made of waste materials of the car tire company Goodyear Dunlop Sava Tires presented in several galleries and museum in Slovenia, Croatia and Serbia (Start, 2018).

The sustainable collection of Nagaya Florjan Gorjup, the fashion and textile design student of the Faculty of Design, was developed out of the desire to use the already existing textile materials, such as scraps of yarns, knits, fabrics and ribbons, which she acquired from various textile companies. With the love of reusing discarded materials, a new, fresh collection of knitted clothes with a timeless look was created under the mentorship of Associate Professor Matea Benedetti. The collection was presented at the “Fashion Walk around Ljubljana” fashion show within the Ljubljana Fashion Week (LJFW 2022) and awarded with the Rozman award for a sustainable clothing collection at the Faculty of Design (2022), and at the same time presented as a fashion story in the Gloss magazine (January 2022) and at the exhibition of the Faculty of Design, Creative Interweaving 2020/21 in Gallery DLUL in Ljubljana and at the exhibition Sustainable Views as part of GoingGreenGlobal design week 2022 at the Faculty of Design, Figure 3.

FIGURE 3. Awarded sustainable knitwear collection of Nagaya Florjan Gorjup (photo: Nagaya Florjan Gorjup; Fashion editorial published in the Gloss magazine, mentor of fashion editorial: lect. Tea Hegeduš)

Men’s shirts and men’s suits consisting of jacket and trousers (including a vest) are durable pieces of clothing that are often found in landfills and Reuse Centres or remain in closets and keep waiting for a new opportunity. In order to give men’s shirts, suits and ties a new life, we at the Faculty of Design have embarked on projects to transform and upgrade them. Our 1st year fashion and textile design students transformed discarded or redundant men’s shirts under the mentorship of Assoc. Prof. Matea Benedetti and with the professional help of Lidija Rotar into interesting creations, which we presented at the “Fashion Walk around Ljubljana” fashion show within the Ljubljana Fashion Week (LJFW 2022) and at the exhibitions as part of the GoingGreenGlobal design week at the Faculty of Design in Ljubljana, Figure 4. In the process of transformation or redesign, the students used various manual techniques of transformation and manipulation of textiles, draping, cutting and joining parts of men’s shirts and included various handmade textile techniques. The project REshirt was awarded during fashion show within the LJFW 2022 and presented in sustainable issue of the Gloss magazine in January 2023. Third year fashion and textile design students started collecting and redesigning men’s business suits and ties under the mentorship of Assoc. Prof. Matea Benedetti and with the professional help of Lidija Rotar. Men’s suits, trousers and ties were first disassembled by the students and then combined into new creations using various techniques and manipulations, Figure 5. Upcycled men’s suits were also presented at the “ Fashion Walk around Ljubljana “ fashion show of the Ljubljana Fashion Week (LJFW 2022) and at the exhibitions as part of the GoingGreenGlobal design week at the Faculty of Design in Ljubljana. In 2022, the project of Upcycled men’s suits participated in the design challenge of the Eco-School for the Young programme: design sustainably, design circularly and was awarded from the Eco-school programme.

FIGURE 4. Upcycled creations made of discarded men’s shirts presented at the LJFW 2022 fashion show (photo: Mimi Antolovič)

FIGURE 5. Upcycled creations made of discarded men’s jackets, pants and ties (photo: Valeria Arkhypova)

Denim has a long history and has been transformed into various shapes according to fashion. The cultivation and production of cotton, dyeing and other denim treatments have a major impact on the environment, both in terms of water consumption and pollution and the exploitation of natural resources. Under the mentorship of Assoc. Prof. Matea Benedetti and with the professional help of Lidija Rotar, the 3rd year students transformed discarded denim clothing according to a certain high fashion design template into unique and voluminous creations made from old jeans, shirts and jackets, and white cotton, Figure 6. Rich handmade details, flounces and perfect tailoring are part of the reproduction of one of the high-fashion Dior collections. Redesigned high fashion creations Re-Couture in Jeans were on display at the first biennial of textile art BIEN 2021 in Kranj, at the exhibition of Faculty of Design, Creative Interweaving 2020/21 in Gallery DLUL in Ljubljana, and in the Kar = In Gallery in Ljubljana at the end of 2021. The Re-Couture in Jeans project participated in the design challenge of the Eco-School for the Young programme: design sustainably, design circularly, and was awarded from the Eco-school programme in 2021.

Lan Krebs (a)

Meta Rogelj, Teja Kovič (b)

Pia Šilec (c)

FIGURE 6. Creations made from old jeans, shirts and jackets and white cotton (photo: Lan Krebs (a), Maša Pirc/Layerjeva hiša/Bien (b), Pia Šilec (c))

With the aim of reusing and transforming the used denim clothing, several other students developed interesting upcycled collections. Aleksandra Lazić, the fashion and textile design student of Faculty of Design, developed her collection from old denim clothing and other textile materials, which she upgraded and enriched with neon and other yarns. She found inspiration in the hip hop style from the 90s of the last century, which she calms down with a touch of Japanese street look. The "Niti neona" collection was developed under the mentorship of Assoc. Prof. Matea Benedetti and presented at the exhibition of the Faculty of Design, Creative Interweaving 2021/22 in Gallery DLUL in Ljubljana and at the exhibitions as part of the GoingGreen-Global design week at the Faculty of Design in Ljubljana, and at the same time presented as a fashion story in the Gloss magazine (October 2022), Figure 7.

FIGURE 7. Clothing collection "NITI NEONA" made of old jeans and other waste textile materials (foto: Aleksandra Lazić, Fashion editorial published in the Gloss magazine, mentor of fashion editorial: lect. Tea Hegeduš)

The most frequently used waste material are not just textiles and clothing, but encompasses many various types of materials. It may be an old punctured rubber, video cassette, old paper or plastic etc. Figure 8 shows a upcycled folk costume (author: Anamarija Pirc, 3rd year student), presented at RiscARTI festival in Italy, and in other galleries in Slovenia, Serbia and Croatia, developed under the mentorship of Assoc. Prof. Matea Benedetti. Automobile seat belts were used to create the vest, and used bicycle inner tubes were used to make the apron. Discarded medical linen and linen textiles were used to make the blouse, skirt and undercoat. The accessories are also upcycled as the socks are woven from a combination of yarn made from plastic bags and wool from an old wool sweater and the belt is made from a seatbelt, decorated with fasteners, nuts and washers found in the depots of various workshops.

FIGURE 8. Reproduction of Slovene folk costume (author: Anamarija Pirc, photo: Andrej Murovec, VSŠ Sežana)

The 3rd year students created upcycled couture garments made from waste materials and old used textiles, which were converted into new material through various techniques. Using these materials, the students designed clothing forms and developed technological processes for upcycling materials under the mentorship of Assoc. Prof. Matea Benedetti. Clothing as sculpture is a reproduction of a well-known fashion designer, while textiles and non-textiles are inspired by motifs of painters from different periods, from Jackson Pollock to Monet. The upcycled garments (Figure 9) were presented at the 10th International Green Fest Festival in Belgrade and in Slovenian galleries. The upcycled dress of Natalija Lesjak, the fashion and textile design student of the Faculty of Design, was awarded in the International Zero Waste Fashion Design Competition, organized by the Faculty of Design in 2018 (Start, 2020). She developed her dress by upcycling old clothing pieces and textile waste materials. Her idea began by developing new textures and transferring an oil on canvas painting by Edward Dugmore, »Untitled«, into a garment. She joined linen weave (plain) and an image pixel into a new haute couture dress.

FIGURE 9. Upcycled couture garments (photo: Domen Lo)
a) Erika Korošec, b) Natalija Krašovec, c) Suzana Bičanič, d) Jan Brovč

4. CONCLUSION

Reusing and upcycling discarded, old, useless clothes and textile leftovers is a sustainable model and circular approach that prolongs the life of old and discarded products, increases their added value and contributes to reducing textile waste and the need for new raw materials, thus reducing energy consumption and air and water pollution. Upcycling the discarded and useless clothing, textile leftovers and other waste materials was a big challenge we tackled at the Faculty of Design and new unique clothes were created that required a lot of manual work and time. It is important to consider that the upcycling design process differs from regular design process and based on the parameters of the waste materials. We could say that upcycling is often a time-consuming activity and usually the price of a new product is not attractive for the fast-fashion consumers. We are aware that the unique products created in this way would be difficult to mass-produce, but they are certainly an interesting market niche for young designers who are finding it difficult to establish themselves in the world of mass production, especially cheap clothes.

Although upcycling is a growing trend among fashion designers, however, it has mostly been used on a small scale, sold as unique pieces or an added element in some collections, and not on an industrial scale. While most debates and circular fashion approaches focus on the problem of used garments – the so-called post-consumer waste, less attention is paid to the textile waste and leftovers from manufacturing garments and textiles (pre-consumer waste) (Aus et al., 2021). Therefore, in the future a lot attention will be put also on integrating upcycling into conventional textile and garment manufacturing processes. We can conclude that upcycling is not just a way of designing and reusing products, it is an understanding that every aspect of life can be perceived from a different angle, as many pieces of clothing would become waste if not included in reuse.

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Redesigning of Traditional Art in Sustainable Lifestyle: Mongolian Felt Stitch

Tsiyen-Oidov Batsaikhan
Design Department,
School of Industrial Technology,
Mongolian University of Science and Technology,
Ulaanbaatar, Mongolia

Davaajav Narantogtokh
Design Department,
School of Industrial Technology,
Mongolian University of Science and Technology,
Ulaanbaatar, Mongolia

Corresponding author:
narantogtokh@must.edu.mmn

ABSTRACT
The running-stitched carpet as one of the Mongolian traditional arts is the craftsman's mind and skills result that overcame nomadic people's lifestyle and time treatment in the high territory of the Central Asia with the harsh climate. It has already preserved 8 out of 12 principles from the Sustainable Design Principles. The craftsman and owners of cultural heritage are getting rare, thus, the "Nomadic crafting" initiatives are introducing since 2019. In order to deliver the redesigning of traditional art, the originality and essential value of running-stitched carpets were determined at the scientific level and resulted to bring up at the next innovation level. Around 500 people joined in initiatives and trained according to the different levels of workshops. In the future, the key contributor's role will be more essential at the different levels.

KEYWORDS
Redesigning / Running-stitched / Felt carpet

1. BACKGROUND

The nomadic lifestyle and the specific features of traditional Mongolian art have several characteristics which derived from the continuously moving circumstances due to the geographical and seasonal conditions. Mongolia located in north-central Asia and lanldocked country which is noted harsh climate, with long cold winters and short cool-to-hot summers. Natural remarkable variety of scenery consists largely of steppe, semideserts, deserts, and high mountain ranges with lake-dotted basins in the west and north areas which is becoming an inspiration for artisans during the different centuries. Through generations of passed-down wisdom about an eco-friendly natural environments, the Mongolian herders have learned how quickly move home and domestic animals through drastic for seasonal changes.

Nature is a symbol for Mongolians thus their lifestyle and every element of daily life are directly connected with it. The livestock based raw materials through eco-friendly technology and art technique were trasformed into different types of products used for everyday. For example, a ger, meaning 'home' in Mongolia has grown popular around the world, that is easy to transport and to build with a circular wooden frame and covered with a thick felt cover made from the sheep wool. The main feature of the felt product is easy to fold and change into the small size like minimal design even it has big size and have multifunctional structures. The felt has many different applications such as a roof for the 'ger' house, clothing, animal herding tools, and also items for the cultural and symbolic way. Felt carpet has own tradition and long history that continues for thousands of years. Ancient archeology findings discov-

ered in the territory of Mongolia belong to the period in BC is a good example that how felt carpet art is reached its high performance. This felt carpet belong to the Hunnu period (Xiongnu from III century to III century BC) represent animal image in textile artwork by their art creation with unique design using a wool fiber and fabric with felting technique and zeeg-cord strip. It means the Nuno-felt technology has been introduced over two thousand years ago. There are four origin places found the felt in the world, one of place is current Mongolia. Based on all above findings, it can noted the products own a sustainable design principle. Thus, this study will conduct the findings of redesigning concept of traditional art in a sustainable lifestyle through the case study of the felt. It can support a fundamental study of other traditional techniques tranfer into the contemporary application without losing cultural heritages.

2. METHODOLOGY

2.1. TRADITIONAL ART TECHNIQUES

The felt stitch is one of the necessary techniques for non-woven and running-stitched traditional carpets. It is densely doubled running stitches of yarn made of the long hair of the throat part of a camel.

As distinguished by the study of theoretical design basis of this progressive art creation can include its development only among the Mongolians, its expression of description only parallel lines in stitches and line like dots that may be considered as a type of art graphics. The change of material properties during the processing of the running stitch is directly connected with the non-woven material prevailed feature. All kinds of static and dynamic patterns can be composed with parallel and rhythmic stitches showing the main beauty of the running-stitched carpet. As these technology qualities are prevailing patterns will be appeared.

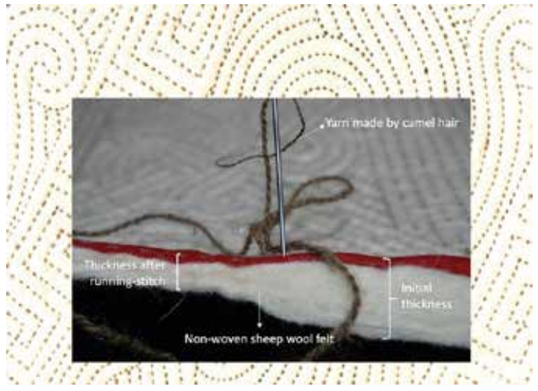

FIGURE 1. Image of the running-stitched carpet

This unique technique not only forms the figures and patterns but also limits the free movement of fibers that compound non-woven material structures (Figure 1). The running-stitched felt carpet patterns and its performance technique have more interrelation and uniqueness than other felt items such as ger-dwelling covers and felt clothes. In other words, during the running stitch performance felt became dense increasing its water-repellent, moisture-absorbant and heat transfer qualities.

2.2. CONCEPT OF ENHANCING THE MONGOLIAN FELT STITCH

The running-stitched carpet as one of the Mongolian traditional arts is the craftman's mind and skills result that overcame nomadic people's lifestyle and time treatment in the high territory of the Central Asia with harsh climate. The 1st author has brought out many advantages hidden in the running-stitched carpet's design expressed by the herder's intelligence and craftsman's skill through his research work. Here, the following question is coming up for us. Should we preserve this cultural heritage, and if so, what features of the traditional art are similar to the concept of Sustainable Development which has been preserved for thousands of years by the Mongolians?
The running-stitched carpet has already preserved 8 out of 12 principles from the Sustainable Design Principles, but, it is necessary to deliver more people including the next generations. The remaining 4 principles are on followings; recycled materials, material reductions, efficient manufacturing, and better working conditions. Another valuable impact was that the Mongolian's mind of respecting their traditions began to revive after the socialist society. However, the craftsman is getting rare, thus, the "Nomadic crafting" initiatives are introducing in redesigning the running-stitched carpet technique since 2019. In Figure 2, important contributors to sustainable lifestyle producing considered and need to be updated in the future.

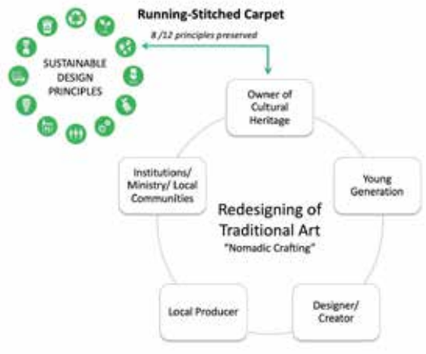

FIGURE 2. Key contributors to Redesigning Concept of Traditional Art in Sustainable Lifestyle

3. RESULTS AND DISCUSSIONS

In order to deliver the redesigning of traditional art, several activities were started and evaluated progress. First, the originality and essential value of running-stitched carpets were determined in the scientific level and resulted to bring up in the next innovation level. It was shown in Figure 3. More than 20 research papers and one monograph were published nationally and internationally.
When disseminating the concept in four years, it became clear that everyone did it in different ways after a certain period of tradition was missed. Thus, the classical design and techniques were practically introduced and guided by us. During the practical training and workshops, making techniques for classic running-stitched carpets were introduced. In the picture 3, 4, and 5, the classic designs showed also. The artworks were introduced at around 10 exhibitions.
At the next level, the dissemination activities were implemented different ways.
Around 500 people from the cities and rural areas participated and trained according to the different level of workshops which organized in the classroom and moving studio types. A running-stitched carpet created with the principle of sustainable development is made using knowledge and local raw materials. It was easiest and simplest ways to train the people during our workshop (Figure 6). Because the Mongolians simply calling their cultural hidden elements and long-term memory and transfer it their product designs.
Thus, we introduced a concept that is working successfully and can use into the other traditional products bringing up the contemporary design. TV programs related to the dissemination of the running-stitched carpet are presented in Russian, Uzbek, Chinese, Mongolian, Japanese and English languages. Also, the thesis of bachelor's degree students elaborated on this topic.

ACKNOWLEDGEMENTS
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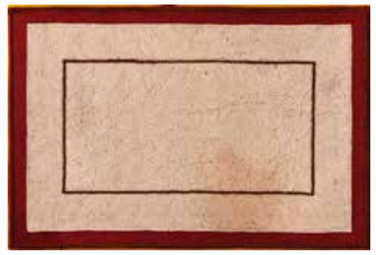
PICTURE 3. Felt carpet of XIV century
A:Findings from the Felt carpet with zeeg-cord strip
B: The First author`s reconstructed design



PICTURE 4. Felt carpet "Shirmel", Ts. Batsaikhan, 2016

PICTURE 5. Felt carpet "Shirmel", fragment, Ts. Batsaikhan, 2016

PICTURE 6. Images of workshops at the country side, 2022

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Social media (2023): Facebook page of Nomadic Craft Initiatives

Interactive Textbook

Assist. Prof. Barbara Dovečar, MsC
Faculty of Design
Ljubljana, Slovenia

ABSTRACT
An interactive textbook (i-textbook) is a digital publication that includes videos, links, GIFs, high-resolution images, and other types of rich media. In this way, we turn our content into a compelling story, which asks for it to be read. Interactive textbooks are a combination of conventional information displayed on the screen, but the possibility of presenting is significantly different from those printed. Static text can be replaced by audio or video material, more images can be displayed through the galleries without losing space for other content, inserting animation and interactive content to retain the attention of users.
It is typically available under its URL address and optimized for a variety of screens, mobile devices being a priority. Since textbooks are not printed, this type of publication is more sustainable. Interactive textbooks as interactive experiences are also much cheaper and easier to distribute. They can be embedded into a website, sent via email, or shared on social media channels.
An interactive format is great for its users, however, it offers exciting benefits for the creators as well.

KEYWORDS
Interactive publications / Interactive textbook / Digitalization / E - learning / Sustainability.

1. INTRODUCTION

Information and communication technology (ICT) is an important part of our lives. It gives us very fast access to a variety of data (text, image, video, etc.). All of this can be used very well in the context of education, as ICT brings new possibilities for imparting knowledge to education, enables learning that is tailored to the student, increases equal opportunities for all students, and brings innovations from the sustainability point of view.

The following definition of e-textbooks is written in the Official Gazette of the Republic of Slovenia: "Textbooks in electronic form are classified into two levels. At the first level, there are digitized textbooks (d-textbooks), which are electronic editions of printed textbooks and contain only text and images. In the second level, there are interactive textbooks (hereinafter referred to as i-textbooks), which include interactive elements and interactive tasks with multiple feedback. The i-textbook can allow saving answers and monitoring the user (Official Gazette of the Republic of Slovenia, 2015).

Today, technology plays a key role in how young people obtain information and communicate with each other, therefore, pupils and students expect the use of various technologies in the learning environment as well (Geer and Sweeney, 2012).

Appropriate interactive materials and their use on devices such as computers, tablets, and mobile phones open up new ways of working in education and become an important element in the educational process. The teacher is no longer the only mediator and promoter of students' knowledge building, the i-book also takes over this role. An important advantage of e-materials is accessibility, the possibility of being saved and accessed on different devices, and the traceability of the student's progress in acquiring and consolidating knowledge. In addition to the fact that the i-textbook provides knowledge, it also enables consolidation, checking, and deepening of knowledge. In this way, interactive textbooks are an important tool for building new knowledge (Repolusk, 2009).

2. INTERACTIVE LEARNING MATERIALS AND I-TEXTBOOK

Compared to traditional approaches to education, e-learning, and interactive learning materials with an emphasis on the use of i-textbooks offer many advantages:

- Access to e-materials is always possible, everywhere. The only requirement is an internet connection and an IT device (mobile phone, tablet, computer).
- Enhanced student motivation and activity and faster learning, as the material is presented in different ways: through text, sound, picture gallery, videos, 3D visualizations, tasks of different levels of difficulty are given with solutions, ... All this enables more independent, successful work and rapid progress.
- Teachers and parents are provided with adequate insight into the student's activities.
- Relief for parents, as they no longer need to sit and study with their child.
- Financial relief for parents, as the i-textbook includes explanations, procedures, videos, etc., and reduces or even eliminates the need for providing additional instructions.
- The students progress according to their abilities, choose their own pace and they gradually build knowledge by consolidating their knowledge and repeating.
- The students' self-esteem increases as they successfully complete different tasks.
- Interactivity and multimedia have a positive effect on the students' attention as they can persist in learning for longer.
- Multimedia elements enable the visualization of abstract concepts and processes and thus contribute to greater learning efficiency.
- Quick elimination of possible errors, the constant addition of current content, interactive elements, and tasks.
- The use of e-materials results in the reduction of printed materials, which has a positive impact on the environment and represents a sustainable aspect. Over a long period of time, in this way, we significantly reduce the costs of education, and at the same time, heavy school bags will become a thing of the past (Pesek, Zmazek, Milekšić et al., 2014).

An example from Slovenian education also speaks in favor of the use of i-textbooks, i.e., in the 2013/14 school year, the Ptuj secondary school started using i-textbooks in science lessons. A survey among students showed that the students accepted this type of learning material very well. The students gave feedback with many advantages (Vrtačnik, Zmazek, 2014):

- Reduced weight of school bags.
- Transparency of the material (structure of e-learning units).
- Increased level of motivation to learn.
- Interactive elements (pictures, animations, 3-D models) improve the visualization of learning content.
- Interactive tasks simplify the consolidation of knowledge.
- Immediate response (key and feedback) when solving exercises.
- Access to the i-textbook anytime and anywhere.

There were certain disadvantages of such interactive materials that the students pointed out (Vrtačnik, Zmazek, 2014):

- Occasional technical problems related to Internet access, which means unstable connection with the i-textbook.
- Some students prefer the classic textbook, as they are more used to it and learn from it more easily.
- Learning from the screen can be a problem for some students.
- The danger of unfocused work, as students quickly lose attention to other pages (links) that are not relevant to the learning material in question.

The interactive i-textbook brings a new experience for both the student and the teacher. We define an i-textbook as an e-textbook that includes i-learning components with a high degree of interactivity (Pesek, Zmazek, Antolin and Lipovec, 2013). The I-textbook is designed in such a way that it provides the student with different experiences, taxonomically diverse tasks, and incentives for (systematic) integration of knowledge. This means that the i-textbook also enables the students to develop process goals, as it encourages the students to justify, explain, classify... The i-textbook offers many possibilities of use both in the classroom and outside, it is easily accessible, and can be used on a computer

with or without an online connection.

The design of the i-textbook also enables the student to learn independently. In the case of a long absence of the student (illness, sports, travel…) the student can master most of the goals independently with focused, well-planned work. However, even when using the textbook independently, it is sensible that the teacher monitors and directs the students' work.

3. I-TEXTBOOK AS A SOURCE OF ACTIVITIES FOR PUPILS AND STUDENTS

The shift in the role of the textbook must be seen as a departure from the dominant role of the textbook as a source of the content part of the preparation for the teacher to the role of the textbook as a source of activity for students (Lipovec, Senekovič, Repolusk., 2014). Due to their interactive capability, i-textbooks can, in addition to the usual content role, also take on some didactic functions that were usually reserved for the teacher in printed textbooks, real-time feedback to the student during individual activities, new examples of tasks, multisensory approach in illustrating concepts (text, picture, video, sound, applets).

The shift in the student's role is reflected in the student's basic activity when using the i-textbook compared to the printed textbook: with the printed textbook, the students are primarily readers and observers (pictures, derivations), with the i-textbook, they also become examiners of the interactively designed activities.

The I-textbook helps the students to become aware of their own responsibility for effective and permanent knowledge building (also in the light of independent learning at higher educational levels and in the context of lifelong education).

Therefore, we can conclude that i-textbooks can provide an additional supportive environment for students compared to printed textbooks (Lipovec, Senekovič, Repolusk., 2014).

4. CONCLUSION

With the final look at the importance and role of interactive publications with an emphasis on i-textbooks, we can find that by integrating technologies such as HTML5, multimedia content is added to the i-textbook, such as images, audio and video, galleries, tasks with procedures and solutions, 3D models and visualizations of complex data, … New technologies, such as augmented reality and virtual reality, can provide students with a realistic and immersive experience when delving into the selected study content. Physics textbooks of the older generation are limited to standard learning methods. These methods are non-interactive and are limited to reading and learning only. The I-textbook, on the other hand, is designed in such a way that it offers the student different experiences, taxonomically diverse tasks and incentives for (systematic) integration of knowledge. This means that the i-textbook also enables the students to develop process goals, as it encourages them to justify, explain, classify…

Unlike physical publications, content in e-books can be replaced/updated very quickly or whenever needed, without reprints. Digital publishing platforms make it easy to add multimedia to content. Taking advantage of this, eBook creators can update all digital assets whenever the content changes. Publishing physical publication is usually very expensive. The quantity and quality of the paper have a big impact on the cost. Accordingly, creating and printing multiple versions of a book due to changes in content greatly increase costs. Creating i-textbooks is challenging, but sustainable and relatively economical in this respect. Any new information, correction or change, images, and extra material can be easily added and the contents of the textbook can be updated without expensive reprints.

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Circular Fashion Design in Respect of Post - Consumer Process

Dr. Enes Esra
Tarsus University,
Mersin and Turkey

Corresponding author: esraenes@mersin.edu.tr

ABSTRACT
Today's linear fashion design system ends up in huge consumerism. As an alternative, the circular fashion design system has been developed to keep the material production system. Circular fashion design plays a major role in creating a well-designed circulating system for customers. Garments should be designed with the 3R approach in mind to be accessible after the end of their life cycle. This way, post-consumer processing facilities can extend the life cycle of a garment. At this point, customers have a responsible role in being a part of the circular fashion design process.

In this situation, customers should take part in this process either individually or through fashion firms. The most well-known ways of addressing post-consumer waste problems are to reusing, repairing, and recycling. In this study, related to this issue, investigated that the reuse, repair, and recycling options for extending the life cycle of garments to support circularity for post-consumption process. Various ways are suggested for consumers to become more sustainable by saving materials through the circular economy in fashion design.

KEYWORDS
Circular Fashion / Post-consumer waste / Reuse / Repairing / Recycle

1. CIRCULAR FASHION DESIGN

Circular fashion design is seen as an improvement over the linear production model, which follows a "take-make-use-throwaway" system in the fashion industry that leads to economic losses and environmental destruction and poses a threat to society (Ki et al., 2020). These issues are relevant to the three pillars of sustainability, namely people, planet, and profit (3P). The ideal circularity can be achieved by harmonizing these three pillars of sustainability (Figure 1).

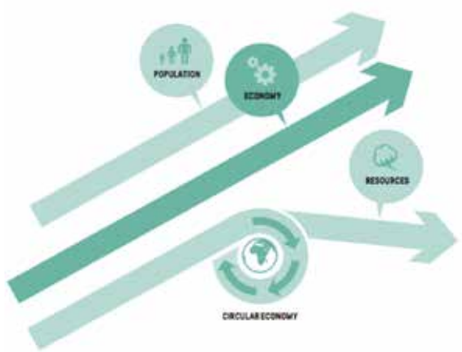

FIGURE 1. Reducing resources and the other factors (H&M,2015: 3)

Globally, the fashion industry is one of the most significant sectors, employing around 300 million people across the value chain and generating employment opportunities (Ellen MacArthur Foundation, 2017). In the European manufacturing industry, the fashion industry employs 1.7 million workers and generates approximately 166 billion euros (European Commission, 2022, as cited in Abdelmeguid & friends, 2022). These numbers highlight the industry's significant human-intensive aspect and its global impact on the economy.

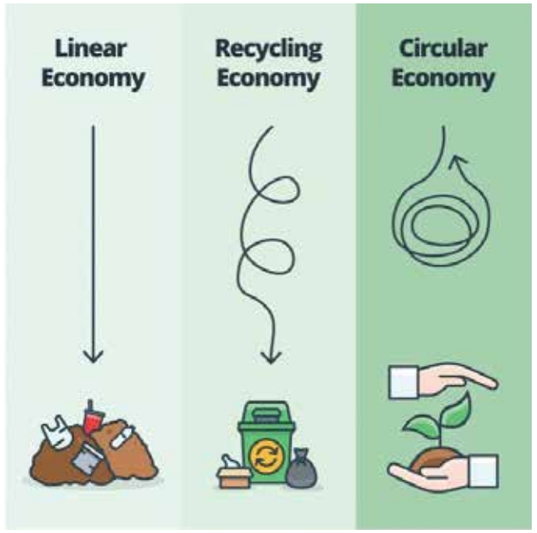

FIGURE 2. Linear economy versus circular economy (Flannigan, 2021)

FIGURE 3. Linear economy model and circular economy model (Flannigan, 2021)

In March 2020, the European Commission announced a new Circular Economy Action Plan aimed at creating a cleaner Europe (European Commission, 2020). In Europe, national programs and regulations for a circular economy must comply with the EU Environment Council's proposals, as per Koszewska et al. (2020). According to a guide by Koszewska et al. (2020), textiles have the fourth highest level of effective use of natural resources.

The fashion industry have mass production process and new collections every week to meet the demands of consumers. This results in an enormous amount of mass production, with excess garments being sold or wasted. This fast fashion model encourages excessive consumption and promotes the idea that people need more clothes than necessary, leading to a throwaway culture (Flint, 2011:25). The linear production model in the fashion industry is a consequence of this process, resulting in more consumption, more production, and more discarded fashion products. In contrast, the circular production model aims to prevent this faster madness by preserving materials and creating durable products that can be used for a longer time or recycled when necessary, without requiring additional natural resources.

To achieve sustainability in circular fashion production, a consumer-centered approach is necessary. Informing consumers about the environmental impact of their fashion consumption behavior can play a significant role in achieving this goal (Kirchherr, et al., 2017). The European Commission (2020) recommends easy access to reuse and repair services, as well as the reuse and recycling of textiles, as ways to reduce post-consumer waste. The 3Rs - reduce, reuse, and recycle - are the most commonly known approaches to achieve this (Fletcher, 2013:98). In addition, circular fashion design can be supported by post-consumer solutions such as reusing, repairing, and recycling to extend the lifecycle of garments.

2. POST-CONSUMER CIRCULARITY OPTIONS

These are classified as reusing, repairing, and recycling. Reusing is indicated by second-hand clothing markets, rental services, and sharing clothes emotionally. Recycling is examined through upcycling and downcycling.

2.1. REUSING

Increased reusing and recycling of textile materials can support the decrease in the use of virgin materials and reduce the use of water, chemicals, energy, etc. (Dahlbo et al., 2017). Consumer attitudes and behaviors have a significant effect on the evolution of reusing and recycling op-

tions (Fontell and Heikkilä, 2017).
Fletcher (2013:99) notes that reusing is critical to the fashion production process because it helps with redistribution and release. Reusing is a simple way to save materials without requiring a long process. There are three different ways to deliver clothing to another user: second-hand clothing markets, rental services, and sharing emotional endurance clothes.

2.1.1. SECONDHAND CLOTHING MARKET

The second-hand clothing market is the best solution for keeping materials in the circular economy. Reused clothing is referred to as "second-hand" fashion, consisting of already produced fashion products in the circular economy and does not require new production (Kasavan et al., 2021). Second-hand clothes are collected through donations and are laundered before being ready for sale.

FIGURE 4. Alfies Antique Market in London (Visit London,2023)

Vintage clothing markets, as a type of secondhand market, offer unique styles that appeal to customers with specific tastes (Figure 4). Some vintage customers become more desirable to deal find and hunt. A part of second-hand marketing vintage shopping is a convenient cloth market for original design users (Gwilt & Rissanen, 2012: 149). Seeking nostalgia is another aspect of the secondhand clothing market.

2.1.2. RENTAL SERVICES

Rental services are also an important option for special occasion clothing needs, without the waste that typically results from buying a new clothing. Today, there are many rental service applications and websites advertised on social media platforms thats are mostly preffered than shopping service. These rental services offer a cheaper and more sustainable way to access valuable and specific special occasion garments, which may only be worn for a few days. Special day garments mostly not used one or more day in a year and it costs more than a casual day clothes, so renting those garments is the best way to reach them practically.

FIGURE 5. Some examples of advertisements of online rental services

Figure 5 shows Stylelend online garment rental service, mostly focused on designer designs, but also there is another examples for casual, sport, pregnancy, and other types of clothing rental services. Renting a garment is cheaper than buying a new one, and is more ecologically friendly, actively contributing to reducing post-consumer waste.

2.1.3. SHARING EMOTIONAL ENDURANCE CLOTHES

Emotional endurance clothes often have a special meaning for the wearer, such as a favorite t-shirt that brings good luck or a dress from one's mother's youth. These types of clothes can hold an emotional significance for the wearer, as they may have been given to them by someone important such as a mother, sister, or brother.

FIGURE 6. The dress from 'Antribes' weared from six members of two family (Photo by Sean Michael).

Fletcher (2017:5) discussed the dress form "Antribes" that was worn by six members of a family (Figure 6). These moms and daughters shared this experience at different times in their lives. The second mother in the family indicated that "The people who lived next door gave me this dress from Antibes which they had worn there over many seasons and they said I could have it for our holiday. A great success. And, I can't think how many more years I wore it". This mother and her two daughters wore this summer dress for many years.

The emotional and experiential connection between a garment and its user can result in a reduced need to consume new clothes (Chapman, 2005). Emotional endurance garments have a positive effect on our feelings, and we tend to wear them for many years if possible. For this reason, the design of the garment often features simple lines, one-size or elastic fits, and physical durability.

2.2. REPAIRING

Repairing can be supported by fashion firms after the sale or can be done individually. The product service model supports repairing service or remodelling services, which can positively help reduce the amount of post-consumer waste caused by overconsumption (Gwilt & Rissanen, 2012). Repairing may seem less aesthetically appealing, but this can be designed with techniques such as embroidering. Figure 7 shows examples of Eric Eggenburg's mending project, which includes Levi's wide-legged denim repaired by kimono scraps (Eggenburg, 2019).

Figure 7. Denim mending project by kimono scraps (Eggenburg, 2019).

Individuals have traditionally repaired their own household textiles and garments and reused clothes for one more wear. However, the fast fashion production system has disrupted this valuable circulation (Fletcher, 2013:98). Repairing a damaged garment is an easy and cost-effective solution (Allwood et.al., 2006:39). By repairing, the whole parts of a garment can be kept useful as long as possible (Fletcher, 2013:100). The success of repairing a garment is dependent on its durability (Gwilt & Rissanen, 2012: 128). Repairing can be a promising approach to prevent post-consumer waste if a garment has physical durability.

2.3. RECYCLING, UPCYCLING & DOWNCYCLING

Recycling begins with the design of the garment. If a garment is designed with the recycling process in mind, it can be recycled (Flint, 2011:25). Recycling is a way of keeping raw materials by manufacturing another product (Fletcher, 2013:99). Therefore, the post-consumer process of recycling, returning used clothes to create a new product, is essential. From the consumer's perspective, choosing garments made from recycled materials is a responsible choice (Flint, 2011:25). Consumers can use recycling points, or some fashion markets have companies that collect second-hand clothing to support recycling by the firms. Recycling is a necessary processing method to eliminate the landfill waste problem caused by secondhand clothing. Recycling, as an act, requires various production processes, and upcycling and downcycling have emerged as alternative design ways to save the garment, either by individuals or fashion producers.

Upcycling is a process of creating something new from old clothes by cutting and rethinking the design. Used or old clothes have a nonstandard style, and each design is original and unique. However, the design process is intensive, resulting in higher prices (Gwilt & Rissanen, 2012:150). Upcycled clothes can be more valuable and fashionable by adding more value and labor. As seen in Figure 8, French designer Manon Planche showcased an upcycled denim jacket at the London Fashion Week (Shurvell, 2020).

FIGURE 8. Manon Planche's upcycled design (Shurvell, 2020 adopted from Manon Planche).

If a garment cannot be upcycled or recycled as a last opportunity it can be downcycled. Downcycling involves transforming the garment into a new form, such as a rug or insulation fabric, by breaking it down into pieces. For example, worn clothes that cannot be repaired can be turned into a patchwork blanket or used to weave rag rugs (Flint, 2011:30). Rag collectors and shoddy manufacturers have been using downcycled materials for hundreds of years (Fletcher, 2013:98). Additionally, Yörük women have been producing their own household textiles in their homes for many years.

FIGURE 9. Chapputz upcycled bags (Parlak, 2016).

Downcycling involves downgrading the quality of the material into low-value and cheap products. This often entails mixing various fibers to create a blend of lower quality (Fletcher, 2013:100). A good example of downcycling is traditional weaving styles used by Yoruk, Turkish nomads in Anatolia. They cut up used clothes and weave them on their looms in the gardens of their homes, creating home textiles such as lace pillows, chair covers, rugs, or door mats. One Turkish entrepreneur, Yasin Sert, has even created the Chapputz brand which uses these rugs to produce a range of upcycled products such as textiles portfolios, women's bags, iPad cases, and various pillows (Figure 9).

3. CONCLUSION

Consumers have a positive attitude towards circular clothing ideas and are interested in taking care of their clothing at the end of its lifecycle due to environmental awareness (Vehmas et al., 2018). Considering the destructive effects of contemporary fashion production on the environment, a circular economy must be adopted in the fashion industry as an alternative. Fast fashion's mass consumption has made buying clothing a leisure activity, necessitating more conscious consumption. That approach can be prevent at beginning of the design stage.

The design of a garment should be considered the extension of its whole lifecycle. Fashion producers have an important role in guiding consumers towards the post-consumer process of a garment, including reusing, repairing, , and recycling which can be achieved by individuals or through garment brands. In each case, responsible consumer behavior is essential.

Raising consumer awareness is important to highlight the benefits of reusing, repairing, and recycling. Keeping the lifecycle of a garment in mind is valuable for environmental sustainability. Maintaining materials within this cycle can be adopted from an economic circular perspective. In the view of circular fashion design, designing a garment indicates that designing the entire lifecycle of the clothes. Therefore, designing for circularity is a significant factor in achieving longevity.

In conclusion, adopting circular economy principles and designing for circularity can bring significant benefits to the economy, the environment, and society as a whole, while also offering new opportunities for creativity and innovation to fashion industry.

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Folk creativity as a representative of cultural heritage - history, development and contemporary application

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Dragana Frfulanović
Academy of Vocational Studies South Serbia,
Leskovac, Republic of Serbia

Snežana Urošević
Technical Faculty,
Bor, Republic of Serbia

Milena Savić
Academy of Vocational Studies South Serbia,
Leskovac, Republic of Serbia

Corresponding author: dfrfulanovic@gmail.com

ABSTRACT
The work was created to present the main products of folk art from Eastern Serbia as authentic in terms of their motifs and production techniques. The primary place was given to the Pirot carpet and double-spun socks of the Knjaževac region as a living cultural heritage on the list of the National Intangible Cultural Heritage of the Republic of Serbia. The developed cattle breeding tradition of the mountain area around Stara Planina favored the successful processing of wool and the production of textile products in the home industry of the rural regions. Closely integrated into the life of an ordinary person, these products become an indispensable element in significant life situations of its user, and the applied motifs acquire a specific symbolism for a given event - for birth, wedding, death, employment, or going to the army. The modernization of society and the industrialization of production caused the traditional crafts of carpet weaving and sock knitting to be almost completely lost during the 20th century, as well as their consumer goods, while the symbolism of these traditional products was denied and suppressed. As a result, we enter the 21st century with rare, and by age, connoisseurs of standard wool processing and textile production. The guardians of tradition have become women's associations, and they receive significant help from the state, which has recognized the potential for the employment of women from rural and underdeveloped areas. At the same time, the traditional product received a modern redesign and became a representative of Serbia's cultural heritage.

KEYWORDS
Pirot carpet / Double-thread socks / Tradition / Cultural heritage / Modern consumer / Redesign

1. INTRODUCTION

The Pirot carpet and double-thread socks from the Knjaževac region represent a unique product and an element of the cultural identity of Eastern Serbia. Due to their specific forms in design, they have gained an international reputation and represent the cultural heritage of Serbia. These textile products must become part of the present to preserve the former value. By promoting traditional crafts, such as weaving and knitting, and their products, which with their appearance, characteristics, and beauty, satisfy the aesthetic requirements of modern man, inspiration is found that can become part of contemporary fashion, and at the same time a sign of recognition of this era.

New models inspired by traditional motifs and elements of Pirot carpets and double-spun socks from the Knjaževa region open a new dimension in fashion. It is a fashion in which old and valuable handicrafts give a second life to new products. Sustainable fashion is not a trend, it is the future, and this idea is presented in newly redesigned models. The purpose of those models is to show the importance of the circular economy through the application of handmade products in a new modern model. Their redesign and creation of new products renew awareness of their cultural heritage values, successfully preserve and promote the country's culture, and offer new fashion forms that can be acceptable to everyone.

HISTORY AND CHARACTERISTICS OF DOUBLE THREAD SOCKS OF THE KNJAŽEVAC REGION

Double-knitted socks became known to the general public thanks to the engagement of cultural workers of the Local Museum of the municipality of Knjaževac, who recognised them as an authentic product of the folk creativity of Eastern Serbia. The basis of this thorough work is the original collection of over 420 double-spun socks, most purchased from the Popović couple, educational workers Vidosava and Svetozar. They spent more than half a century researching these socks, analysing and systematising the ornaments on them, and creating rich documentation from the area of middle and upper Timok. Thanks to Popović, today in the museum fund, in addition to the rich collection of double-spun socks, there is an album made up of about 240 panels with drawn socks in the original size and colour, 426 ornaments in colour, an album with 800 boards with decorations in black and white technique, as well as handwritten material and map of the research of double-spun ornamentation in the area of Timok (TV Zona Plus, 2022).

Precisely because of its volume and content, this collection is unique not only in this area of the Balkans but also in the whole of Europe, as it is essential evidence of the development of double-yarn knitting and its ornamentation (Živković, 2001). Furthermore, the Knjaževac collection of double-yarn socks is a significant witness to the ornamental phase of double-yarn knitting. These socks are made using the "straight" knitting technique with two yarns in two colours, the interweaving of which forms a two-yarn ornament (ZA MEDIA, 2019).

FIGURE 1: Double-yarn socks in Museum and Ethno Center Knjaževac

According to the analysis of Svetozar Popović, based on the patterns from upper Timok, the ornamental motifs of double-yarn knitting patterns reached their peak in the 18th century. In the later post-classical period, at the end of the 19th and the beginning of the 20th century, the set standard in the arrangement of ornamental surfaces and the composition of ornaments was broken, so that at the end of the 20th century was a minimal number of connoisseurs of this knitting technique. The ornamentation on double-spun socks is highly diverse and rich with striking colours. It is characterised by originality in the combination of patterns, and it isn't easy to find two identical socks (Živković, 1985).

Socks were made from domestic wool by knitting on five needles with two yarns in two colours, most often in a combination of black as the base and red. The knitting of the sock started from the toes to go up over the foot and heel to the part next to the leg, which has a thread (podvezalka, uzica) at the top, which was tightened to prevent the sock from falling. The surface of the entire sock, which is made up of the foot (naglavak) and the part around the leg above the ankle (gornjište), is divided into belts filled with ornaments. On the upper part of the cap, the most significant feature is covered by the middle pattern, but the most striking decoration, which the double-spun sock can be recognised, is on the upper part - a large or medium pattern. Between and around these most critical areas for ornamentation, there are smaller ornamental belts, and they are all separated from each other by thin woven strips – tkaničke.

According to the method of processing the upper part, the sock was divided into men's or women's. The women's socks always had a longer top and a more complex ornamental treatment of the area of the middle pattern, which is more extensive. The construction of the patterns was complex - flowers, branches, stars, horses, and roosters. The motifs were combined, larger, and necessarily colourful. In contrast to this, on men's socks, the pattern of the upper part is of simple, geometric construction, given in a horizontal sequence, of smaller dimensions, and a combination of two colours. This modesty is partly offset by more important colouring and complex ornamentation in the upper and lower patterns surrounding this central part (Živković, 1985).

In development, the oldest applied patterns are geometric shapes of small dimensions (bopčice, potrčarci, krstići - crosses). Later, more complex geometric constructions (zevalice, metlice, "na rebra") were gradually stylized into forms (circles, stars). Zoomorphic motifs are knitted less often. They are constantly on larger surfaces, such as a large pattern on the top of the headpiece (Živković, 1985). Of course, inspiration was found in the environment of the

knitter, which was usually nature, so the names of the patterns were also inspired by it.

Double-spun socks were not only an article of clothing for the peasants of the Timok Valley. Their complexity in the structural division of the knitted surface, the selection and arrangement of motifs, and the combination of colours indicate great care during their production. The person to whom these double-spun socks were intended was influential in the knitter's life and when they would be worn. Double-knitted socks were an essential part of the folk costume of the peasants of this region on festive and important occasions (weddings, baptisms, celebrations, covenants), they were given as gifts to important people in the life of the village family (bride dowry), and the selection and symbolism of the ornaments indicated that they were made on purpose for a specific person. A knitter chose motifs at her discretion, combined them, and shaped them to differ from those previously seen. The work "from the head," due to the impossibility of making notes, showed the knitter's skill and trickery but also a special connection with the created socks. That is why the most beautiful specimens were often selected and kept for burial or burial in the grave with the deceased.

HISTORY AND DEVELOPMENT OF PIROT CARPET AND MOTIFS

The Pirot carpet is an authentic product of folk creativity from the area of Pirot and its surroundings. It is distinguished from carpets from other regions by the quality of the material and the way it is treated, the manufacturing technique, and the choice and combination of patterns on it. The development path of the Pirot carpet is known in more detail from the second half of the 18th century, when it already took on a recognisable form, as evidenced by the oldest surviving examples (Petković-Vlatković, 1996). It is woven with yarn from mountain sheep wool, which the Pirot region abounded in its hinterland, and was treated with selected natural dyes. Women who make a carpets (ćilimarke) were woven using the kneeling technique on large vertical looms, so the rugs could have different dimensions, which gave them their name (šestak, merka).
The established aesthetic principles in the making of carpets influenced this product to be more easily distinguished from the others and to go beyond the scope of local trade, especially if you consider the convenience that Pirot, as a Turkish town, was located at the crossroads (Ćirić, 1954). The business of the Pirot population was intended to satisfy the needs of the Muslim population for religious reasons (mihrab), but soon its customers also became Christians. The reason was the improvement of the production technique and the enhanced aesthetic atmosphere to eliminate the competition.

FIGURE 2: Pirot carptr, motivs and boots with Pirot motiv

The Pirot carpet (kilim) became an attractive product due to its practicality and durability because it was woven to have two identical faces, then due to its beauty in the combination of colours, i.e., the combination of patterns, which had their symbolic meaning. It became a valuable inventory of every more prosperous house, but it had to be found in homes of more modest financial means for festive occasions. Due to the symbolism of its patterns, this rug is made to order for important events (weddings, dowry for girls) and important people in the life of a family. Accordingly, its dimensions also varied.

Such a high-quality and valued product has become part of the area of interest of the local Turkish economy, which was involved in the further development of the Pirot carpet. After the liberation in 1878, Pirot and its surroundings became part of the Principality of Serbia, and Pirot carpet-making continued to develop through associations and organisations (Petković, 1996). Recognised as an authentic Serbian product of national creativity that entered the framework of the national economy, the Pirot carpet quickly gained international recognition. First, at the Paris Exhibition in 1900 and then at the Serbian Exhibition in London in 1907, the Pirot carpet (kilim) attracted a lot of attention, positively affecting sales, i.e., the increased number of orders (Dušković, 1995).

The weavers of the Pirot carpet were women of modest means from urban areas, and the skill of this craft was mainly passed on in women's family circles. Since the beginning of the 20th century, there have been various forms of organising production, but mostly without adequate material profit for the carpet makers who diligently worked on the production. Increased production to meet the needs of the market influenced the changes. Carpets from the first half of the 19th century are compositionally more uncomplicated and have calmer tones, while from the beginning of the 20th century, the norm of the Pirot carpet as we know it today was formed (Jovanović, 1977). It is made up of a central field that occupies the largest area of the carpet - the field (polje), around it, is a border that surrounds it - a plate (ploča), and on the outer edge, there is an edge (ćenar), which can also be found between the field and the plate.

FIGURE 3: double-spun socks, motif and tablet bag

A crucial element in the appearance of the carpets when ordering was the choice of ornaments and their combination, which was by the purpose, that is, the occasion for which it was made because the patterns had their symbolism. Ornaments are of geometric type, more precisely, geometrically stylised objects from the environment, floral, anthropomorphic, or zoomorphic elements. Among the most well-known are - kornjača (turtle), sofra, đulovi, vraško kolo, gugutka, kondićeva šara etc. (Petković-Vlatković 1996). A kilim with a flower (đulovi) motif was most often given as a gift to a girl, and there is a belief that a carpet with a pattern of scattered flowers (razbacani đulovi) signifies a world where people with high life values are scattered. Perhaps the most famous pattern of the Pirot carpet is the turtle (kornjača). It carries the symbolism of a long and happy life, well-being, and harmony in the family, so a rug with this motif was most often given as a gift for a wedding or to a girl before marriage. The "sofra" ornament symbolises agreement, wisdom, and good words. The devil's wheel (vraško kolo) is a mystical pattern that signifies family, home, and family glory, and carpets with a bomb (bombe) pattern were given as gifts to men, people of business, and significant reputations. From the above, it can be concluded that the Pirot carpet is not an ordinary homemade item intended for decoration in the house. On the contrary, it is a set of symbols that, by their meaning, should help or provide protection to its owner. It is a kind of guardian of the home in which it is also of its owner.

APPLICATION OF PIROT CARPET MOTIF AND DOUBLE YARN SOCKS IN CONTEMPORARY DESIGN

In the collection of double-spun socks of the Native Museum in Knjaževac, there are examples of the oldest preserved socks from the 18th century (Knjaževacinfo, 2020), which is significant in studying this almost extinct folk art. In 1965, this collection was declared a cultural asset of Serbia, and today it is exhibited as part of the permanent exhibition of the Museum as a separate entity - the Museum of Socks (Zavičajni muzej Knjaževac), which stimulated the interest of foreign as well as domestic visitors. The fight for the preservation and revitalisation of double-spun socks has been going on for several decades. Undoubtedly, the National Museum from Knjaževac made the most significant contribution to this activity, regularly including this collection in museum activities such as exhibitions, workshops, and various projects, initiating cooperation with the local self-government, the Ministry of Culture and Information of the Republic of Serbia, as well as multiple organisations and associations.

A significant contribution to the revival of the double-yarn knitting technique was made through the cooperation of the Museum and the association Ethno Center Knjaževac. The members of this association, who started knitting double-threaded socks, familiarised themselves with the material from the Museum's collection so that the reproduction of the model would be credible (Knjaževacinfo, 2014.). Furthermore, since the summer of 2017, as part of the Summer School of Old Crafts, organised by the Knjaževac Local Museum, there is also a double-yarn knitting school aiming to educate the younger population. Finally, in December 2018, after decades of engagement with the Knjaževac museum, double-yarn knitting of woollen socks was recognised as a living cultural heritage and entered the list of the National Register of Intangible Cultural Heritage of the Republic of Serbia (Nematerijalno kulturno nasleđe Srbije, 2018).

FIGURE 4: Creations with Pirot motifs – Ana Grgurović and Silvana Tošić

Continuous work on the valorisation of double-spun Timoka socks is necessary. Today, this activity takes place in two ways: one is in a traditional form with respect for all established standards when making this product of folk creativity. The realisation is in the hands of women organised in an association that deals with traditional crafts. Joining the Ethno Network organisation, the members of the Knjaževac Ethno Center make double-knit socks that are included in the protocol gifts of the Government of Serbia and state institutions (Etnomreža). For example, in the past year 2022, on the joint project of the Coordinating Body

for Gender Equality of the Government of Serbia, NALED, and the Ethno Network, which is being implemented to preserve cultural heritage through the engagement of women from rural areas in making handicrafts, the association Ethno Center Knjaževac received significant support due to the recognition of work on the preservation of double-spun socks (Politika, 2022.).

A second form is an innovative approach in the so-called leading economy, i.e., in the synergy of intangible cultural heritage, science, economy, and tourism. For example, the native museum of Knjaževac has included in its offer of souvenirs the products of double-yarn knitting created by the Summer School of Old Crafts. As it is a project during which socially sensitive and vulnerable groups are engaged (Zavičajni muzej Knjaževac), the product itself, in addition to its cultural and historical role, has economic importance for the local environment while simultaneously participating in the formation of a tourist brand (Krasojević – Đorđević). It is important to point out that these products, with the use of the traditional two-yarn knitting technique, have a new function that is appropriate and attractive to the modern consumer (leg warmers, laptop bags, tablets and mobile phones, bottle bags, pendants, scarf holders). Modernising a traditional product is the way to forming a national brand (Bjelajac – Terzić – Lović, 2015), which double-yarn knitting of woollen socks justly deserves.

In 2002, the municipality of Pirot carried out the geographical protection of the name of origin, „Pirotski kilim“, which indicated a clear intention to protect the existing brand and all producers from this region. The role of custodian of tradition in the production of Pirot carpets using the traditional technique belonged to the Craftsman Cooperative for the production of carpets and souvenirs, Damsko srce, which has been successfully operating in this field for more than a decade. This cooperative produces certified rugs according to the standard defined by the Elaboration on Geographical Protection and is the authorised user of the name of origin, „Pirotski kilim“ In June 2012, Pirot carpet making was added to the list of the National Register of Intangible Cultural Heritage of the Republic of Serbia, and weavers from the Damsko srce cooperative and the PP Ćilimarska zadruga appear as proponents (Nematerijalno kulturno nasleđe Srbije, 2012).

In recent years, a severe shift has been made in the presentation of this traditional product, which went beyond the scope of the local and became a national brand. The municipality of Pirot has shown interest in the projects of NALED, Ethno Network, RARIS, Institute for Border Areas, and Coordination Body for Gender Equality of the Government of Serbia (Politika 2022). It is about a work program to empower women from rural areas by engaging in the production and presentation of traditional folk art products to preserve cultural heritage.

The patterns of the Pirot carpet have become a recognisable element. They have received their new application in contemporary design, a new form of life of the cultural heritage of the Pirot region. Designer Silvana Tošić undertook one of the more extensive endeavours in promoting Pirot carpet ornaments. She used Pirot patterns on her creations, skillfully exploring clothing pieces for every occasion to haute couture. She went a step further by using Pirot kilim as the base fabric when making women's coats, which deepened the connection with this magical guardian of its owner and home. These creations were presented in Belgrade, Novi Sad, and Paris fashion weeks. Designer Ana Grgurović began her career by applying stylised forms of Pirot patterns to avant-garde baroque-type creations. In the later period, she returned to stylisation again through a combination of materials and techniques on dresses in the spirit of the Middle Ages. It is essential to point out that in both cases, we are talking about designers from Pirot who found inspiration in the patterns of Pirot carpets but also recognised the potential of redesigning folk creativity as unique stamps when forming their fashion line. The possibilities are great. The Pirot factory AD Tigar launched its line of boots with motifs from the Pirot carpet, which were presented in far Asia. Modern rubber boots with the same patterns were worn by mannequins at Fashion Week in Paris in 2019 (Frfulanović-Savić, 2020).

CONCLUSION

The new concept of applying traditional elements is one of the ways of internationalising motifs and their application in the global fashion industry. Symbols derived from our folklore tradition are an important key in preserving identity, an original spiritual wealth, and a potential basis for inspiration in new fashion trends. With contemporary stylisation, these motifs become very attractive in modern creativity, even fashion design. A brief analysis and presentation of traditional products, characterised as intangible cultural heritage, indicated the potential of application in contemporary design and the intention to preserve the history and tradition of a region. Also, the modernization of the aforementioned traditional products is the way to form a national brand.

Promoting traditional culture with motifs and elements of the Pirot carpet and double-spun socks of the Knjaževa region is a successful way of representing Serbia, and the potential of fashion and design is multiple. The purpose of models imprinted with tradition is to show the importance of the circular economy through the application of handmade products in a new modern model. Models with elements of old and valuable handicrafts, redesigned according to the needs of contemporary fashion, are given a second life.

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Application of Spalting method in Wooden Furniture Industry

Prof. Jasna Hrovatin, PhD
Faculty of Design
Ljubljana, Slovenia

Assoc. Prof. Jordan Berginc, PhD
Faculty of Design
Ljubljana, Slovenia

Corresponding author: jasna.hrovatin@fd.si

ABSTRACT
The use of bio-based methods in the wooden furniture industry presents a big potential for the development of unique furniture items. It can also reduce the environmental impact. Bio-based methods can be used for wood protection and decoration. The bio-based methods, investigated for their potential in the wood industry, include the use of living organisms, natural products, and biomimicry. In this review, we present the application of a bio-based method called spalting in the Slovenian furniture factory Alples.

KEYWORDS
Design / Spalting / Natural products / Wood / Furniture / Wood colouring

1. INTRODUCTION

Furniture production represents a big market (International Wooden Furniture Markets: A Review, 2004; Wang et al., 2016), which requires the design of original products to move up the value chain. Such original products can be designed also with the use of innovative bio-based technologies. Wood biotechnology and the use of natural products in the wooden furniture industry have a long history and are still being developed. They have very big potential for the development of materials with new characteristics, and unique furniture elements, and can help to reduce the environmental impact (Burgert et al., 2015; Mai et al., 2004; Robinson et al., 2012). Our main focus in this research is the Spalting method and showing the results of using this method in the new prototypes of the Alples company. As it is known, visual characteristics of wood are highly valued by consumers (Knauf, 2015; Manuel et al., 2015). With bio-based wood processing methods, we can create some unique decorative patterns. In addition, this type of processing is more environmentally friendly.

Consumers are becoming interested in natural dyes as the production of synthetic dyes is often environmentally unfriendly and their use can be potentially harmful to health (Colak, 2016; Prabhu & Bhute, 2012; Yeniocak et al., 2015). Different natural dyes are still being tested, such as extracts from pomegranate, red beetroot, and fungi (Colak, 2016; Vega Gutierrez et al., 2016; Yeniocak et al., 2015).

However, there are also downsides to using natural dyes. The final colour can depend on the wood composition and may be affected by UV (Yeniocak et al., 2015). Some dyes do not penetrate into the wood and thus colour only the surface (Vega Gutierrez et al., 2016). Furthermore, natural dyes can have a poor affinity for binding to wooden surfaces. Their resistance to discolouration can be improved by the use of mordants, which form complexes with dyes and thus increase their binding to the surface. Metal-based mordants (e.g. iron, aluminium) and vinegar are among the commonly tested mordants for colouring of the wood and other natural products. (Colak, 2016; Goktas et al., 2008; Prabhu & Bhute, 2012; Vega Gutierrez et al., 2016; Yeniocak et al., 2015). However, mordants can lead to colour changes in the dye.

2. CRADLE-TO-CRADLE

The United Nations World Commission on Environment and Development broadly describes sustainability as meeting the needs of the present generation without compromising the ability of future generations to meet their own. (Leonard and Conrad 2011) Therefore, everything we produce and consume must be biodegradable to feed the biological system or designed so that the product can be dismantled and the materials could be returned to the industry and thereby feed the technological system. (Coevolve 2019) The idea behind the cradle-to-cradle philosophy is therefore that all materials used beyond their lifetime in one product can be usefully used for other purposes.

Decorative wood coloring can be achieved by using living organisms that produce unique patterns and can secrete protective antimicrobial substances. At the same time, wood treated with fungi is completely absorbed by nature, without damage or danger to nature. Wood is food for new organisms in nature. It is also possible to use a combination of a living organism and products of organisms such as essential oils. Here, it is important that the used oils are not toxic to the chosen protective organism (Wang et al., 2012).

In the following, we present two methods for coloring with the help of living organisms.

2.1. SPALTING – ZONE LINES (INTRASPECIFIC ANTAGONISM)

Spalting is any form of wood coloration caused by fungi. Although primarily found in dead trees, spalting can also occur in living trees under stress. Dark dotting, winding lines and thin streaks of red, brown, and black are known as zone lines. This type of spalting does not occur due to any specific type of fungus but is instead an interaction zone in which different fungi have erected barriers to protect their resources. (Rayner et al. 1982). They can also be caused by a single fungus delineating itself. The lines are often clumps of hard, dark mycelium, referred to as pseudo-sclerotial plate formation. (Cease et al., 1989)

The coloring of wood can also be achieved by the use of live organisms, which produce unique patterns and can excrete protective antimicrobial substances. The process of wood coloration based on dye secretion by organisms inhabiting the wood is called spalting. As many consumers desire unique wooden products, spalted wood is highly valued, regardless of the wood species used (Robinson et al., 2012). Spalted wood does not have importantly reduced mechanical or acoustic properties. Moreover, spalting increases wood permeability, affecting gluing and surface finishing of the products (Robinson et al., 2013b). Increased permeability can be beneficial, leading to better impregnation (Schubert et al., 2011).

Initial lab work was conducted on spalting in the 1980s at Brigham Young University. A method for improving machinability in spalted wood using methyl methacrylate was developed in 1982, (Christensen, 1982) and several white rot fungi responsible for zone line formation were identified in 1987. (Phillips, 1987). As part of the project “A creative path to knowledge” - PKP, we made samples with the Spalting method with an interdisciplinary group of students. (Fig. 1)

FIGURE 1. Some samples of wood, which we colored in combination with fungi. The task was created together with a group of students of the PKP project in colaboration with the Alples company

2.1. XYHLO

Xyhlo biofinish is a sustainable and 100% environmentally friendly method for protecting wood, especially for outdoor use. It is entirely based on natural raw materials and an environmentally friendly process. Xyhlo biofinish not only protects the wood for many years but even has the unique ability to repair damage by itself without the need for additional treatment.

The Xyhlo finish is created as an organic protective layer on the timber by first processing the wood with natural oil (linseed oil), and then applying an organic coating based on a non-hazardous and naturally occurring fungus. As a result, domestic, less durable types of wood can also be protected in the long term. After the expiry of the technical service life of the wood, the timber can be completely returned to the natural biological cycle. (https://www.xyhlo.com/bio-finish/)
Xyhlo biofinish forms a live black protective layer that is able to repair itself when damaged, for example by cracking or splitting, but also to damage from outside sources. Xyhlo biofinish is in the first years of use even better, in contrast to conventional coatings, which degrade and always have to be renewed in a certain period of time.

The principle of operation of the protective organic coating is based on the presence of active fungal cells and chlamydospores which adhere by biopolymers to the wood. Xyhlo biofinish not only protects against climatic conditions but also against degradation by UV radiation and other fungi. It offers great advantages for applications such as cladding, sound screens, and gazebos. Not only because of the environmentally friendly method of preservation but also because less maintenance is required. (Xyhlo, 2022) (Fig. 2)

FIGURE 2. Xyhlo - black biofinish

FIGURE 2. Xyhlo - black biofinish

3. THE PROJECT "ON A CREATIVE PATH TO KNOWLEDGE" FOR COMPANY ALPLES

With an interdisciplinary group of students from the Faculty of Biotechnology, Department of Biotechnology, and the Faculty of Design course of Interior Furnishings, Visual Communications, and Design Management, we developed furniture for small apartments for the company Alples. In addition, we paid special attention to innovative materials from the field of biotechnology, which has achieved great development in recent years. We decided to include furniture jewelry made of decorative solid wood in the products, with patterns created by microorganisms.

The biotechnology student, together with the interior design students, defined the possibilities for the innovative use of modified wood with the help of biotechnology and the inclusion of this wood in the elements of the system. In addition, students from the field of visual communications, however, devoted themselves to graphic design and, together with Design Management students, produced a promotional film for the successful marketing of the products.

At first, we decided to create a furniture system for small apartments because of the trend in demand for small apartments on the market. Due to the increase in population and the increasing migration of people to cities, the price of residential space is rising, which affects the demand for small apartments. Due to limited space, such apartments require multifunctional and mobile equipment that takes up little space. As part of the project, we have therefore designed products for the rational furnishing of small apartments, which are a response to the needs of modern people.

In a world of increasing competition, we can be successful if we make innovative products that stand out from the average. Thus, we were looking for innovative ideas that will solve the problems faced by owners of small apartments. This is how multifunctional products were created, such as: a 20 cm wide cupboard that serves as a small dining table and a writing desk with a hanging net, a 20 cm wide cupboard that serves as a drying and ironing rack, a cupboard with a hidden two-level pull-out folding table, which serves as a dining table or work corner with conveniently placed elements for storing office supplies. In addition, the element has a dimensionally appropriate pull-out element where folding chairs can be stored. (Fig. 3)

FIGURE 3. A multifunctional cabinet that also serves as a dining table and work space, with decorative elements achieved using the spalting technique. (work of interior design students for Alples)

By including solid wood stained by fungi, we achieved that each piece of furniture is unique, despite mass production. (Fig. 4)

FIGURE 4. An example is on the front of a drawer with a fungi-colored. Due to the coloring method, each piece is unique, and, consequently, the look of each cabinet is individual, despite the fact that it is manufactured in series production.

4. CONCLUSIONS

New materials offer opportunities to improve mechanical and visual properties and reduce the burden on the environment. Environmental friendliness must be covered throughout the entire life cycle of the product, from planning and selection of materials through manufacturing, packaging, and transport, and then the use and processing of waste. Many preservatives are hazardous to health (e.g. arsenic, zinc, copper, chromium, and creosote oil) (Schubert et al., 2012) and therefore their use is prohibited in many countries. In addition, they are often harmful to the environment, especially when disposed of after the end of their useful life (Pánek et al., 2014). The advantage of bioprotective materials is that they are biodegradable.

The uniqueness of products is highly valued among customers, especially for products with a strong hedonic role as opposed to a strictly utilitarian function of the product (Reich et al., 2017). Therefore, new technologies that enable the creation of special products have great potential. Such an example is the controlled fungal staining of the wood. In addition, the 'newness' of the market is also of great importance in the decision-making process of buyers. Based on the model of demand for novelties in the market, Cojocaru et al. (2013) showed that the level of dif-

ference between the new product and the old one must be just right. Indeed, excessive differences lead to customers' fear of not knowing how to use or maintain a new product (Cojocaru et al., 2013).

We live in a world where we can talk about rapid progress in different areas. Innovation and improvements are every daily practice. This is a great advantage if a designer is able to combine artistic and scientific work at once. Design is a combination of artistic and engineering, irrational and rational. In addition, it is important for the designer to be aware that the development of complex products is not possible without the interdisciplinary work of experts from different fields and research of the needs of existing or potential users. User experiences from the market can confirm and bring new insights and ideas for future fruitful collaboration between research institutes, designers, and manufacturers.

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Sustainable furniture modelling by using generative design

Lana Jarža
University of Zagreb,
Faculty of Forestry and Wood Technology,
Croatia

Silvana Prekrat
University of Zagreb,
Faculty of Forestry and Wood Technology,
Croatia

Stjepan Pervan
University of Zagreb,
Faculty of Forestry and Wood Technology,
Croatia

Corresponding author: ljarza@sumfak.hr

ABSTRACT
The generative design is part of our reality that defines new qualities in furniture development and design. Starting from computer science, architecture, engineering generative product technics slowly enters in furniture industry. Generative design allows new approaches of modelling whereby designer defines a series of instructions, rules, and relations for making new products or optimizing material. In furniture manufacturing generative design enables nature inspired designs such as biomimicry, use of complex shapes, modelling customized products and sustainable design. Nowadays increased population causes increase in furniture buying (faster furniture changes) which is defined as consumerism. Generative design contributes to savings and optimization of material products and furniture parts with special requirements. The aim of the paper is to explore how generative design can be implemented and used in furniture design and manufacturing. This paper also emphasizes methods of generative design that can be used in designing and achieving sustainability.

1. INTRODUCTION

Generative design is variation of product design, performance, and manufacturability enabled by artificial intelligence. It is a computer based system which solves a problem that is usually tasked to a human, by use of data and algorithms. The differences between designers and programmers dictates that first group think intuitively and visually, second group rationally and logically, while a combination of both ways of thinking is more the exception than the rule. Nevertheless, many designers (and other members of the creative industry) bring programming into their process, because of the changes and needs in the development environment - fast prototyping, one-sample production, custom needs, added values, desire for unique furniture pieces, ecological needs etc.

Today innovative materials and manufacturing technologies are already being used in every field of design. Some of these technics and materials have proven to be very ecological and sustainable and very useful as recyclable or reusable. It is important to mention that through the past different methods for three-dimensional modelling have been also developed and expanded in use. - One of those most important innovation of 19th century in the furniture industry was wood industrial bending which allows curved shapes, complex geometry, easier transportation, and disassembly of furniture. Michael Thonets' chair is considered - representative of the mass production paradigm.

Today Generative design (GD) is expanding method which attracts attention as a new tool that can support the imagination and originality of designers through different software results. During product development, the designer can control various problems that may appear in the design phase even before the product is made or further processed.

Figure 1A shows traditional designing methods where designers first create shape and model and finally from analyse get interpretation of results for making optimal form. In generative design method (figure 1B) designer inputs parameters for his created model, then computer make variations based on analysis, interprets results and finally designer chooses the variations of new designs for further development of optimal product shape. Generative design allows new approaches of modelling. Products made by generative design methods have main characteristics such (McKnight, 2017): reduced weight; improved performances, increased creativity and efficiency; reduced developing time and customized product development.

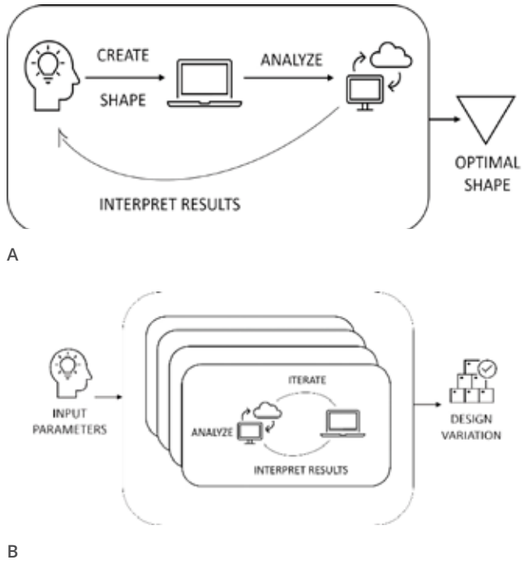

FIGURE 1. Schematic view of differences in **A** traditional and **B** generative design method

2. HOW GENERATIVE DESIGN WORKS

Using of that computational technique allows additional exploration of a given design and the possibility of automating form refinement, thus aiding the designer in the search for an acceptable solution. Designer first determines specifics and main requirements like dimensions, strength and loads, materials, and costs. Then if it is necessary in software can be added loading requirements such as safety factors, weight, and method of further processing. Computer by use of algorithms generates variations of designs/versions of product which includes performance analysis for each design. Generative design is compatible with other modern technologies and when software formulates and finish complex geometry as 3D model, it possible to combine it with additive technologies and 3D printing.

Advantages of generative design are many. By using GD it is possible to save time – providing solutions to the designer broadens and shortens the design process. Programs generate many designs variances and choose the one optimal option as the best choice according to designers' initial inputs. GD allows non-traditional and complex shapes and models which human cannot imagine, which enables design freedom. Generative design can be economic way for furniture development because gives possibilities of simulation and testing prototypes and preventing expensive changes later in manufacturing process.

FIGURE 2. the process of generative design (Hanbeom and Wonsup, 2022)

The figure 2. shows an example of a design process of chair by generative design method. Designer initially modelled the backrest and the seat and marked the position of the stand or chair legs. These elements and

parts of the chair are unchanged and those are green parts shown in figure 2. Red marked chair positions (figure 2) are the loads and forces that will act on the backrest and seat. The computer generates results based on the given data and creates a connection between the seat and the backrest. Then different versions of models are offered and possibilities for optimization and simplification of model are given depending on the applied loads. At the end of the design process, the solution that designer considers the most acceptable can be used as a 3D model for further production preparation. Examples of such furniture are shown in figure 3 which shows examples of well-known designers who applied the generative design method in the development of chairs.

A

B

C

FIGURE 3. Shows the examples of chairs designed with GT

A: Philippe Starck and Kartells; chair made of 100% recycled thermo plastic techno polymer using additive technologies and 3d printing, (https://www.dezeen.com/2019/04/11/ai-chair-philippe-starck-kartell-autodesk-artificial-intelligence-video/)

B: The Elbo chair; the culmination of a collaboration between human and machine, (https://www.wired.com/2016/10/elbo-chair-autodesk-algorithm/)

C: Joris Laarman's 3D printed chair – Bone chair, (https://www.joris-laarman.com/work/bone-chair/)

Generative design, as mentioned above, in product development plays not only a role in creating shapes using algorithms provided by existing design but also meets engineering needs like construction solutions, material needs, product reinforcement etc. Therefore, the inclusion of generative design tools in development and production is spreading in all niches. Hanbeom and Wonsup, (2022) consider GD as a useful tool for product developing, for generating ideas and solving engineering problems in production. GD enables engineers to control the design development process, maintain set requirements from the initial concept based on CAD programs, and easy conversion for the next phase of design development, (Krish, 2011).

Generative design also enables technological solutions. Given solutions of additional structural reinforcements or material savings by 3D printing are solving some problems of structural joints or furniture components. This includes designing custom made products, shelf supports, elements and parts of special requirements etc. Using generative design makes it easy to reduce the weight of a piece without compromising functionality. It also brings sustainability benefits, reducing raw material use and environmental impact while increasing performance and reducing costs. Good examples of special furniture pieces and joints are shown on figure 4A: complex and specially constructed self-standing shelves and 4B: wall shelve support constructed according to the most loaded points of the shelve support. In figure 5 is shown how generative design (by use of software Solid edge) made an optimization of material. Optimisation is the ability to find the best solution within a given space.

A

B

FIGURE 4. An examples of good generative design practice:

A: Self-standing shelves (https://noeduchaufourlawrance.com/),

B: Support for wall-hanging shelves (https://cults3d.com/en/3d-model/architecture/generative-design-topology-shelf-bracket)

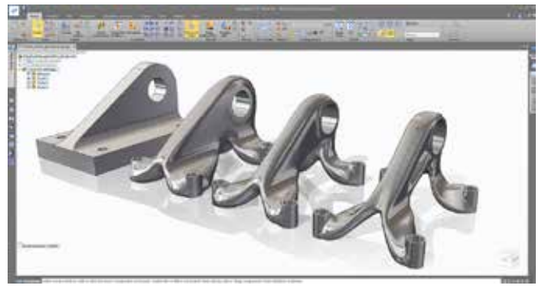

FIGURE 5. A view of GD software material optimization used https://grabcad.com/library/topology-optimization-with-solid-edge-generative-design-1

3. BIOMIMICRY DESIGN APPROACHES

Nature inspiration is endless. Imitated examples of nature can be find in every kind of art, science, architecture (Wojtkiewicz, 2015), sculptures, paintings, industrial design, and everyday items (Tavsan and Sonmez, 2015). Nature contains geometries, patterns, movements, and varieties of forms that can give us additional inspiration as a solution for technical and engineering problems (Benyus, 1997).

Bioinspired products (figure 6) are widely used and include emphasize of emotional interaction. Therefore, the understanding of the psychological effects of designing like this need correct studies (Wu and Chen, 2015), (Parras-Burgos, et al. 2019). Implementation of biomimicry in design process results with many successful solutions (whether it is technical or visual solutions) and in this way improves the quality of knowledge and education for designers. Connection between natural characteristic (organism, behaviour, and ecosystem) and natural typology (form, construction, material, function) has been described by Abbasli and Selcuk, 2016. Generative design is an opportunity for designers since it can produce novelty and complexity of products. Wood furniture products can increase its competitiveness by using biomimicry design principles and eco/environmental green materials (Bumgardner and Nicholls, 2020).

FIGURE 6. Nature inspired furniture design
https://www.freyjasewell.co.uk/hush
https://grabcad.com/library/topology-optimization-with-solid-edge-generative-design-1
http://www.rebeccaasquith.com/design/nautilus

4. CONCLUSIONS

The use of generative design with the help of 3D printing can increase sustainability and also reduce consumerism. This can be achieved for example, by printing smaller parts of the furniture or replacement parts what gives a person the impression that he has changed the design of his furniture and thus (changing of the elements according to his own mood). In this way the purchase of new furniture is greatly reduced. Generative design can be seen as a value-adding process in consumer-oriented products. It can also reduce mass production for unknown customers which is than replaced with custom made production.
Generative design's ability to provide structural solutions without using of material where it is not needed, allows designers to do more with less material. GD optimizes the material, and printing it by using ecological or recycled materials positively affects the environment and reduces the waste. What makes a piece of furniture suitable to get mark of sustainable products? Some of requirements are durability of the product, the possibility of reuse, upgrade and repair, percentage of use of recycled materials, ecological and carbon footprint together with energy and resource efficiency.
Design sustainable furniture means having a strategic approach based on the awareness of the environmental limits, the real needs of the community and adopting of ecological oriented technology such as additive technology, renewable sources of energy, 3D printing with biodegradable materials and others.

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Sustainable Design: Rethinking the Vitality of Built Environment with Christopher Alexander

Assist. Prof. Špela Kryžanowski, PhD
Arhitelje nova d.o.o.,
Faculty of Design
Ljubljana, Slovenia

Corresponding author: spela.kry@gmail.com

ABSTRACT
Christopher Alexander offers a unique concept of creating sustainable buildings, towns and design objects where he draws from the natural order itself. In a compendium of four book with the same name (Nature of order), he explains in depth the concept of design that produces the so-called living structures. For Alexander that what we call life is a general condition that exists to a certain extent in every part of the space: brick, stone, grass, human being, forest, city or landscape. With a proper design process this life can be strengthened and the emerging building or designed object can thus become a living structure. This living structure can have the power to strengthen our inner human person, our Being, our Self, which in his holistic worldview permeates everything there is.

KEYWORDS
Christopher Alexander / Nature of order / Sustainability / Living structures

1. INTRODUCTION

Architect Christopher Alexander (1936 – 2022) is known to most experts and laymen as the author of the book The Pattern Language (Alexander et al., 1977). Less well known is his seminal work The Nature of Order (Alexander, 2002, 2002a, 2004 and 2005), in which he argues that there is a natural order, a specific structure that supports life and in the presence of which we can more easily establish contact with our higher Self or our essence. Although his life's work, a compendium of four extensive books, is subtitled An Essay on the Art of Building and the Nature of the Universe, the text is far from a fiction essay. Alexander is the first architect to get a PhD degree at Harvard and he is well versed in the methodology of scientific writing. He substantiates each of his claims precisely and in detail through his own architectural research and his knowledge of biology, physics, mathematics and others. The only exception is the discussion in the last book, where he also discusses the concepts of the Self and God and where he states in advance that he will be able to rely only on his own reasoning and logic.

2. MODERN MECHANICAL SCIENCE AND THE SELF PRINCIPLE

Alexander presents us with a view of life that goes far beyond design and architecture and bridges the four-hundred-year-old divide between science and technology on the one hand and art and the humanities on the other. Alexander bases his concept of the nature of order on two assumptions that clash with an exclusively mechanistic view of the world. The first claims that every particle of space or matter is alive to a greater or lesser extent, depending on its arrangement and structure. The second claims that every particle of matter or space also contains a part of the Self and that this Self, or some form of the personal, permeates the whole of creation, including the material level, which today we understand as inanimate. Every culture creates a system of order, which then dominates it. Thus, our current mechanistic view affects our actions, our perception of beauty and our way of thinking within which we design buildings. Among the current ideas of order in our culture, there is no concept that focuses on creating the deep sense of life that can be found in some historical buildings and artifacts. To create objects that create a sense of aliveness, our current concepts of order, according to Alexander, are completely inadequate.

A mechanistic way of thinking, which we developed to perfection in the 20th century can adequately explain the mechanical structure of a leaf, building or atom. Descartes' idea that it will be easier to understand how something works if we pretend that what we are observing is not alive, that it is a machine, was methodologically extremely effective. But it is still only a method, a mental exercise of breaking down processes and beings into component parts, into individual cogs in a big machine. Which does not mean that what we are observing is actually an inanimate machine. And Descartes understood this well. This is the reason why looking at Mozart's symphony or any other supreme art object as a mere machine is completely inadequate and insufficient. This harmony that fills us and that we can physically feel cannot be satisfactorily explained simply as a machine or a mechanism, because the beauty and order we perceive is impossible to describe only through the structure of the mechanism. With the dominance of the mechanistic view of the world, the concept of Self slowly disappeared from our way of thinking and our art. The Self has no place in the concept of a mechanical machine. Therefore, the entire field of art is plunged into a kind of vacuum, where there is no clear definition of the Self, its value and the ways of its realization in the material world. At the same time, the feeling of value, what we internally feel as value, lost its meaning and became a subordinate subjective category. In mechanistic thinking, only mechanistic facts that can be measured are objective, and the categories of perceived wholeness, beauty, internal harmony of an arrangement, or the level of liveliness of spaces and objects, are purely a matter of personal opinion. Values have become subjective in the scientific worldview. They have become a matter of personal ethics or artistic vision, where there is no objective common denominator, but every democratic individual is almost forced to create his own personal opinion, and diversity of opinions is even desirable. In this mechanistic worldview, the principle of the personal (Self) is eliminated from the equation. And yet the principle of the Self, the capacity for personal feeling or sense of connection, is essential in understanding the universal nature of the order that defines a culture. A personal feeling is one that goes to the heart and touches us. And it is interesting that when it comes to deep feelings of harmony and beauty, all people, regardless of race or culture, feel almost the same, as if we are connected to each other and we are part of some larger sentient being. According to Alexander, the re-inclusion of the personal principle (I or Self-principle) in modern science, does not in any way contradict the current scientific view but means its expansion and quality upgrade.

3. PHENOMENON OF LIFE

Alexander claims that everything that exists is imbued with life. This concept can be found in ancient Buddhist texts and in modern scientific research by biologists (e.g., Imanishi) and physicists (e.g., Bright in Whitehead). According to Whitehead, the potential for life is a priori embedded in matter and is not merely a phenomenon that occurs when matter becomes highly ordered and organized. It is in the nature of matter to be alive. And in this way, every building is more or less alive as well as every single part of the physical space and in this way everything that exists. We can also feel this different liveliness of objects that are otherwise considered dead. For example, we see an interesting piece of wood and marvel at its liveliness, while another piece of wood leaves us completely indifferent. In the same way, we can feel the liveliness of a building, an art object or a square. According to Alexander the beauty of the building, its vibrancy, and its ability to support life derives from its wholeness. The building is not an isolated fragment but is part of a world that also includes a garden, fences, trees, roads and other buildings. In Alexander's concept, the wholeness of an individual part is effective only in relation to the wider whole. Alexander's fundamental assumption is that wholeness is not some elusive personal concept but a structure that can even be mathematically defined. At the same time, wholeness is an essential property that affects the physical behaviour of matter. The key property of wholeness in a structure is that it is neutral, it just is. Every whole is made up of parts and the parts come from the whole. Alexander calls these individual parts 'centers'. Centers are carriers of life and support each other in strengthening the level of aliveness. The centers are the ones that we perceive first in the composition, and which also have the greatest influence on our feeling. The principle of the Self, which Alexander reintroduces into scientific discourse, represents the essence of each center. The Self in each center connects directly with our own Self. And as designers and architects, we should be able to bring this personal aspect of the Self to the fore in each artifact. Wholeness in the object and wholeness in us are ultimately one and the same thing for Alexander.

When the vitality of the structure and the intensity of the centers reaches a certain level, we recognize it as universally beautiful, as a structure charged with life. A great example of centers, vibrancy and associated beauty is flowers. For Alexander, the structure of a flower or flower group is a perfect example of loveliness and beauty that touches us. In the presence of deep wholeness, we become happier.
Alexander identifies fifteen characteristics that are found time and time again in life-supporting structures. They can be found in natural systems, superb works of art, and even more often in simple objects that are the results of the sincerity of everyday life. The general concept of design that supports life and reaches the level of universal beauty is simple: the stronger the individual center and the more it has the properties that give it vitality, the stronger and more alive the entire structure. Normally, living structures are calm, act innocently, and are extremely simple. In them we recognize a truth that cannot be explained by a mere mechanistic interpretation of the composition but can only be felt. It is partly described by the Japanese term 'wabi-sabi', which could be translated as 'imperfect beauty'.

FIGURE 1 (https://i.pinimg.com/originals/60/73/3d/60733d-51608550fc3d86995dbc4c69b3.png):

There must be several **levels of scale** and the jump in scale should not be too great. There should be some kind of a principal structure, a **strong centre** guiding the whole, composed of smaller centres. The **boundaries** strengthen the living centres. **Alternating repetition** is one of the ways the centres can intensify each other. In **Positive space** every single part of the space has positive shape as a center. There are no amorphous meaningless leftovers. A **good shape** is itself made up of multiple coherent centres and simplest elementary figures. What is important in a pattern are not the apparent large symmetries, which add little to the coherence of the pattern, but the intensity of the smaller, i.e. **local symmetries**, which act as a glue, that holds the space together. All living structures contain some form of **interlock**, where centers are hooked into their surroundings. Life cannot occur without differentiation. So the difference between opposites, the **contrast**, gives birth to something new. **Gradients** will follow as a natural response to any changing circumstances in space. Buildings and artifacts without gradients are more mechanical and with less life. Things which have real life always have a certain ease, a morphological **roughness**. This arises because real things have to adapt to irregularities in the exterior environment correctly. **Echoes** denote a deep underlying similarity, where all the motifs used have a single guiding feeling and seem to be members of the same family. In the most profound centres which have perfect wholeness there is at the hearth a **void**. This emptiness is needed to create a simple, silent, empty large calm space that draws the center's energies to itself. In most cases this simplicity shows itself in geometrical **simplicity** and purity. **Not separateness** or connectedness means that we experience the living whole as being that is connected with the world and not separate from it. Such structure is simple, harmonious and it melts into surroundings. The structural feature that is most responsible for the easy feeling of **not-separateness** is lack of abruptness, of sharpness.

4. THE LUMINOUS GROUND

In the last of the four books, Luminous ground, which is certainly the most nerve-wracking for the materialistically oriented modern intellectual, Alexander connects the concepts of universal order, which supports life, with the concepts of Soul and God. Such an approach can be regarded as unscientific in the contemporary intellectual sphere, since the Soul and God are not concepts with which contemporary science would operate. Alexander notes that throughout history, most of the beautiful artistic creations were made in the cultural context of one religion or another. In this way, matter and spirit, or matter and Self, appear to be connected all the time. "The great creations of the European Middle Ages were created by Christian mystics, the great buildings of Japan were created by Zen practitioners, the great Turkish carpets and illuminated miniatures were inspired by the Sufis. Tantric paintings of Indian culture were created by mystics of an obscure Hindu sect. Beautiful pieces of Shaker furniture were created as an act of worship within a narrow religious community. (Alexander, 2004:32)" This certainly does not mean that a religious context is necessary for the creation of an inspiring work of art, but it does indicate that all these great works (even those built today) have a specific cosmological background or framework of thinking. According to Alexander, if any of the authors listed above were asked what they were thinking about while they were creating their art work, the common denominator of all the answers would be something along the lines: "I designed the church for the glory of God" or "Through creation I tried to unite with the source of everything" (Alexander, 2004: 34-35). Alexander calls this state the state of connectedness. Connection of oneself with oneself and with other people and with everything that exists. Including that substance that Alexander calls Luminous ground – the ground material of the universe, i.e. the fundamental substance of the universe and all existence. Recommendations for how to achieve this state of connectidness vary in different religious traditions. Muslims recommend prayer and talking to God, Catholics emphasize the principle of love, Buddhists emphasize meditation, etc. What they all have in common is that they strive to silence the ego, emphasize work and discipline, and set as their highest goal the desire for direct, one-on-one communication with God. In all these traditions, the process of design and construction is understood as part of a spiritual practice, as an attempt to come into direct contact with this fundamental essence of the universe.

5. THE PROCESS OF CREATING LIFE

The importance of the process in creating products and buildings that support life is crucial for Alexander. He comprehensively explains and justifies it in the second part of his compendium entitled The Process of creating Life. The intensity of liveliness of a structure is conditioned by the level of wholeness that the structure achieves. Understanding the wholeness of a structure as it is - by its very nature (not the wholeness that results from our mental constructs and ideas) is extremely difficult, but it can be learned. For the artist this means that in every step of the creative process, he must strive to first clearly recognize the structure of the whole, keep it in front of his eyes the entire time of the process, and that each step is made in the direction of supplementing and upgrading this already existing wholeness of the structure. Alexander calls this process structure - preserving - steps. It is a process of unfolding wholeness that is both conservative and creative. This is the process by which the animal and plant worlds develop anew every day. The seed develops step by step until it finally grows into a mighty tree. In order to be able to use this kind of process in the design of buildings, we would have to move from a descriptive design method, in which all the details are defined in the office, to a more generative design method, where the main parameters and steps in the construction process are defined in the office, but all the other design decisions are defined through testing on the construction site itself. Alexander argues that structures that support life can only be generated through the process of construction and cannot be created through design that takes place entirely behind a desk in an office. Alexander is aware that such a way of designing and building is almost impossible today. The building permit and construction process make it extremely difficult. But Alexander insists that if one wants to generate a living structure one must count on changes to building permits, a series of large scale on-site models and also failed attempts on the construction site until finally a shape that is full of life emerges, one "which can be felt as correct". An essential element in the decision-making process is feeling. Feeling the degree of the wholeness of the structure we are creating each step at a time. Which, of course, requires more time, means more expensive construction and requires the client's complete trust in the architect. For Alexander, these are also the main reasons why we find only a handful of living built structures in modern architecture.

To help create a structure full of life, Alexander introduces the "mirror-of-the-Self" criterion. Which in practice means that every step in the design process should be refined through questions in the sense of: "Which of the two designs has more life?" or "Which of these two variants makes me more whole?" or posed purely ontologically "Does does this represent a true image of my true Self?" The research Alexander has done on these principles shows a surprising concordance of answers. As it turns out, humans are at some deep level completely aligned when it comes to recognizing structures that are alive and that support life. And we also recognize these same structures as universally beautiful. Spaces that have a strong vitality of centers and structure, and in this way have a clearly expressed principle of Self, also have the ability to pull from within ourselves our own Self, our Soul or our higher Self principle. Such spaces, objects, music or other superb artistic creations touch us deeply, move us to the heart and strengthen within ourselves our own sense of liveliness and holiness. The process of creating a living world, in Alexander's eyes, can never be separated from the search for the truth about our own essence.

"I built the first buildings of this kind because I intuitively believed that it was the right thing to do. I gave the users a living structure, the best I could create. It was extremely hard work. But as I slowly began to progress and I could express these qualities, I noticed that the environment had an impact on a person's inner freedom, as if something in them would be released and in the presence of these buildings, people would more sincerely be who they really are or what they wanted to be. ... The experiences of people in the spaces we built gradually helped me to understand that it is possible to build an environment in which people are emotionally free, fully themselves, alive and fully present in their own reality. (Alexander, 2002a:396)"

6. CONCLUSION

We can now understand why the mystical religious framework has been so supportive for creating wholesome, life-supporting and universally beautiful structures. Maintaining and pursuing wholeness during the creative process is a hard and demanding work. Seeing wholeness throughout the design process requires an extraordinary purity of mind, which is constantly challenged by our mental constructs, theories, ideas and images. By focusing his mind on God, the artist was able to focus on the wholeness of the art he was creating. Through the practice of performing the recommended mystical-religious techniques, he brought himself to a state of humility, withdrawal of the ego and dissolution of his images, constructs and concepts and was therefore able to see the structure of reality itself. He saw the structure of the whole, he saw the truth itself and it materialized in his work. Through this process the artist came into contact with the Great Void and through this direct contact he realized the essence of his existence. Art works that embody the wholeness can, according to Alexander, only occasionally be found in the art of the 19th and 20th centuries. Some of the works of Nold, Matisse, Bonard and Van Gogh, do not have a religious basis but come from the same state of mind. Alexander mentions the work of Mackintosh, Lutyens, Vesey, F.L.Wright, Baw, Asplund and Behrens as an example of modern architecture that partially reaches the level of structural liveliness. Alexander claims that, if we want to achieve the same level of liveliness of the structure as was achieved by e.g. Christian mystics, we would need to rediscover the deepest source of our being and existence. And we would need to express it through our contemporary works of art.

"When I look at the Madonna painting by the painters Fabriano or Duccio, when I listen to Mozart's Requiem or Bach's Hosanna, it seems almost impossible to achieve such things nowadays. ….It is not the beauty that remains unattainable to us, but the spiritual depth that these works contain. (Alexander, 2004:45) «

Alexander believes that direct contact with one's Self can be practically experienced on a personal level and that it is only a matter of time before this kind of understanding becomes part of the official physical explanation of the world. He specifically emphasizes that he is not talking about a new religion, spirituality or supernatural abilities. He is only interested in the creation of living structures and his concepts are based on a new physical and intellectual interpretation of the material universe in which matter and spirit connect into one inseparable whole. In nature, the creation of life-filled structures happens spontaneously, it is part of the basic structure of nature, but when people are creating, it is increasingly difficult for them to remain in harmony with the whole. Our actions, as well as our architecture and urban planning, are often intentionally or unintentionally in conflict with our own wholeness and the wholeness of the world. After all, whatever we create as culture is always a representation of our culture's state of the Spirit.

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Life Cycle assessment as a part of Eco-Design

Maja Cergol Lipnik, MSc
Faculty of Design
Ljubljana, Slovenia
maja.cergol@fd.si
& Solski center Srečka Kosovela, Sežana,
Višja strokovna šola
maja.cergol-lipnik@vss-sezana.si

Assist. Prof. Aleš Lipnik, PhD
Faculty of Design
Ljubljana,, Slovenia
ales.lipnik@fd.si

The purpose of this paper is to present importance of Life Cycle Assessment (LCA) as important part and precondition of Eco Design.

MAIN RESULTS:
This paper presents theoretical basis and practical application of LCA methodology as a tool which helps to enable and identify environmental performance through its entire life cycle of a product. Paper shows importance, contribution and relations of LCA to all stages of entrepreneurial process from Eco-design branding, public relations, (eco) labeling, and of course, management and production.

THE RESEARCH:
Life Cycle Assessment (LCA) represent leading environmental management techniques, which asses possible environmental impact over the whole lifecycle of the product, from raw materials until the end of the product Defined in ISO 14040 standard, LCA is complex method which gain holistic insight into entire product life including extraction of the raw materials, acquisition of energy resources, production and distribution of energy required, production of semi-finished products and by-products, transportation and distribution, effects during use and alternatives handling of the product after (primary).
Such a complex approach is particularly important for identifying and optimising alternatives which are less harmful to the environment, when We are taking into account essential parameters required to determine in LCA: Raw materials, water, transport energy consumption emissions to the atmosphere and waste.
LCA in relations to companies can play role in the entire life cycle of the product and have significant contributions for business success, beginning with the Eco-design, which can be oriented toward extended use, product efficiency harmful ingredients and recycling.

KEYWORDS
Lice Cycle Assessment (LCA) / ISO 14040 / Circular economy / sustainability

1. INTRODUCTION

1.2. TRANSITION FROM LINEAR TO CIRCULAR ECONOMY

In a traditional linear economy, resources are extracted, used, and then disposed of as waste. In a circular economy, resources are kept in use for as long as possible, after use period extracted materials are again reused or recycled with tend to minimize or annihilate any waste. Transitioning from a traditional linear economy to a cir-

cular economy means a fundamental shift in all aspects of production and consumption as products as services. (Michelini et al 2017)-

This aspect has to be included in all main steps of product/service lifecycle. Prolonged durability and reuse should be taken into consideration in the phase of design, including materials, maintenance and reparation and disassembling at the end of use. Closing supply chain into the closed loop, preferably within the same production process, in order to reducing waste, need for new materials and transportation and also adopting new innovative technologies into recycling processes, renewable energy sources, and new, more sustainable materials. In order to manage all this process, companies should implement relevant strategy, and last but not least: to educate and engage consumers: Educating consumers on the benefits of a circular economy and encouraging them to adopt circular practices. Picture 1 shows transition from traditional linear to circular Economy.

PICTURE 1: Transition from traditional, linear to circular Economy (Remko, 2015)

1.2 EU GREEN TRANSFORMATION

The EU Green Transformation is a set of policies and initiatives that aim to shift the European Union towards a more sustainable and environmentally friendly future. The EU Green Transformation is based on the European Green Deal, which was launched in 2019 and outlines a comprehensive plan to make the EU climate-neutral by 2050.

Main components of the EU Green Transformation consist of:

- Reducing greenhouse gas emissions: The EU has set a target to reduce greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels. Goal should be achieved through a different sets of measures, including through promotion of renewable energy, increasing energy efficiency, and improving transportation.
- Transition to Circular economy: The EU is promoting a circular economy, where resources are kept in use for as prolonged period possible, waste is minimized, and products are recycled and reused. This should be achieved through policies such as the EU Circular Economy Action Plan and the Single-Use Plastics Directive.
- Biodiversity protection: The EU is aiming to halt biodiversity loss and restore degraded ecosystems. This should be achieved through policies such as the EU Biodiversity Strategy for 2030 and the Farm to Fork Strategy.
- Sustainable finance: The EU is promoting sustainable finance, which supports investments that have a positive environmental and social impact. For this purpose, EU Sustainable Finance Action Plan was prepared.
- Just transition fund: The EU is committed to ensuring a Just transition fund to a more sustainable future, which takes into account the social and economic impacts of the transition. (European commission, 2023)

This should be achieved through policies such as the EU Just Transition Fund. Main instruments of green transition are shown in picture 2:

PICTURE 2: Main instruments of green transformation
Source: European commission (2023)
EC 2023 (https://state-of-the-union.ec.europa.eu/leading-green-transition_en)

Overall, the EU Green Transformation represents a comprehensive and very ambitious plan to shift the European Union towards a more sustainable and environmentally friendly future. The EU Green Transformation will require significant investment and policy changes.

2. DEFINITIONS AND BASIC TERMS

2.1. ECO-DESIGN

By definition, Eco-design means the integration of environmental aspects into the product development process, by balancing ecological and economic requirements. Eco-design considers environmental aspects at all stages of the product development process. Main objective of Eco-design is optimising products which make the lowest possible environmental impact throughout its life cycle (European Environment Agency. 2001

There a more different terms for Eco-design. It is also known, as sustainable design or green design, which commonly designate an approach to product design that takes into account the environmental impact of a product throughout its entire life cycle. Eco-design aims to reduce the environmental impact of products by considering factors such as energy and resource efficiency, material selection, product durability, and end-of-life disposal.
Typically concepts included in Eco-design are:

- Life cycle thinking: Eco-design considers the environmental impact of a product throughout its entire life cycle, from the extraction of raw materials to end-of-life disposal.
- Selection of materials: Eco-design considers the environmental impact of the materials used in a product, including the extraction, processing, and disposal of those materials.
- Energy and resource efficiency: Eco-design aims to reduce the amount of energy and resources needed to produce and use a product.
- Durability: Eco-design aims to increase the lifespan of a product and reduce the need for replacement.
- End-of-life disposal: Eco-design considers the environmental impact of a product at the end of its life, including the potential for recycling, reuse, or responsible disposal.
- User behaviour: Eco-design considers the impact of user behaviour on the environmental impact of a product and aims to encourage more sustainable user behaviour.

Eco-design is an iterative process that involves considering these concepts throughout the product design process, from concept development to manufacturing and end-of-life disposal. By incorporating eco-design principles into product design, designers and manufacturers can create more sustainable products that have a reduced environmental impact throughout their entire life cycle.
https://www.eea.europa.eu/help/glossary/eea-glossary/eco-design

2.2. ECO LABELLING

Eco-labelling is a voluntary labelling scheme that is used to identify products that have a reduced environmental impact compared to similar products. Eco-labels are typically awarded by third-party organizations that evaluate products based on their environmental performance. It help consumers and institutional purchasers in order to quickly and easily identify those products that meet specific environmental performance criteria. (EPA, 2022)

Eco-labelling programs have been developed for a wide range of products, including household appliances, electronics, cleaning products, building materials, and food products. The criteria for eco-labels typically include a range of environmental factors, such as energy and water use, waste generation, greenhouse gas emissions, and use of hazardous substances.

Eco-labels can serve several purposes, including:

- Informing consumers: Eco-labels can provide consumers with information about the environmental impact of products, allowing them to make more informed purchasing decisions.
- Encouraging sustainable product design: By setting environmental performance criteria for eco-labels, manufacturers are incentivized to design and produce more sustainable products.
- Promoting environmental awareness: Eco-labels can help to raise awareness of environmental issues and encourage consumers to consider the environmental impact of the products they buy.

There are many examples of eco-labelling programs, some of them are:

- Energy Star: A program that identifies energy-efficient household appliances and electronics.
- Forest Stewardship Council (FSC): A program that identifies wood and paper products that have been produced in a sustainable and responsible manner.
- Green Seal: A program that identifies cleaning products, paints, and other products that meet environmental performance criteria.
- Global Organic Textile Standard (GOTS): A program that identifies textiles that have been produced using organic and sustainable practices.

In summary, eco-labelling is a voluntary labelling scheme that is used to identify products with a reduced environmental impact. Eco-labels can provide consumers with information about the environmental impact of products, encourage sustainable product design, and promote environmental awareness.

2.3. LIFE-CYCLE ASSESSMENT

Term: Life-cycle assessment (LCA) referred also as »cradle to grave« analysis is in use for a methodology which is used for evaluation the effects that a product has on the environment over the entire period of its life. Main purpose of the LCA is to support increase resource-use efficiency and decreasing liabilities. Mainly it is used to study the environmental impact of either a product or the function the product is designed to perform. LCA takes into acount all the steps that lead from raw material through manufacture, distribution, and usage to final disposal. Key elements of LCA analyse are:

- Identification and quantification of environmental loads as raw material and energy consumed.
- Identification and quantification the emissions and wastes generated.
- Evaluate the potential environmental impacts of these loads; and
- Assess the options available for reducing these environmental impacts.

(EEA, 2001)
In general, LCA is a standardized, science-based tool for quantifying the impact in ordr to assess lifetime environmental impact through lifetime perspective of product. Therefore, it represents a valuable tool for companies, governments, and other organizations to identify opportunities for environmental improvement, reduce their environmental impact, and make more informed decisions about product design, manufacturing, and other activities.

2.4. CONNECTION OF LCA WITH ISO 14000 FAMILY STANDARD

LCA, have its base in ISO 14000 family of international standards that provide a framework for organizations to manage and improve their environmental performance. The ISO 14000 standards cover a range of environmental management issues, such as environmental impact assessment, life cycle assessment (LCA), environmental labelling, and environmental communication.

ISO 14040 and ISO 14044 are two standards in the ISO 14000 family that specifically provide guidance on conducting LCA. ISO 14040 outlines the general principles, requirements, and procedures for conducting an LCA, including:
Goal and scope definition: The LCA should clearly define the goal and scope of the assessment, including the functional unit, system boundaries, and environmental impact categories to be evaluated.
Life cycle inventory analysis: Data should be collected on all inputs and outputs associated with the product or system being evaluated, including raw materials, energy, and emissions.
Life cycle impact assessment: The environmental impacts associated with the product or system should be assessed across a range of impact categories, including global warming potential, acidification potential, and human toxicity.
Interpretation: The results of the LCA should be interpreted and conclusions drawn based on the findings of the impact assessment. This includes identifying areas for improvement and potential trade-offs between different environmental impact categories.

ISO 14044 in addition provides the specific requirements and guidelines for conducting an LCA. Both standards cover a range of topics related to LCA, such as goal and scope definition, inventory analysis, impact assessment, and interpretation.

By providing a standardized framework for conducting LCA, the ISO 14000 family helps organizations to assess and manage the environmental impact of their products and operations in a consistent and systematic way. This can help organizations to identify opportunities for environmental improvement, reduce their environmental impact, and demonstrate their environmental performance to stakeholders. (ISO, 2016)

In summary, the ISO 14000 family and LCA are closely connected as the standards provide guidance on conducting LCA, which is a valuable tool for organizations to assess and manage their environmental impact.

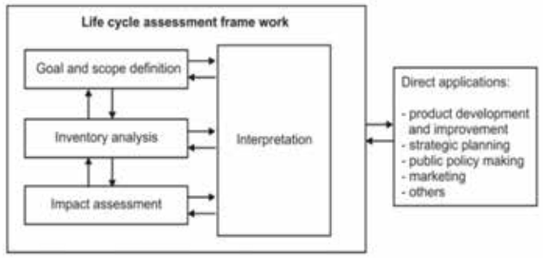
3. OVERIVEW OF LIFE CYCLE ASSESSMENT (LCA)

3.1. STEPS OF LIFE CYCLE ASSESSMENT (LCA)

Life cycle assessment (LCA) is a methodology used to evaluate the environmental impact of a product, process, or service over its entire life cycle, from the extraction of raw materials to final disposal. LCA is a comprehensive and objective approach that quantifies the environmental impacts of a product or system, including its inputs, outputs, and intermediate stages. LCA tends to take into consideration all the steps that lead from raw material through manufacture, distribution and usage to final disposal. Picture below shows framework of LCA regarding the ISO standard:

LCA consists of four main steps: goals and scope definition, inventory analysis, impact assessment and interpretation. All steps are described below as follow:

In first step, Goal and scope definition, goals and scope of the study are defined. Definition includes the functional



PICTURE 3: Life cycle assement frame work
Source: ISO 14040

unit, system boundaries, and environmental impact categories which to be evaluated. (ISO 14040, 2023)
In second step- Inventory analysis, data is collected on all the inputs and outputs associated with the product or system being evaluated. This includes the raw materials, energy, and water used in production, as well as the emissions and waste which are generated during lifecycle of product. The data collected in the inventory analysis step is then used in next step, Impact assessment, where analyse should assess the environmental impacts associated with the product or system. This stage evaluates the impact of the product or system on various environmental categories, such as climate change, human health, and biodiversity.

The final step of LCA is interpretation. It involves interpreting the results and drawing conclusions based on the findings of the impact assessment. This includes identifying areas of improvement and potential trade-offs between different environmental impact categories. (Muralikrishna, Manickam, 2017)

LCA act as a valuable tool for companies, governments, and other organizations to identify opportunities for environmental improvement and reduce their environmental impact. It help to make more informed decisions about product design, manufacturing, and other activities. In this way, LCA can help organizations to achieve their environmental and sustainability goals by providing a comprehensive, quantitative analysis of the environmental impact of their products and operations. In general, LCA provides both: the big picture and the fine details about the product and measure a product's lifetime impacts. At the same time, also quantify the impact of a single material in the product.
As LCA is underpinned by international standards, ISOs 14040 and 14044. results obtained via an LCA can be trusted. This helps to ensure consistency, reliability and independence from commercial pressure. (Finkbeiner at al, 2006)

3.2. PRACTICAL EXAMPLE: USE OF LCA IN TEXTILE INDUSTRY

As a practical example We could take possibility for use of LCA in Textile industry. Life cycle assessment (LCA) can be used to evaluate the environmental impact of products in the textile industry, including (a) the production of fibres, fabrics, and finished products such as clothing and household textiles. LCA can be used to assess the environmental impact of various processes and activities, including:

Fibre production: LCA can be used to evaluate the environmental impact of producing different types of fibres, such as cotton, wool, polyester, and other synthetic fibres. This includes the production of raw materials, processing, and transportation.

Fabric production: LCA can be used to assess the environmental impact of fabric production, including the production of yarns, weaving, knitting, and dyeing. This includes energy and water use, chemical inputs, and waste generation.

Clothing production: LCA can be used to evaluate the environmental impact of clothing production, including the cutting and sewing of fabrics, the use of accessories such as zippers and buttons, and transportation.

Use phase: LCA can be used to evaluate the environmental impact of the use phase of textiles, including the energy and water use associated with washing and drying clothing and household textiles.

End-of-life disposal: LCA can be used to assess the environmental impact of textile disposal, including the potential for recycling, reuse, and responsible disposal. (Muthu, 2015).

By conducting an LCA, textile companies can identify areas for improvement and make informed decisions about product design, manufacturing, and other activities to reduce their environmental impact. LCA can help companies to evaluate the trade-offs between different environmental impact categories, such as water use and greenhouse gas emissions, and prioritize areas for improvement.

In summary, LCA is a valuable tool that can be used to evaluate the environmental impact of textiles throughout their entire life cycle and help textile companies to make more sustainable design and manufacturing decisions.

4. CONCLUSIONS: IS LCA ANALYSIS PREREQUISITE FOR ECODESIGN:

Life cycle assessment (LCA) is a methodology used to evaluate the environmental impacts of a product or system throughout its entire life cycle, from raw material extraction to disposal. On the other hand, ecodesign is an approach to designing products or systems with the goal of reducing their environmental impacts. (Sustainibleminds, 2023)

The two concepts are closely related because LCA is often used as a tool for ecodesign. By conducting an LCA, designers can identify the environmental hotspots of a product or system and use this information to guide their design decisions. For example, an LCA may reveal that the largest environmental impact of a product occurs during the use phase. In response, designers may seek to reduce the energy consumption or materials used during that phase.
Furthermore, an LCA can help designers to set environmental performance targets and assess the potential environmental impact of different design choices. By considering the entire life cycle of a product, designers can avoid the problem of "shifting the burden" - that is, reducing the environmental impact of one stage of the life cycle at the expense of another.

In summary, LCA and ecodesign are closely related concepts, with LCA providing a valuable tool for designers to identify the environmental impact of their products and to make informed design decisions that reduce their products' environmental impact throughout their life cycle.
Life cycle assessment (LCA) is not a prerequisite for eco-design, but it is a valuable tool that can be used to inform and support eco-design practices.

Eco-design, also known as sustainable design or green design, is an approach to product design that takes into account the environmental impact of a product throughout its entire life cycle. Eco-design aims to reduce the environmental impact of products by considering factors such as energy and resource efficiency, material selection, product durability, and end-of-life disposal.

LCA is a methodology used to evaluate the environmental impact of a product or system throughout its entire life cycle and can be used to identify areas where eco-design improvements can be made. By conducting an LCA, designers and manufacturers can identify the environmental impact of their products and prioritize areas for improvement.
Eco-design and LCA are complementary practices that can be used together to improve the sustainability of products. LCA provides the quantitative analysis needed to identify the environmental impact of a product, while eco-design provides a framework for incorporating sustainability considerations into the product design process.

In summary, while LCA is not a prerequisite for eco-design, it can be a valuable tool to support eco-design practices and help designers and manufacturers make more sustainable product design decisions.

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Urban challenge

Assoc. Prof. Inge Kalan Lipar
Faculty of Design
Ljubljana, Slovenia

Demetra Jarc
Faculty of Design
Ljubljana, Slovenia

Corresponding author: inge.kalanlipar@fd.si

ABSTRACT
In this paper, we present a thesis [1] on the conceptual design of an international cultural center on the border between Italy and Slovenia. We showed the historical background of the area in question, the urban development of Gorica and Nova Gorica, as well as their cooperation and co-creation of a common center over time. We described the location of two existing buildings and their current condition and purpose. This is followed by a reflection on the renovation, i.e. on the process and goals of creating a new image and a new program of the building. We specifically addressed the topic of the coincidence of the old, already existing architecture and the newly added part, the image of which, in contrast to the style of the older buildings, was created by design.

We connected the interior with the new purpose of the premises, the cultural center. The aim of the assignment was to rearrange the old architecture, change its purpose and create a facility that will offer the environment, i.e. both Gorice, new spaces for preserving and upgrading their common cultural heritage.

KEYWORDS
Renovation / Connecting architectural element / Border / Cultural center / International cooperation

1. INTRODUCTION

In 2025, the European Capital of Culture will be hosted by Slovenia and Germany. The cities of Nova Gorica and Gorica will represent the Slovenian capital of culture. They will receive the very prestigious one-year title of European Capital of Culture (EPC), which will enable them to implement an original cultural and artistic program with an emphasis on European cultural wealth. The project of the future event is called GO! 2025, the goal of which is to overcome barriers and unite cities that have been divided by war, thus becoming a cross-border European city of culture.

In the perspective of this event, we wanted to create a concept project of an international center that would be located on the border between the two countries, where not only the two cities, but also the two countries, Slovenia and Italy, would show the intertwined cultures. The concept of culture, which the international cultural center will embrace, will be very broad, it will combine cuisine, history, art, etc. The project is an example of the combined cultural customs of Slovenia and Italy in the social and private sense. The facility contains small and large conference rooms, a restaurant, a small museum section and a small number of rooms for the accommodation of potential international, more influential guests on a city tour or business trip.

In the diploma thesis from which the article originates, the conceptual concept of the renovation of the currently dilapidated town hall with a hayloft, which stands in the immediate vicinity of the border on the Italian side, is designed. The buildings on the southwest side overlook the Goriška medieval castle. One of them ends on a side road with less traffic, and the other is right behind it. There is a courtyard between the two buildings. On the northeastern side, they are separated from the border by a green area that is currently used for agriculture. The conceptual concept that we will present in this article will cover the renovation of both buildings by changing their purpose. We will also design a more modern architectural connection between the two buildings, the purpose of which will be to connect the architecture of the two cities, Gorica and Nova Gorica. The green area behind the two buildings will be turned into a footpath and cycle path, which will connect to the already existing cycle path on the Novi Goriška side. This connection will allow access to the cultural center from both countries. In addition to the descriptive work, plans and 3D visualizations will be added to the project (Internet 1).

2. HISTORY OF CONSIDERED AREA

2.1. GORICA

Villa quae sclavorum lingua vocatur Goriza (in the translation “Village called Gorica in the language of the Slavs”) was recorded on April 28, 1001 in the grant book of Emperor Otto III. to the patriarch of Ogle. This is the first mention of Gorica in written historical sources. It got its name from gorica, i.e. a small mountain or a 150 meter high hill, on which the city castle still stands today (Marušič et al., 2002). The Italian version of the name Gorizia comes from the notary tradition, which adapted toponyms to Italian with the ending -itia, following the example of the name Venetia (Venice) (internet 2).

Gorica was developing rapidly, which is why it had Emperor Otto already in the 13th century IV. granted marketing rights. Part of the settlement retained the status of a village until 1455, when Count Henrik IV. united the village and the square and granted Gorica city rights. A town was created in which the Slovenian, Italian, Friulian and German-speaking population still lives today (Marušič et al., 2002). After the extinction of the counts of Gorizia (Eppenstein, Mosburg, Lurngau) at the end of the 15th century, the administration of the city was taken over by the Habsburgs. Until the end of the First World War in 1918 (except for a short period between 1809 and 1813, when the city became part of Napoleon’s Illyrian provinces), Gorica, which was also known as the Austrian Nice during that period, was part of the Austro-Hungarian Empire (internet 2).

After the end of the First World War, Gorica finally came under Italian rule, and thus the Goriška region became an eastern borderland, in contact with the then kingdom of SHS (Marušič et al., 2002). The definitive image of a unified space was drawn by the historical period after the Second World War, which divided Goriška between two countries on the basis of the Paris Peace Treaty of 1947: the smaller part with the city of Gorica belongs to Italy, and the larger part to Yugoslavia. Gorica remains without a natural hinterland: the Soška and Vipava valleys, parts of the Gorica Karst, Brd, Trnovsko gozd and Banjšice. Part of Goriška under Yugoslav rule remains without an administrative, economic and cultural center (Bufon, 1995).

2.2. NOVA GORICA

In 1947, the new heart of Goriška, the city of Nova Gorica, the youngest Slovenian city, began to be built on the Slovenian side of the border. The urban plan chose Solkansko polje for construction, where the Gori cemetery used to be (Bufon, 1995). The choice was thought out because it was supposed to continue the already existing tradition of moving the inhabitants of Gorica in this direction. After the decision was made that the new settlement would grow on the plain between the railway line, Panovec and Solkan with the city center in Blanče and Ledine, three plans were proposed, made by architects Gvardjančič,
Zupančič and Ravnikar. The plan of Eng. Edvard Ravnikar and after its acceptance, the preparatory work proceeded quickly (Lozič, 2022).

The beginning of construction was not very promising, it was accompanied by many problems with the supply of materials and labor. In 1948, the People’s Youth of Yugoslavia decided to send youth work brigades to the construction site: around 8,000 brigadiers, many of whom were from other Yugoslav republics, together with construction, carpentry and other companies built five residential buildings on both sides of the main city road by 1950. blocks in which about 700 people lived. Today, Nova Gorica has around 13,000 inhabitants (internet 3).

The name of the new settlement, Nova Gorica, officially appeared for the first time on November 7, 1949, when the Presidium of the People’s Assembly of the LRS determined that the settlement of Nova Gorica is an integral part of the Solkan district. Nova Gorica became the city and seat of the municipality only on April 18, 1952, when the People’s Assembly of the LRS adopted the law on the division of the republic into cities, districts and municipalities (Lozič, 2022).

3. THE BORDER BETWEEN ITALY AND SLOVENIA

3.1. FORMING A BORDER IN TIME

The ethnic border between the Slavs and Lombards was almost definitively formed already in the 7th century: the former appeared in this area around 570 and settled in the highlands of today's Brda, while the latter occupied the plain. Even during the reign of Charlemagne, Goriška was a border area, with the fact that the Slavs settled it even deeper towards the Friuli Plain (Rupel, 1995). From the mention of Gorica in 1001, the border status of Goriška between the nascent County of Goriška and the Ogle Patriarchate is evident. The border between the Republic of Venice and Austria-Hungary was moved from Goriška to the west, and the Rapala Treaty of 1920 moved the border line to the east. The last change that befell this area after the Second World War was the Paris Peace Treaty, which entered into force in 1947. It divided Goriška between two countries: the smaller part with the town of Gorica belongs to Italy, and the larger part to Yugoslavia, respectively its successor, the Republic of Slovenia (Marušič, 1998). Relations between Italy and Yugoslavia remained tense and hostile after the signing of the agreement. The improvement came only in 1975 with the Osim Agreement (Bufon, 1995). In 1947, even a concrete wall was built inside Gorica, the so-called Goriška wall - a concrete construction with a width of 50 centimeters, on top of which was a fence one and a half meters high. The wall separates Gorica from the suburbs and the railway station it passed by t. i. the transalpine route, which were annexed to Yugoslavia at the end of the Second World War. Only in 2004, after Slovenia's accession to the European Union, was the part of the wall that divided the Goriška northern station in two demolished (internet 4).

Cross-border water supply with the river Soča, electricity supply from the nearby Soča power plants, the possibility of residents choosing to be citizens of one or another country, dual ownership cards for land owners in the hundred-meter border buffer zone, low-border crossings that allowed residents of the border zone to crossings with a special permit, pass (Bufon, 1995). These factors maintained a normal everyday life in the neighborhood and already shaped a new cross-border life.

3.2 SMUGGLING ACROSS BORDER

Last but not least, a special form of "exchange" should be mentioned, i.e. smuggling, smuggling (from the German word schwarz = black, illegal) or contraband (from the Italian contrabbando, contro la legge = against the law), the secret transfer of various goods across the border. In the past, it was forbidden to carry certain products across the border and they were simply confiscated if discovered. A permanent exhibition dedicated to this post-war activity has been set up in the Pristava Museum Collection - Goriška Museum, in the premises of the former small border crossing of Pristava (Goriška Museum, 2022).

The introduction of two-owner permits and, later, passes helped to increase and facilitate the flow through the border, which was fairly closed at the time. This is how goods are smuggled from Italy to Slovenia or Yugoslavia and vice versa. They brought meat, brandy, cigarettes, and butter to Italy, because there was plenty of that in Yugoslavia. From Italy, they brought what was in short supply or of inferior quality in Yugoslavia: coffee, sugar, rice, southern fruit, flowers and confetti, clothes and the like. In doing this, they were extremely resourceful and flexible, they had to look for different possibilities of hiding the goods and anticipate where the customs officials on one and the other side of the border would not look and find the hiding places. Over time, such trading even becomes a profitable business (Goriški muzej, 2022).

3.2 THE BORDER DURING THE COVID-19 EPIDEMIC

On January 1, 2007, Slovenia joined the Eurozone, which means that the economic border finally falls and border crossings with buildings, ramps, nets and controls disappear. The generations that grew up with these obstacles had to get used to moving freely through the territory almost overnight (Internet 5). After all the years of free cross-border movement, in 2020 the covid-19 epidemic cut into this region again. Plastic and cement blocks, large stones and rocks blocked all passages and evoked unpleasant memories in the older generations, astonishment in the younger ones, and in both a sense of limitation and awareness of the senselessness of imaginary lines through space, which curtail individual freedom (Devetak, 2020). All this actually proves the importance of the border area, which, with its uniqueness and uniqueness, forms a neutral zone and a unique bond between the two neighboring nations (Bufon, 1995).

4. URBAN DEVELOPMENT AND ARCHITECTURE OF THE CITY OF GORIZIA (GORICA)

The written documentation of the city of Gorizia, Slovenian Gorica, dates back to the Middle Ages, from which we also have the first records of its urban design. This period strongly marked the image of the entire city, especially its core. The urban planning in this period was comparable to other medieval cities. It developed around the castle, which still stands today on a hill in the middle of the old city center and remains one of the biggest attractions and symbols of Gorica. The morphological construction of the city developed slowly (Jarc, 1997). Until the first half of the 16th century, development took place only in the part immediately below the castle, which was surrounded by the walls, and in the part that extended to the other side of the walls at the foot of the hill and up to the moat, which was dug in the 14th century. After that, the development of the city began to follow the market routes that at that time ran towards the Soška valley (Rupel, 1995). In the 18th century, a moat was filled in and the inner city center was connected to the surrounding area with the help of bridges. In this century, Gorica experienced an economic boom due to the large number of craft activities that took place in the vicinity of the town. This made it possible to restore old buildings, build new palaces, widen roads and arrange the surroundings and the very image of the city. The period was marked by architect Nicolò Pacassi, who is credited with the water fountain on Travnik and the Attems Palace. The first attempts at spatial planning of the city date from the 19th century (Rupel, 1995).

The morphological image of the city changed the most after the First World War, as the city was badly damaged during the war. This encouraged the repair and rehabilitation of the entire city and nearby settlements. An office for the planning of war-damaged settlements (Ufficio Provinciale Ricostruzioni e Architettura, UPRA) was created, headed by the architect Maks Fabiani, one of the leading architects in shaping the image of Gorica. We attribute to him the regulation plans and renovation plans between 1915 and 1922 for the area where the Soča front took place. He introduced a building order modeled after the Viennese one and determined by the city administration. In the construction of new areas, new regulations were introduced - creation of a plan for road regulation before the subdivision plan of the area, roads with a flat and suitably large road surface and a sidewalk on both sides, residential buildings had to have fences that did not exceed 2.5 meters, etc. Fabiani is also credited with the first urban planning law of the Julian Region after the approval of the law on the renovation of war-damaged settlements (Jarc, 1997).

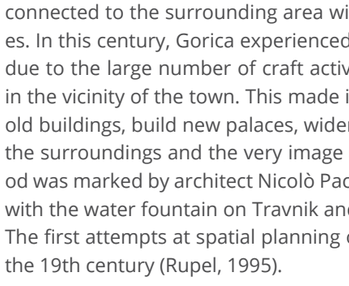


FIGURE 1: Gorica after the First World War (photo: Daniel Jarc)

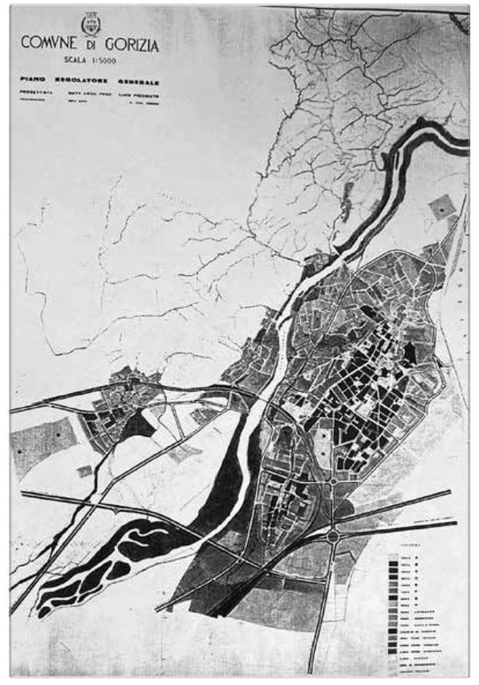


FIGURE 2: Piccinati's plan of Gorica (photo: Daniel Jarc)

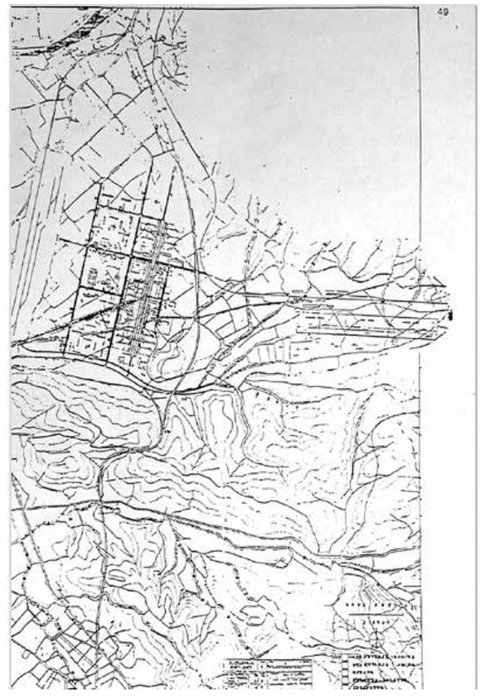


FIGURE 3: Ravnikar's plan of Nova Gorica (photo: Daniel Jarc)

According to Fabiani, in 1969 the architect Luigi Piccinati prepared a new regulatory plan for Gorica. He focused mainly on the renovation of the city center and the development of the area that was built in the 19th century, i.e. the backbone of Gorica. Piccinati's plan was followed by the regulatory plan of engineer R. Costa from 1981, the aim of which was to change the theoretical settlement capacity of Gorica (Jarc 1997). He proposed the arrangement of the northwestern part of the city, which would enable the harmonious development of Gorica and Nova Gorica (Rupel, 1995).

Even today, Gorica is most characterized by medieval architecture - Gorica Castle, Gorica Cathedral (Duomo) and the Church of Saint Rocco (San Rocco) -, Pacassi's architecture from the 18th century, for example the Attems Palace, and modernist architecture by Fabiani, e.g. Trading house.

5. URBAN DEVELOPMENT AND ARCHITECTURE OF NOVA GORICA

Nova Gorica was created in the post-war period due to the new border between Italy and Slovenia, which separated the then Gorica and the hinterland in two and left the Slovenian part of Goriška without a main center (Angellino et al., 1993). The first plan of Nova Gorica was the work of the architect B. Gvardiančič, but at that time the search for a suitable location for the building was still underway.

After choosing the location, they chose the work of the architect Edvard Ravnikar among the three proposed draft plans. According to the completed plan, the construction of Nova Gorica began in 1948. The image of the city stems from the education of the architect Edvard Ravnikar and is therefore inspired by the urban theories of Le Corbusier. The basis of the theory is the division of the city into four areas for the four main human needs, namely to live, work, have fun and move (Jarc, 1997). The development of the city, however, after the basic needs were met, i.e. with the construction of the first residential buildings, began to deviate greatly from Ravnikar's initial plan. Ravnikar's blocks with their roofs and details and the general spatial planning of the city remain today the main symbols of the image of Nova Gorica (Krečič et al., 1996).

6. CO-CREATION OF A CENTER BETWEEN GORICA AND NOVA GORICA

In the nineties of the 20th century, raising awareness of the issue of the compatibility of the two Gorica mountains became very relevant. The first challenge for spatial planning of the city was the international architecture competition Europan 2 in 1991. Architects Angellilo, who won the

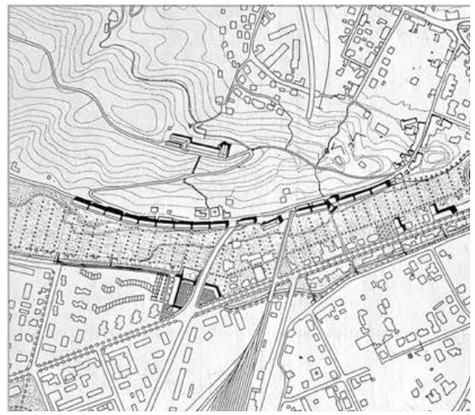


FIGURE 4: Urban plan of the studio AXA from Nova Gorica (photo: Daniel Jarc)

competition, presented a project with some urban proposals for the common Gorica. Their main goal was to evaluate the natural wealth of Gorica and the unused border strip. At the same time, the project included the design of a new border bypass, the arrangement of three parks and the merging of two railways with an intermediate park (Jarc 1997). In addition to the Angellilo brothers, the studio AXA from Nova Gorica also dealt with the spatial planning of Gorica, which follows some of the already existing urban plans in Gorica and mainly researches common bases for the development of the two cities (Poìenel et al., 1991; Jarc, 1997). In the 1990s, it became the border that marked the end of everything, for the first time the possibility of establishing a new dimension at the regional and local level. The first major achievement of Gorica as a whole is very relevant today. In December 2020, the two cities were chosen as the European Capital of Culture 2025. Gorica, as a combination of two hitherto separate cities, will be restored to its former role as an economic and cultural center for the first time (Poìenel et al., 1991).

7. GO! BORDERLESS EUROPEAN CAPITAL OF CULTURE 2025

7.1. GO! BORDERLESS

Since 1985, the European Capital of Culture has developed into one of the most ambitious cultural projects in Europe: to offer Europeans the opportunity to get to know each other's culture better, to experience common history and values, to enjoy the feeling of belonging to the same European community, to develop European cultural links and partnerships, and emphasize the role of culture in urban development (internet 1).
In 2025, the European Capital of Culture will be hosted by Slovenia and Germany, the Slovenian Capital of Culture will be represented by Nova Gorica and Gorica with cross-border candidacy and cooperation, with the goal of becoming cross-border European Capitals of Culture. Considering the historical connection of this area, any project for only one side would be pointless, because, as written in the project, it is a new life of a previously common area, which is still separated by an administrative and legal border. Creating the European Capital of Culture only in Nova Gorica would be like trying to clean a river only up to the point where it crosses the national border. Because culture, like water, is not considered points and lines on a map (Internet 1).

Trg Evrope – Transalpina, the joint square of the two Goricas, will be the starting point of the GO! project. BORDERLESS, with which Nova Gorica, together with Gorica, was chosen as the European Capital of Culture 2025. The duo, which has been illustrating the coexistence of cultures on the border for many years, wants to further upgrade coexistence by revitalizing the urban space, by getting to know the common heritage of the cross-border area, by creating cultural production , which knows no borders and is connected to the basic values of European culture. In 2025, more than 600 cultural events will take place and more than 60 projects will be implemented, which will take place in both cities, but also in their wider area on both sides of the border: Vipava valley, Soča river valley, Goriška brda, Trnovska and Banjška hills plateau, part of the Karst and the Gorica region (Vipava valley).

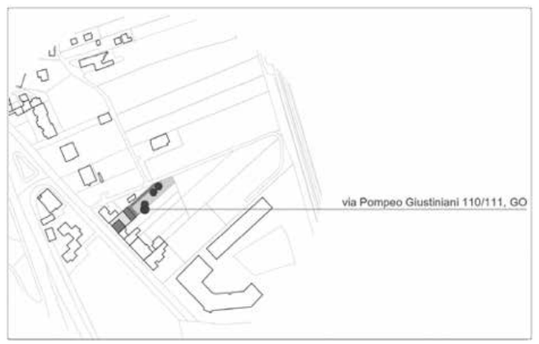


FIGURE 5: New state of the location (illustration: Demetra Jarc)

FIGURE 6: Living room - existing condition (photo: Demetra Jarc)

FIGURE 7: Bedroom - existing condition (photo: Demetra Jarc)

FIGURE 8: Kitchen - existing condition (photo: Demetra Jarc)

8. CONURBATION - CONURBAZIONE

On the websites of the public institution GO! 2025 writes: "If critical residents of Nova Gorica and Gorica were asked to briefly describe the cultural profile of their cities, the answer for Nova Gorica would most likely be: 'My city has no soul', and for Gorica, 'my city has no life'." The urban cores of the culturally rich and interesting landscape find it difficult to fully realize their potential and remain trapped: Gorica in a nostalgic focus on "the city that once was", and Nova Gorica in a vague vision of "the city that has yet to become".

And it is precisely through conurbation, the formation of neighborhoods, i.e. interconnected cities in which activities and functions do not just add up, but complement each other, that we can obtain a quantitatively and qualitatively upgraded center that an individual city could not achieve.

This is the vision of the project, the core of which is to live in one city that spans two countries and draws from them what is best and means added value as a whole. This is the construction of an international space that does not allow the marginalization of areas that lie on the outskirts. This is also proof that, anywhere in Europe, uniform and artificially divided areas can be reunified, that even the outskirts can be the cultural centers of Europe (Internet 1).

9. LOCATION

The two buildings in question are located on a side street in the quiet Svetogorska quarter of Gorica. Due to its close proximity to the border crossing of the same name, the location is also known as Casa Rossa, or as members of the Slovenian minority from Gorica call it, Russian House.

The location was of key importance in the design of the project, as it encompasses the set goal and the presented story. The street on which the house stands, since the period after the First World War, runs along the foot of the hill, which is adorned by the Goriška castle, right next to the main, busier, ring roads and the Slovenian border.

The plot of buildings extends on one side to the Goriška Pompeo Giustiniani road, next to which the first house stands and whose facade looks in the direction of the Goriška castle, and on the other side it extends to the Slovenian border and the Novogoriška bicycle path. Therefore, it could be said that the plot of the building in question is the connecting thread of both Gorice.

10. THE OBJECT UNDER CONSIDERATION

The project deals with the two buildings located at the above-mentioned location. The two buildings are quite different from each other, due to their different purposes over time and their current condition.

The first building, which stands right next to Pompeo Giustiniani Street and looks towards Goriška Castle, is in a slightly better condition, as they lived in it until 2020. It was built before the First World War as a residential building. The Močilnik family lived in it until the thirties of the 20th century, when, due to the crisis period of the Second World War, the owners began to rent out the building and moved to the building behind the first one, which was previously used for farming. In the fifties of the 20th century, they moved again into the main residential house and used the second one as a garage and wine cellar. It has remained so until today.

The facade of the apartment building is typical bourgeois, characteristic of Gorica before the First World War. There is only one recognizable detail on it, namely the convex lines, which are also repeated on neighboring buildings. The current building consists of the ground floor, in which we have an entrance, dining room, living room, kitchen, toilets and veranda, the first floor with three bedrooms, two of which are smaller and one slightly larger, and a bathroom with a balcony and an attic. The floor plan of the building has been slightly changed over the years, namely an extension was added on the northwest side of the building, in which a bathroom was arranged on the first floor and a veranda on the ground floor.

This building is separated from the neighboring one by an 8 meter long courtyard. The building, which has been used as a garage and cellar in recent years, is in a much worse condition than the first one, as it has hardly been renovated since the post-war period, when it was converted into a residential unit, due to its secondary purpose. In the post-war period, unnecessary equipment was removed and the entrance to the garage was enlarged. The building currently consists of a ground floor with a garage, a wine cellar and a separate lower extension and an unused first floor with a relatively low ceiling. In the mentioned extension, there is a passage to the vegetable garden, which lies behind the two houses and is also the rear part of the fenced plot. In this part, there is another courtyard door that leads to a longer field with an orchard, which lies right next to the border with Slovenia.

FIGURE 9: Cellar – existing condition (photo: Demetra Jarc)

FIGURE 10: Transition - existing state (photo: Demetra Jarc)

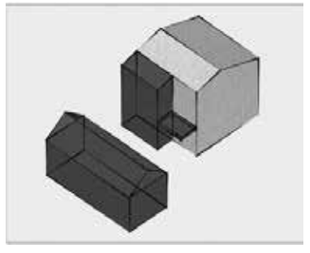
FIGURE 11: Garage - existing state (photo: Demetra Jarc)

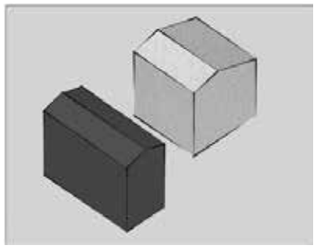
10. RENOVATION OF THE BUILDING

The goal of the renovation is based on combining the old and the new, as we would like to keep the appearance of the existing buildings and place a new connecting part between them with a completely contrasting architecture. Due to its poor condition, the secondary building would be demolished and rebuilt in exactly the same dimensions, while the internal layout of the walls and openings would be adjusted according to the purpose of the individual rooms. The only major difference in the renovation would be the building's height, as it would be raised by one floor due to the vantage point and the beautiful view of the Slovenian hills. In the primary construction, the dimensions of the building would remain unchanged. Load-bearing walls with a width of 60 cm would not be moved in the floor plan of the renovation. The only major change to the project would be to raise part of the structure, which involves demolishing the roof and leveling the height with an intermediate addition. The major contribution to the renovation would be the L-shaped intermediate connecting structure between the two existing buildings. This part is completely different in shape and structure from the other two, which is also the main goal of the renovation. The added steel structure not only enlarges the newly created building, but also creates a special lighting effect in the room due to the large number of windows and transparency. The added facility also enables plants to be integrated into common areas.

10.1. COMBINING OLD AND NEW

Combining old and new, i.e. older and more modern architecture as well as existing and added structures, was crucial in the renovation. The contrast that was created between the parts of the resulting construction contributed to the fact that both parts and both approaches to architecture acquired their charm precisely in their diversity and in the beauty of their combination. We decided on this contrast because we believe that the charm and symbol of both Gorice is precisely adding a new, more modern face to the older, already existing base. Both architectures flow into the new building, which becomes the joint cultural center of both Gorice.





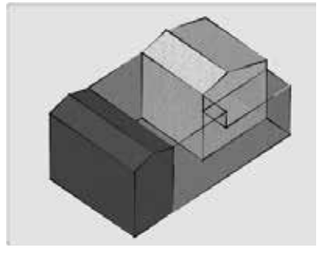


FIGURE 12: Volumetric representation of the initial state and demolitions (illustration: Demetra Jarc)

FIGURE 13: Volumetric representation of the renovation of existing buildings (illustration: Demetra Jarc)

FIGURE 14: Volumetric representation of the added architectural element (illustration: Demetra Jarc)

11. THE STORY AND GOALS OF THE RENOVATED ARCHITECTURE

The goal of the renovation of the existing buildings in Gorizia, right next to the Slovenian border, is to create a space, a meeting point and a cultural center for both Gorizia, taking into account the events and the need for new spaces for the European Capital of Culture in 2025 and its GO! 2025.

We decided to renovate due to the need to revive old, rundown city areas, which are losing their charm due to disuse and changing the external appearance of the city. Preservation, renovation and upgrading of degraded buildings in the old city quarters is necessary not only from an economic point of view, because the year 2025 will bring a greater number of tourists to the city, but also to restore the current corner town to its former reputation. It is for these reasons that we decided during the design process that the object of consideration will be an old homestead, to which we will add a new part in a completely different architectural style and assign it a new purpose. This is how the cultural center of the two Goricas GO57.15 was created, the name of which comes from the border marking that separates Gorica and Nova Gorica (Aebischer, 2018).

The desire to connect the two Gorizias led us to create two main entrances to the building: one on the Italian side, i.e. on Pompeo Giustiniani Street, and the other on the side of the building facing Slovenia. The entrance from the Novogoriška side continues with a bicycle path that leads all the way to the Slovenian border. Here, on the plot in question, we designed a well-kept yard with an open bicycle shed and a row of trees, under which we placed benches for sitting.

The aim of the renovation is to create spaces for learning, collaboration, interaction and relaxation. So we wanted to create a multifunctional space for the two cities, which have always been connected, in order to restore their lost, common point. A cultural center would encourage visitors of all ages to explore and engage internationally. At the same time, the new premises of both Gorice would contribute to the preservation of their common cultural heritage and be a starting point for exploring the beauty and peculiarities of two cities that are separated by nationality and language, but have shared culture, traditions and customs for more than a thousand years. At the same time, premises jointly owned by two countries would be a model and would lead to many similar cross-border collabora-

FIGURE 15: View of the facility (illustration: Demetra Jarc)

tions and integrations.

12. NEW IMAGE OF THE FACILITY

12.1. INTERIOR

The cultural center GO57.15 is designed on three floors, namely the ground floor, the first and the second floor.
On the ground floor, we have two main entrances on two opposite sides of the building, which join in the reception area. We have a waiting room for guests right next to the reception under the stairs leading to the upper floor. One of the main interesting interventions in the interior is the opening in the building, located just behind the reception, which extends over all three floors. In it, we have vegetation and an elevator that allows disabled access to the upper floor. In the left part of the building, on the ground floor, we also have a bistro with additional space for catering and a cafe. The bistro also continues into the central part of the building, from which it also passes into the rear part of the ground floor in the right part of the building. Here we have a larger space intended for meetings and a smaller office, which can also become a room for debates and meetings of smaller working groups, if necessary. We designed this part with glass partitions for a better passage of light into the rooms. A narrow corridor separates the meeting rooms from the men's, women's toilets and toilets for disabled.

The transition to the upper floor is possible via the staircase next to the reception or with the elevator in the middle of the building, where there are four rooms with private bathrooms, intended for a narrow selection of important guests. They are connected by a larger central space for socializing and relaxing. Access to the main part of the building, which is on the second floor, is only possible using the elevator. On this floor, there is a large open space with a view of the Slovenian hills, which has different purposes, as it can be used as a lecture hall or as an exhibition space. In addition, there is also a small space for a

FIGURE 16: Equipment floor plan with room descriptions - ground floor (illustration: Demetra Jarc)

FIGURE 17: Equipment floor plan with room descriptions - first floor (illustration: Demetra Jarc)

FIGURE 18: Equipment floor plan with room descriptions - second floor (illustration: Demetra Jarc)

bar and storage.
When renovating the interior, we decided not to keep the existing furniture, as it is very diverse and comes from different historical periods, but at the same time it is not unified with the external appearance of the building, which was built in a different period and under different circumstances. When designing the interior, we decided on a more modern approach in connection with the completed architectural work. We wanted the interior of the building to express freshness, novelty and alternative, and above all, for the interior to be unified with the program of the cultural center. Spaces intended for learning, debates and collaboration require suitable equipment, color tones and lighting, which we naturally took into account in the interior design.

12.2. FACADE

The main goal of the renovated facade is to preserve as many of the features of the existing structure as possible, so during the renovation we kept the horizontal stucco above the floors and added the same detail above the new floor. Due to the elevation of the building, we repeated the line at a higher point, i.e. between the first and second floors. The facade would be supplemented with the left

FIGURE 19: Visualization of the facade (render: Demetra Jarc)

FIGURE 20: Visualization of the facade detail (render: Demetra Jarc)

contrasting part of the new construction.

12.3. LIGHTING AND BRIGHTNESS OF ROOMS

One of the main guidelines in interior design is the brightness of the rooms. Therefore, and at the same time due to the aesthetic aspect and the desired combination of old and new, a large part of the completed building was designed with glass surfaces. In this way, we get a lot of light in all common areas. For the same reason, we created transparent glass walls in the room, which can be transformed into a smaller space for debates if necessary, and in the meeting room, which keep the corridor bright and allow light from the common areas into the work rooms as well. In the sleeping areas, the light intensity can be adjusted according to the wishes of the users. The number of lights in these rooms is smaller. If the sunlight is too weak,

FIGURE 21A: Reception visualization – 1 (render: Demetra Jarc)

FIGURE 21B: Reception visualization – 2 (render: Demetra Jarc)

FIGURE 21C: visualization of the bistro (render: Demetra Jarc)

the room can also be illuminated with ceiling lights.

12.4. SELECTED PIECES OF FURNITURE

We wanted to be alternative when it came to furnishing, so we designed furniture that adapts to the room and can be supplemented with selected designer pieces. An important part of the interior is the design and placement of bookcases in most of the common areas, which offer visitors the opportunity to learn and explore.

12.5. MATERIALS AND TEXTURES

When designing an interior where we want to create a special effect, materials and textures and their combination in the room are important. The construction of the building is dominated by steel and glass, so as a counterweight we used colors of warmer and lighter shades and placed wooden furniture in the interior.

We designed two types of spaces: shared workspaces and private spaces. In rooms intended for learning, research, getting to know each other and meetings, heavy elements and materials would interfere with concentration, which is why we used lighter and calmer color tones here.

In the rooms, which are intended for relaxation, privacy and rest, we used several warmer and darker materials. In the shared bathrooms, we combined aluminum-clad cabinets with marble walls. Similarly, in the bistro and bar, we combined aluminum tables with a marble wall and leather backrest. For the floor, we chose terrazzo in shades of red and orange throughout the building. The reception desk is also made of the same material, which creates the illusion that it is an integral part of the press. Chairs covered with textiles in two color shades give the room softness. They are located on the ground floor and second floor.

FIGURE 22: Visualization of the meeting room
(render: Demetra Jarc)

FIGURE 23: Visualization of a space for socializing and relaxing
(render: Demetra Jarc)

FIGURE 24: Visualization of the bedroom (render: Demetra Jarc)

12.5. ADDED VALUE OF THE INTERIOR

The added value of the interior is the vegetation that can be found in all common areas, but especially in the central open part of the building, which surrounds the elevator with hydraulics in the basement area due to better functionality and a better appearance of the entire interior. By placing plants in most rooms, we create a common thread and a more coherent appearance of the building, while at the same time adding softness and freshness to the rooms.

13. CONCLUSION

In the article, we presented the renovation of buildings in Gorizia, right next to the border between Italy and Slovenia. The description of the environment, the location, the historical background of both Gorica cities and the changing of the border between them over time was supplemented with conceptual plans for the renovation of two buildings. The main feature of the renovation is the integration of a new, more modern architectural part, which is completely opposite in appearance to the older part of the building. The contrast between old and new was the main design guide. In the concept project, we created spaces for learning, collaboration, interaction and relaxation, i.e. multifunctional spaces for both cities, which have always been connected, with which we wanted to restore their lost common ground. In the cultural center, visitors would have the opportunity to research, get to know each other and cooperate on an international level. At the same time, the premises would contribute to the preservation and upgrading of the cultural heritage of both Gorica cities.

ACKNOWLEDGEMENTS

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New biomaterials solutions paving the way to zero-waste fashion industry

Petra Erič
National Institut of Chemistry
Jozef Stefan International Postgraduate School
Ljubljana, Slovenia

Assoc. Prof. Blaž Likozar, PhD
National Institut of Chemistry
Ljubljana, Slovenia

Assist. Prof. Uroš Novak, PhD
National Institut of Chemistry
Ljubljana, Slovenia

Corresponding author: uros.novak@ki.si

ABSTRACT
The transformation of the fashion industry into a sustainable one remains a big challenge. Mostly because of the fast fashion movement being concentrated on mass consumerism which creates in us a fake belief that we need a lot of clothes to feel and look good. The quality, health risks, and environmental impact are forgotten and in a lot of examples even hidden. In this research, we developed a new biobased material that consists of natural polysaccharides that can potentially be extracted from food waste. The material can be either recycled or biodegraded in nature and therefore, it leaves no waste behind. Another sustainable advantage of eco-friendly clothes of the future is their self-cleaning property, which eliminates the use of traditionally used washing methods and their negative effects on the environment. We believe that clothes can be much more than just items that are purchased with high speed. Developed materials have added value for the customer. They contain a personalized smell. A pleasant smell can have positive influences on our mental and physical health, which can improve our life quality. Final products clothes and fashion accessories were also produced. With responsible design practices, we are trying to create long-lasting high-quality products with enormous value for the users without exploiting workers, animals, or nature and without making a health risk for the user.

KEYWORDS
Biomaterials / Design / Sustainability

1. INTRODUCTION

Fast fashion has become a major concern in the fashion industry. It refers to the practice of producing and selling trendy clothing items at a rapid pace, often at low cost and a high volume. It is criticized for its negative impact on the environment, and labor conditions, in consideration of users and labor health and the cultural appropriation of traditional designs. The fast fashion model has also contributed to overconsumption and waste, as consumers are encouraged to buy cheap and trendy clothing that falls out of fashion quickly. The trend toward sustainability and ethical fashion is starting to challenge the fast fashion industry. However, despite the positive development, there remains much work to be done. Unfortunately, many fast fashion brands use the language of sustainability merely as a marketing tool, without truly committing to more environmentally and socially responsible practices. To combat this, consumers are becoming increasingly aware and educated about the true impacts of the fashion industry, and demanding more transparency and accountability from fashion brands. By supporting sustainable and ethical brands, customers can drive positive change in the fashion industry and work towards a more sustainable future.

(Zafar et al. 2015a) Fashion sustainability refers to practices and efforts within the fashion industry to minimize its negative impact on the environment and promote the responsible use of natural resources. This includes practices such as using sustainable materials, reducing waste, minimizing water usage, and increasing energy efficiency in production processes. The goal of fashion sustainability is to create a more environmentally-friendly and socially responsible fashion industry and to ensure that the production and consumption of fashion products are sustainable for future generations. (Hethorn and Ulasewicz 2009) Before industrialization, people lived sustainably without even realizing it. Manual production was costly and textiles were scarce, so even wealthy individuals reused and repurposed clothing, and sold the old clothes to second-hand shops. The introduction of machinery made textiles and clothing more affordable, and accessible, to people of all economic classes. However, cheap production and mass consumerism have led to environmental problems that place the fashion industry as the second largest contributor to environmental pollution, right after the oil industry. (Hethorn and Ulasewicz 2009) It's important to note that synthetic fibers are still widely used in the fashion industry. According to the Lenzing Group's annual report, 63% of textile fibers are derived from petrochemical-based synthetic fibers such as nylon, acrylic, polyester, and polypropylene, while the remaining 37% is primarily made up of cotton. (Shirvanimoghaddam et al. 2020) Synthetic polymers can release harmful and cumulative chemicals that disturb hormone balance and pose potential health risks, including an increased risk of cancer. These fibers are also environmentally damaging, as they are made from non-renewable petrochemical sources and contribute to significant greenhouse gas emissions. The fashion industry is responsible for 10% of carbon dioxide emissions. Synthetic fibers also release microfibers into our waters that harm ocean ecosystems and potentially all species that rely on them. Additionally, synthetic fibers are not biodegradable and persist in the environment, whereas natural fibers like cotton and linen biodegrade much faster. While natural fibers may appear to be a more sustainable option, they also come with their environmental challenges. For example, the production of cotton can use a significant amount of water and pesticides, and the growing process can contribute to water scarcity and soil degradation. However, there are alternative fibers, such as hemp and bamboo, that grow quickly and require fewer resources. (Macdermott, n.d.)

The use of toxic dyes and post-processing treatments in the fashion industry is another major concern. The numerous chemicals used in the textile industry can cause both environmental and health problems, and there is growing evidence of the potential health impacts of exposure to these chemicals, both for those involved in textile production and for customers. While much of the research on the health effects of chemicals in textiles has focused on the potential for allergic skin reactions, contact allergy is not the only potential human health issue. Studies have also shown that certain chemicals, such as benzothiazole, can penetrate the skin and enter the human body after being released from textile materials. These findings suggest that there are significant health risks associated with exposure to chemical contaminants in textiles. Clothing acts as a storage for biotic and abiotic particles from both occupational and environmental sources. This process is influenced by factors such as the type and history of the clothing, the nature of the contaminant, and the way the clothing is worn, cared for, and stored. (Iadaresta et al. 2018; Licina et al. 2019)

2. FASHION WASTE CHALLENGES

In 1943, Maslow placed basic psychological needs. Among air, water, and food he placed clothing at the bottom of his hierarchy of human needs, emphasizing the fundamental role that these necessities play in maintaining survival and well-being. (Papamichael et al. 2022)
However, in contemporary times, the rampant overconsumption of clothing has resulted in numerous adverse consequences.

Most products will eventually become obsolete due to advancements in technology or changes in consumer preferences. Fast fashion involves quickly designing and producing trendy garments to fulfill the rapidly changing demand of consumers. The process that not long ago took 6 months is today done in a few weeks. The process is facilitated by in-house designers, quick prototyping, and small-batch production. Fast fashion can lead to quick customer flow, new trends, and higher profits due to high demand. However, it also increases disposability and has negative impacts on the environment. (Zafar et al. 2015b)

Besides customer's waste, there is also a lot of hazardous waste that is made through the production of textiles and clothes especially in third-world countries without strong regulations about the disposal of this kind of waste. **Pre-consumer waste or industry waste** refers to the waste generated during the manufacturing process that can be reused as a secondary raw material. Textile waste is damaging soil, water, and air. In China, 70% of natural water sources are being polluted, particularly by the textile industry which is using hazardous chemicals in dyeing, finishing, and other processes. These include acetic acid, hydrochloric acid, hydrogen peroxide, sulfuric acid, sulfur dyes, and more, which are difficult to decompose and can threaten human health and the environment. Due to all the industrial estates together, half of the water in China is not safe for human use. (Varelly et al. 2019)

Post-consumer waste in fashion refers to everything used and discharged by the costumer. These are clothing, textiles, and other fibrous products discarded after their lifespan including household items (such as cloth, bags, and curtains...), packaging, commerce and industry products (for example uniforms, industrial and construction textiles). (Shirvanimoghaddam et al. 2020)This type of waste contributes significantly to the growing problem of textile waste and environmental degradation, as many fast fashion items are not designed to be durable or biodegradable, and end up in landfills. The fashion industry also has a high rate of consumer turnover, with many garments being worn only a few times before being discarded, contributing to the growing mountain of post-consumer waste in the fashion industry. (Papamichael et al. 2022)

According to recent studies, the textile industry has not only doubled in production in recent years but also doubled in consumption from 7 to 13 kg of clothes per person. Annual waste of clothing amounts to $400 billion. The average Australian, on the other hand, buys 27 kg of new textiles per year, with 23 kg of it being sent to landfills. On a global scale, approximately 85% of textiles end up in landfills and only 15% are recycled. Two-thirds of the materials are man-made fibers, including natural fibers that take several decades to decompose. On the other hand, polymer-based clothing will take a staggering 200 years to break down in landfills. (Shirvanimoghaddam et al. 2020) North Americans lead the world in textile consumption, using an average of 37 kg per person annually. This is followed by Australians, who use 27 kg, Western Europeans who use 22 kg and developing countries such as Africa, India, and southern Asia, which only use 5 kg each year. (Shirvanimoghaddam et al. 2020) According to the United Nations, the fast fashion industry is responsible for producing 20% of the world's total waste(Papamichael et al. 2022), with 39,000 tons of unused and unwanted clothing being transported to the desert. Furthermore, the fashion industry produces approximately 150 billion garments per year, with 50% of these garments eventually ending up in landfills. (Mazotto et al. 2021) The Atacama Desert in Chile is a prime example with new dunes forming from the accumulation of non-biodegradable textiles and clothing from around the globe. (Papamichael et al. 2022)

2.1 CIRCULAR ECONOMY

For a long time, producers and consumers have followed the linear economy model of »take, make, use, and throw away« resulting in the extraction of vast amounts of non-renewable resources to create products that are used only briefly before being discarded in landfills, creating waste. (Doppelt, n.d.) As a result, nearly 80% of raw materials are discarded after one use, leading to serious negative impacts on the environment, economy, and society, including the depletion of natural resources, deforestation, changes in global temperature, and ecomomic damage from climate-related disaster, all of which put human health and well- being at risk. (Ellen MacArthur Foundation, n.d.)(Ki, Chong, and Ha-Brookshire 2020)

The circular economy in fashion refers to a system of production, consumption, and waste management where resources are used, reused and recycled in a closed loop. In this model, the goal is to minimize waste and extend the life of products, materials, and resources. The circular economy in fashion involves practices such as using sustainable materials, reducing waste, improving production processes to be more energy-efficient, and designing products for repair, refurbishment, and reuse. By embracing these principles, the fashion industry can become more environmentally friendly and sustainable, reducing its impact on the planet and preserving resources for future generations. (Moorhouse and Moorhouse 2017; Ki, Chong, and Ha-Brookshire 2020)

Both producers and consumers play a role in this model, with producers being encouraged to use local resources, reduce toxic chemicals, and embrace renewable energy, while customers are encouraged to prioritize quality over quantity and engage in activities like washing, swapping, and repurposing their clothes.

FIGURE 1: Circular economy of biomaterial

3. NEW TRENDS IN SUSTAINABLE MATERIALS

Current development in biomaterials for the fashion industry is a response to the use of materials made from synthetic polymer and their bad environmental influences, especially poor degradability. In practice, it is quite rear nowadays to be able to buy 100% natural textiles. Due to price and their properties, they are often added to the natural materials. Unfortunately, mixed materials cannot degrade well in nature as well since the synthetic material is stopping the degradation. It is even harder to degrade clothes since they are full of adhesive linings, polyester threads, plastic buttons, zippers, and other elements. Biodegradation of clothes is possible only if it is considered before production. (Fletcher 2009)

The term **biomaterial** originates from the field of biomedicine but has existed in different disciplines for quite some time now. However, it is quite a new term in fashion and without a clear definition. Biomaterials have biological connections without specification of what this biological is. It can be made out of biomass, made out of biological sources, biological sources are used in production, is biodegradable all is a mix of all of this. (Gregory and Marshall, n.d.)

Biobased materials are materials made from renewable organic resources, such us plants, and crops, rather than from fossil fuels. They can range from purely natural materials like cotton to synthetic materials that incorporate waste from fruits and vegetables. (Gregory and Marshall, n.d.)

Biosynthetic materials are materials that are produced through the use of biotechnology, such as fermentation processes, to synthesize chemicals that are used in the production of "synthetic" polymers. These materials have similar properties to traditional materials but are more sustainable and environmentally friendly. (Gregory and Marshall, n.d.)

Biofabricated ingredients refer to materials that are produced through the use of living organisms, such as bacteria, yeast, or algae. These ingredients are used to create both natural and synthetic polymers. The building blocks for these materials are produced through microbial processes, rather than through traditional chemical synthesis methods. (Gregory and Marshall, n.d.)

Bioassembled materials include 'leathers' grown by mycelium, bacteria, or mammalian cells. The living organisms produce the whole material, they are "self-grown". (Gregory and Marshall, n.d.)

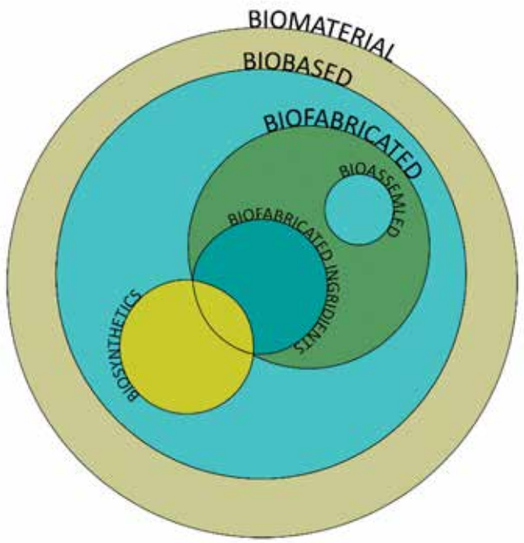


FIGURE 2: Classification of "bio" materials in fashion (Gregory and Marshall, n.d.)

Each biomaterial should be evaluated based on its specific attributes and characteristics. The term »clean«, »sustainable« and »better« are subjective and can vary depending on the context and the criteria used for the evaluation. (Gregory and Marshall, n.d.)

The standard for material to be considered »clean« may vary, but it typically refers to the absence of harmful chemicals or pollutants in the production process. The standard for materials to be considered »sustainable« also varies, but they often include factors such as resource usage, energy consumption, greenhouse gas emissions, waste generation, and lifecycle analysis. The comparison of one biomaterial to another as »better« depends on the specific context and the desired attributes as well. (Gregory and Marshall, n.d.)

It is important to consider the entire life cycle of biobased materials and the potential impact on the environment. While biobased material can be a more sustainable option compared to traditional petroleum-based products, their production and use can still have negative impacts, such as the use of fertilizers, pesticides, and the release of pollution into the environment.

If not possible to produce biomaterials from waste, the production of crops must consider sustainable practices such as organic farming methods, reducing the use of chemical fertilizers and pesticides, and minimizing water usage. It's also important to consider the transportation and processing of these crops to ensure that their carbon footprint is minimized. Furthermore, growing crops for material can be considered unethical keeping in mind that these crops could be someone's food. (D'Itria and Colombi 2022)

4. EXPERIMENTAL BIOMATERIAL INNOVATION

4.1 OBJECT

New biomaterial for fashion use was developed from natural polysaccharides. To achieve the most appropriate material 3 different versions of materials were created. Those materials vary only in one component; used polysaccharide. Polysaccharides that were used are corn starch (C), tapioca starch (T), and agar (A). Mechanical properties, wettability, and biodegradability were analyzed.

The hydrophilic properties of the materials, resulting from their chemical structure, can pose a challenge for practical applications. To overcome this issue, coatings made from natural waxes, including candelilla wax (CW), jojoba wax (JW), and almond wax (AW), were applied to the materials to decrease their surface energy.

4.2 MATERIALS

Corn starch and tapioca were purchased at a commercial local grocery store. Agar and Glycerol were purchased from Sigma Aldrich (Steinheim, Germany). Cellulose pulp was obtained from Pulp and Paper Institute, Ljubljana.

4.3 METHODS

Material preparation

In a laboratory setting the substances for biomaterial were weighted and mixed in a laboratory bead. Distilled water was then added to the mixture. The mixture was heated until it reached boiling temperature at 100-110° C. It was boiling for 5 minutes, resulting in a thick consistency. The liquid compound was then evenly distributed onto a metal plate inside the luminarium while still hot. The power of the luminarium was set to 180W and the samples were left to dry for 24-48 hours.

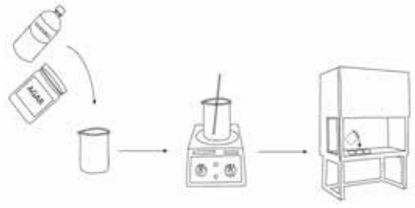


FIGURE 3: Outline of the process of making biomaterial

Preparation of the samples before measurements of mechanical properties

To determine the mechanical properties of each material, each sample was cut into three 8 x 2 cm squares. The thickness of each square was measured ten times using a digital thickness gauge, and the average thickness was calculated from the results. The thickness measurement was a necessary step before performing the mechanical properties measurements. The mechanical properties were measured using an XLW Auto Tensile Tester which provided results for max. force (N), strength (MPa), stretched length (mm), and elongation (%).

Preparation of the samples before contact angle analysis

To measure the contact angles, the samples were cut into 2x3 cm2 squares and affixed to an object glass that was then placed in an optical tensiometer. Water contact angles were measured using the sessile drop method with a Tensiometer Theta T200 (Biolin Scientific, Darmstadt, Germany). The contact angles of water droplets were measured after 5s, 100s, 150s, 200s, and 300s. Each sample was measured in triplicates.

Preparation of the samples before the soil burial test

For the soil burial test, test samples of different materials were evaluated for their degradation over time. The samples were first cut into 5x5 cm square shapes and then placed onto paper with 5x5 cm squares drawn on it to obtain the initial appearance with the help of photography. Each sample was then placed into its cup and arranged with the help of small paper flags to differentiate between material types. The cups with the materials were buried together in a larger pot, with the samples positioned parallel to the soil surface. The soil was watered and then the pot was placed inside a room with an average temperature of 15 ° C.

The samples were removed from the soil at various intervals, including 48 hours, 7, 15, 22, 35, 42, 47, and 50 days, to assess their biodegradability. The samples were placed on paper with 5x5 cm squares down on it. All of the samples were then photographed. In the end, the pictures were analyzed using the software to determine the absent surface area of the material and from that to conclude about the time of biodegradability. All the samples biodegraded in 40-60 days.

FIGURE 4: Preparation of samples before biodegradation in the soil test

5. RESULTS AND DISCUSSION

5.1 AN ANALYSIS OF THE MECHANICAL PROPERTIES OF VARIOUS SAMPLES

The mechanical properties of various samples were analyzed and evaluated, revealing noteworthy differences in maximum force, strength, stretched length, and elongation. The results showed that the highest maximum force was recorded in the sample made from agar, while the lowest was observed in the sample made from tapioca starch. Results of the strength indicate that the sample made from corn starch showed the highest value, while once again the sample made from tapioca starch demonstrated the lowest strength. In terms of stretched length, the samples made from tapioca and agar were observed to have the highest values, whereas the sample made from tapioca starch showed the lowest stretched length. The sample made from corn starch had the highest elongation value, while the lowest value was recorded in the samples made from tapioca starch. These results suggest that the material made from tapioca starch demonstrated the weakest mechanical properties among all the samples analyzed. It is important to note that this could be due to the difficulty in placing the tapioca material evenly on the board and consequently not being able to obtain thicker material due to the chewy nature of tapioca. In conclusion, the best mechanical properties were observed in the samples made from agar and corn starch.

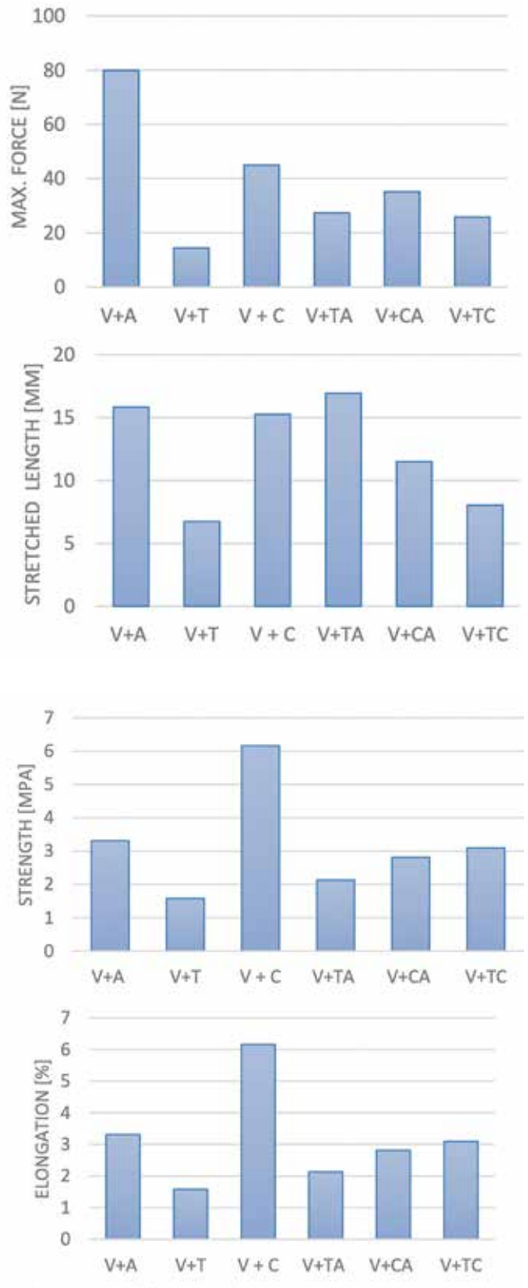


FIGURE 5: Graphs of mechanical properties of biomaterial

5.2 AN ANALYSIS OF WETTABILITY

The study has shown that wax coating can significantly improve the wettability of a material. The research focused on three different types of wax coating – candelilla, jojoba, and almond wax. The results of the study showed that the highest contact angle was achieved by the wax coating, showing the most hydrophobic properties of almond wax. However, it is not possible to conclude anything since the results were close together. It is also important to note that the wettability of a material is influenced by several factors, including temperature, humidity, and the properties of the liquid. The measured values and the used protocol is shown in Figure 6 and Figure 7, respectively.

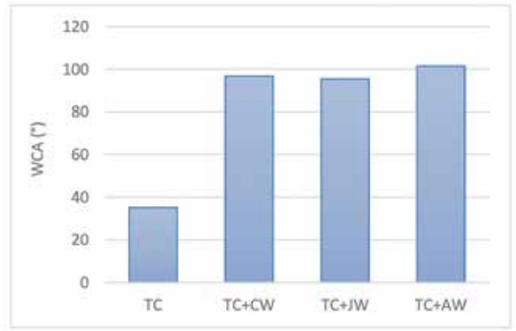


FIGURE 6: Graph presenting a comparison between WCA of untreated sample and wax-treated samples

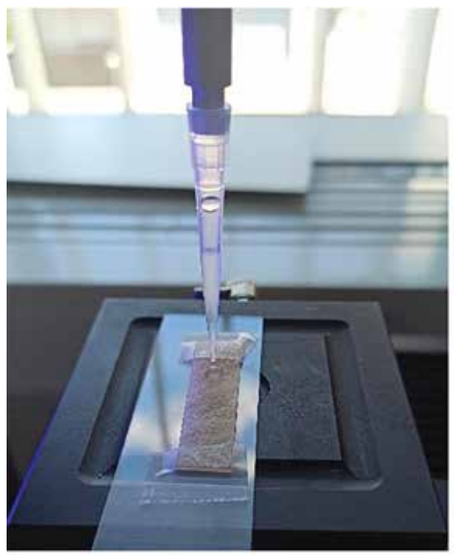


FIGURE 7: Measuring of WCA

5.2.1 AN ANALYSIS OF TIME-DEPENDED OBSERVATIONS

The goal of this analysis was to investigate the impact of wax coating on the wettability of a material over time. The results of the study showed that wax coating has a significant impact on the wettability of a material. Observing the wettability of the sample for 300 seconds, it was found that the contact angle of the uncoated sample decreased by 71% in 100 seconds. In contrast, the contact angle of the coated sample only decreased by around 3% in the same time frame. This indicates that the wax coating effectively reduced the wettability of the sample. Moreover, the coated sample was able to maintain hydrophobic contact angles for close to 200 seconds, after which the contact angles started to decrease rapidly. This suggests that while wax can effectively reduce the wettability of a material, it may not be a permanent solution, and further research is needed to determine the long-term effects of wax coating on wettability.

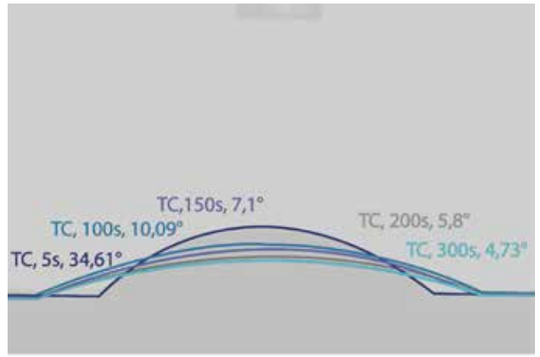


FIGURE 8: Schema of changing wca of untreated sample in a time period of 300s

FIGURE 9: Schema of chancing WCA of treated sample with jojoba wax in a time period of 300s

5.3 BIODEGRADABILITY - SOIL TESTING

Biomaterial biodegrades in 20-60 days when exposed to soil and activator of the growth. For the analyses, 3 different types of biomaterials were tested differentiating in their consistency and thickness. The first sample was composed of corn starch and agar with cellulose fibers, with an average thickness of 505 um. The second sample was composed of starch, agar, and candelilla wax, with an average thickness of 300 µm. The third sample consisted of corn starch, agar, cellulose fibers, and candelilla wax, with an average thickness of 694 µm.

The results showed that more stable materials have a slower rate of biodegradation. Sample 1, without wax, had a slightly faster degradation rate compared to samples 2 and 3. Sample 2, despite containing way, had a biodegradation rate closer to sample one due to its thinner thickness. Sample 3, with the addition of cellulose fibers and way, had the slowest biodegradation rate, almost doubling the time compared to the other two samples.

FIGURE 10: Samples before degradation (left) and samples after 15 days in the test conditions (right)

6. USING DEVELOPED MATERIAL IN A UNISEX COLLECTION OF CLOTHES AND ACCESSORIES

6.1 PURPOSE OF DESIGNING A COLLECTION

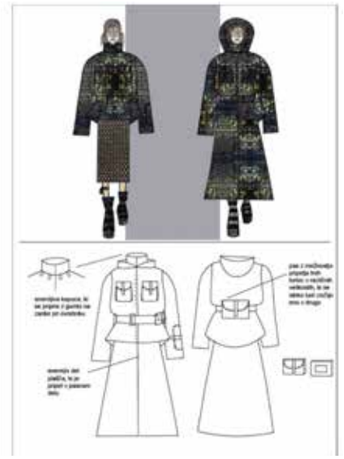
The purpose of this collection and the accompanying paper is to showcase concrete solutions to the sustainability issues facing the fashion industry. The paper details the step taken to develop the materials used in the collection, from initial research in the laboratory to scaling and potential production. It highlights the importance of collaboration between different disciplines, specifically science and fashion design, to create “sustainable” consumerism. The research is presented from both a physical and design perspective, demonstrating how sustainable materials can be developed and incorporated into a fashion collection. The aim is to showcase the potential for sustainability to be integrated into every aspect of the fashion industry, from material development to design and production.

FIGURE 11: Samples before degradation (left) and samples after 15 days in the test conditions (right)

6.2 CONCEPT OF THE COLLECTION

The concept behind the development of this collection was centered around designing for the real needs of customers, with a focus on sustainability. The target customer for this collection is a future person, who is envisioned as being active and vigilant. The clothes are unisex since the differences between genders are believed to vanish. The clothes and accessories in this collection are designed to be multifunctional with each piece carefully thought off to meet the needs of the intended customers. The materials used in this collection have hydrophobic properties, making them suitable for use in fast-changing and extreme weather conditions that are expected in the future. Materials do not need to be washed in the washing machine, the dirt can be self-cleaned by material. Additionally, materials are wholly biodegradable, including threads, buttons, and buckles. This collection is a step towards achieving a wholly sustainable lifestyle by reducing the number of clothing items and promoting the use of natural plant-based materials.

FIGURE 12: Photography of produced outfits from biomaterial



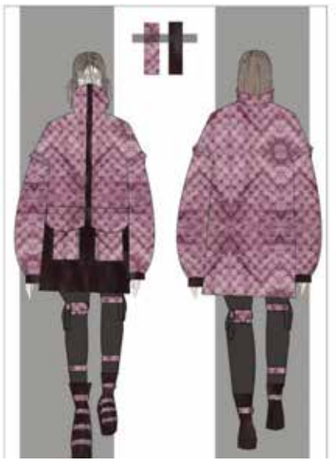


FIGURE 13: Fashion sketches of designed models

FIGURE 14: Samples before degradation (left) and samples after 15 days in the test conditions (right)

6.3 SENSUAL DESIGN

In today's fast-paced world, stress has become a part of our lives. This collection was designed to focus also on enchasing our well-being. Two additional components, tactical and olfactory senses have been incorporated into clothing design to improve overall health as studies have shown the impact of our senses on our physical and psychological health. (Philadelphia and Hastings 2008)

In the collection, the scent was added to materials using essential oils as different etheric oils have different influences on our mood and mental state. In the produced clothes vanilla and lemongrass scent were used. Vanilla helps to calm a person down, and decrease stress and anxiety. Lemon grass refreshes the air, reduces stress, and improves the overall frame of mind. However, we do not perceive the same smells in the same way, which is why a customer could choose their preferable smell and could even change it depending on his/her mood.

7. CONCLUSION

In conclusion, the study sheds light on the pressing issue of waste in the fashion industry and presents sustainable alternatives. This research provides a practical example of developing a biodegradable biomaterial and production of a final product from it. It is important to notice that the term "biomaterial" does not necessarily mean 100% biodegradable or natural and that is why this research is trying to develop truly sustainable and natural materials with functional use. The results showed that it is possible to create a hydrophobic surface of biomaterial with wax coatings, however further research is needed to determine the most effective type of wax coating and the conditions under which it is most effective. In addition to the practical aspects of biomaterial development, the study also highlights the role of design in creating sustainable fashion. A collection of clothes made from the developed biomaterials is presented, which incorporates the idea that clothing can be more than just a physical shield. The design incorporates tactile and olfactory senses, based on recognition of their positive impact on physical and psychological well-being.

This paper serves as a call to action for greater collaboration between the fields of science and fashion, with the ultimate goal of creating a more sustainable future for the industry. It presents a model for how this collaboration can work in practice, with concrete solutions to the sustainability challenges facing the industry. By working together, we can achieve a more sustainable and responsible approach to fashion design and production, paving the way for a brighter and more sustainable future.

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Facial reconstruction possibilities of historical significant person using 3-D computer graphics based on archeological artefacts

Tserendulam Aleksandr
Design Department
Mongolian University of Science and Technology,
Ulaanbaatar, Mongolia

Tumenbold Dashzeveg
Design Department
Mongolian University of Science and Technology,
Ulaanbaatar, Mongolia

Corresponding author: tumenbold@must.edu.mn

ABSTRACT
Restoring the faces of the mediaeval people found in the territory of Mongolia is important to resolve many disputes about the origin of Mongolians that are being discussed today. In addition to the ethnic dispute, the general understanding of the image of Mongols in the Middle Ages, i.e. 10th-13th centuries, which is limited to Chinese wall paintings, Chinese portraits, and vintage Persian books, is difficult for international researchers and history buffs, as well as for ordinary people misleading. Digital reconstruction of ancient human skulls will be a research that will bring progress not only in history and archeology, but also in many fields such as design, medicine, criminology, aesthetic arts, etc. Materials and methods: In this study, we have selected the skull was found in the grave of a nobleman of the Mongol tribe in Bornuur Sum, Central Province, Mongolia. According to archaeologists this skull belonged to a 20-25 years old female person. Craniofacial Reconstruction (CFR) is a method of creating a living face on a human skull to enhance the person's appearance. It is often used in forensics, but is also used in the science of palaeontology and archeology to reconstruct human faces.

KEYWORDS
Craniofacial Reconstruction / Digital model reconstruction / Dimorphism / Design / Management / Design Management

1. INTRODUCTION

1.1. THEORETICAL PART

Summary The three-dimensional shape of the human face is the result of the combination of the hard skeletal structure - the skull and the cartilage in the nose, and the soft fatty tissues, muscles and skin. Differences in these tissues, together with variations in color and texture of the skin, differences in hair and facial features such as eyes, nose and mouth, provides the basic data which is used to categorize the face (Bruce and Young 1998).

The advantages of the computerized method over the manual clay reconstruction are speed, rapid editing capability, production of images that can be stored and reconstructions repeated at any time if required. Furthermore, in many cases, the original skull instead of a cast or model may be used for reconstruction because the 3-D computerized procedure is rapid and noninvasive. However, the most significant advantage of this technique with regard to the aims and objectives of the article is that a number of alternative reconstructions may be produced sequentially for the same skull by using different facial templates from the database that meet the anthropological/biological criteria of the skull[1].

1.2. MATERIALS

Skull: A 64% complete and well-preserved skeleton of a 20-25-year-old woman was found in Mongolian grave# EGAS 3-001. It was possible to calculate body height, leg length, and trunk length. Body height was 167.1 cm (Table 1), forearm length was 55.7 cm, leg length was 89.5 cm, and trunk length was 77.6 cm. When comparing these with data from the Mongolian burial population of western, central and eastern Mongolia stored in the bioarchaeological collection of the National University of Mongolia, they are about 5 cm taller than the average. This difference in height is determined by the length of the trunk and legs.

1.3. METHODS

Along with forensic cases, CFR is also utilised in archaeological research to recreate the faces of paleontological and archaeological humans, particularly where there is little facial information available (Wilkinson, 2011). Scientifically, it is widely accepted that the first CFR was attempted by the Swiss-born German anatomist Wilhelm His who rebuilt the face of the composer Johann Sebastian Bach (His, 1895). Thereafter, the demand for CFR in archaeological research has increased and interdisciplinary studies have been performed world-wide to rebuild interesting faces from the past (Cesarani et al., 2004; Gregersen et al., 2006; Wilkinson, 2008; Papagrigorakis et al., 2011; Hayes et al., 2013). Computed tomography (CT) and post-factum dissection studies by Lee et al. (2009) investigated the cause of death. A pathological change on the left side of the mandible was observed and it was concluded that the lesion might be caused by a fracture, which eventually led to his death. The CFR however was produced with the assumption that the lesion would not have influenced the general facial appearance during her life time. The CT data utilized was employed for the CFR.

When one is presented with a skull for the purpose of identification of an individual, the techniques used fall into two groups: cranio-facial superimposition, and cranio-facial reconstruction.

1. Cranio-Facial Superimposition Techniques
- Comparisons with busts, Portraits and death masks (historical)
- Photographic superimposition (forensic scenario)

2. Cranio-Facial Reconstruction techniques
- Two-dimensional facial reconstruction: Traditional and computerized
- Three-dimensional facial reconstruction: Manual/traditional and computerized.

2. PREPARATION PROCESS OF SKULL MODEL FOR CFR

2.1. A MEASUREMENT OF SKULL

To prepare for skull model for CFR we had provided following actions:
- Measurements on excavated bones
- 3D scanning process / VIVID 9I non-contact 3D digitizer
- Polygon editing tool process
- The process of fixing and cleaning the surface of the mesh file.

A three-dimensional (3D) head model was obtained from the original CT scan data of the selected skull was carried out by an independent practitioner from Archeological Institute. Facial photographic images of the selected skull were not revealed to the CFR practitioner until the project was completed.

VIVID 9I non-contact 3D digitizer was used for scanning the skull and Polygon editing tool software were used for the process of fixing and cleaning the surface of the mesh file. MeshLab Software is a 3D mesh processing software system. Also using Autodesk Maya 2018" Software M:1 scale ratio, facial soft tissue thickness points were placed on the skull and placed according to Anthropological dimensions.

№	Measurements	Length (mm)
1	Max cranial length	180
2	Max cranial breadth	147
3	Basion-bregma height	124
4	Porion-bregma height	-
5	Basion-porion height	-
6	Auricular height	-
7	Min frontal breadth	90
8	Total facial height	119
9	Upper facial height	73
10	Facial width or bizygomatic breadth	108
11	Nasal height	39
12	Nasal breadth	15
13	Orbital height	23
14	Orbital breadth	24
15	Maxilloalveolar length	55
16	Maxilloalveolar breadth	66
17	Palatal length	40
18	Palatal breadth	40
19	Bicondylar breadth	120
20	Bigonial breadth	-
21	Height of ascending ramus	53
22	Min breadth of ascending ramus	39
23	Height of mandibular symphysis	36

TABLE 1: A Measurements of the skull on EGAS 3-001

2.2. 3D MODELLING

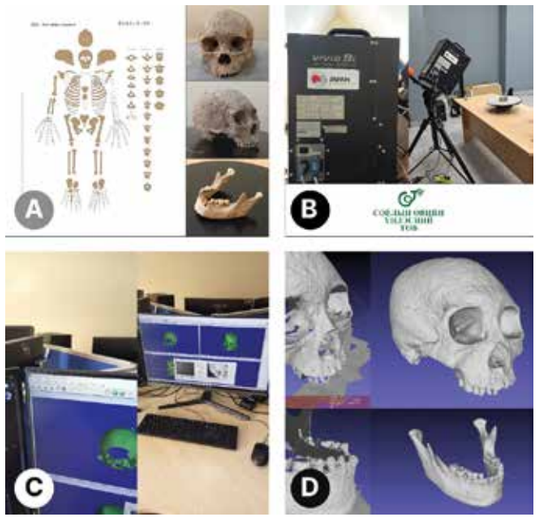

FIGURE 1:
A. Measurements on excavated bones,
B. 3D scanning process / VIVID 9I non-contact 3D digitizer/,
C. Polygon editing tool process.
D. The process of fixing and cleaning the surface of the mesh file

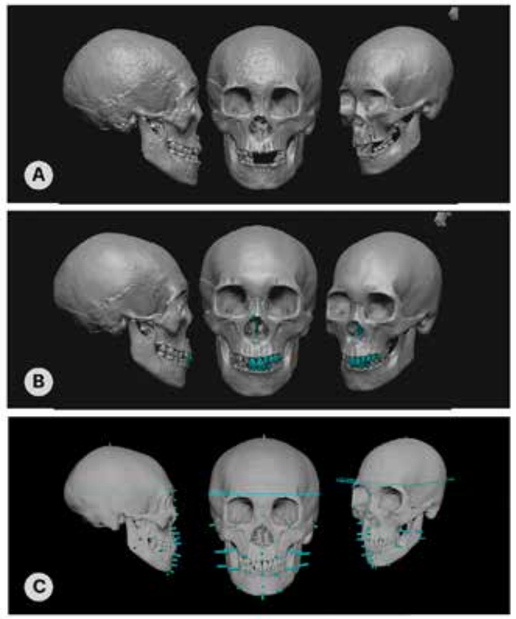

FIGURE 2:
A. Joint placement of jaw bone and head parts /Pixalogic Zbrush/,
B. Reconstruction modeling in Pixalogic zbrush/
C. Facial soft tissue thicknesses

2.3. ILLUSTRATION FOR CFR

The virtual skull models were imported into Freeform Modelling as STL files followed by transforming the STL format into Clay (CLY) files to be visualized in the software. The sex and age at death of the selected individual were assessed again from the reconstructed skull model. Three CFRs were produced from the two skull models according to the combination method of Wilkinson (2004):

There are three types of methods for determining the appearance of a person, the most commonly used method is the 2D imaging method. This method is still used to create verbal images in investigative activities. Defining only the front view limits usability. Therefore, there is a need to use three-dimensional imaging methods to determine human appearance. By developing the traditional method of sculpting using the depth of the soft tissue of the skin and the average size of a person by the method of sculpting based on the skull, the scope of its visualization has expanded, and the scope of its application has expanded with the increase in the possibilities of visualization.

FIGURE 4: The research process of creating the average a ppearance of a modern Mongolian woman aged 20-25 using 2D imaging. / 2014

3. RESULTS

In our study, a digital model of skull scanned and a geometric measurement of skull was defined and skull registration was taken. On this digital model a sexual dimorphism was generated and compared with calculated average shape of nowadays 20-25 years old females from our previous study provided in 2014.

A preliminary comparison of the modern Mongolian female figure with the EGAS-3-001 artifact from the 12th-13th century Mongolian finds shows that the cheekbones

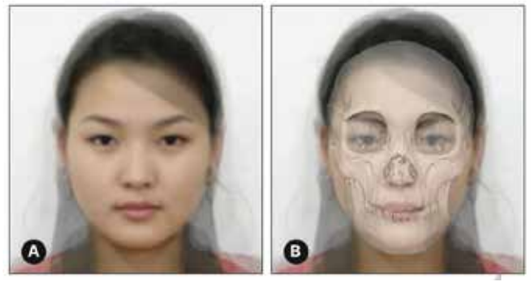

FIGURE 5:
A. The results of the research to create the average appearance of a modern Mongolian woman aged 20-25 using 2D imaging in 2014,
B. Comparison of the results of the average appearance research with the skull of the EGAS-3-001 fossil from 2014 year with measurement of EGAS-3-001.

are similar in size, but the chin bone is relatively small. A limitation of this technique is that the 2D imaging method allows working on face projection seeds. Therefore, other dimensions such as height of the nose and the shape of the sides of the face cannot be compared.

DISCUSSION/CONCLUSION

In our study, a digital model of skull scanned and a geometric measurement of skull was defined and skull registration was taken. On this digital model a sexual dimorphism was generated and compared with calculated average shape of nowadays 20-25 years old females from our previous study provided in 2014.

A preliminary comparison of the modern Mongolian female figure with the EGAS-3-001 artifact from the 12th-13th century Mongolian finds shows that the cheekbones are similar in size, but the chin bone is relatively small. A limitation of this technique is that the 2D imaging method allows working on face projection seeds. Therefore, other dimensions such as height of the nose and the shape of the sides of the face cannot be compared.

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Design development of casual clothes inspired by 13th century nobleman's costume

Ishdorj L.
Mongolian University of Science and Technology, Mongolia

Corresponding author: ishdorj@must.edu.mn

ABSTRACT
Introducing the style of traditional costume to the modern costume is based on the research of both its history and symbol. Otherwise there is a need to have its design or appearance definition.
Having this is important for introducing correctly the style of traditional costume to the casual costume; making modern casual clothes harmonizing with traditional style; introducing the style of traditional costume to the world-wide clothing tendency; advertising the wealthy heritage of traditional costume to the world; introducing national brand product with specific features to the world market. The collection "Globalization" for seasonal coats is based on the results of design studies for ancient Mongolian clothes.

KEYWORDS
Design / Ethno Design / Style / Fashion / Collection

1. INTRODUCTION

It's true that, clothes is one of the means of life, but it's a valuable wealth for nation's history. The traditional dress of Mongol's has a rich history spanning many centuries. Mongolian costumes certainly speak of the Mongolia's rich ethnic diversity and traditions. In this period of globalization the culture relationship between countries is becoming more open, specially, is developing intensively the modern art that called ethno design.

Beginning of history of Mongolian traditional dress is connected with Hunnu period and it has developed into many branches and tendencies influencing to the clothes design of nearby urban civilization. Lately dress of XIII century had been found and it represented that the design art of clothes of that period was very fine. On the basis of the rich traditions of Mongolian costume, the contemporary masters are making use of the heritage that has come down to us from many centuries, and are creating new styles of national costume. Mongolian traditional costume have always been on attention of foreign designers, so there are some Mongolian styles and elements in the modern design tendency.

Since 90-s Mongolia has transferred into the world market economy and joined to worldwide globalization. Afterwards, national pride has been cheered and placed the basis of development of modern clothes with traditional style. Nowadays Mongolian youth has an interest of wearing traditionally styled clothes on holidays and casually.
It is important to study and discover the basis of traditional dress to create ethno styled clothes. There are some mistakes and delusions caused by misunderstanding of the national basis style and tradition.

2. INSPIRATION

Research is the important base of completing the conception of collection. The objects of the study on casual women dress collection " Globalization" are the portrayal of stone man grand nobleman's costumes that were found by archeological finding outs, which related to the XII-XIII centuries. Resources of clothes of Mongolian Empire period was remained on the stone man. Lately archeologists have found many valuable artifacts of Mongolian dress.

A. Stone man

Nowadays there are about 500 stone men are registered and 400 of them are related to the Tureg period. Stone men, related to the Great Mongolian Empire have a distinguished characteristic. They are sitting on the armchair,holding a goblet on the right hand and wearing a dress. Men are in the majority slanting front side dress, oriented from east to the west side /p-1/.

Stone man is the important resource for studying people's nature during that period, their clothes, accessories /belongings/, types of arms /weapons/ ets. On the other hand, it reflects art development and the level of beauty evolution of that period.

FIGURE 1: Stone man (The National Museum of Mongolian History)

B. Artifacts

The deel is shown on picture 2 was found in Buheen Hoshuu of Kherlen Bayan area of Delgerkhaan sum, Khentee province, is a dress with the finest design. It was stored very well, too. Scientists, who studied this dress discovered that it was the nobleman's costume. This dress has ornaments on the front and back sides, the lower part of the skirt and fixing of sleeve edge are decorated with same ornaments. The slanting front side is oriented to the west, the lower part has many folds. The end part of the sleeve is narrow, the design of upper arm part is going slightly wide. Costume on the picture 2b has a similarity on design and time period with. It was found in the nobleman's burial-mound, which was located in Ikh-Nart mountain cave of Dalanjargalan sum, Dornogobi province. The dress was worn on corpse. It was an underwear that called "Tsegdeg" and was made of red cotton with fine knittings.

FIGURE 2: XIII century nobleman's costume
(The National Museum of Mongolian History)

3. ANALYSIS OF THE STUDY

In spite of damage by weather pollution, clothes of stone man has fine design with clear folds and layers. The costume, represented on the stone man, which is stored in the National Historical Museum has a clear front side, oriented from east to the west side. The collar is vertical and continues to the front side as a border. There are wide borders at upper part of elbows. It seems to like a double layered clothes . Ornaments can be seen on the front side, shoulders and on the end parts of sleeves. These characteristics made it very close to the general design, to the type of nobleman's costume. On the whole the nobleman's costume consists of an upper part and a lower part. The square shaped pattern of lower part having many equal folds joined with waist part. It was the common design, but equally devided folds improved aesthetic evaluation of appearance and consumption of comfort on horseback at the same time. Upper part of dress has rectangular shape and lower part is trapeze shaped that made the general appearance of this dress very interesting. The sleeve part from upper arm part became narrow at the end of sleeve. This advantage of design helped men, when they were in fight and gave it very specific contrast. On the waist part of dress there is a 10 cm wide layer rowing opposite plies like a belt. It made the joint between upper and lower parts more harmonized. The most mass of ornaments in rectangular shape are put in the front size of the upper part. It classifies the feature of the face. There are ornament border on sleeves, that add a rhythm in whole mass of ornaments. The most specific design of this dress is a slanting collar. Its equality made an appearance of dress very specific.

4. DEVELOPMENT OF THE COLLECTION "GLOBALIZATION"

Supporting on an ancient nobleman's costume the collection was named "Globalization" in case of an idea, that at present an abundant heritage of each nation globalizes all the time and becomes a common sufficient. However, research is important, we must create collection, which meets current lifestyle of people and beauty evaluation. It means, we interconnect our study results to the modern life. Representing the main form and idea of my topic I transferred it into current design tendency,turned ancient ornaments into harmonized abstract norme.

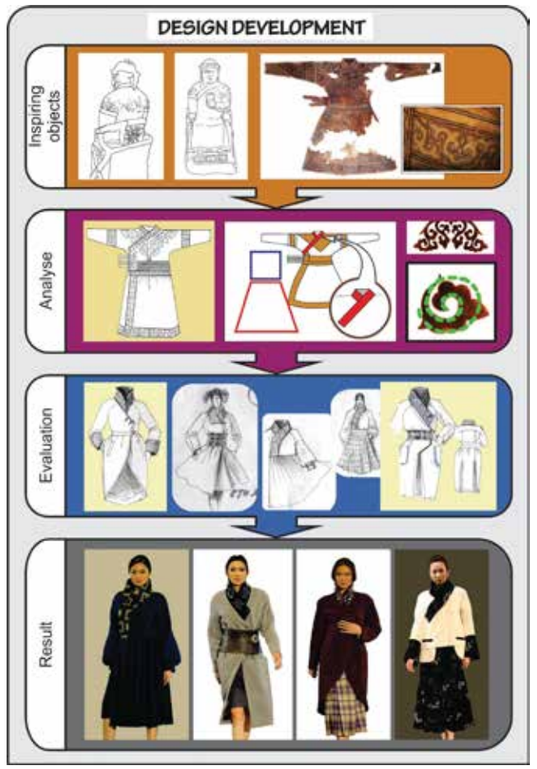

FIGURE 3: XIII century nobleman's costume
(The National Museum of Mongolian History)

5. CONCLUSION

It's important to define the type of the ethno design. In this way we need to do detailed study of nobleman's costume, the artifacts both appearance and consumption comfort. Designers need to corporate with archeologists in their studies.

It is possible to make national brand in the world market, when we define the basis mongolian dress style
There are facts that connected with mixed different cultures. Therefore, I think, people must learn and know well history of their national costume.

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Research on visualization of the historical heritage using virtual reality

Nomin.M
Mongolian University of Science and Technology, Ulaanbaatar, Mongolia

Gantulga.O
Mongolian University of Science and Technology, Ulaanbaatar, Mongolia

Corresponding authors: mnomin@must.edu.mn
o.gantulga@must.edu.mn

ABSTRACT
In the XXI century many countries are realizing the importance of virtual reality or the importance of creating virtual reality, so, they using it as a tool to promote their culture by recreating the demolished and vanishing cultural heritages. Recreation of Kyoto city, Japan, Bam, Iran, Prasad Sours Prat HIL] tower in Angkor, Cambodia can stand as an example. In the frame of this study, we aimed to represent cultural heritages in virtual reality were made as a "Virtual Representation of Tsogt Taij's White Palace". Information and noted facts are extremely rare about The Tsogt Taij's (1581-1637) White Palace vanishing heritage representing the geologically central area's social condition, culture, and life by the period of Baga Khans also known as the mid-period in Mongolian history. The "Tsogt Taij" 35mm film movie about the White palace with 8 chapters in the first episode, and with 7 chapters in the second episode created in 1945 is one of the gems of Mongolian cinematography.

The VR technology was used in three biggest projects such as "White ruins of Tsogt taij - VR, 2015", "3D Panorama of Janchkhuu's height fight, 2016" and "War of Khalkh gol,2017". The last project is aimed at the latest technological advances and their application in the education sector. But the high load factor of the program is one of the reasons for creating this virtual museum.

The project "White ruins of Tsogt taij - VR, 2015" created the first virtual museum based on the film "Tsogt taij" and its paintings. But that virtual museum is still researching because historical sources are missing. This research is basically made on 3D modelling based on historical facts. The research is based on historical sources, films, paintings, hand sketches, and nearby historical building designs, with the aim of travelling the environment in virtual reality, and preserving the physical heritage of history in digital form. The result also concluded that VR technology can support the consumer's awareness of rethinking cultural heritage.

KEYWORDS
Culture heritage / Historical architect / Three dimensional model / Digital creating

1. INTRODUCTION

Saving and keeping the cultural heritage is important social issue in Mongolia so "Cultural Heritage" Mongolian law stands for regulating issues concerned investigating, registering, doing research, ranking, assessing, keeping, saving, recovering, restoring and transmitting, demising, acquiring, adopting, publicizing cultural heritage.

Also on Mongolian National Development Millennium Challenge "Government assistance in keeping, saving, recovering, and promoting divulgating as nation and worldwide knowledge and education Mongolians cultural tangible and intangible heritages" had state about a mongolian law. Keeping cultural heritage digitally either as three dimension model has lot of advantages as it has the possibility to be converted to modern technologies. Thus taking those advantages and placing virtual reality gives us the possibilities of time traveling and experiencing the historic value of cultural heritage. Virtual reality is a traveling, educating environment without any borders such as time, location and nationality.

Therefore made research and modelling possibility on direct example by using information technology advances, estimating the advantages faithfully and demonstrating to public, so that we can present the value of our culture and recovering, keeping digitally those vanishing art pieces. When keeping, saving, cultural heritage it is important to base on actual historic facts and source data. This research is about 3 dimensional modelling for virtual reality representation of Tsogt's White palace or Setgeshgui Chandmani palace including 6 temples rounded by wall was built in 1601-1617 as been named as XVII century's cultural center based on source data of art and historic range.

FIGURE 1: The ruins of the white house

The goal is to conserve and to keep Mongolian vanishing historical tangible heritages such as ruins based on historical source data's in digital form by remodelling in three dimensions.

- Historic facts of XVII century way of life research and comparison with movie Tsogt taij
- Three dimensional remodelling of Tsogt taij White palace based on historical data research
- Creating virtual reality research using virtual reality technology and program data

2. RESEARCH METHOD

2.1 A COMPARATIVE RESEARCH OF HISTORICAL FACTS ABOUT THE WHITE HOUSE

The project "White ruins of Tsogt taij - VR, 2015" created the first virtual museum based on the film "Tsogt taij" and its paintings. But this painting and the film's depiction used artistic exaggeration /Figure 2/. And judging from the buildings near the time and location, there is a reason to reject this architectural design /Figure 3/. Therefore, it is necessary to study the main characteristics and influences of Mongolian architects.

FIGURE 2: "Tsogt taij" film and Painting

FIGURE 3: White ruins of Tsogt taij - VR, 2015

A Mongolian ger is the largest representation of Mongolian traditional architect and consists of many components that correspond to nomadic civilization. But the mid-period Mongolian architecture is dominated by mosques and monasteries depending on the social situation. Because of the great influence of the Manchu-Chin state in Mongolia, Chinese and Tibetan architect design's elements dominate. The figure below compares the transition of the Mongolian house form and the common forms of Mongolian-Chinese-Tibetan temple construction /Figure 3/.

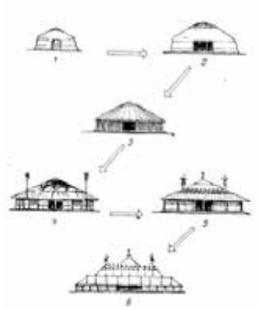

FIGURE 2: Mongolian house development

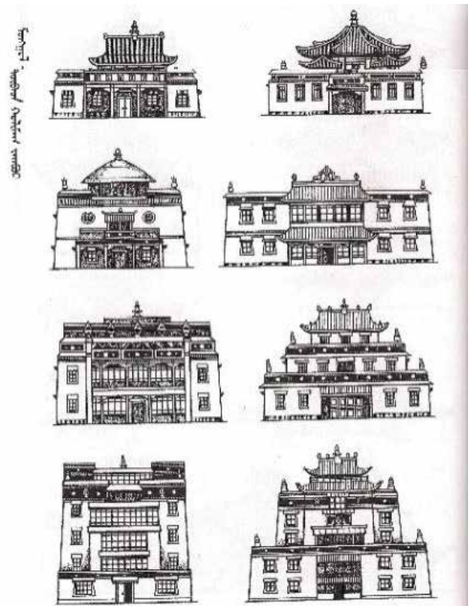

FIGURE 3:
A. Mongolia - China design
B. Mongolian - Tibet design
C. Mongolia - China - Tibet design

In 1892, the Russian scientist Vasiliy Radlov drew sketch of the buildings and ruins of the architectural heritage of the central part of Mongolia and published them in his Atlas of Mongolia book. From a sketch of "The White Palace of Tsogt Taij" in this book, it can be seen that the building is likely to be a religious structure with two floors.

FIGURE 4: Mongolian house development

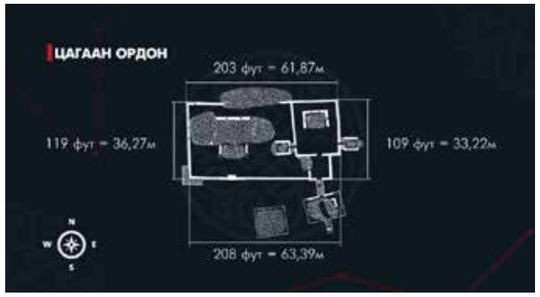

FIGURE 5: "White palace of Tsogt taij" map plan

2.2 PROCESSING AND CALCULATING THE AVERAGE VALUE OF A SEGMENT OF A 3D MODELLING MODEL

The table below shows that the model file size of the computer-based virtual museums we have completed is too high. We used Lowpolygon and high-resolution material to reduce file size by 30.6 percent and reduce loading time.

№	Virtual museum	Three Dimensional	Size	Type	software	Engine development
1	White ruins of Tsogt taij	Sub model	8.64 GB	Architecture / Computer based/	3D max	Unreal engine
2	3D Panorama of Janchkhuu's height fight	Sub model	1.06GB	Adventure / Mobile based/	3D max, Maya	Unity engine
3	War of khalkh gol	Sub model	10.2GB	Adventure / Computer based/	3D max, Maya	Unity engine
4	Virtual Representation of Tsogt Taij's White Palace	Sub model, low poly	6.54GB	Architecture / Computer based/	3D max	Unreal engine

TABLE 1: Table comparing virtual museums

We plan to use it in 3D modelling that can be used in many ways.

- In visual effects and film
- Video game
- Use as an example model in architecture
- Three-dimensional printing
- Conversion to other advanced technologies

	Model 1	Model 2	Model 3
Polygon number	3236	13736	53659
Vertex number	2197	7405	27645
Size	368 kb	732 kb	1.26 mb

TABLE 2: 3D model's size /Figure 5/

FIGURE 6: 3D model's size

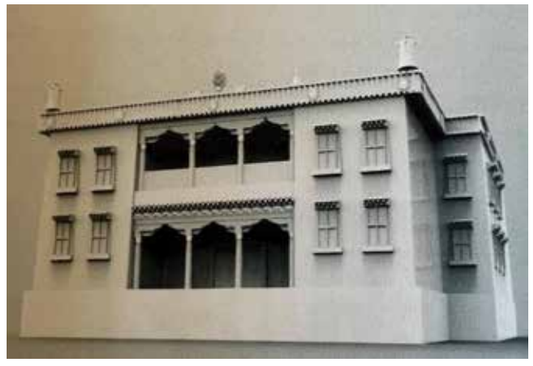

FIGURE 7: Center building of a white palace

2.3 DETERMINE THE SEQUENCE OF ACTIONS TO CREATE A VIRTUAL ENVIRONMENT

Since the work of the 2015 project has been continuing, we have focused on the loading state of the software without changing it. By reducing the load of the program, users have the advantage of the improved visibility of the virtual museum.

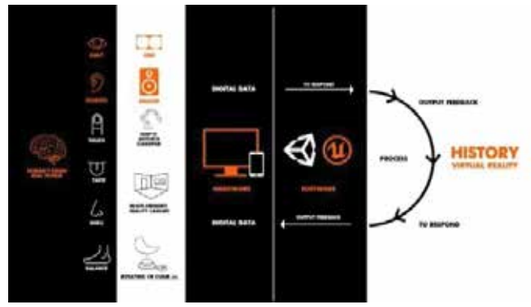

FIGURE 8: Process of virtual environment

FIGURE 8:
A. White ruins of Tsogt taij 8.64mb

FIGURE 8:
B. Virtual Representation of Tsogt Taij's White Palace 6.54gb

3. CONCLUSION

The historic sources to represent the XVI century social way of life, building architecture and culture is not enough. Because of the religious connect, seigneuries collision the records are extremely rare. There is emerging the need of doing research, comparing and concluding standpoints and buildings of influential countries. Tsogt Taij White Palace was chosen as research object because it could represent social life of that time. By doing research on this palace the need of research in fields of poetry, religion. international and inner national relation, Tsogt Taij's philosophy and his patriotism was totally unavoidable.

Based on the hand drawings left by Russian and Mongolian scientists, the design elements, and the ideology of Tsogt taij, this project is confirmed that the building has a tibetian-Mongolian design, the main building has 2 floors, the outer wall has stone walls and consists of up to 6 structures.

Developing programming and VR connection is important for cultivating culture museums where 3-dimensional modelling advances can be used to educate and inform. Also it is important to study exact social life and culture more to impress user and give comprehensive information.

This project achieved a 30.6 percent reduction in loading capacity compared to previous computer-based virtual museum projects and a 24.4 percent reduction from the White ruins of Tsogt taij project.

Lastly, I suggest especially researchers who study the cultures of nations to cooperate so that the research and work results will be more accurate, organized and capable of resolving the public issues.

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Launch of the »Design thinking lab – Coworking« project at the Faculty of design and why it is important for the new generations of students

Anamarija Čuden
Faculty of Design
Ljubljana, Slovenia

Prof. Nada Rožmanec Matičič
Faculty of Design
Ljubljana, Slovenia

Assoc. Prof. Jordan Berginc, PhD
Faculty of Design
Ljubljana, Slovenia

Corresponding author: anamarija.cuden@gmail.com

ABSTRACT
The thesis presents a starting point for the creation of a new Design Thinking Lab - Coworking. In the empirical part, the results of a survey that we conducted with students of the Faculty of Design are presented, on the basis of which we designed the marketing plan and the basic program of operations.The DiFer modular furniture line is specially designed for the Design Thinking Lab - Coworking, which allows the room to be quickly and conveniently adapted to the purpose of use. The development of the mentioned furniture line and the view of the room are presented with the help of visualization techniques.

KEYWORDS
Design / Management / Design Management

1. INTRODUCTION

The aim of this thesis is to present a case study for the Design Thinking Lab at the Faculty of Design, which will serve as a coworking space and a catalyst in the new location of the faculty. The thesis outlines the fundamental guidelines for the activities of the new Design Thinking Lab, aligning with the vision of the Faculty of Design. It also proposes a tentative program that can be implemented within the coworking space, considering the organization's life cycle as a sub-brand of the faculty. The program is designed to be implemented in three phases: short, medium, and long term.

The final part includes visual representations of the space, such as a floor plan and photorealistic renderings. These graphics provide a tangible depiction of the new Design Thinking Lab.

The new Design Thinking Lab holds significant potential for fostering the development of future freelancers in the creative profession. As a sub-brand of the Faculty of Design, it plays an important role in connecting established professionals with creative students, serving as a valuable point of interaction.

The purpose and objective of this article are to translate theoretical knowledge into practical application through the conceptual design of the space, the arrangement of elements, and the anticipation of workflow. The theoretical research conducted will contribute to the establishment and operation of the Design Thinking Lab, outlining its potential for growth in the years to come.

This article will provide the next generation of the Faculty of Design with the opportunity to create and connect in a creative space that also functions as a classroom. The new space has the potential to facilitate student collaboration, foster innovation, and support the launch of young start-ups. It is assumed that the coworking space will significantly contribute to the promotion of student design and innovation projects. Through the promotion of creative design thinking and the presence of professional mentors, it is expected to facilitate networking and collaboration among students from different disciplines and nationalities.

To address the topic, a combination of methods were applied, including surveys for quantitative data, peer-reviewed articles, comparative studies, and concrete conceptual design. Software tools such as AutoCAD, ArchiCAD, SketchUp, Adobe Photoshop, and Adobe Illustrator will be utilized in the process.

Student/user interest analysis - presentation of results of the survey

To investigate the demand for the Design Thinking Lab concept among student users, I conducted an e-survey using the questionnaire, which consisted of 17 questions. Out of the 192 survey clicks, 50 valid responses were submitted. The respondents exclusively comprised students from the Faculty of Design, with 18% male and 82% female participants. Among them, 18% were 23 years or older, while the remaining belonged to the age group of 19-23 years. Regarding their student status, 36% of the respondents were studying on the side, while 64% were full-time students. Additionally, 8% were employed full-time, while the remaining 92% were job or project seekers.

For the next set of questions, a 7-point Likert scale was used to measure the respondents' levels of agreement with specific statements. The average responses indicated that students were not fully committed to developing their own ideas, lacking the extra incentives such as training or co-financing of resources. The highest percentage (38%) of respondents agreed with the statement regarding participation in multidisciplinary projects involving students from different faculties, followed by "strongly agree" (30%) and "agree more than disagree" (18%).

Regarding the willingness to work on their own extracurricular entrepreneurial projects, 34% of respondents agreed, followed by "strongly agree" (30%) and "agree more than disagree" (14%). This demonstrated a high degree of openness and willingness to collaborate in multidisciplinary teams with diverse expertise and experience. When asked about the number of active hours they would invest in their project/idea per week, 38% of respondents chose "up to 20 hours," followed by 38% selecting "up to 10 hours," and 22% opting for "20 or more hours."

The next set of Likert scale questions revealed that students expressed a strong desire to be more involved in developing their own ideas and products. The average ratings for agreement with the statements "One day I would like to create my own brand of the product I am going to create," "Most successful start-ups need effective mentoring support to enter the market," and "Entrepreneurial training is crucial for the success of a company" were 6/7, 5.8/7, and 5.5/7, respectively. The average rating for agreement with the statement "I would be willing to present my idea (by pitching) to other faculties with my team members" was 5.8/7.

When asked about awareness of support opportunities provided to start-ups through the entrepreneurial support ecosystem, 24% of respondents indicated that they did not follow them at all, followed by 22% who said they followed almost nothing, and 20% who were not aware at all. Additionally, 42% of respondents reported having very little experience working with other professional profiles such as natural scientists, engineers, civil engineers, architects, and social scientists.

The final open-ended question received 50 responses, with 29 individuals expressing their willingness to take on the entrepreneurial challenge alone or in a team.

Interpretation of results

Based on the survey results, it is evident that establishing a Design Thinking Lab project at the Faculty of Design would be a valuable addition to the mandatory curriculum. The majority of students expressed their interest in starting their own brand in the near or distant future. The survey also highlighted the students' awareness of the significance of effective mentoring support and entrepreneurial training. Encouragingly, students are willing to dedicate approximately 20 hours per week to develop their entrepreneurial ideas while studying.

However, the survey revealed some areas where students lack knowledge and experience. These include the importance of integrating different disciplines and working in interdisciplinary or multidisciplinary teams, as well as the involvement in international networks. Students also expressed a lack of familiarity with support options available for young startups.

Based on the overall responses, several key findings emerged. Firstly, students require additional incentives to actively participate in the Design Thinking Lab. Offering a variety of motivational entrepreneurial workshops to nurture their product development and startup initiatives would be beneficial. Secondly, there is a need for enhanced involvement of students in collaborative tasks and projects

that span across faculties, universities, and international design platforms.

To maximize the potential of the Design Thinking Lab, it is crucial to integrate suitable timing and products into the entrepreneurial support ecosystem, thereby leveraging financial and other resources. Lastly, appointing a manager dedicated to implementing brand development guidelines and achieving both short-term and long-term goals is essential for the Lab's success. These insights provide valuable guidance for the future implementation and growth of the Design Thinking Lab at the Faculty of Design.

Based on the findings, the following outlines the basic guidelines for the activities of the new Design Thinking Lab, which is in line with the vision of the Faculty and operates as a stand-alone brand within the Faculty of Design. The future of education brings us more and more combined - hybrid work and tends towards new, innovative learning approaches that the Design Thinking Lab would accommodate. Design fosters a better connection between individuals, products and organisations, helping to realise an organisation's strategy (Berginc 2016, p. 20).

Detailed description of the project

- Title: Design Thinking Lab FD
- Legal form: Private-public institution with partners
  Activity: Educational activity
- Purpose: To impart knowledge to young people on creative thinking and entrepreneurial themes

Tuli Kupferberg: "When patterns are broken, new worlds emerge."

The Design Thinking Lab aims to create a collaborative environment where students from various faculties can come together to explore entrepreneurship, network, and develop their creative and innovative ideas with the guidance of expert mentors. The vision of the Lab is to become a highly visible and internationally renowned hub for student-led design thinking, stimulating and incubating the ideas of young creatives while providing networking opportunities and additional knowledge in the field of creative entrepreneurship. The primary objectives are to engage as many students as possible in the program and deliver high-quality training in creative entrepreneurship to facilitate their transition into future entrepreneurial endeavors.

Design thinking is a problem-solving method that can be applied across different fields, focusing on creatively addressing the challenges that arise in the modern world. At its core, design thinking centers around understanding people's needs empathetically. Various definitions highlight its interdisciplinary nature, combining the sensibilities and methods of designers with technological feasibility and business strategies to create customer value and market opportunities. The design thinking process typically involves five steps: empathizing, problem identification, solution suggesting, prototyping, and testing. These stages can be followed sequentially or combined in the creative thinking process.

Design thinking extends beyond traditional design disciplines and encompasses social sciences, humanities, economics, engineering, and more. It offers a holistic approach to problem-solving and strategic planning, enabling companies to adapt to rapid changes, market trends, and individual needs. By fostering innovative thinking, design thinking helps organizations become more agile and gain a competitive edge in the dynamic twenty-first-century landscape. However, companies must overcome constraints and competition to achieve success. Good research and an understanding of feasibility, idea viability, and desirability are crucial for effective design thinking. Applying design thinking to business problems can improve work quality, communication, organizational culture, and overall competitiveness, as it uncovers areas of weakness and identifies opportunities for growth.

In summary, the Design Thinking Lab provides students with a platform to embrace design thinking principles, collaborate across disciplines, and develop innovative solutions to real-world challenges. By integrating empathy, problem-solving, and interdisciplinary approaches, the Lab empowers students to become creative entrepreneurs and addresses the evolving demands of the modern business landscape.

Purpose and vision of the space

The Design Thinking Lab is (planned to be) situated on the ground floor of an office building at 129 Dunajska Street, conveniently located just a 10-minute bike ride or a 5-minute bus ride from the center of Ljubljana. This location is particularly advantageous for students, with student hostels at Kardeljeva ploščada and other faculties such as the Faculty of Economics, Faculty of Social Sciences, Faculty of Education, and Faculty of Administration in close proximity.

Within this urban environment, the Design Thinking Lab serves as a vital hub that bridges industrial and creative activities. Its vision is to transform the values of industry by enriching them with design, which represents the highest value of corporate culture.

The entire space is designed to accommodate groups of up to 50 people and is divided into four sections. The first and largest section is dedicated to events, group work, lectures, and workshops, with a capacity of approximately 35 people. The second section consists of a partitioned room or meeting room, suitable for small workshops, meetings, and group work for up to 15 people. The third section comprises a smaller enclosed area for printing and storage of larger materials. Lastly, there are dedicated toilet facilities.

The floor plan presented in Figure 19 illustrates the layout of the space. This layout is inspired by Selingo's (2018) study for Steelcase titled "The Future of Faculty Offices - Rethinking Existing Spaces to Create a Student Friendly University." The article compiles studies and best practices from American universities and proposes three guidelines for improving university spaces in the future.

One of the proposed methods is the concept of a "third space." As described by Oldenburg (1999) in his work "The Great Good Place," people need a third space, distinct from home and work, where they can connect, meet, and network. In contemporary times, cafes often fulfill this role. Networking with professors is crucial for students' success, and these interactions often occur in informal settings such as corridors. However, approaching professors in formal spaces can be more challenging.

Therefore, the design of the Design Thinking Lab as a "third space" is meaningful. It offers a flexible environment where students can connect with experts and professors outside of office hours. Additionally, the lab welcomes everyone, including alumni, retired professors, and those currently studying and teaching, fostering a collaborative and inclusive atmosphere.

Planned activities and implementation phases

The activities foreseen for the Design Thinking Lab will be partly permanent and partly flexible. Entrepreneurship arenas, trainings, international projects, innovation camps, entrepreneurial breakfasts, cafés, workshops are just some of the ideas; the initial timetable and the phases of implementation of the objectives are described below. The Design Thinking Lab will be open to all students, Monday to Friday, from 9.00 to 21.00. Outside of the activity hours, the space will be available for coworking, for students to work on group projects, for anyone who wants to start developing their idea and doesn't know where to start. The space also has a printer, 3D printer and laser cutter for prototyping.

A week in Design Thinking Lab

MONDAY	Business gatherings on selected themes	9.00–11.00 in 17.00–19.00
TUESDAY	Entrepreneurial arenas	18.00–20.00
WEDNESDAY	Thematic workshops (pitch, marketing, idea funding, social networks...)	17.00–19.00
THURSDAY	Mentoring	9.00–15.00
FRIDAY	Socialising/networking for all	19.00–21.00

FIGURE 1: Weekly schedule at the Design Thinking Centre

In Phase 1 (1-10 months), the focus is on establishing a new department at the Faculty of Design that encourages students to engage in applied design thinking challenges. Regular events, workshops, and study courses would be organized to foster creativity and innovation. The project would be publicized, and the target group would be recruited through social media platforms such as Facebook, Instagram, and LinkedIn. Networking with potential mentors and mentees, including successful alumni, active students, entrepreneurs, and professionals from various design disciplines, would be a key aspect. Additionally, a website would be set up to provide information and resources.
Phase 2 (10-24 months) would involve expanding the network by connecting with students and professionals from abroad. Events, workshops, and mentoring activities would continue to facilitate collaboration and skill development. A creative hackathon would be organized to promote participation among students. Social media management would be carried out with relevant content, and efforts would be made to publish articles in print media. Guest lectures by successful alumni would be arranged, and content for an e-newsletter would be created. The Design Thinking Lab would also aim to have its own publications featured in foreign newsletters and journals.
In Phase 3 (24-36 months), the project would seek publicity to secure public funding. Competitions would be organized, and collaboration with different faculties would be pursued. The dissemination of knowledge on the applicability of design thinking in all sectors would be emphasized through lectures for companies. The support network would be expanded, events would be announced, and collaborations with diverse creatives would be fostered.

In the long term, the Design Thinking Lab would add value to the Faculty of Design by bridging creative studies with industry. It would provide knowledge that complements the mandatory higher education curriculum and support young professionals in pursuing entrepreneurial paths after graduation. The Lab's impact would align with findings from a study (Eagle 2022), which highlights coworking spaces as accelerators of entrepreneurship and talent development through increased interactions and collaborations.

The target group primarily includes students from creative studies in Ljubljana, followed by students from other disciplines interested in incorporating design thinking into their creative process. Alumni of the Faculty of Design, young successful designers, and entrepreneurs also form part of the target audience. Different communication and interaction strategies will be employed for each group.

The marketing strategy and communication channels encompass LinkedIn, Facebook, and Instagram profiles, an e-newsletter, occasional print media publications, brochures, a dedicated website, and online media platforms of foreign faculties. Participation in events, workshops, conferences, trade fairs, and student events, as well as networking with partner organizations, would also play a role in outreach efforts.

Regarding the organizational structure, the Design Thinking Lab would operate as an independent institution under the umbrella of the Faculty of Design. Funding would come from a combination of public funds, supporters/ sponsors, and donations, as well as revenue generated through workshops conducted for external faculties and companies. The Lab would initially have one Design Faculty Associate responsible for entrepreneurship and design, with the possibility of engaging external collaborators for technical and professional services.
Overall, the Design Thinking Lab aims to create a thriving ecosystem that nurtures creativity, innovation, and entrepreneurship while connecting students, professionals, and the broader design community.

SWOT analysis of the Design Thinking Lab project

Strengths:
The Design Thinking Lab brings several
strengths to its operations. It introduces Design Thinking to a wider audience, promoting problem-solving and innovation techniques. It also raises the profile of the Faculty of Design and offers opportunities for public funding. With a wide network of creators, it encourages collaboration and interdisciplinary approaches. The Lab promotes entrepreneurship among young people and provides practical skills. It shares knowledge in diverse fields and facilitates networking and potential partnerships.
Weaknesses:
The Design Thinking Lab faces some weaknesses. There is a lack of awareness about the importance of design across sectors. Inflation and economic crises can impact resources and funding. The dispersion of the design profession poses challenges in building a cohesive community. Limited knowledge of design and management practices can hinder optimal utilization of resources.

Opportunities:
The Design Thinking Lab has opportunities for growth. International cooperation can expand collaboration and knowledge sharing. Workshops in different fields cater to a broader audience. Guest lectures for students from all disciplines provide valuable insights. Networking with industry professionals strengthens partnerships. The alumni network can foster connections. Career counseling services and merging short-lived disciplines encourage innovation.
Threats:
The Design Thinking Lab must be aware of potential threats. Competition from copied concepts by other incubators and centers may dilute its uniqueness. A competitive project like the KCDM project can divert attention and resources. Insufficient interest from the target audience may impede growth. Attracting sponsors and investors may be challenging in a competitive funding landscape.

FIGURE 2: Cross - section of the new Design thinking lab

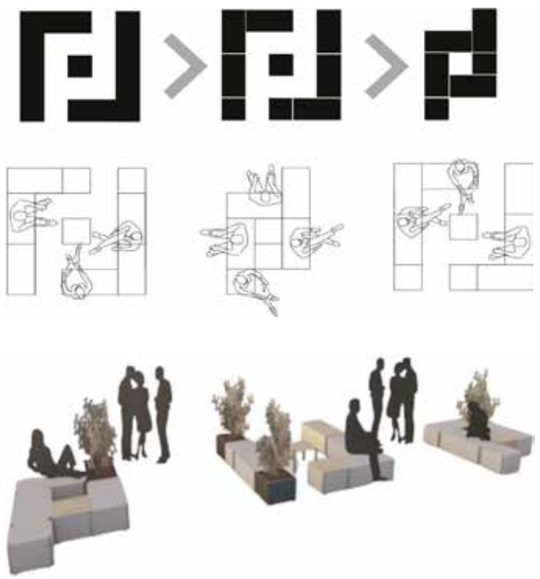

FIGURE 3: Demonstration of the development of a modular system

FIGURE 4: Visualisation of the space - an example of a gathering

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Small space, big home – conceptual renovation of an apartment

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Eva Šintler
Faculty of Design
Ljubljana, Slovenia

Assist. Prof. Tamara Hajdu
Faculty of Design
Ljubljana, Slovenia

Corresponding author: tamara.hajdu@fd.si

ABSTRACT
Nowadays, the popularity of small apartments is increasing. Due to financial hardship and rising prices on the real estate market, young people are increasingly choosing to live in apartments with a smaller surface area, but if they want to use their full potential, they must be more creative with small spaces. A major challenge of designing a small apartment is maintaining the quality of life that you would have in a larger living area.

1. INTRODUCTION

The aim of the project is to renovate a flat with a small surface area, located on the ground floor of an apartment building. We were looking for solutions that should give the feeling of a larger space and we tried to create as passable a space as possible. The purpose is to explore different ways to design a small space and fully adapt it to the wishes of the clients. We delved into the functional use of space, sustainable design, and at the same time we created a sense of prestige in the space, which is not limited only to larger surface area.

With a new floor plan design and flexible furniture, the apartment will feel more open and therefore larger than the actual area it occupies. In the assignment, we explored different ways of designing and transforming space from the point of view of sustainability, which is crucial for the growth of society. With a minimalist design style, we offered the room flexibility and usability.

2. SUSTAINABILITY

“Whoever wants to create good design must do so sustainably and on a long-term basis. This requires mutual understanding, commitment and willingness to take risks. This is what I want for myself and what we designers need.” (Predan and Požar 2009, p. 23)

It is the responsibility of designers to try to extract something useful and aesthetic from a poorly designed, thoughtless environment saturated with information. We have polluted the world as we know it today with poor design, garish colours and violent shapes. We have created an artificial reality that harms the naturally formed world and has allowed individual interests to take precedence over society. The key is to change our behaviour, and we should be guided by the principle of “less, but better”. We must strive for a smaller quantity of products that are designed with high quality and are not subject to trends, but to sustainability. (Predan and Požar 2009)
“Sustainable design as a discipline, deals with the creation of objects, spaces and experiences that follow the fundamental guidelines of economic, social and environmental sustainability.” (Predan and Požar 2009, p. 51)

In the past, a man was better connected to the earth. People lived with nature, were more attached to it and knew that they depended on it. Nowadays, we are aware of the negative impact we have caused to our biosphere, but these were the topics that appeared many years before. The environmental issue first appeared in the 13th century, when the German theologian Meister Eckhart described the earth as a fragile resource, and people as figures who have the power to intervene and change it. With the industrial revolution, excessive materialism also appeared in the world for the first time as a result of easier and faster manufacturing of products. For the first time, we can talk about ecological awareness spreading in society. (Predan and Požar 2009)

People are greedily depleting natural resources without considering the footprint we are leaving behind. We have to change the way we think. We need to focus on the cause, not how to alleviate the consequences. For example, the key is to reduce the amount of waste material we produce, rather than just worrying about what to do with that waste and not reducing its amount. We need to create products that have a longer lifespan, and use new practices, ways of thinking and methods to create them. (Predan and Požar 2009)

We can contribute to change by combining new and old technologies. Much inspiration can be drawn from traditional buildings and their designers, while incorporating new products such as LED lights and replacing environmentally unfriendly materials with the use of more sustainable ones. (Moxon 2012)

Quality architecture and design are determined not only by appearance, but also by their durability and sustainability. The buildings we live in can only be preserved if they follow the dynamic transformation of the society, which means that the building must also be transformed. (Steel 2019)

As part of the green transition, the Republic of Slovenia has designed a number of plans that will help us fulfill the path outlined in the national energy and climate plan of the Republic of Slovenia and the European Green Agreement, among them the sustainable renovation of buildings, the purpose of which is to promote the renovation of buildings and at the same time at least 30 per cent lower energy consumption compared to the starting position. The results will be achieved by investing in the thermal insulation of buildings, with high-quality windows and doors, energy-efficient lighting and efficient ventilation and heating systems. (C1K2 – Sustainable renovation of buildings. Acquired 10. 5. 2022)

Slovenia plans to decarbonize the building stock by 2050, whereby the main part of the existing buildings will be used. They expect 74 percent of renovated single-family buildings and 91 percent of renovated multi-family buildings. (Sustainable building. Acquired 20. 3. 2022)

When renovating the interior, the designer plays a key role, but must be aware that no material is completely sustainable. When planning and choosing materials, the designer has to take a lot of responsibility and decide where the positive prevails over the negative and take environmental aspects into account, especially in the area of energy and water consumption.

2.1 EXAMPLES OF GOOD PRACTICES OF SUSTAINABLE DESIGN

2.1.1 ZERO WASTE HOUSE

The zero-waste house in Žalec is a project where the architect Jona Rak Koceli and the environmentalist Andrej Fideršek participated. The project involves the renovation of a 130-year-old building, which is expected to be completed at the end of 2022. The new building will be built within the dimensions of the existing building, the materials that will be used for the construction will consist of 80 percent of the material that was created with the demolition of the existing house, and the rest from the local materials. The new house is planned in such a way that it will produce almost no waste and will be more self-sufficient. The project was awarded the New European Bauhaus Award and promotes sustainable solutions with its originality. (Bračič 2022)

FIGURE 1: Zero waste house, current state (Bračič 2021

FIGURE 2: Zero waste house, new plan (Bračič 2021)

2.1.2 NIGHTINGALE 1 COMMUNITY

Nightingale Community was created by the non-profit organization Nightingale Housing, which provides housing that is socially, financially, and ecologically sustainable. They are committed to building homes for people and not for profit. Their approach consists of four important points:

- Sustainability: the buildings are energy efficient, with carbon-neutral systems and rooftop solar cells, they are built close to public transport and have the ability to store rainwater for the gardens.
- Community: apartments are sold to future residents and not to investors. The building features common areas such as a laundry room and gardens that allow the community to bond even more.
- Price: the organization wants to provide homes for people and not profit from the sale of the apartments, the principle must be adhered to when selling the apartment later.
- Low costs: the investment is made in the long term, for this reason the residents are provided with solar panels on the roof and a shared and thus cheaper connection to the Internet. (We make homes for people. Acquired 9. 8. 2022)

FIGURE 3 Nightingale Housing
(We make homes for people. Acquired 9. 8. 2022)

The apartment building has 20 one-bedroom and two two-bedroom apartments and three business premises. The facade is made of recycled bricks in the lower part and a steel-glass structure in the upper part. Preference is given to common areas, such as the laundry room and the roof, which has a terrace, sandboxes for children, greenery and shared gardens. (Beath 2020)

3. SMALL APARTMENTS

Over the past few decades, the world has seen new ways of living due to various social, economic and ecological changes. The changes are also reflected in architecture and interior design, where people choose different ways of living than were common in the past. When designing a space, in the past, the users of the space and their needs were always put first, as it was important to create the most practical and functional environment for him. Changeability, privacy, inclusion and sustainability are now at the forefront. (Stouhi 2022)

Scientists expect that as much as 60 percent of the population will live in cities by 2030, so it is crucial to redefine what a typical form of living is. Due to the lack of space in urban centres, co-living is becoming more common, popular especially among younger generations, where residents have less private living space and much more common surface area, which is used for washing clothes, cooking and socializing. In addition to cohabitation, more and more people are choosing to live in small or micro-apartments, which enable cheaper and more sustainable living in larger city centres. (Stouhi 2022)

Many people in modern times ask themselves the question, what will the future of urban life look like? For most, the answer is a life that puts sustainability first, but that doesn't mean we have to cut back on the comforts of our lives. It means thinking carefully about what we really need to create a home where a bigger home does not mean a better one. (Beath and Price 2021)

Planning a small home can be approached in different ways. We can design multi-purpose rooms or furniture that adapts to the resident's needs. We can use vertical instead of just horizontal space and create a home at different height levels. A big challenge is designing a small apartment in an old building, where we have to adapt to the building, but at the same time respect it and preserve some of its character. The most welcome is creativity, where we do not limit ourselves with standard equipment and adapt the furniture to our measurements and needs, making maximum use of the space. (Beath and Price 2021)

3.1 EXAMPLES OF GOOD PRACTICES OF SUSTAINABLE DESIGN

3.1.1 MICROLUXE

Designed by architect Ben Edwards of Edwards Studio, the apartment is in Fitzroy, Melbourne. It is one of many apartments that are set in a completely normal exterior. This further encouraged the author to create something surprising on 22 square meters. His idea was to combine the function of an apartment with the function of a sales space, where guests could also buy certain furniture or simply be inspired by the space. (Beath and Price 2021)

FIGURE 4 Micoluxe (Wu 2016)

Microluxe is a project that shows that there is no need to compromise prestige with a small square footage. None of the decisions and materials used are boring or expected, creating a truly exceptional interior that is also very functional.

3.1.2 ITINERANT

The Itinerant is a 29-square-meter apartment in Richmond, Melbourne, designed by T-A Square Architects. The space was designed for the architect Timothy and his wife Linda. The couple bought an old, unkempt apartment from the 1960s. The original idea was to convert the floor plan into a home and a hotel at the same time.

The author drew inspiration from Scandinavian and Japanese interiors. He used the texture and warmth of natural wood, which became the main guide in design. Behind the closed cupboards is all the appliances, as the couple wanted to hide the mess that could arise very quickly in such a small apartment. Only the lower kitchen cabinets in contrasting black remained visible. The location of the bedroom and bathroom has remained the same according to the old layout of the room, the biggest changes are in the living room with kitchen and dining room. The private spaces are separated from the others by a storage element, through which we also access the more intimate spaces. (Beath and Price 2021)

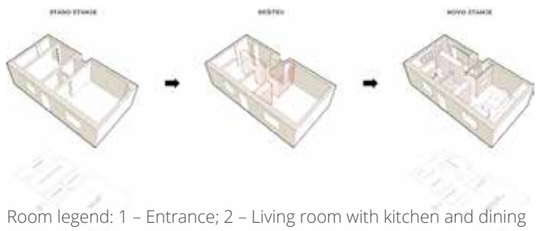
FIGURE 5 Micoluxe (Wu 2016)

In smaller apartments, the problem of the accumulation of appliances, everyday objects and clothes occurs more quickly, so it is very important to provide a sufficient amount of storage areas in the room. In the case of the Itinerant the interior combines the practicality of storage cabinets with the fun element of moving around the room on a very small surface area.

4. CONCEPTUAL RENOVATION OF AN APARTMENT

The apartment is located in a multi-apartment house that was built in 1901, in the Ljubljana- district of Moste on Zaloška cesta. The ground-floor apartment is accessed through a shared courtyard, where parking is also organized for the residents. The apartment is being renovated for a young couple who want to modernize and adapt the current outdated arrangement to their lifestyle. The apartment has not been renovated, therefore, in addition to refreshing and arranging the furniture, it is also important to change and update the electrical and plumbing installations.

After consulting with the clients about their desired changes in the apartment, we measured the apartment precisely. Based on the measured information, we drew a draft of the existing situation with furniture placements, different placements of new walls and demolitions. The proposal they had involved quite a lot of demolition, so when the work continued, we consulted a structural engineer and determined how we would implement the planned solutions. After the client and the structural engineer approved the floor plan, the selection of the materials followed. The clients wanted the style of the apartment to be minimalist, but still fun and, above all, prestigious. It was also important to them that the renovation of the apartment would be sustainable, because it was for this reason that they decided to renovate their grandparents' old apartment and not buy a new property. We decided to use materials such as wood, recycled plastic and stone, which is not environmentally friendly due to the demanding extraction process, but can be defined as sustainable due to its durability and resistance. In order to create the optical illusion of a larger apartment, we also used a lot of mirrors in the interior. The couple will buy the dining table and chairs second-hand, as well as the second-hand tables next to the sofa set, which will be upholstered in recycled textiles as a wall covering in the sleeping alcove. In order to use the apartment as much as possible, we decided that most of the furniture would not be bought, but made by carpentry. After the selection of all materials was completed, the rest of the implementation plans were drawn up.



Room legend: 1 – Entrance; 2 – Living room with kitchen and dining room; 3 – Bedroom; 4 – Bathroom; 5. Bathroom with utility; Total surface area – 41.79 m2

FIGURE 7. 3D visualization of the central space

LEGENDA PROSTOROV:

1.	VHOD	3.43 m²
2.	DNEVNI PROSTOR S KUHINJO IN JEDILNICO	19.80 m²
3.	SPALNICA	7.37 m²
4.	KOPALNICA	1.88 m²
5.	KOPALNICA Z UTILITY-JEM	9.31 m²
Skupaj:		**41.79 m²**

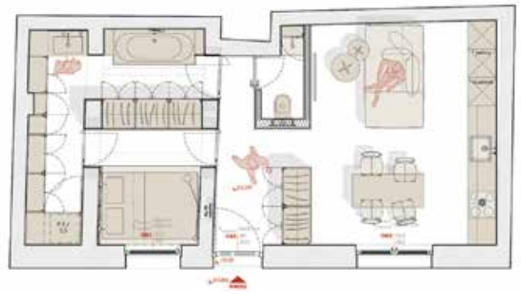


FIGURE 8 Apartment plan

FIGURE 9. 3D visualization of the kitchen
FIGURE 10. 3D visualization of the living room

FIGURE 11 3D visualization of the bathroom

FIGURE 12. 3D visualization of the bedroom

5. CONCLUSION

In the assignment, we presented the conceptual design of the renovation of an apartment in a multi-apartment building in the Moste district in Ljubljana. The beginning of the research combined learning about the topics that are included in the final result of the project. Initially, we researched sustainability, why it is important for the future of construction and renovation, and examples of good practices. This was followed by an analysis of the minimalist style, its history and representatives in both architecture and design, and their representative works. Then we focused on the way of living in smaller apartments and creative real-life examples of micro apartments.

Arranging a large surface area is much less of a challenge than arranging a home in a small space, where it is necessary to create a functional and pleasant environment that is not cramped. It is necessary to plan the space carefully and use every centimetre of space. It is necessary to utilize the entire vertical, as this enables storage without unnecessarily occupying valuable floor space. The final project showcases an apartment with a transitional floor plan with a minimalistic design style and the use of sustainable materials in the renovation, incorporating prestige into a small surface area.

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Urban4furniture - unique project of urban furniture according to the corporate identity of Faculty of design

Prof. Nada Rožmanec Matičič
Faculty of Design
Ljubljana, Slovenia

Assist. Prof. Karin Arzenšek
Faculty of Design
Ljubljana, Slovenia

Assist. Prof. Tamara Hajdu
Faculty of Design
Ljubljana, Slovenia

Corresponding author: nada.maticic@fd.si

ABSTRACT
URBAN4FURNITURE – the development project of urban furniture has been made according to the corporate identity of Faculty of design – an independent higher education. We wanted to present that urban furniture is not only a furniture, but we wanted to add character, comfort to our public spaces, helping people to enjoy a better experience outdoors.

KEY WORDS
Urban furniture / Modular furniture elements / Pavilion

1. INTRODUCTION

URBAN4FURNITURE represents of several elements with different functions use of natural materials as wood, iron and ... is not a question of future anymore, but it is our everyday job. Designers have an especially role and social responsibility to make projects according to the 17 goals of AGENDA 2030 and AGENDA 2050.

We divide urban furniture into categories according to different function. Normally it is a place of inter generations meetings, rest, reading the books, playing with children or just enjoy sun and fresh air in the parks or another green zones.

It is also very important to give a separate attention of urban illumination, it means to give light to un open space at night. Urban furniture is a huge field and we represented with this project only few of the options available.

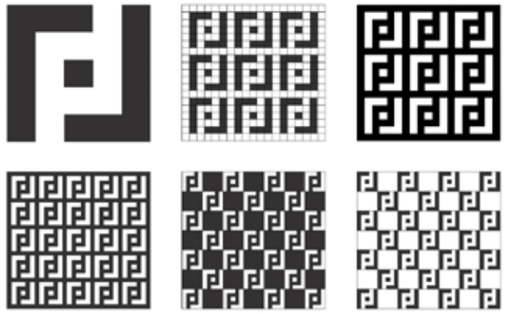
2. DEVELOPMENT PROJECT – URBAN4FURNITURE

With this project we wanted an unique project and with all these elements we can find the best solutions for people needs and the functions of every composition.

Also with this project sustainable innovation involves making international changes to a company's products, services or process to generate long-term social environmental benefits while creating economic profits for the firm.

The square is a symbol of the universe, the earth with four elements, it represents stability, security and strength, both temples and shrines are built in the shape of a square, connected by the four sides of the sky.

The square is one of the most recognizable shapes in 20th century art. The German artist and teacher at the Bauhaus school Josef Albers outlined square shapes in countless coloured areas and spent decades researching the interaction of colours in the Hommage to the Square Project.

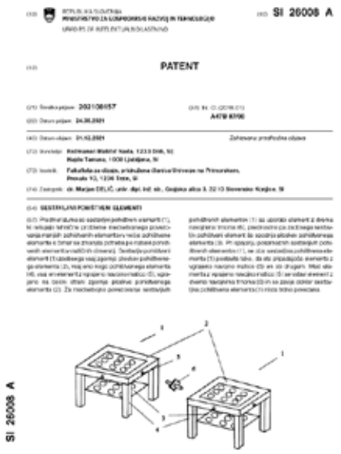


A century ago, Kazimir Malevič, a painter of the Russian avant-garde, painted the Black Square, one of the key works of art: a black square on a white background, questioning the mimesis of painting commandments with a newly established paradigm − Suprematism, with zero form image.

The presented ambient elements of the Faculty of Design also follow a kind of 'decomposition' of form, like Malevič in art, they reduce the classical interior of centuries of various styles, from Renaissance, Baroque, Rococo to Neoclassicism, to an exclusively flat horizontal and vertical line that outlines a square in its pure and perfect form.

The squares with the code of the Faculty of Designs logo consist of a metal matrix in wooden frames, designed into modules in the form of benches, chairs, tables, shelves, which can be randomly assembled, removed or added in the open plan or even placed in a cube interlaced with plants, as a 'temple' intended for contemplation, for a composed reader, a place to rest, to be placed in the garden or to be used as a space for debates, a sort of 9'Plato's Academy', an outdoor lecture room.

3. FOUR PATENTS HAS BEEN CONFIRMED FROM SLOVENIAN INTELLECTUAL PROPERTY OFFICE.



PATENT

SI 26008 A

3.1. PATENT SI 26008 A

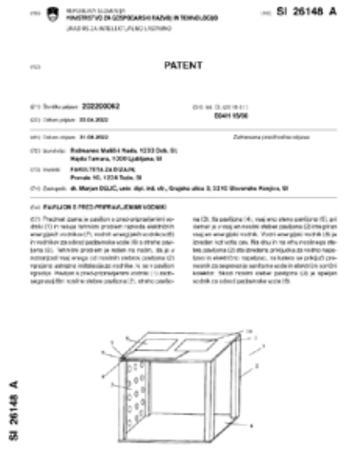
MODULAR FURNITURE ELEMENTS - The subject of the invention are modular furniture elements (1), which solve the technical problems of interconnecting smaller furniture elements into larger furniture elements, thereby reducing the need to purchase furniture elements of different dimensions. The modular furniture element (1) consists at least of the upper surface of the furniture element (4), at least one element with an integrated screw thread nut (5) installed on the side of the upper surface (2). An element with two threaded pins (6) is used to interconnect the modular furniture elements (1), and preferably the modular furniture element includes the lower surface of the furniture element (3). When joining the individual modular furniture elements (1), the two modular furniture elements (1) are placed so that the corresponding elements with the integrated threaded nut (5) are next to each other. An element with two threaded pins (6) is inserted between the elements with an integrated threaded nut (5) and is twisted until the modular furniture elements (1) are firmly connected.

3.2. PATENT SI 26145 A

FURNITURE ASSEMBLED WITH MODULAR ELEMENTS - The subject of the invention is furniture assembled with modular elements (1), which solves technical problems: to assemble furniture into any shape, to be able to subsequently modify the shape of the furniture or to add or to remove individual modular elements, whereby the furniture assembled from modular elements (1) consists of at least furniture support surfaces (2), furniture legs (3), connecting elements (4) and preferably also includes elements with a built-in screw nut (5) and elements with built-in screw pins (6). At the point where the furniture legs (3) are installed on the furniture support surfaces (2), there are drilled holes for the installation of connecting elements (4) both perpendicular to the base plane of the furniture support surfaces on the furniture support surfaces (2) and on the front surfaces of the furniture legs (3), which lie perpendicular to the axis of the furniture legs. Elements with a built-in threaded nut (5) are installed on the side surfaces of the furniture support surfaces (2). The furniture support surfaces (2) are connected to each other with an element with two threaded pins (6).

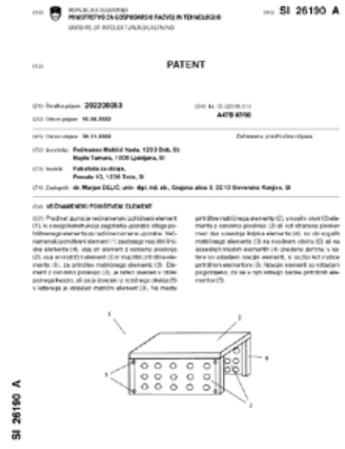
3.3. PATENT SI 26148 A

PAVILION WITH PRE-PREPARED CONDUCTORS - The subject of the invention is a pavilion with pre-prepared conductors (1) and solves the technical problem of technical energy conductors (7), water energy conductors (8) and rainwater drainage conductors (6) from the roof of the pavilion (3). The technical problem is solved in such a way that a suitable installation for conductors, which are installed into the interior of at least one of the bearing pillars of the pavilion (2). The pavilion with pre-prepared conductors (1) consists of at least four supporting pillars of the pavilion (2), the roof of the pavilion (3), the floor of the pavilion (4), at least one wall of the pavilion (5), where at least one energy conductoris installed into at least one supporting pillar of the pavilion (2). The water energy conductor (8) is designed as a hollow tube. At the bottom and at the top of the supporting column of the pavilion (2) there are connections for the water supply, to which the portable water heater and the electric solar collector are connected. A connector for the drainage of rainwater (6) is conducted through the bearing pillar of the pavilion (2).



3.4. PATENT SI 26190 A

MULTI-PURPOSE FURNITURE ELEMENT - The subject of the invention is a multi-purpose furniture element (1), the construction of which ensures the use of the same furniture element for different purposes or use. The multi-purpose furniture element (1) comprises at least four line elements (4), at least one element with a base surface (2), at least one matrix element (3) and at least four fastening elements (5) for fixing the matrix element (3). The element with a base surface (2) can be a rectangular solid or it can consist of a support frame (6) into which a matrix element (3) is inserted. At the point of attachment of the matrix element (3) in the supporting frame (6) of the element with the base surface (2) or as a side surface between two adjacent line elements (4) there are boreholes into which threaded elements are inserted at the corners of the matrix element (3) on the support element (6) or on the adjacent line elements (4), which serve as nuts to bolting elements (5). Screw thread elements are deeply embedded so that the cups of fastening elements (5) can be inserted into them.



4. CONCLUSION

The URBAN4FURNITURE development project is a project that includes various urban furniture, from benches to pavilions, which are intended for various activities both in outdoor and indoor public space and above all take care of the pleasant well-being of people during various activities, be it resting or reading. These elements are coordinated and integrated with each other in such a way that they are attractive and functional. In addition to comfort, the purpose of the equipment is to provide a space with character and the corporate identity of Faculty of Design. The patterns implied in the urban elements come from the logo of the Faculty of Design, an independent higher education institution. Through the development of the urban furniture project, four patents were created, which were confirmed at the Slovenian Intellectual Property Office.

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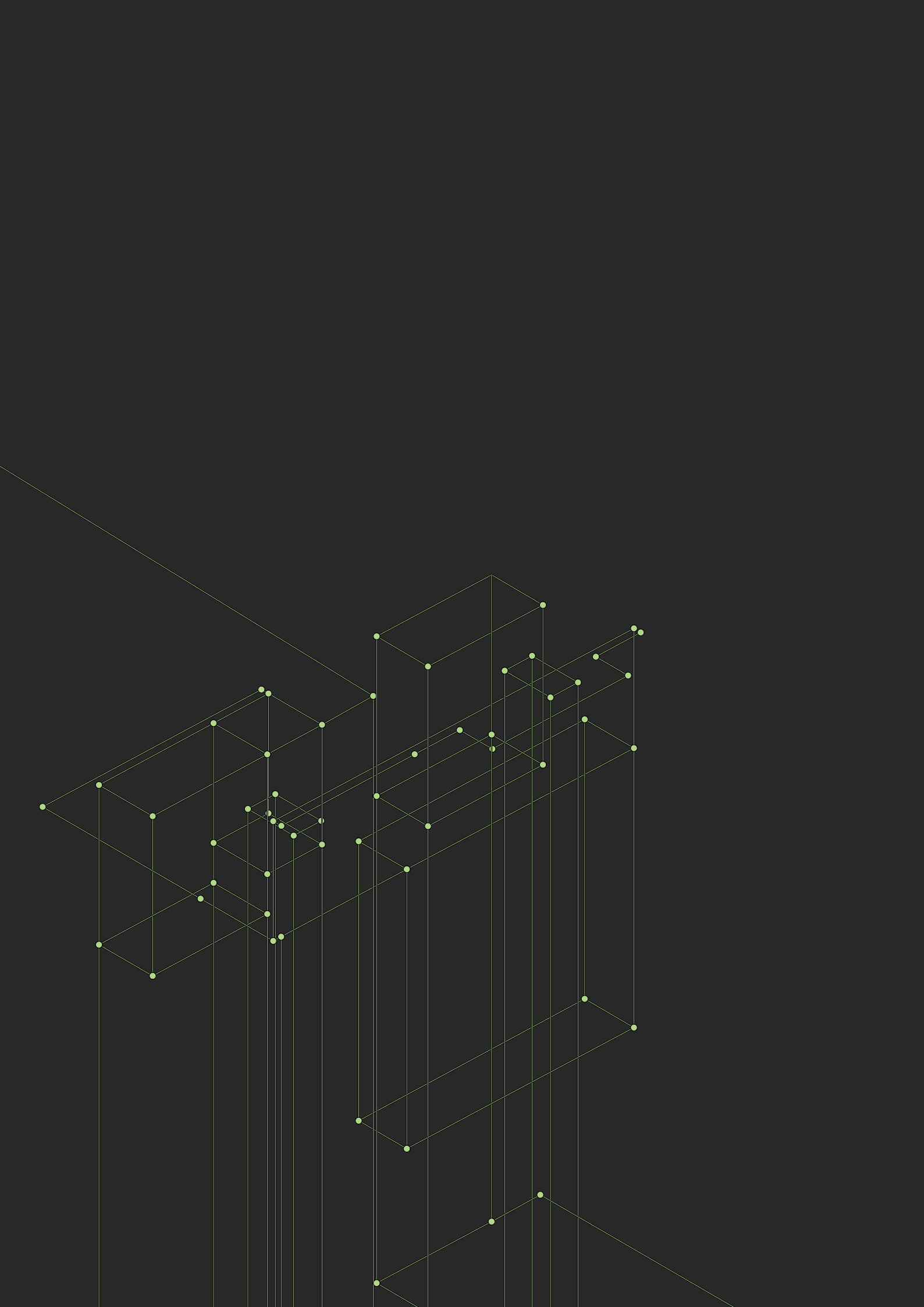
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