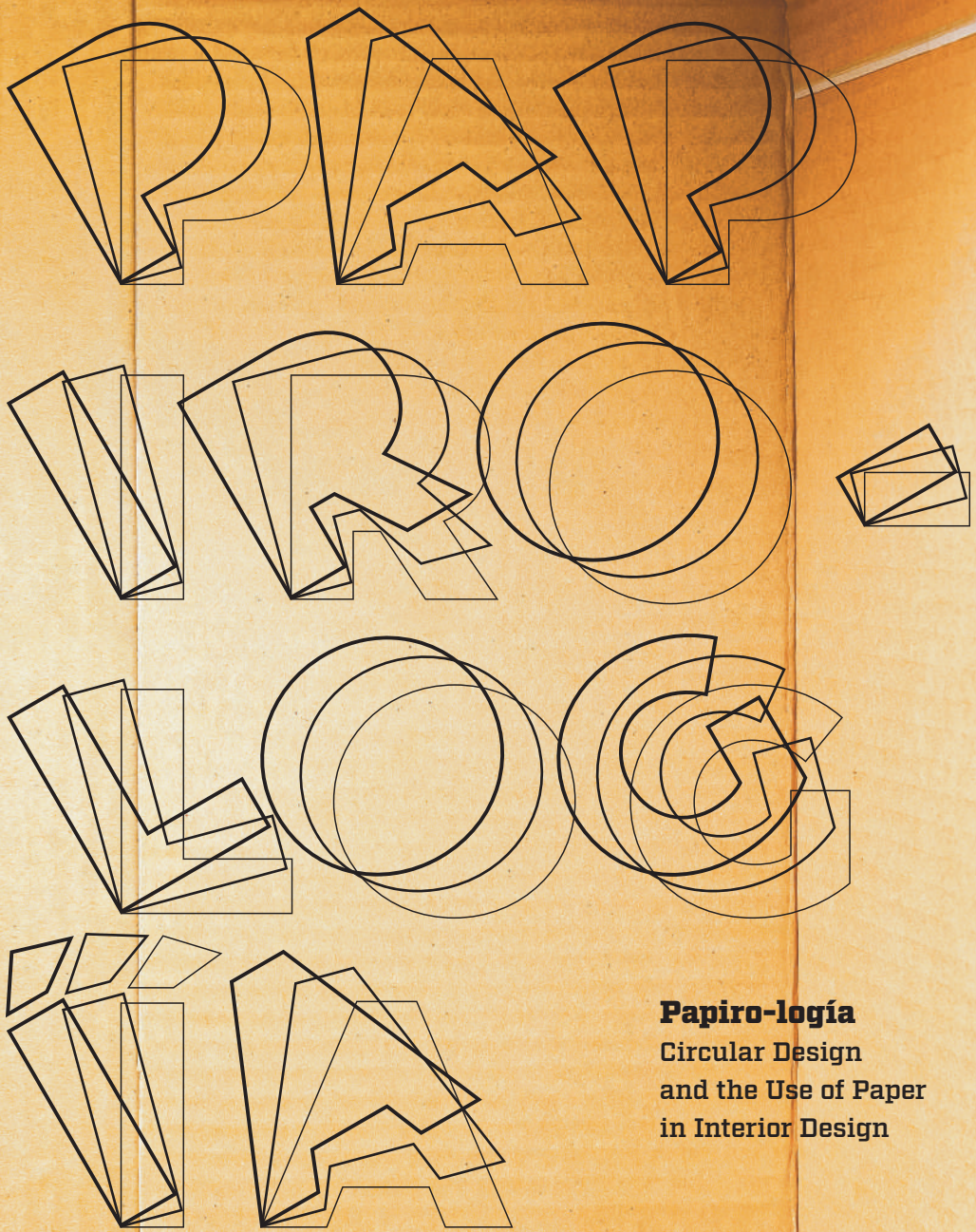
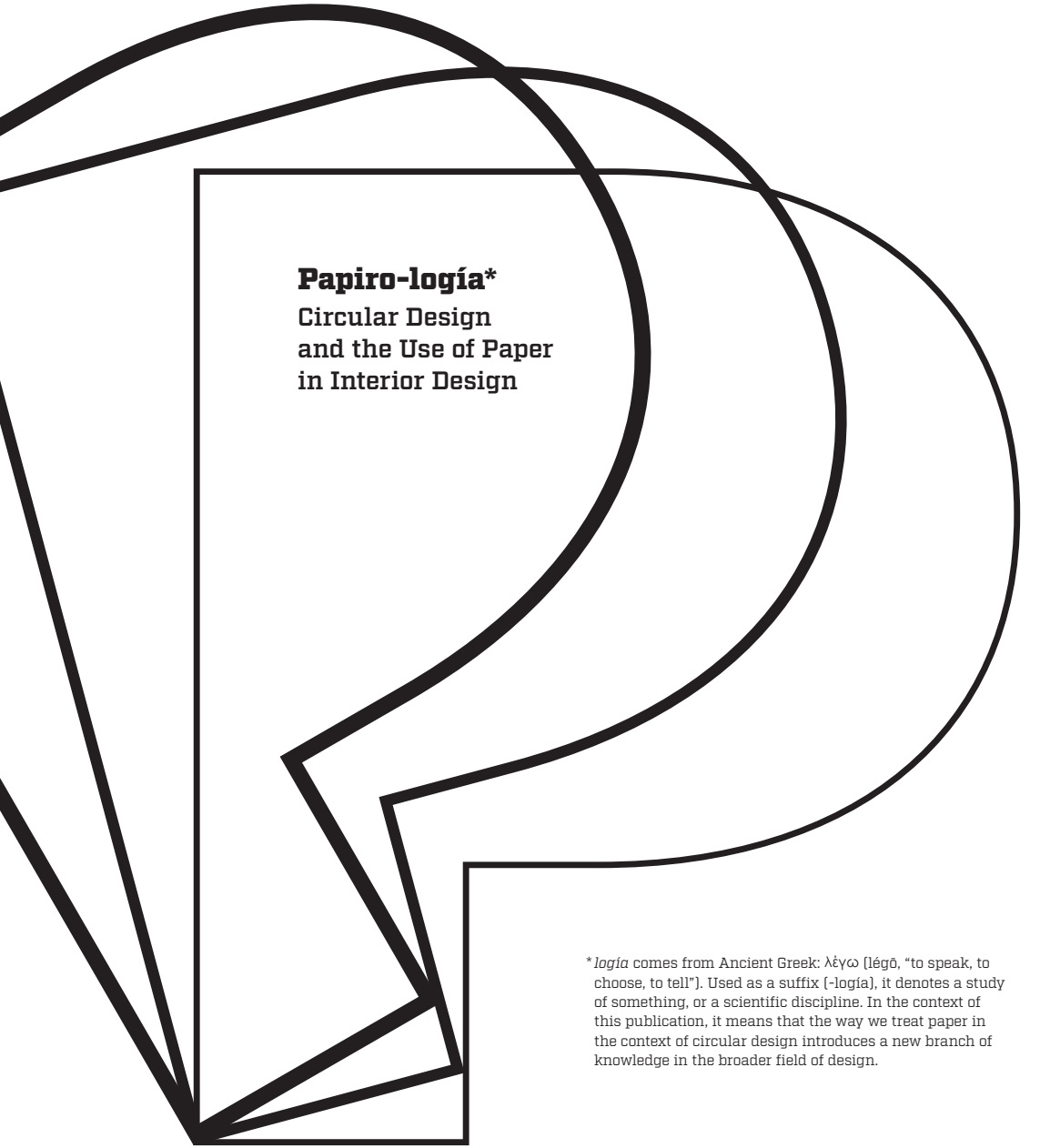


Papiro-logía
Circular Design
and the Use of Paper
in Interior Design

Barbara Predan



Papiro-logía*
Circular Design and the Use of Paper in Interior Design

* *logía* comes from Ancient Greek: λέγω (légō, "to speak, to choose, to tell"). Used as a suffix (-logía), it denotes a study of something, or a scientific discipline. In the context of this publication, it means that the way we treat paper in the context of circular design introduces a new branch of knowledge in the broader field of design.

Regional Development Agency of the Ljubljana Urban Region
Academy of Fine Arts and Design, University of Ljubljana
Ljubljana 2019

Papiro-logía
Circular Design and the Use of Paper in Interior Design

Issued and published by:
The Regional Development Agency of the Ljubljana Urban Region,
represented by **Lilijana Madjar, the Director,** and **the University of Ljubljana, Academy of Fine Arts and Design,**
represented by **Lucija Močnik Ramovš, the Dean**
Author: **Barbara Predan**
English translation: **Tadej Rosa** (Jezikovna zadruga Soglasnik)
Photos: **Kristjan Dekleva, Urša Peršič, Aleš Rosa** (studio photographs of the products), **project authors**
Papiro-logía project authors: **Simon Bregar, Eva Garibaldi, Lin Gerkman, Miha Hain, Jakob Koncut, Neža Medved, Tjaša Mužina, Simon Rozman, Blaž Skodlar, Gregor Stražar, Jera Tratar, Andraž Rudi Vrhovšek**
Mentors: **Assist. Prof. Rok Kuhar, Assoc. Prof. Jure Miklavc, Assist. Prof. Barbara Predan, Assist. Prof. Lidija Pritržnik**
Associate Experts: **Mateja Mešl, MSc, Gregor Lavrič, Barbara Šumiga** (Pulp and Paper Institute), **Alenka Knez, Ajda Regali Knez, Primož Korenč, Miha Krnc, Marko Jurić** (DS Smith)
The texts of students' projects edited by: **Barbara Predan**
Design: **Barbara Šušteršič**
Reviewers: **Dr Boštjan Bugarič, Dr Andreja Kutnar**
Printing: **Cicero, Begunje**
Printing run: **250**
Ljubljana 2019

CIP - Kataložni zapis o publikaciji
Narodna in univerzitetna knjižnica, Ljubljana

745.54(082)

PREDAN, Barbara
Papiro-logía : circular design and the use of paper in interior design / Barbara Predan ; [English translation Tadej Rosa ; photos Kristjan Dekleva ... [et al.] ; Papiro-logía project authors Simon Bregar ... [et al.] ; the texts of students' projects edited by Barbara Predan]. - Ljubljana : Regional Development Agency of the Ljubljana Urban Region : Academy of Fine Arts and Design, 2019

ISBN 978-961-94713-1-9 (Regional Development Agency of the Ljubljana Urban Region)
COBISS.SI-ID 301380608

Project organisation: Within the framework of the INNORENEW CoE project, RRA LUR, together with the Academy of Fine Arts and Design (UL ALUO), the Pulp and Paper Institute and DS Smith packaging company, established an interdisciplinary supply chain focusing on paper furniture.

Project leads: **Urša Peršič, Tina Pezdirc Nagrašek, MA**

The financial support for the project came from the EU Framework Programme for Research and Innovation Horizon 2020 (H2020 WIDESPREAD-2-Teaming; #739574) and investment financing by the Republic of Slovenia and the EU Regional Development Fund.

RRA LUR regional development agency of ljubljana urban region

Founder
Mestna občina Ljubljana
City of Ljubljana

University of Ljubljana
Academy of Fine Arts and Design

INŠTITUT ZA CELULOZO IN PAPIR
Innovative Cellulose Products

DS Smith

TAMTAM

The monograph is provided free of charge.

Table of Contents

Foreword by the lead partner
Closing the Circle

In the region and the country as well as the world, considerable attention has been given to various youth initiatives appealing to decision-makers to start treating climate change as a global crisis and urging them to accelerate the transition towards a more just and sustainable economy—a circular economy. At the Regional Development Agency of the Ljubljana Urban Region (RRA LUR), we are in full agreement with these young people: there is no planet B. Accordingly, our activities have always been aimed at developing a model of sustainable development that is economically efficient, socially just and environmentally friendly. These activities range from drafting development documents to real-life project realisation.

One of such projects is Library of THINGS: a non-profit rental place where the shelves are lined not with books but with a wide

range of other items useful in the home, in the garden, for play, for sport and much more. Renting things is an innovative way of managing goods more efficiently, as well as helping preserve the environment—many of the items available at the library are of the sort that an individual might only need a few times in their life. It is a social innovation with environmental potential that contributes to the revitalisation of the local community; through sharing, its members get to benefit from items that they would otherwise be unable to afford, and the use of natural resources is reduced as well.

We have identified a number of other successful circular projects in the region, pursued by businesses or organisations that recognise the importance of environmental preservation and sustainable use of resources and who have been successfully tackling challenges of this sort. Among these challenges is one that our region has also been facing—namely, how to limit the spread of invasive alien plant species. One way of mitigating their negative effects is to process the plant matter into raw materials. At the Pulp and Paper Institute (ICP) of Ljubljana, together with the Municipality of Ljubljana, they have been successfully developing new types of paper made out of the invasive plants that are cut down. The more environmentally conscious companies are already using this paper for printing and publication. The public company Snaga uses this paper in the printing of its newsletter, *Snagazin.*

The Ljubljana Urban Region also boasts one of Slovenia's pioneering examples of successful utilisation of waste hot water from industrial processes. The company AquafilSLO, of the Aquafil group, has reached an agreement with Atlantis Water Park (BTC, d.d.) on heating pool water using their waste heat, which results in an approximately 2,000 tonne reduction in annual carbon dioxide emissions—the equivalent of taking 1,100 passenger cars clocking up 12,700 km a year off the road. That the project yields financial savings for both companies suggests that what is good for the environment also brings economic benefits and opportunities.

Our efforts in green development have also been recognised by the European Union; we are proud to say that we are one of the first regions to have obtained its guidelines and recommendations for the transition from a linear to a circular economy. For the region, this represents the foundation for a systematic transition to a circular economy, with coordination between the various departments; it is also sure to bring many business opportunities.

Figuring out how to close the material loop must take place at the very beginning of a product's lifecycle, during the design phase; it must involve judicious design, as well as appropriate selection of materials and production processes. This is why, in 2017, RRA LUR joined the consortium of the European project InnoRenew CoE, which researches renewable materials for sustainable construction, focusing in particular on researching innovative uses of wood and applying the scientific findings to industry practices. Within the framework of the InnoRenew CoE project, along with our partner ICP, we have established an interdisciplinary supply chain focusing on paper furniture, inviting the collaboration of our partner from the industry, DS Smith, d.o.o., as well as industrial designers from the Academy of Fine Arts and Design. Who, other than young designers, could have managed to so creatively transform a straight line into a closed circle?

We present twelve innovations that resulted from a collaboration between the creative and the research sector. We are pleased to have played a part in this partnership and hope that this project inspires the emergence of other chains that will bring green opportunities to the region.

Lilijana Madjar, MSc, director
Regional Development Agency of the Ljubljana Urban Region

Foreword by the strategic partner
Design Unites and Guides Society

Since its inception, the Industrial Design programme at the Academy of Fine Arts and Design of the University of Ljubljana (UL ALUO) has been fulfilling its mission of acting as a bridge between the public and the private sector. Where many institutions are only just now starting on the path of affiliation and knowledge exchange among partners, our department has been putting this principle into practice for more than 35 years. In this time we have successfully collaborated with numerous businesses of all sizes as well as with crucial public institutions, and carried out countless well-known projects.

It is for this reason, as well as due to the high-quality pedagogical work and the successes of our students and graduates, that the Department of Industrial Design and Applied Arts of UL ALUO remains the only Slovenian educational institution to have regularly been placed among the top 50 design schools in Europe in a selection that has, since 2012, been carried out by the pre-eminent Italian professional magazine *Domus*.

The department's curriculum is considered to be one of the most interdisciplinary programmes available. While sustainability topics, taught to graduate and post-graduate students by Assoc. Prof. Barbara Prinčič, have long been a prominent part of the programme, sustainable approaches are included in one way or another in every area of research and design in the Industrial Design study programme.

Apart from its stated orientation towards sustainability and active inclusion of the circular economy, the project *Papiro-logía: Circular Design and the Use of Paper in*

Interior Design also demonstrates the tight integration of the classes *History and Theory of Design, Service Design* and *Industrial Design* and the close collaboration among their mentors: Assist. Prof. Barbara Predan, Assist. Prof. Lidija Pritržnik, Assist. Prof. Rok Kuhar and Assoc. Prof. Jure Miklavc.

In addition to requiring close collaboration, technical and technological knowledge and understanding of sustainable and circular principles, the successful completion of the project also crucially depended on the research portion, in which students focused on identifying the right opportunities for using paper in interior design. Through methodological work, they were able to find sensible development directions for their projects, and seek out innovative solutions and integrate them effectively into the context of the circular economy. The different approach and the context chosen enhance the project, bringing the perennial design topic—designing using paper—into the present.

In addition to being used in the *Papiro-logía* project, a similar approach of connecting and enhancing knowledge yielded astonishing international success in the beginning of this year; a project developed in the industrial design programme was selected to be exhibited at this year's 22nd Triennale di Milano, with the slogan *Broken Nature: Design Takes on Human Survival*. The project, titled *Thinking the Conditions of Our Time*, was included with the very best of the creators invited and selected by the curator Paola Antonelli, who is otherwise the curator at the Department of Architecture and Design and the Director of Research and Development at the New York Museum of Modern Art.

The concept was conceived under the mentorship of Assist. Prof. Barbara Predan by 11 postgraduate students of industrial design in the 2017/18 academic year; the design of the exhibition was developed in the following academic year with the help of the mentors and alumni of the department: Assoc. Prof. Jure Miklavc, Assist. Prof. Rok Kuhar and Assist. Prof. Lidija Pritržnik. A scientific monograph was published to accompany the exhibition, featuring an introduction written by the leading design theorist and philosopher Tony Fry.

This is one of the greatest international successes in the fields of design and culture and in terms of national promotion—a success made even more significant by the fact that even though—in our capacity as representatives of the UL ALUO—we applied for admission to the

triennale as an educational institution, the organisers felt our project was of high enough quality that they placed it among the national pavillions. This year, the project was also presented at one of the top design faculties, the IDAS in Seoul (South Korea), as part of a two-day workshop.

In light of the above, we feel we are justified in saying that with its activities and influence, the Department of Industrial Design and Applied Arts plays an active role in the development of the design profession and wields a strong influence on the direction of society.

At the successful conclusion of the project *Papiro-logía: Circular Design and the Use of Paper in Interior Design,* I would like to sincerely thank our new partner, the Pulp and Paper Institute (ICP), as well as our ongoing partners, the Regional Development Agency of the Ljubljana Urban Region (RRA LUR) and the DS Smith company. I also want to congratulate the students and mentors for the superb execution of this project.

Jure Miklavc
Head of the Department of Industrial Design and Applied Arts
ALUO UL

Foreword by the partner

The Pulp and Paper Institute joined the project of establishing an interdisciplinary paper furniture supply chain as an expert partner in the field of natural fibrous materials and as one of the partners of the InnoRenew CoE project. The institute has a leading role in the CEL.KROG (CEL.CYCLE) programme and as such has a central and very active role in the Slovenian circular economy.

They intend to continue with their strategy for transitioning to a circular economy, focusing primarily on environmentally friendly utilisation of alternative resources that have potential uses in a wide variety of fields and sectors (advanced materials, packaging, construction, automotive industry...).

Gregor Lavrič, researcher
Pulp and Paper Institute

Foreword by the partner

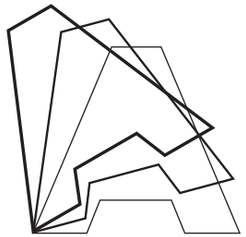
Corrugated board is a versatile and ecologically sound material that creative hands can transform into something much more than packaging. It becomes a material of countless shapes and uses. Through our participation in the InnoRenew CoE project we threw the doors of imagination wide open...

We recognise the benefits of cardboard as a packaging material that is 100% renewable, 100% recyclable and 100% biodegradable, with a low carbon footprint. Our products are manufactured using the bare minimum of material and we strive to optimise all the stages of the customer's supply chain—from distribution, through warehousing and shelf space optimisation, to recycling and reuse.

In short—we are transforming packaging for a changing world.

Alenka Knez, manager of PackRight Centre
DS Smith

Introduction
Papiro-logía



The essence of an object has something to do with the way it turns into trash.
— Roland Barthes, *Non Multa Sed Multum,* 1976

Awareness of the environmental issues in design has developed hand in hand with the professionalisation (and industrialisation) of the discipline of design. In tracing the development of the discipline, we encounter numerous research and practical studies: from in-depth investigations of the properties and uses of (novel) materials and their environmental impact, through approaches for the optimisation of manufacturing flows and understanding the ways that they affect the environment, and last but not least, to behavioural economics and nudge theory, focusing on the understanding of how both individuals and institutions reach decisions.

The above has given rise to numerous theories and practices offering concrete alternatives to the prevailing “throw-away culture” that we have been immersed in since the second half of the 20th century. Among these novel alternatives is the cradle to cradle concept by William McDonough and Michael Braungart. The authors developed the concept around nine principles that they published in 1992 with the title *The Hannover Principles: Design for Sustainability*:

1. Insist on rights of humanity and nature to co-exist.
2. Recognize interdependence.
3. Respect relationships between spirit and matter.
4. Accept responsibility for the consequences of design.
5. Create safe objects of long-term value.
6. Eliminate the concept of waste.
7. Rely on natural energy flows.
8. Understand the limitations of design.
9. Seek constant improvement by the sharing of knowledge.

Ten years later, they published their seminal work: *Cradle to Cradle: Remaking the Way We Make Things* (2002). The authors have since continued to demonstrate and develop ways, both in theory and in practice, to successfully disrupt the linear concept that is based on the unsustainable logic of "cradle to the grave". Their "cradle to cradle" concept turns the paradigm of understanding materials on its head; they view materials as biological and technological "nutrients", discovering opportunities for their evolution and for changing the way they are used.

One of the models that have developed from the "cradle to cradle" concept is the circular economy; the key benefit of the alternative model that it proposes is that it is based on the principles of environmental regeneration. At the same time, the model has at its heart the promise of transforming existing business models into ones that are more sustainable. All of this is intimately associated with the idea of actively changing the prevailing mentality in design. Just over two decades ago, the talk was about how designers need to carefully plan out the entire product lifecycle; in the context of circular design, however, this is not nearly enough. The goal is in perfect recurrence, in perpetual circulation, in finding sensible ways of avoiding waste to the maximum extent possible, with the fundamental purpose of this endeavour being to optimise and minimise the extraction of new resources.

This book takes on the task of discussing this final point, the nascent paradigm of circular design, by way of an example that involves the use of paper in interior design. Hence the project name: *Papiro-logía,* where the title deliberately uses the original Greek suffix. We intentionally wanted to emphasise the suffix *-logía,* which, in essence, denotes a study of something, or a scientific discipline. In the context of this publication, it means that the way paper is treated in the context of circular design introduces a new branch of knowledge in the broader field of design. More than that, we emphasise reflecting on the urgency of treating circular design as one of the new fundamental disciplines of knowledge with respect to approaches towards designing products, services,

systems and policies; in the future, the plan is to retain the suffix *-logía,* while replacing paper with other materials from our everyday environment.

The rest of the book is divided into four parts. First comes an explanation of the significance and position of the circular economy and circular design within the broader socio-environmental context and an overview of policy development, then a presentation of the project's stated starting points of researching the use of paper in interiors on the basis of circular design, followed by a detailed breakdown of the steps and the research methods and circular and service design tools that were employed. In the final part, the twelve results of the students' research work are presented. The book resulted not only from the establishment of an interdisciplinary paper furniture supply chain and testing new educational approaches in the field of design, but also from a joint effort of all the expert and scientific partners in the project and selfless exchange of new knowledge.

References

Barthes, Roland (1976). "Non Multa Sed Multum", *Cy Twombly: Fifty Years of Works on Paper,* Munich: Schirmer/Mosel.

McDonough, William and Michael Braungart (1992). *The Hannover Principles: Design for Sustainability,* www.mcdonough.com/wp-content/uploads/2013/03/Hannover-Principles-1992.pdf. The edition published on the 20th anniversary of the first publication is available here: www.mcdonough.com/writings/the-hannover-principles/ (5 May 2019).

McDonough, William and Michael Braungart (2002). *Cradle to Cradle: Remaking the Way We Make Things,* New York: North Print Press.

Circulation as an Imperative

Design is everything that is, that will be and that could be. According to one of the many definitions, designers should be capable not only of recognising problems, but also of transforming them into opportunities and eventually coming up with effective solutions (WDO, 2015). Then there are those who feel that in uncritically following and supporting other industries, design is perceived as the main culprit for the devastation of the environment that we are witnessing (Escobar, 2018). Still others see design as an effective tool in the service of business, much for the same reasons (Info entrepreneurs, 2009). Practice shows that design is all of that, and much more.

Design and Care

For a while now, a growing chorus of voices has been questioning the criteria for evaluating design, as well as the role and potentials that the design profession ought to start systematically adopting in the future. Among these voices are the authors of the document *The Lancaster Care Charter* (2019), which is their attempt at answering the fundamental question: Does Design Care...? They state the following:

> We see a need for a practice of design that is oriented to care as a commitment to human and nonhuman co-existence—that brings to the surface its entanglement with caring ecologies. Design-with-

> care shifts away from a model of the "designer-as-hero," and instead offers a more humble, but no less valuable, expertise. [...] Design has neglected its responsibility (and response-ability) to care. Design needs to be attentive to context, difference, and time; to be relational, ecological, modest and reflexive, and therefore caring (The Lancaster Care Charter, 2019: 73).

In this document they propose the following three conditions for the design of possible futures: care of complexity, care of the project and care of relations. The latter, the "care of relations", fits this book's research topic—circular design—perfectly. With this, the authors not only point out the need to build balanced relationships between people, things, the environment and ecology, but also the need to emphasise their mutual dependence. The leading global foundation for the circular economy, the Ellen MacArthur Foundation, states something similar. Since 2010, the foundation has systematically worked on integrating the principles of a circular economy and circular design into all areas of society. More than that—they are creating a whole new system of operation. They write:

> The way we design and make things is changing. We are creating a new system that can meet our needs within planetary boundaries. Shifting the system involves everyone and everything: businesses, governments, and individuals; our cities, our products, and our jobs. By designing out waste and pollution, keeping products and materials in use, and regenerating natural systems we can reinvent everything (2017).

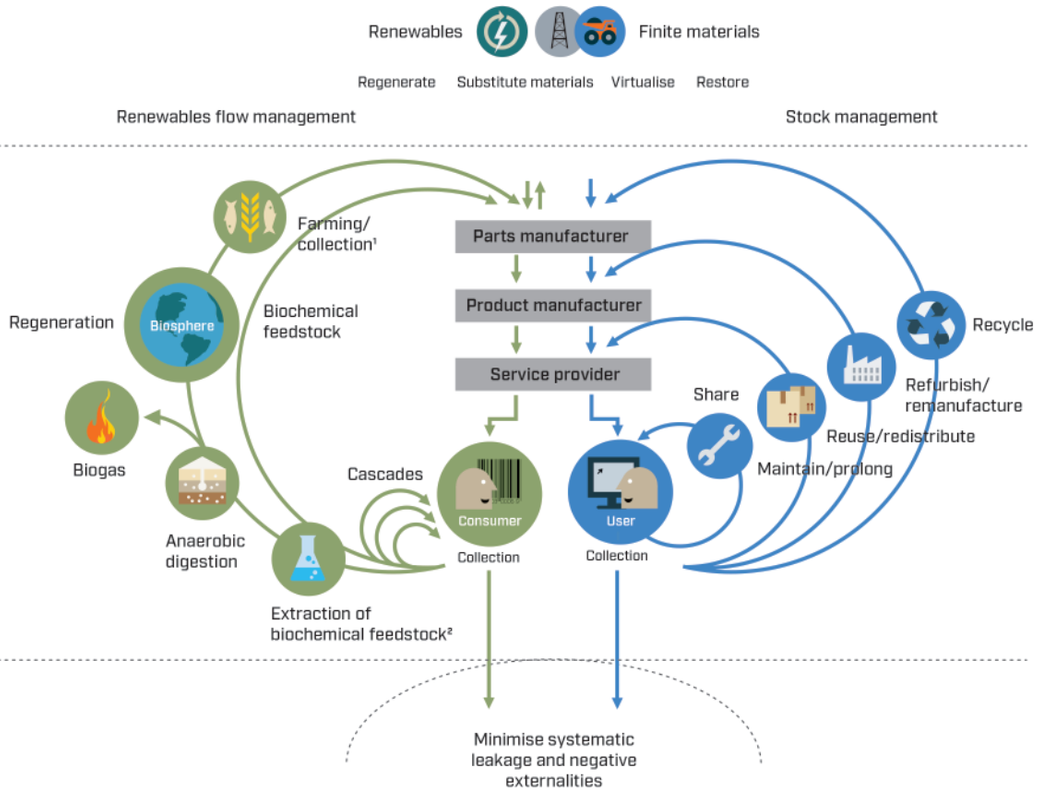
Outline of a circular economy

PRINCIPLE 1
Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows
ReSOLVE* levers: regenerate, virtualise, exchange

PRINCIPLE 2
Optimise resource yields by circulating products, components and materials in use at the highest utility at all times in both technical and biological cycles
ReSOLVE* levers: regenerate, share, optimise, loop

PRINCIPLE 3
Foster system effectiveness by revealing and designing out negative externalities
All ReSOLVE* levers

Circular Economy System Diagram



* The ReSOLVE initialism consists of the initial letters of the six activities that characterise circular economy: ***re***generate, ***s***hare, ***o***ptimise, ***l***oop, ***v***irtualise, ***e***xchange.
¹ Hunting and fishing
² Can take both post-harvest and post-consumer waste as an input

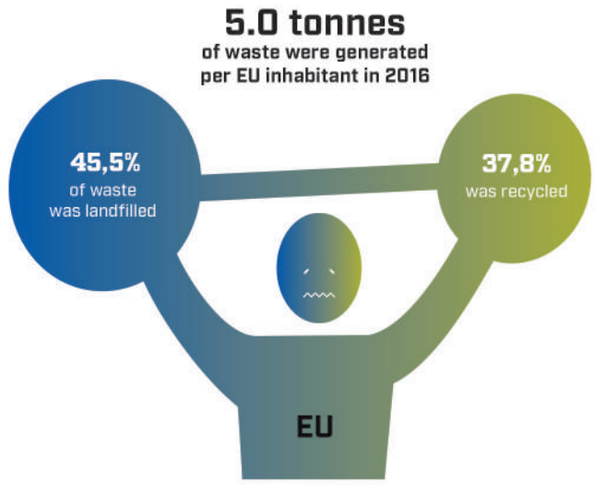
Source: Ellen MacArthur Foundation, SUN and McKinsey Center for Business and Environment, *Growth Within: A Circular Economy Vision for a Competitive Europe*, 2015: 24. Authors of the diagram: William McDonough and Michael Braungart, *Cradle to Cradle* (C2C). Also available at: www.ellenmacarthurfoundation.org.

A Regenerative Circular Economy

In 2014, the transition to a new, regenerative circular economy became one of the declared goals of the European Union. The authors of the report *Growth Within: A Circular Economy Vision For a Competitive Europe* see the transformation into a regenerative circular economy as a macroeconomic project no less ambitious than the establishment of the single European market. In the report, they also stress that the prevailing model of value creation in the European economy is surprisingly wasteful: "on average, Europe only uses materials once" (Ellen MacArthur Foundation, 2015: 12). This is a clear indication of the problem that is our culture's predominant linear orientation.

Put another way, this means that if we continue to act in an unchanged, linear way—if we keep thoughtlessly discarding items as soon as they are slightly (if at all) deteriorated, uncritically replacing them with new ones—it is only a matter of time before the developed world starts drowning in waste, as well. Likewise, the chemical pollution caused by having to create new materials over and over again often threatens the planetary environmental and social boundaries that we depend on (Steffen et al., 2015, Raworth, 2018). At this point it is important to point out, as Albin Keuc did in 2002 in his report *Odpadki: problem ali izziv?* [Waste: A Problem or a Challenge?], that, properly speaking, there is no such thing as "waste". This is only "a generic name, or designation, for a whole class of materials" (Keuc, 2002: 7). For this reason, as Keuc continues, it is necessary to set up a system where instead of using up the limited natural resources (substances and materials), we start utilising the limitless capabilities of the human mind. The "'waste' that is generated today represents undeniable proof of our unsustainable ways, of how we are squandering the natural resources. 'Waste' is not only evidence of our (private and social) wastefulness, but also of our inefficiency and uninventiveness" (ibid.: 8). In the *Growth Within* report, the latter is illustrated with concrete numbers:

> In 2012, the average European used 16 tonnes of materials. Sixty percent of discarded materials were either landfilled or incinerated, while only 40 percent were recycled or reused as materials. In value terms, Europe lost 95 percent of the material and energy value, while material recycling and waste-based energy recovery captured only 5 percent of the original raw material value (Ellen MacArthur Foundation, 2015: 12).

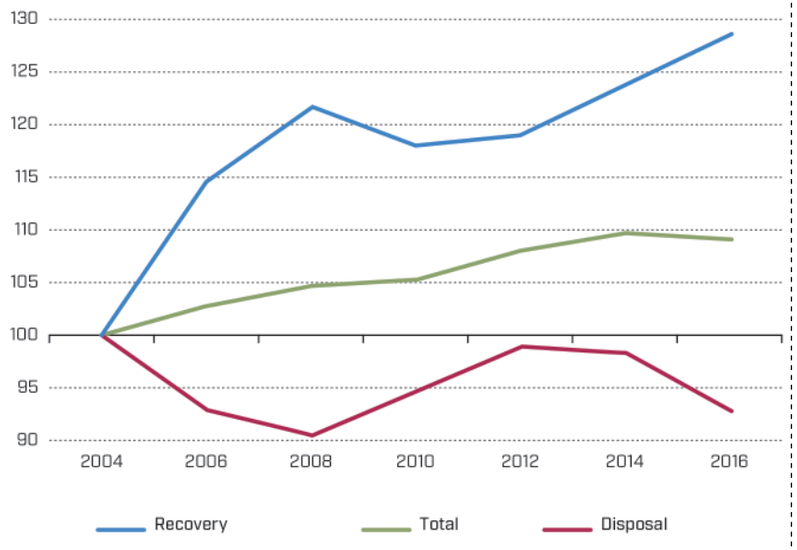


Source: "Waste statistics", *Eurostat*, November 2018

It therefore did not come as a surprise that the same year the report *Growth Within* was published, an action plan was adopted at the European level: *Closing the loop: Commission delivers on Circular Economy Action Plan* (European Commission, 2015). The objective of the action plan was (and is) "to help stimulate Europe's transition towards a circular economy, boost its global competitiveness, foster sustainable economic growth and generate new jobs" (European Commission, 2019A). At the beginning of this year, the European Commission prepared a status report on the situation three years after the implementation of the action plan. In the press release, they say that the transition from a linear to a circular economy is on track; that, in fact, the first results are already evident:

> In 2016, sectors relevant to the circular economy employed more than four million workers, a 6% increase compared to 2012. Circularity has also opened up new business opportunities, given rise to new business models and developed new markets, domestically and outside the EU. In 2016, circular activities such as repair, reuse or recycling generated almost €147 billion in value added while accounting for around €17.5 billion worth of investments (European Commission, 2019B).

Development of waste treatment, EU-28, 2004–2016



Source: "Waste statistics", *Eurostat*, November 2018

As a consequence, the emphasis on the importance of establishing a low-carbon circular economy is also apparent in many of the newer Slovenian government documents. In *Slovenia's Smart Specialisation Strategy* (Šooš et al., 2017), high quality of life for all has been placed at the centre of the development strategy. The authors of the strategy hope to achieve this goal by 2030 through five strategic orientations and 12 goals (a low-carbon circular economy is the eighth), as well as by actively working towards the 17 sustainable development goals of the UN[1] (UN, 2015).

1 In September 2015, the United Nations General Assembly adopted the *2030 Sustainable Development Agenda*. The new agenda, which is based on the principle "no one gets left behind", emphasises a holistic approach towards achieving sustainable development for all. The goals of sustainable development address the global challenges facing us, including those relating to poverty, inequality, climate, environmental degradation, prosperity, peace and justice. The goals are interrelated, and in order to leave no one behind, it is important that we achieve all of them by 2030.

In the *Slovenian Smart Specialisation Strategy – S4* (SVRK, 2017) document, as part of the developmental area *Natural and traditional resources for the future,* we also find "networks for the transition to a circular economy". Within this developmental area, or pillar, the government endeavours to "connect the different stakeholders and individual production stages into a complete supply chain, or network". It sees its own role in this as threefold: "a promoter of cooperation, assuming the risks related to the development of technologies, as well as playing a key role in terms of establishing adequate regulatory conditions" (SVRK, 2017). The newest document, *Roadmap Towards the Circular Economy in Slovenia* (Godina Košir et al., 2018) goes one step further. This roadmap outlines the potentials that could establish Slovenia as the leader of the transition into a circular economy in Central and Eastern Europe, sets out to identify and connect stakeholders of circular practices, creates recommendations for the Government of the Republic of Slovenia to facilitate a more efficient transition, as well as identifying circular opportunities for the strengthening of international economic competitiveness and quality of life for all (ibid.: 7).

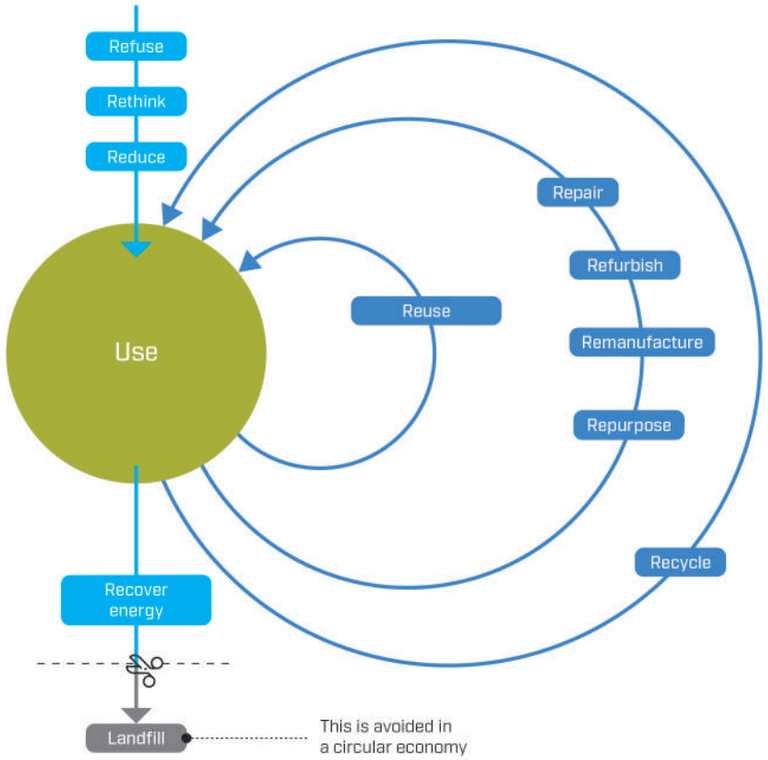
Circular Design

These plans can not be realised without design. The new paradigm of a regenerative circular economy requires close cooperation with the new principles of circular design. It must be especially emphasised that we are talking about building on entirely new principles; all too often, circular design and the circular economy are equated with the old-fashioned understanding of materials recycling. That this involves a change in approach is also remarked upon by Sonja Eser, who writes that:

> unlike the old recycling economy concept of the 80s, the new regenerative circular economy does not limit itself to recycling and disposal of residual and toxic waste, but focuses on designing cycles for biological and technical materials[2] (nutrients) from the beginning (Eser, 2015).

2 In biological cycles, non-toxic substances return to the biosphere after use, replenishing the natural capital. Biological cycles involve renewable resource flows, whereas in technical cycles, it is about products, components and materials that are processed after use (repair, maintenance, reuse, restoration, processing and finally recycling) and subsequently returned to the market with the best quality possible, thus staying in use for the long term (Ellen MacArthur Foundation and Granta Design, 2015: 7, and Ellen MacArthur Foundation, 2015B: 7).

Circular economy: more than recycling



Source: José Potting and Aldert Hanemaaijer, *Circular Economy: What We Want to Know and Can Measure*, PBL Netherlands Environmental Assessment Agency, Haag 2018: 11.

The key is, therefore, in the understanding that the circular economy is more than just a new name for recycling: it is a systemic approach that involves circular use of resources. Whereas in the linear economy materials are continually extracted, processed, used and disposed of, the circular economy sets out at the very start to systematically and prudently evaluate all the possibilities for reuse of materials and substances, with the aim of reducing the need for the extraction of new resources and materials. Before reaching for new materials, the circular economy looks towards previously used materials; it also seeks to keep the materials it uses in circulation for as long as possible. Understanding the latter is crucial for an industry like design: as much as 80% of waste and the resultant pollution results from decisions taken in the design phase of the product (Ellen MacArthur Foundation, 2017).

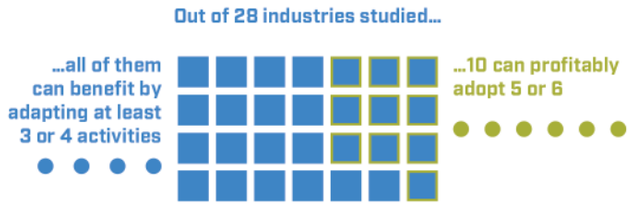
If we start deliberately changing our design approach from linear to circular by taking different decisions in the planning and design phase, then designers will have to start considering more than one product lifecycle before the design process has even started. We will have to foresee in advance how the product will facilitate repair, simplify dismantling and allow waste-free final recycling of material. Naturally, the latter does not only apply to product design; the principles of circulation must also be implemented in the transformation of business, service and distribution models, into systemic-strategic approaches, and just as importantly, into influencing consumer habits by utilising nudge theory.

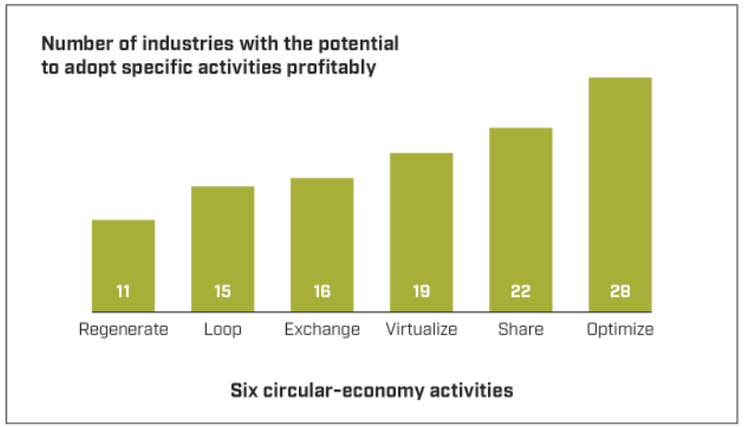
In her work *The Designer's Atlas of Sustainability* (2007), Ann Thorpe sees design as having reached a mature stage, a stage in which its already established focus on energy and materials must be combined with a thorough examination of the field's role in economic, social and behavioural aspects of sustainability. Jonathan Chapman (2005) adds that this maturity once again puts design at the forefront of the quest for solutions to the aforementioned dimensions of sustainability. It is necessary to adopt a pluralistic approach to reducing waste through sustainable design, accounting not only for post-lifecycle recovery methods, but also for effective new strategies arising from studying, in detail, the non-material phenomena that shape the patterns of consumption.

In order that Slovenia may also start effectively addressing the patterns of consumption and transition away from practices that waste materials and resources, it will be necessary to deliberately establish new, circular business and service models. In other words, there is an urgent need for a systematic introduction of smart design and deliberate development of circular design. To repeat the point: at the heart of a circular economy lies circular design (Ellen MacArthur Foundation, 2013: 9). As is further explained in the aforementioned press release by the European Commission:

Smart design at the beginning of a product's lifecycle is essential for ensuring circularity. With the implementation of the *Ecodesign Working Plan 2016–2019,* the Commission has further promoted the circular design of products, together with energy efficiency objectives. Ecodesign and Energy Labelling measures for several products now include rules on material efficiency requirements such as availability of spare parts, ease of repair, and facilitating end-of-life treatment. The Commission has also analysed, in a dedicated *Staff Working Document,* its policies for products, with the intention to support circular, sustainable products (European Commission, 2019B).

Six circular-economy activities have the potential to improve performance and reduce costs for a number of industries.





Source: Ellen MacArthur Foundation, SUN and McKinsey Center for Business and Environment, *Growth Within: A Circular Economy Vision for a Competitive Europe,* 2015: 25–26.

It is, therefore, a fact that the transition to a circular economy is inextricably linked with circular design. This was further confirmed in practice by the steps that were subsequently taken by the aforementioned Ellen MacArthur Foundation. Together with the world-class design firm IDEO, they came up with *The Circular Design Guide* (2017). On their website they write the following:

> A new mind-set for business is emerging. It's worth around a trillion dollars, will drive innovation in tomorrow's companies, and reshape every part of our lives. The scale of what we're designing has shifted from products, to companies, to economic systems. Who we're designing for has expanded from a solitary user to an intimately connected web of people, spanning the globe.
>
> New tools such as artificial intelligence, the internet of things, and biomimicry mean our design ambitions are limited only by our imagination. Meanwhile, creativity has never been more important. The global economy is stuttering and disruptive technologies challenge established business models. Solutions that are invaluable for people, give businesses a competitive advantage, and are regenerative for our world (The Circular Design Guide, 2017).

Paper in Circular Design

On the basis of the above, the Academy of Fine Arts and Design — at the initiative of the Regional Development Agency of the Ljubljana Urban Region (RRA LUR) — has established an interdisciplinary paper furniture supply chain within the framework of the InnoRenew CoE project together with the Pulp and Paper Institute (ICP) and DS Smith packaging company. With this scientific research project, we have actively involved ourselves in the key mission of the InnoRenew CoE project, which is to conduct first-rate research into the use of renewable materials.

At the same time, we wanted to use the pilot supply chain project to test out the possibilities for establishing circular design in cooperation with partners from the public and private sectors. Wishing to acquire new know-how, come up with new approaches and test out the tools of circular economy in practice by using them in design education, we set out to introduce into the project the principles, possibilities and criteria of circular economy and circular design. In the *Growth Within* report, the authors recognise a problem with academic research, namely that the attempts at integrating circular design tend to remain at the initial, conceptual level (2015). This makes the interdisciplinary supply chain that enables students, together with the scientists from the Pulp and Paper Institute, to pursue detailed research into the circulation of paper, its derivatives and paper products so much more significant. Another benefit that this brings to design education is in the collaboration with the experts and technical staff of the DS Smith company, who gave students the opportunity to acquire the know-how for designing and manufacturing a product all the way to the prototype stage (with the possibility of transitioning to industrial-scale manufacturing later on).

The Starting Point of the *Papiro-logía* Research Assignment

In the *Papiro-logía* research assignment, we joined forces with the partners involved in the project in order to undertake the challenge of finding innovative and thoughtful solutions for using paper in interior design. While the central topic was furniture design, the project also accommodated research focusing on interior equipment and accessories. There was a special emphasis on making sure that the proposed solutions are suitable for the requirements of modern living and grounded in the principles of circular economy and circular design.

The additional benefits of choosing paper as the material to experiment, design and explore the new principles of circular design with, are that it is relatively easy to work with and has been successfully used as a primary material for furniture several times in the past. Through the deliberate introduction of circular design and with the help of cutting-edge research in general, as well as the emergence of advanced new technological capabilities, paper continues to offer wonderful opportunities for research, education and redesigning our everyday life.

Choosing paper had further benefits: properly employed, it has considerable structural strength, yet remains relatively light. It is readily shaped and easily protected, can be recycled multiple times and is easy to equip with graphics. Another benefit is its low carbon footprint in production, transport and disposal. It also facilitates rapid progression from prototypes to mass production and as such represents a good starting point for the introduction of circular economy and circular design approaches into the field of furniture making.

Summarising the above, the crucial design challenges were the following:

- recognising the situations and needs calling for the use of paper in interiors;
- proposing solutions in line with the principles of circular design;
- proposing solutions that are appropriate for the chosen material and the associated technology (toolless furniture assembly; the possibility of mass production);
- proposing solutions that facilitate cost-effective transport (flat packing);
- proposing consistently recognisable solutions;
- proposing marketable solutions (solution cost appropriate for the price range);
- proposing niche solutions (those solving specific problems) or comprehensive solutions (complete room furnishings, for instance).

The Working Process

The project can be roughly divided into three stages. The research-analysis stage was followed by the synthesis and design stages. An overview of the tools and methods used by the students in the first, research-analysis stage is provided below. The results of the synthesis and design stages are presented in the second part of the book, in the descriptions of the students' projects.

Research-analytical Stage

The first stage consisted of eight sessions. In the Service Design class, the purpose of this stage was to introduce the principles of circular economy and circular design and achieve understanding of the needs for and possible ways of implementing them in the living environment. At the same time, the participants sought out and critically evaluated elements that are already based on or could be based on utilising technically treated and processed paper. In the Industrial Design class, the first stage focused on reviewing the concepts and surveying the existing solutions on the market. The participants examined and critically evaluated the various paper-based intermediate products (cardboard/fibreboard and paperboard, hemp-based paper, Japanese knotweed…) and then investigated in detail the existing, as well as emerging technologies in the field of paper processing.

The Tools and Methods Used in the First Stage

SESSION 1

A lecture on service design and a presentation of the literature, tools and methodology were followed by an in-depth presentation of the project. After the introductory presentation of the characteristics of circular design and circular economy and the key players in this field, there were two tasks, followed by instructions for further work.

Task 1

OBJECTIVE: Familiarisation with the broad topic of interiors.
APPROACH: Group brainstorming on the topic.

FIRST BRAINSTORMING: Familiarisation with types of interiors. What kinds of interiors do we know?

SECOND BRAINSTORMING: Examine the identified types of interiors in detail; using your own criteria, choose the spaces that could potentially be interesting for further investigation. Argue your choice.

Task 2

OBJECTIVE: Understanding interiors according to Hannes Meyer's principles (see *Building,* 1928).

INSTRUCTIONS: On the basis of the points listed below, identify three typical examples, as well as two that deviate from the average, the "normal".

APPROACH: Divide into groups of three and work together through the steps below.

STEP 1: The occupants of the chosen interior

1. Who lives in/occupies the chosen interior? (Hint: it's not just people, and people can also be further divided into different groups.)
   >> Categorise the generated list into different groups (come up with the grouping criteria independently).
2. What kinds of residency/occupancy do we know (e.g. family, flatmates, business partners...)? What main characteristics does an individual type of residency have?
   >> In the examples collected, identify any deviations from the norm (deviations from all other forms of residency).

STEP 2: Occupants of the chosen interior and their activities

3. Building on the first two points, make a list of activities that you believe the selected groups of individuals perform in the chosen interior (alone, together...).
   >> Where it makes sense, come up with groups according to activities or according to what the majority (everyone?) does, as opposed to what just some groups do.
4. Who enters the chosen interior and with what intent? Which activities are performed only if someone else, that is, someone who does not live with us, has entered?

STEP 3: Interior accessories and equipment

5. What remains constant, no matter what we do in the selected interior, and what is variable? What do we need all the time and what only occasionally? For what purpose? What only characterises specific groups and which needs are "universal"?
   >> Categorise the generated list into different groups (come up with the grouping criteria independently).

Until next time, work through the following:
What is circular design? What is a circular economy? (In general and in the context of paper.) What are the advantages and disadvantages of the circular economy in the paper industry? Where are the issues and where are precious materials wasted in furniture produced in a linear manner? How much furniture ends up in bulky waste annually? How much of this furniture could reasonably be made out of paper instead?

EXTRA: Read Cameron Tonkinwise's *'I prefer not to:' Anti-progressive Designing* (2018).

SESSION 2

The session began with a discussion of Cameron Tonkinwise's text, in which the author wonderfully outlines the logic that a contemporary linear designer operates under, laying the foundations for acting differently. He writes, among other things:

> Designers rarely take responsibility for the end-lives of what they do design (i.e., making things disassemble for component and material recovery, and designing the reverse logistics to get products back from customers for that disassembly). However, designers almost

> never take responsibility for the waste they make when their new design replaces old, probably still functional, ones. [...] Because designers are not required to take responsibility for the waste they turn existing products into when making preferable replacements, things pile up—the previous two or three versions or every thing in the household collect in landfills after dwelling for a while in wardrobes, garages, attics and basements (Tonkinwise, 2018: 75).

The discussion was followed by the class compiling together findings about circular design and circular economy; later on, individual groups of students presented the types of interiors along with the answers to the focus questions (results of tasks 1 and 2). The second session concluded with task 3.

Task 3

OBJECTIVE: Preparing questions for field visits to the DS Smith company in Brestanica and the Pulp and Paper Institute in Ljubljana.

INSTRUCTIONS: Adding to the initial questions—where to find the opportunities for introducing circulation of material and paper products, how do paper and its derivatives already circulate, how do products made out of paper and its derivatives circulate, for what reasons does paper stop circulating—and taking into account all the interior contexts that we have so far investigated, compile a series of substantive questions.

APPROACH: Divide into groups of three. With the help of the worksheets on the topic of circular design by the Ellen MacArthur Foundation and the IDEO company (2016B), come up with questions—as specific as possible—that will (once answered) help you understand paper as a material, its derivatives, existing paper products and the potential of all these things for circulation. What is the use of worksheets? They help you think about how to best include key stakeholders right from the very beginning of the design process, in line with the principles of circulation; how to recognise and distinguish linear production from the circular (often, minor changes in production are too quickly characterised as examples of circular production), how to devise a new business model that is based on circular principles and how to keep systematically introducing learning loops for acquiring new knowledge.

SESSION 3 and 4

Field visits to the DS Smith company in Brestanica and the Pulp and Paper Institute in Ljubljana.

SESSION 5

After brief presentations of the current situation and the new understanding of the field of interest that was gained during the field visits, the next step involved focusing on individual aspects in order to narrow down the research to the specific. The deepening of the research into the chosen focus began with two tasks.

Task 4

OBJECTIVE: Consider and comprehend the chosen focus in detail.

INSTRUCTIONS: According to the focus you have chosen, select three circular design worksheets by the Ellen MacArthur Foundation and the IDEO company (2016B). You can choose, among other things, worksheets facilitating an in-depth consideration of topics like circular flows (with an emphasis on the technical and biological flow of resources and materials), opportunities for circulation and service flips (considering not only the material itself, but also services, our habits and systemic changes), smart material choices, materials traceability and product journey mapping (what happens to the product after its first use cycle and what more could happen).

Task 5

INSTRUCTIONS: Check/answer the questions/criteria listed below with respect to the chosen focus.[3] In the initial stage of the research, the questions allow you to quickly find out where the study needs to be made more in-depth; at the same time, their purpose is to be used as guidelines in coming up with criteria for further design work. It makes sense to refer back to the questions multiple times in the design process in order to verify ideas and then use them to evaluate the finished work once the process is concluded.

Verifying the Circular Design Principles
How well does your proposal demonstrate understanding of the principles of circular design? What is the relevance of choosing the principles of circular design in your solution? Which criteria did you base your choice on when determining the circular design principle most relevant for your proposal? Does your proposal facilitate the establishment of a new, circular systemic operating pattern?

Suitability of the Context and the Starting Points
How well did you define the chosen design challenge? Do you understand the context (in terms of opportunities and constraints) of the chosen challenge? Which long-term impacts did you foresee and does your project address them?

The Feasibility of the Challenge
How does your chosen challenge/proposal demonstrate your understanding of, or familiarity with, the current situation on the market or in society? What is your understanding of the technology (both existing and emergent) available to the stakeholders who you will have

3 The questions are adapted from the criteria that were given to the applicants in the course of the competition *Biomimicry Global Design Challenge:* https://challenge.biomimicry.org.

a direct or indirect effect on, or the short-term and long-term environmental impacts of your project once it has entered the market? How careful were you in choosing the experts and mentors to help you develop the project further?

Achieving the Social and Environmental Benefits
Which crucial social, cultural and/or environmental aspects does your proposal address and improve? (Does your concept enhance the general public's ability to satisfy basic needs, does extending the product lifecycle reduce the pressure on the environment, are you addressing the problem of material toxicity, are you working on reducing the amount of waste through a different, novel or additional use of a material...) How extensively did you address sustainability issues in your design? How well do you understand the problem of sustainability in the context of the challenge you have taken on? How well are you solving it? To what extent is your success in solving the chosen sustainability issue measurable?

The Degree of Innovation and Creativity
What makes your proposal innovative, in what way is it different from what already exists? What is the advantage of your proposal in comparison with what already exists? Is the value proposition clear?

SESSION 6 and 7

The sixth and seventh sessions were meant to build upon the findings and decisions from the fourth and fifth tasks. The students were presented with four tasks, the latter two of which would be carried out under all the mentors involved in the project development.

Task 6

OBJECTIVE: A single-sentence description of the challenge; meant as a test of the degree of understanding of the problem/concept/challenge.

INSTRUCTIONS: Describe, in a single sentence, the problem/concept/challenge that you want to address with your (re)design.

The description of the problem/concept/challenge must include:

1. the user: an individual or a group that the chosen problem/concept/challenge concerns.
2. The space/location: where the (re)design will be used or realised
3. The principle of circulation: what circulates (material/extended use cycles/methods of deconstruction, or disposal).
4. The goal (describe what you wish to accomplish).

Task 7

OBJECTIVE: Reframing the identified problem/concept/challenge. This step can help you avoid the trap of excessive initial enthusiasm about the problem/concept/challenge/idea. It also helps you overcome limitations arising from having to express your idea in words (which are often limited). A poorly formulated problem/concept/challenge needlessly limits our understanding—a fact that later often ends up reflected in weaknesses of the solution proposal.

EXAMPLE: If the starting point states that the intent is to design a new lighting fixture, and if the description of the problem/concept/challenge features the word "lighting fixture", it often suggests that the idea is to merely redesign existing lighting fixtures. If, on the other hand, we undertake to redesign how individuals can regulate the amount of light in a space, the field of potential solutions is greatly expanded.
Reframing therefore enables us to completely, or at least partially, redefine the challenge. The goal is to expand the challenge, make it more abstract; this way, the spectrum of possible answers to the identified topic of research gets larger.

INSTRUCTIONS: Drawing on what you've read, answer the questions below.

IMPORTANT: The steps enumerated below may be repeated multiple times; afterwards you can decide which of the reframings resonates the most.

Copy the single-sentence description of the problem/concept/challenge (from task 6):

Alter the description afterwards by changing the following key elements:

1. persons/users;
2. space/location of realisation, potential uses;
3. the principle of circulation;
4. the goal.

Restate the identified problem/concept/challenge in line with the above changes.

Task 8

OBJECTIVE: With the help of a mood board, we search for visual elements, visual representations of the concept/problem/challenge. The main purpose of a mood board is to start a discussion; to find something that encourages the generation of ideas. We are looking for a reference point to guide further thinking and designing. Mood boards are often used to communicate a thinking process, complementing, or better yet, extending the starting point in its written form.

IMPORTANT: The collection should not be precisely defined, but left open-ended. We are looking for something that might, for instance, stir up a memory of an event, or a trip; something that evokes the desired feeling, scent, tactile sensation...

APPROACH: When using a mood board, the result is typically a collage of photographs (sometimes including videos), patterns, textures... Build on what you have come up

with in task 7, but not by illustrating it directly; look for analogies, metaphors, something that materialises the desired experience (but not the potential solution). The goal is to answer to yourself what kind of an experience you wish to facilitate with your solution to the problem posed.

Task 9

OBJECTIVE: Through contextual observation, we familiarise ourselves with typical users' behaviour and responses, as well as with the different spaces and uses. The observations do not take place in a vacuum, however; they can thus include everything else that might happen (according to plan, or otherwise) down the road.

INSTRUCTIONS: Perform at least two contextual observations.

APPROACH: The task is simple. Observe the user in an existing situation, interacting with existing products/service providers.

WHAT ARE WE LOOKING FOR? Users during the action selected for observation, their movements, posture, changes in the facial expression, where they direct their gaze, which items they makes use of, how they respond to the environment and any changes that occur in it. To make preparation and realisation easier, follow the steps below.

STEP 1: Preliminary preparation for the observation

1) Set out what you want to find out through observation in the form of at least three questions. For example: what are the key issues with the existing design?
2) Choose the location/situation that you will observe. Pay attention, for instance, to whether something is used during other activities. Define those activities and choose the context of the observation depending on the aforementioned purpose.

STEP 2: Observation

3) Observe interactions between people and the interaction of people with products and interior equipment. Record the observations as you go. If you have the opportunity (and the participants' consent), you may also photograph the situation or record it on video. Sketching is another good medium, if you are good at it. Meanwhile, during observation, pay attention to the following:
   a. facial expressions (whether the people smile, shake their head in disagreement, scowl…);
   b. body posture (head, arms, body);
   c. gestures and body language;
   d. sounds (those that express feelings: comfort, frustration…).
4) Collate the notes and recordings into a sensible whole, emphasising new findings.

SESSION 8

At the eighth session of the research-analytical stage, the tenth—final—group task (group passing) was carried out, as well as a standalone additional exercise of bisociation, taken from the Victor Papanek's book *Design for the Real World* (1992: 177–181).

Task 10

OBJECTIVE: Through the task of group passing, you can get an additional, unencumbered (yet relevant) perspective from your colleagues. The task provides a new perspective, while making sure that everyone involved consciously avoids criticising and giving negative responses.

INSTRUCTIONS: This is a tool that some call brainstorming with a sketch. The steps are detailed below.

STEP 1: Take the result of task 7, along with the rest of the findings (observations, completed circular design worksheets, completed analyses from both classes), and collate everything on sheet 1. Write down on the sheet everything you consider crucial for understanding your chosen focus (its context, the chosen users, the long-term goals). Do not forget to show in what

way your proposal deliberately includes circulation (of material, production, service).
Time: 10–15 minutes

STEP 2: On the second sheet, sketch out the (first) suggestion that comes to your mind regarding the content of sheet 1. Here, as well, you are invited to include the context, the user, the intent, the principle of circulation (anything that can help explain your suggestion in a simple sketch).
Time: 10–15 minutes

STEP 3: Each individual gives a brief presentation of both sheets, gauging the level of understanding by the responses.
Time: at most 2 minutes per individual.

STEP 4: Now comes the time for passing the sheets. Each individual passes their sheets to their colleague on the left. After receiving the sheets from your own neighbour, read them and review the ideas; think about what might be missing, what it would make good sense to include. Perhaps it might be worthwhile to think about the issue from the perspective of yet another user—a third context? What else might circulate, and how? What if we change the type of paper used by the design?

Once you have finished reading, sketch out the idea featuring your own improvements. Even if you have not added anything, sketch out the first idea that came to your mind while reading.
Time: 5 minutes

STEP 5: The sheets are passed on every 5 minutes until you get your own (now thoroughly elaborated on) proposal back. Examine how your idea was developed.

STEP 6: Modify the challenge posed according to the results obtained.

The Synthesis and Design Stage
Having completed the steps and tasks comprising the research-analytical stage, the students commenced with the synthesis stage, in which they used the findings of their research to define the chosen problems, the understanding of the wider context and the (potential) uses. They also defined the design starting points for the chosen focus. This was followed by the design stage, which lasted several weeks. This included steps such as in-depth interviews with users and other key stakeholders, mapping the current state of a typical product in production or a service in a process, generating ideas, as well as rapid prototyping and testing of conceptual solutions together with the Pulp and Paper Institute and selected stakeholders (on the basis of the observations and in-depth interviews conducted). Iterations were performed on the basis of preliminary testing, with the aim of improving the conceptual solutions, followed by the selection of conceptual solutions that would undergo further design, processing, development and detailing (selecting materials, specifying the manufacturing technology, preparing the graphics). This was further followed by the creation of a model and a blueprint in a vector format and by preparing reports in which the steps were recorded.

Finally, there was the first presentation of the generated proposals to all project partners, followed by the technical implementation. On the basis of the instructions received and the creation of the manufacturing blueprint, the students collaborated with the expert partners of the project (Pulp and Paper Institute and DS Smith) to produce prototypes demonstrating the envisioned uses of paper in the interior (the results are presented in the latter part of this publication).

In the course of the *Papiro-logía* project, the participants have more than once become aware of our linear perception of time, which is clearly reflected in the way we perceive the world, our thinking, our actions, and just as importantly, designing. In Ancient Greece, the situation was the opposite. Inspired by the astronomical movements, Ancient Greeks perceived time as “cyclical in nature, endlessly folding back on itself” (Puech, 1951: 39–40). This is also a fine metaphor for understanding the operation of circular design; design that is capable of continually regenerating and transforming the materials, resources, energy and

information already in circulation. Again and again, what has been used previously is returned into service, returning to itself, with the goal of abolishing the insatiable extraction of new resources and the intolerable accumulation of waste (which, as we now know, is not waste at all).

Several months of in-depth work on the *Papiro-logía* project has given us a new understanding of the potentials for establishing different relations between linearity and circularity, both in design and in the economy. Through careful design, the students transformed what is today a piece of waste into a new building block; they took a disposable material and creatively introduced a long-term product design approach that enabled them to "build" a series of lifecycles into the product—the result of facilitating simple maintenance and reuse. Others exploited the superb recyclability of the selected material and systematically identified products that are currently immediately disposed of, yet are still being made out of non-recyclable materials. The project therefore opened up numerous avenues for different, more sensible ways of acting; ways of acting that, in the long term, facilitate establishing a non-invasive relationship between the living and the non-living, artificially produced world. With one important addition: we have to make every effort so that using the adjective circular becomes redundant when talking about design. The circular mode of operation must become a categorical imperative in design. It must become a completely normal way of designing.

References

Chapman, Jonathan (2005). *Emotionally Durable Design: Objects, Experiences and Empathy,* London: Earthscan.

Ellen MacArthur Foundation (2013). *Towards the Circular Economy: Economic and Business Rationale for an Accelerated Transition,* vol. 1, www.ellenmacarthurfoundation.org/assets/downloads/publications/Ellen-MacArthur-Foundation-Towards-the-Circular-Economy-vol.1.pdf (15 October 2018).

Ellen MacArthur Foundation (2015A). *Growth Within: A Circular Economy Vision for a Competitive Europe,* SUN (Stiftungsfonds für Umweltökonomie und Nachhaltigkeit), Ellen MacArthur Foundation and McKinsey Center for Business and Environment, www.ellenmacarthurfoundation.org/publications/growth-within-a-circular-economy-vision-for-a-competitive-europe (1 May 2019).

Ellen MacArthur Foundation (2015B). *Towards a Circular Economy: Business Rationale for an Accelerated Transition,* www.ellenmacarthurfoundation.org/assets/downloads/publications/TCE_Ellen-MacArthur-Foundation_26-Nov-2015.pdf (1 May 2019).

Ellen MacArthur Foundation (2017). *What is the Circular Economy,* www.ellenmacarthurfoundation.org/circular-economy/what-is-the-circular-economy (5 October 2018).

Ellen MacArthur Foundation and Granta Design (2015), *Circularity Indicator: An Approach to Measuring Circularity* (Methodology), www.ellenmacarthurfoundation.org/assets/downloads/insight/Circularity-Indicators_Methodology_May2015.pdf (1 May 2019).

Ellen MacArthur Foundation and IDEO (2016A), *The Circular Design Guide*, www.circulardesignguide.com/ (3 October 2018).

Ellen MacArthur Foundation and IDEO (2016B), *The Circular Design Guide: Worksheets,* www.circulardesignguide.com/resources#worksheets (3 October 2018).

Escobar, Arturo (2018). *Designs for the Pluriverse: Radical Interdependence, Autonomy, and the Making of Worlds,* Durham and London: Duke University Press.

Eser, Sonja (2015). *Circular Design: Gestaltung der Kreislaufwirtschaft,* Buch am Erlbach http://circular-design.eu/automatisch/ (20 October 2018).

European Commission (2015). *Closing the loop – An EU action plan for the Circular Economy,* Brussels, 2 December 2015 (COM(2015) 614 final) https://eur-lex.europa.eu/resource.html?uri=cellar:8a8ef5e8-99a0-11e5-b3b7-01aa75ed71a1.0012.02/DOC_1&format=PDF (2 May 2019).

European Commission (2015). *Ecodesign Working Plan 2016–2019,* http://ec.europa.eu/growth/industry/sustainability/ecodesign_en (2 May 2019).

European Commission (2019A). *Circular Economy: Implementation of the Circular Economy Action Plan,* http://ec.europa.eu/environment/circular-economy/index_en.htm (2 May 2019).

European Commission (2019B). *Closing the loop: Commission delivers on Circular Economy Action Plan* (European Commission – Press release), http://europa.eu/rapid/press-release_IP-19-1480_en.htm (2 May 2019).

Godina Košir, Ladeja, Niko Korpar, Janez Potočnik, Robert Kocjančič et al. (2018), *Roadmap Towards The Circular Economy in Slovenia,* Ljubljana: Ministry of the Environment and Spatial Planning of the Republic Of Slovenia, www.mop.gov.si/fileadmin/mop.gov.si/pageuploads/medijsko_sredisce/2018/05_Maj/04_SJ_Kazipot/18_05_04_SJ_Kazipot_EN.pdf (2 May 2019).

Info entrepreneurs (2009). *Use design in your business,* https://m.infoentrepreneurs.org/en/guides/use-design-in-your-business/ (2 May 2019).

Keuc, Albin (2002). *Odpadki: problem ali izziv? Poročilo o izvajanju zakonodaje in doseganju strateških ciljev* (Waste: A Problem or a Challenge? A report on the implementation of legislation and achievement of strategic goals), Ljubljana: Umanotera, www.umanotera.org/wp-content/uploads/2014/11/Odpadki_priloznost-ali-izziv.pdf (4 April 2019).

McDonough, William and Michael Braungart (2002). *Cradle to Cradle: Remaking the Way We Make Things,* New York: North Point Press.

Meyer, Hannes (1928). "Building", *The Industrial Design Reader,* ed. Carma Gorman, New York: Alworth Press, 2003.

Papanek, Victor (1992). *Design for the Real World: Human Ecology and Social Change,* Chicago: Academy Chicago Publishers.

Puech, Henri-Charles (1951). "Gnosis and Time", *Man and Time. Papers from the Eranos Yearbooks,* ed. Joseph Campbell, Bollingen Series XXX/3, Princeton 1983.

Raworth, Kate (2018). *Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist,* London: Random House Business Books.

Steffen, Will, Katherine Richardson et al. (2015). "Planetary Boundaries: Guiding human development on a changing planet", *Science,* vol. 347, 13 February 2015, no. 6223: DOI: 10.1126/science.1259855 (1 May 2019).

SVRK (2017). *Slovenia's Smart Specialisation Strategy,* December 2017, Ljubljana: Government Office for Development and European Cohesion Policy, www.svrk.gov.si/fileadmin/svrk.gov.si/pageuploads/Dokumenti_za_objavo_na_vstopni_strani/S4_dokument_V_2017EN.pdf (2 May 2019).

Šooš, Timotej et al. (2017). *Slovenian Development Strategy 2030,* Ljubljana: Government Office for Development and European Cohesion Policy, www.vlada.si/fileadmin/dokumenti/si/projekti/2017/srs2030/en/Slovenia_2030.pdf (2 May 2019).

"The Lancaster Care Charter" (2019). *Design Issues,* vol. 35, no. 1, winter 2019, Cambridge MA: MIT Press.

Thorpe, Ann (2007). *The Designer's Atlas of Sustainability: Charting the Conceptual Landscape through Economy, Ecology, and Culture,* Washington: Island Press.

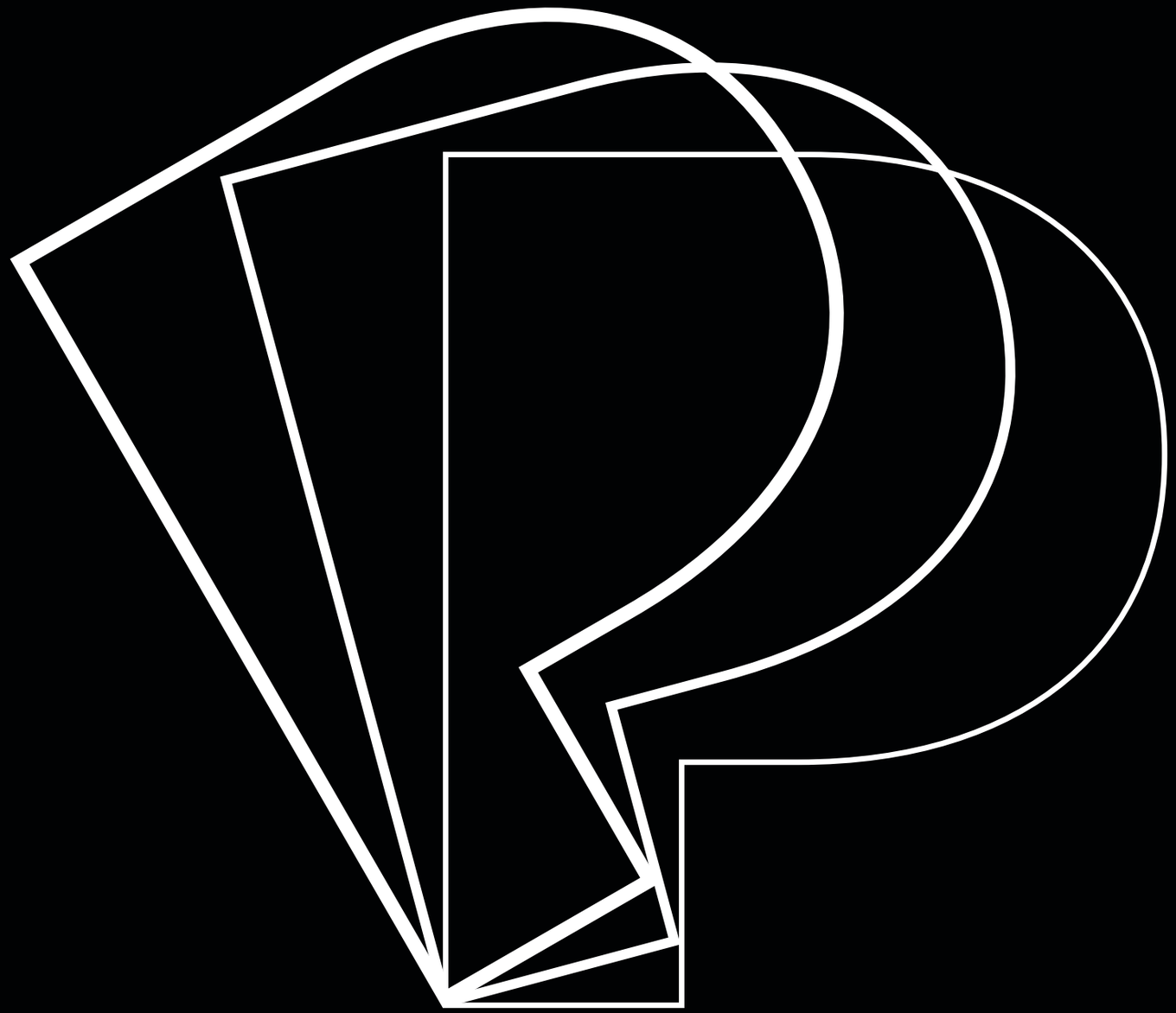
Tonkinwise, Cameron (2018). "'I prefer not to:' Anti-progressive Designing", *Undesign: Critical Practices at the Intersection of Art and Design,* eds. Gretchen Coombs, Andrew McNamara, and Gavin Sade, 74–84, London and New York: Routledge.

UN (2015). *Sustainable Development Goals,* www.un.org/sustainabledevelopment/sustainable-development-goals/ (7 October 2018).

"Waste statistics: Statistics Explained" (2018). *Eurostat,* https://ec.europa.eu/eurostat/statistics-explained/pdfscache/1183.pdf (5 May 2019).

WDO – World Design Organisation (2015). *Definition of Industrial Design,* https://wdo.org/about/definition/ (2 May, 2019).

Project results
Papiro-logía:
Circular design
and the use of paper
in interior design



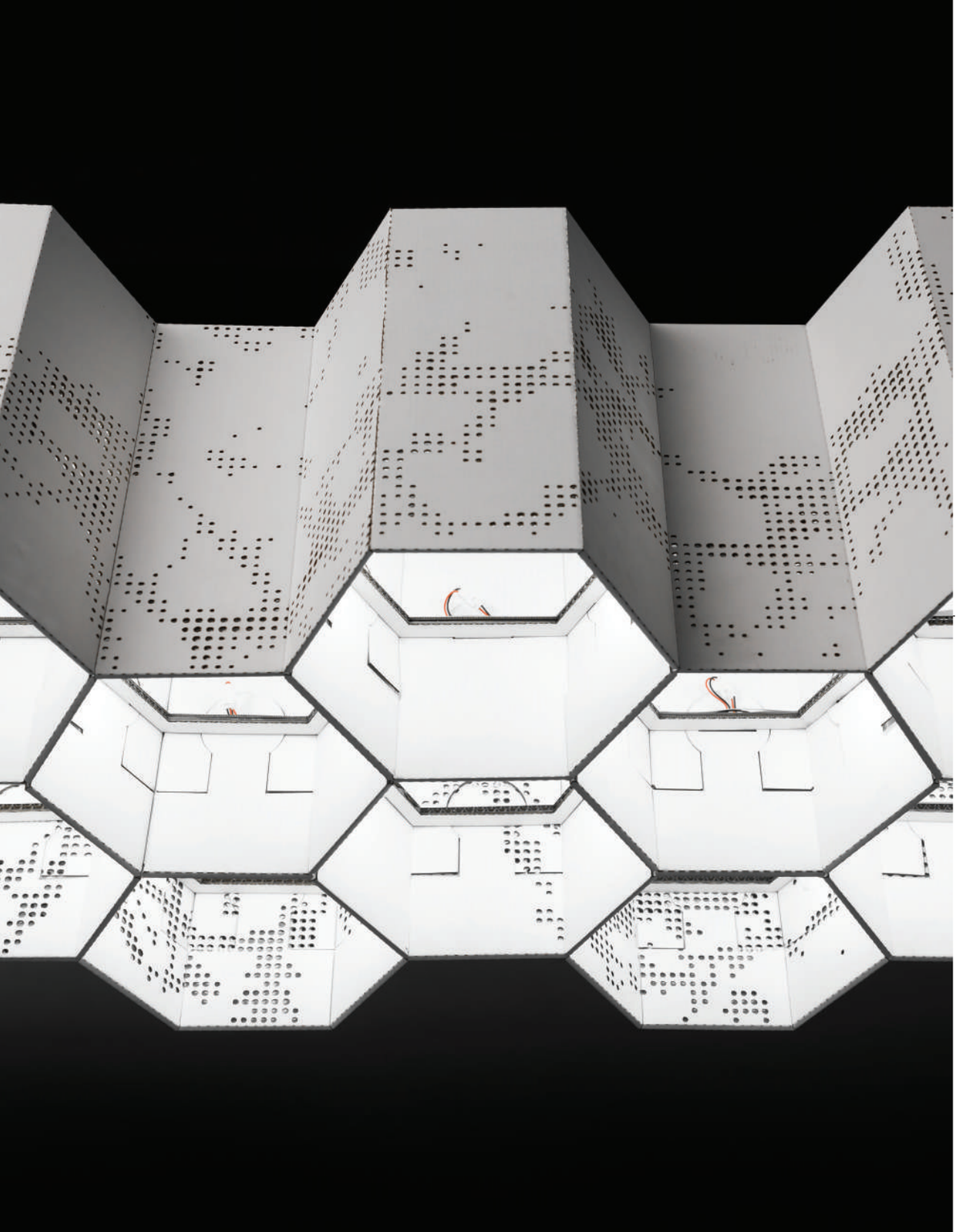
Presented below are the students' works created for the project *Papiro-logía: Circular Design and the Use of Paper in Interior Design* in the classes *Industrial Design* and *Service Design.* The project was carried out in the 2018/19 academic year at the Academy of Fine Arts and Design of the University of Ljubljana (the Industrial Design programme) as part of an interdisciplinary supply chain focusing on paper furniture.

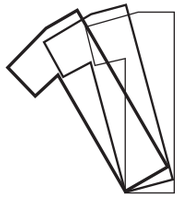
PROJECT PARTICIPANTS:
Simon Bregar, Eva Garibaldi, Lin Gerkman, Miha Hain, Jakob Koncut, Neža Medved, Tjaša Mužina, Simon Rozman, Blaž Skodlar, Gregor Stražar, Jera Tratar, Andraž Rudi Vrhovšek

MENTORS:
Assist. Prof. Rok Kuhar
Assoc. Prof. Jure Miklavc
Assist. Prof. Barbara Predan
Assist. Prof. Lidija Pritržnik

ASSOCIATE EXPERTS:
Mateja Mešl, MSc
Gregor Lavrič
(Pulp and Paper Institute)
Alenka Knez
Ajda Regali Knez
Primož Korenč
Miha Krnc
Marko Jurić
(DS Smith)

PROJECT LEADS:
Tina Pezdirc Nograšek
Urša Peršič
(Regional Development Agency of the Ljubljana Urban Region)





Hive

DESIGN:

Blaž Skodlar

DOMAIN:

lighting design

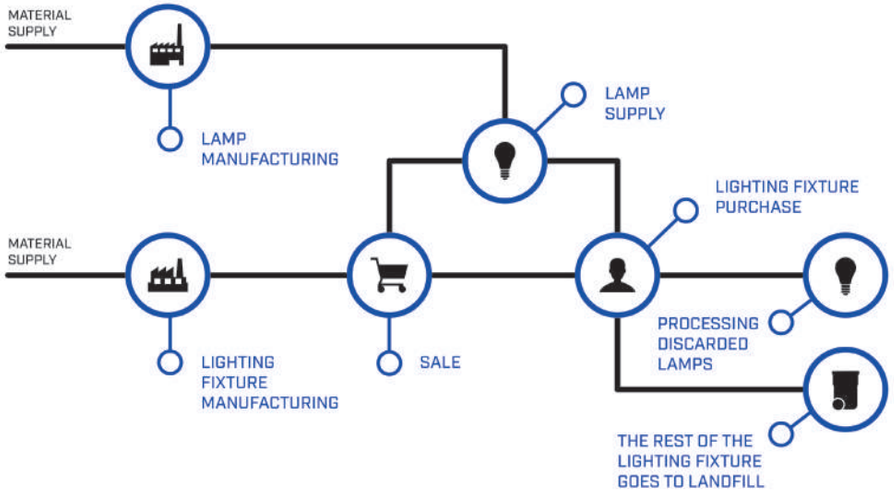
Hive is a modular lighting system produced primarily out of paper; meticulously designed, it invalidates any preconceptions of being a temporary product made out of a disposable material.

Starting Point/Background of the Identified Problem

Since paper wears rapidly, furniture pieces made of this material are often perceived as temporary, short-lived products. Yet at the same time, the US environmental agency EPA reported that in 2009 in the United States, furniture accounted for 9.8 million tons (4.1 per cent) of household waste. In Slovenia, 10 kg per capita of items were disposed of in 2015 that were still useful (from furniture, through clothes and toys, to household appliances). Despite the obvious short-term, consumerist attitudes towards furniture, very little of it is made out of paper.

The challenge in terms of planning and design was therefore twofold: to change the public perception of cardboard furniture, as well as to fully utilise the characteristics of paper in order to introduce circular economy principles into the furniture industry. The data on the amount of furniture that is disposed of is alarming, so there is an urgent need to reduce the carbon footprint in this sector. Paper furniture is an excellent fit for this context.

Diagram of a Currently Typical Process



The Analytical Research and Product Development Process

Familiarisation with the principles of the circular economy was followed by an in-depth study of the lighting fixture segment. Designing large lighting fixtures was found to represent the best opportunity for further investigation. Few vendors in this segment offer prefabricated products, with custom solutions predominating; moreover, the segment is characterised by the large investments necessary for product development. This leads to high manufacturing expenses, meaning that in order to bring down the costs, large lighting fixtures often end up not being used.

The analysis of the problem involved carrying out four contextual observations (methods for selecting lighting fixtures and making purchasing decisions; placing the lighting fixture in an interior; installation), a bisociation exercise, creating a mood board **(figure 1)** and testing various paper materials (corrugated cardboard **(figure 2)** was found to be the best candidate). All of these steps provided guidelines for further design work.

Figure 1: Mood board: researching lightweight natural structural shapes in combination with the physical properties of the material. The emphasis is on shapes that have evolved for strength.

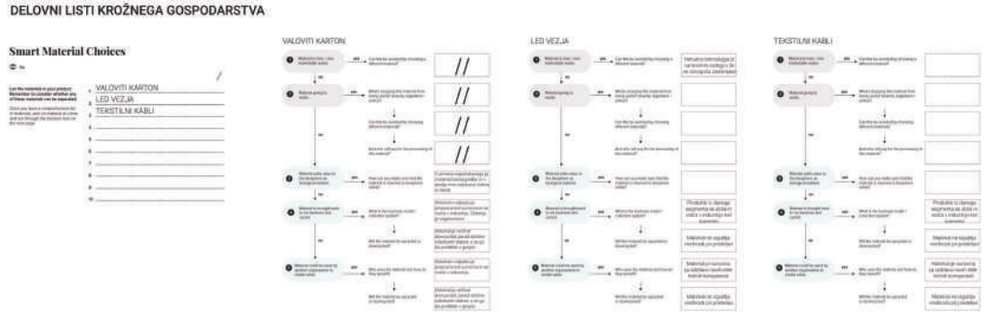


Figure 2: Material choice verification (circular economy worksheet)

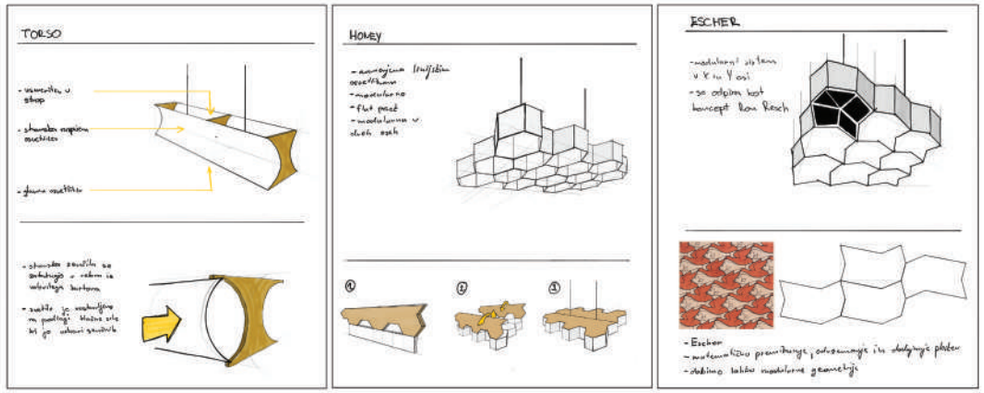


Figure 3:
Paper lighting fixture design (sketches)

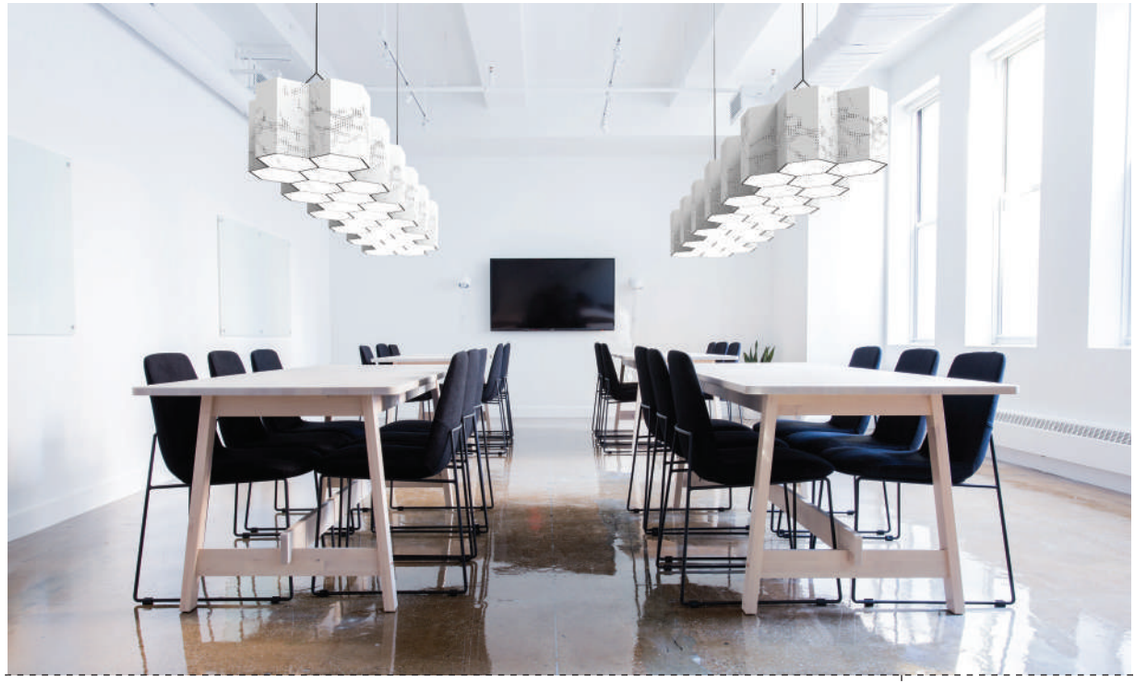


Figure 4:
Modular lighting fixture Hive

In the process of developing the lighting fixture **(figure 3)** and testing the various models, numerous concepts were tried out. The common denominator in the testing of the various models was investigating the best ways of providing functional illumination and adapting it both to the user's wishes and to the characteristics of the space where the lighting fixture is meant to be installed. Other important features of each concept were the possibility of flat packing, as well as toolless assembly of the lighting fixture by the end user.

Proposed Solution

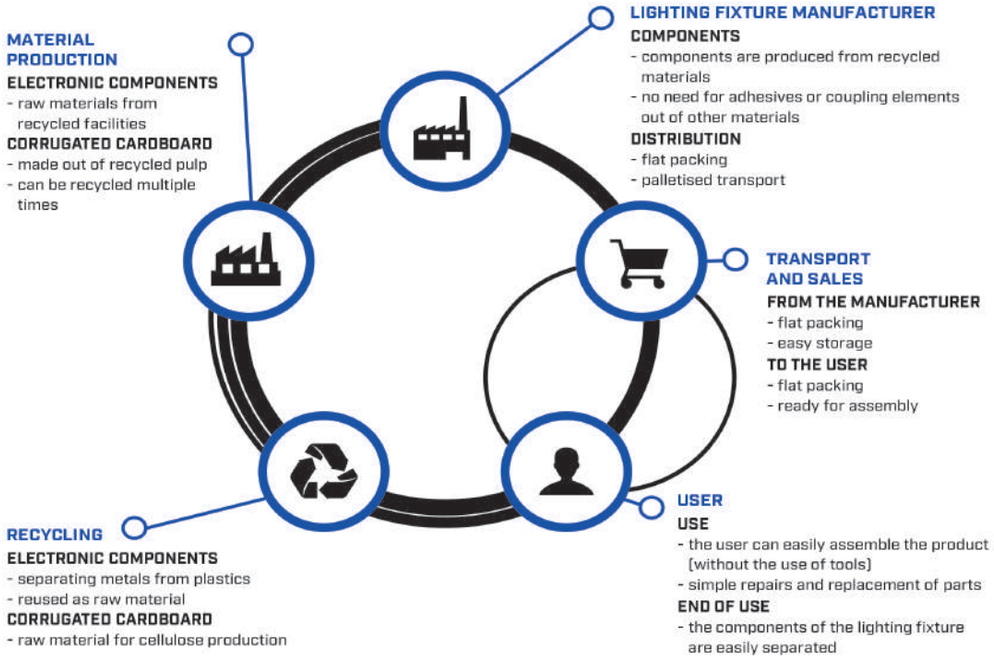
Hive is a modular lighting fixture manufactured out of corrugated cardboard, fire-safe electronics and LED modules **(figure 4)**.

Each component of the lighting fixture can be recycled or replaced, if necessary. Since all of the materials employed are recyclable and since the product is designed to facilitate replacement of every component, two circular economy loops are created. The first loop encompasses the raw material production cycle—the production of basic materials and the manufacture of final products—while the second loop involves repair and maintenance

The use of cardboard as the primary material, the sensibly chosen production processes and the carefully designed shape (inspired by honeycombs) facilitate flat packing and lead to a reduction of weight. Likewise, every critical step in the production cycle of the lighting fixture has been optimised; everything that has been mentioned adheres to the principles of the circular economy.

In comparison with competing products currently on the market, the Hive modular lighting fixture requires half the number of light sources for illuminating an equal area and its carbon footprint is a third smaller. The technologies used in the manufacturing of the newly designed lighting fixture are all mature and well established in the industry, which means that starting production would not require any additional financial investment.

Diagram of the redesigned process

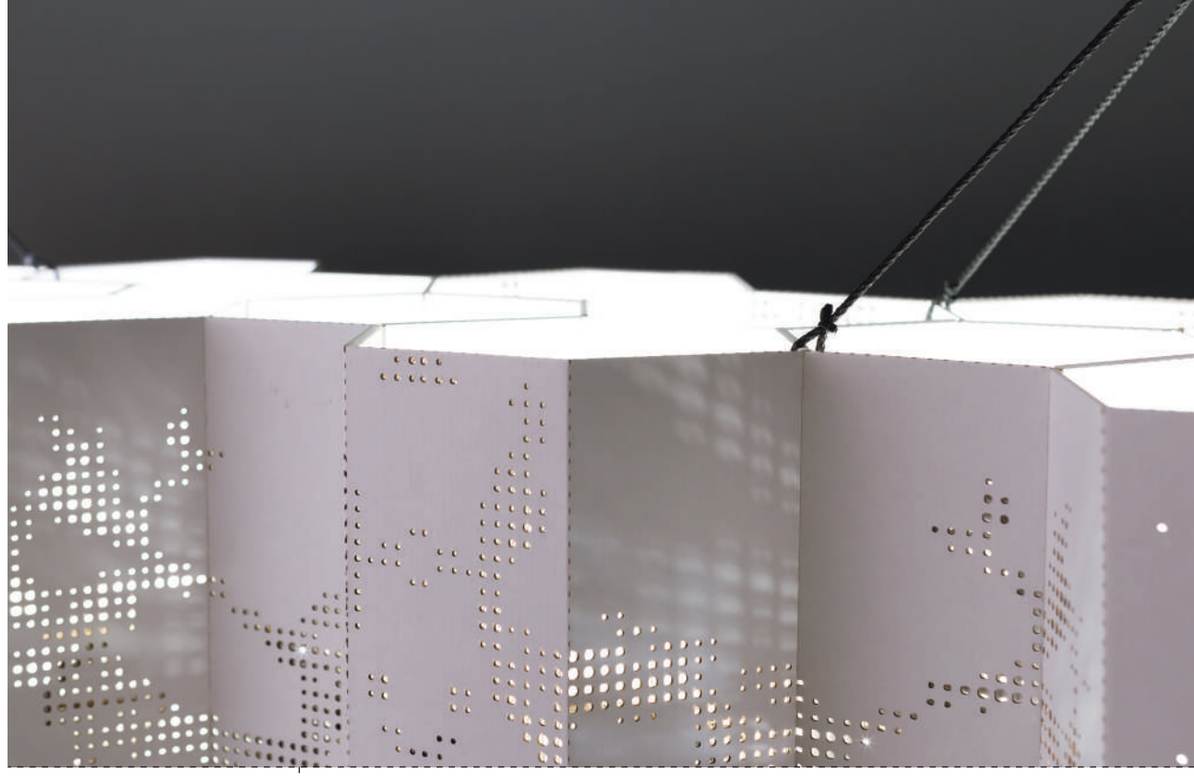


Advantages of the proposed solution

- flat packing
- low weight
- no need to manufacture tooling or moulds
- half the number of light sources for illuminating an equal area; carbon footprint reduced by a third in comparison with comparable products on the market (according to a comparison made using the Ecoliser system)
- possibility of immediate production

Public Presentations of the Project

It was among the winners of the "Young Balkan Designers 2019" competition and presented at the 10th Mikser Festival, which took place on 24th–26th May 2019 in Belgrade. The theme of this year's festival, titled "CIRKULIŠI!", is circular design. Organiser: Mikser festival.



Literature and Sources

Ayan, Özlem, *Cardboard in architectural technology and structural engineering: A conceptual approach to cardboard buildings in architecture* (doctoral dissertation), ETH Zürich, Zürich 2009, www.research-collection.ethz.ch/handle/20.500.11850/151987 (22 October 2018).

Circular City – Shaping our Urban Future, The Central Denmark Region and European Regional Development Fund, 2018, www.circularitycity.dk/wp-content/uploads/2018/05/Circularity-City-Book-Digital.pdf (18 October 2018).

"EPA Reports 9.8 Million Tons Per Year in Furniture Waste", *Reuters,* 6 May 2011, www.reuters.com/article/idUS126369713020110506 (12 November 2018).

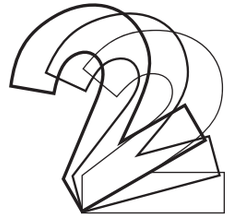
Holzer, Dominik, Richard Hough and Mark Burry, "Parametric design and structural optimization for early design exploration", *International Journal of Architectural Computing,* vol. 5, no. 4, Melbourne 2008, pp. 625–643, https://cumincad.architexturez.net/system/files/pdf/ijac20075403.pdf (25 October 2018).

Lloyd Wright, Frank, "The Cardboard House", *The Future of Architecture,* Horizon Press, Michingan 1953, pp. 387–398.

Morad, Abdel-Kader, Ahmed Atef Faggal and Yara S El-Metwally, *Efficiency of Corrugated Cardboard as a Building Material,* October 2012, Research Gate, Doi: 10.13140/RG.2.2.24879.53927 (20 October 2018).

Sekulić, Branko, *Structural cardboard: feasibility study of cardboard as a long-term structural material in architecture* (master's thesis), Universitat Politècnica de Catalunya, Barcelona, 2013, http://hdl.handle.net/2099.1/21603 (20 October 2018).

T. H., "Povprečni Slovenec letno zavrže več kot 10 kg še uporabnih stvari" [In a year, an average Slovenian throws away more than 10 kg of items that are still usable], *MMC RTV SLO,* 12 June 2015, www.rtvslo.si/okolje/novice/povprecni-slovenec-letno-zavrze-vec-kot-10-kg-se-uporabnih-stvari/367361 (10 November 2018).



Sensory Dome

DESIGN:

Tjaša Mužina

DOMAIN:

sensory integration

The sensory dome adapts to the needs of children with sensory processing disorder, providing them with the opportunity for quality learning, development and play. It is designed according to circular design principles.

Starting Point/Background of the Identified Problem

The basis for the research were diverse paper textures **(figures 1 and 2)** and the exploration of ways to make them useful. My research into the importance of tactile contact for an individual's development brought me to the issue of sensory processing disorder, a condition highly prevalent in children on the autistic spectrum. An analysis of existing products has shown that they are often made out of materials harmful to the environment, as well as designed in a way that makes recycling them difficult, if not impossible.

Figure 1: The texture of a crumpled piece of office paper

Figure 2: The texture of a dual layer corrugated cardboard

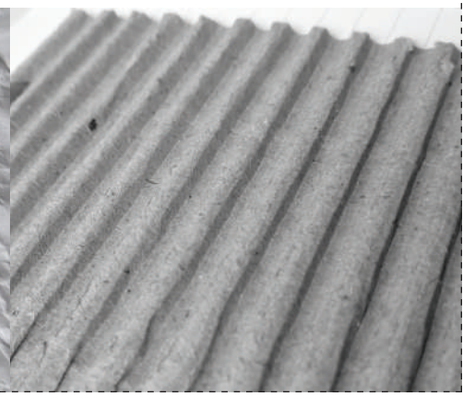
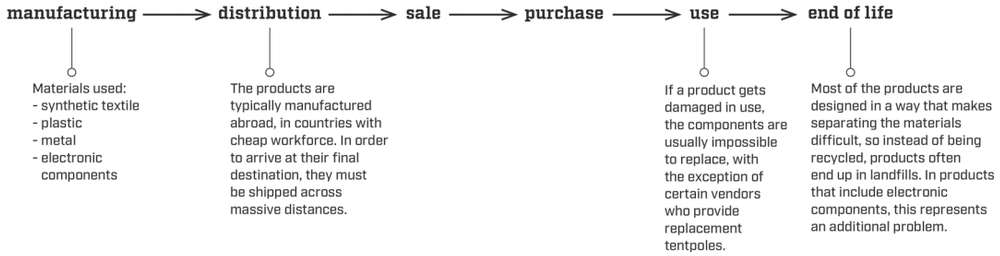


Diagram of a Currently Typical Process (a sensory tent)



The Analytical Research and Product Development Process

Sensory processing disorder is a dysfunction in which individuals have trouble perceiving sensations from the environment, as well as processing them. According to Lucija Batič, a sensory integration therapist at the Centre for Education, Rehabilitation and Training Vipava, the behaviour of such individuals often represents a direct response to a sensory experience. They typically experience difficulties in movement and proprioception. Everyday functions that most people take for granted can represent a deeply unpleasant experience for a person with sensory processing disorder.

This dysfunction also affects touch, an important component of social development that helps us assess our environment and enables us to respond appropriately. An individual with sensory processing disorder might have issues involving either lack of sensitivity or hypersensitivity. With the help of tactile objects, such an individual can gradually become accustomed to textures that would otherwise cause them discomfort, thus alleviating their issues to some extent. However, as Lucija Batič pointed out during field research, the problem with existing products is that, in addition to being too expensive, they are not individually adaptable. As a result, therapists end up crafting most of these objects themselves.

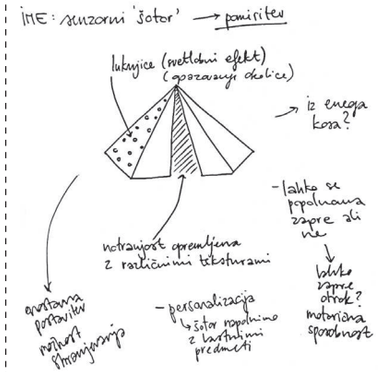
Design starting points

Since sensory processing disorder manifests differently in every individual, the central design guideline was facilitating individual adaptability. At the same time, using paper in the design of the object made it possible to lower the price of the end product while offering better opportunities for recycling **(diagram 2).**

Concept development and prototyping

The starting point of the concept is a self-supporting object featuring individual elements **(figures 3 and 4)** that stimulate the development of visual-motor coordination, tactile object recognition and fine motor skills. In addition

Figure 3:
Sensory tent concept sketch



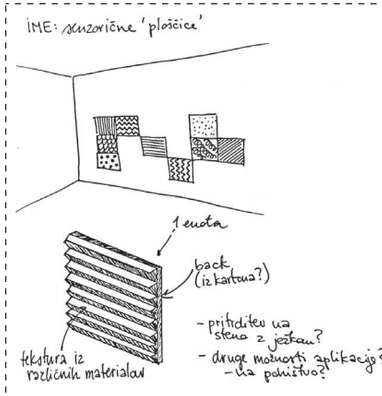


Figure 4:
Sensory panel concept sketch

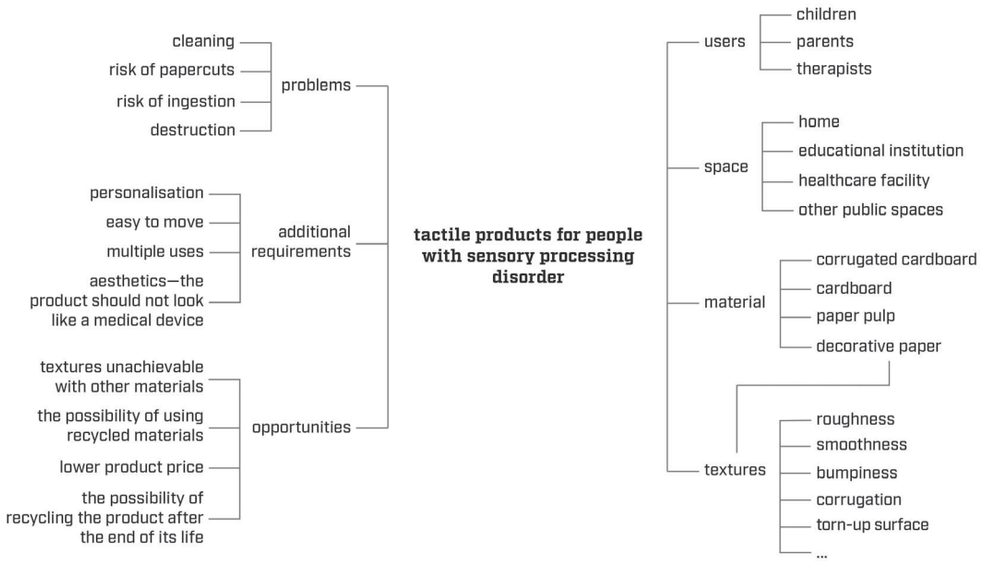


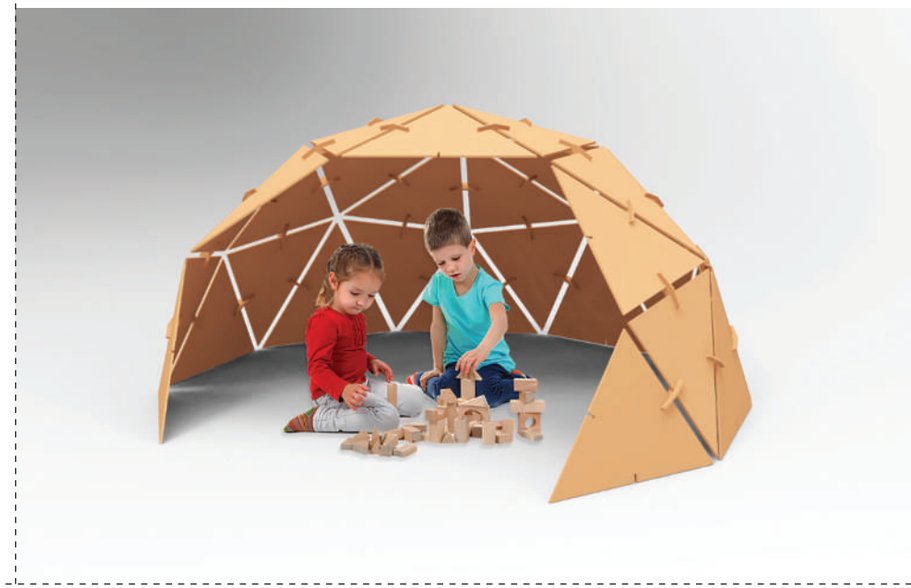
Diagram 2: Design guidelines

Figures 5–7: Dome prototype in its closed-off, partially open and fully open configurations

to featuring a variety of colours, textures, patterns and reflections, the elements are also designed to facilitate assembling and moving the product.

In the next stage, we used rapid prototyping to investigate and develop different configurations and forms that the object can take, as well as define component parts and materials **(figures 5–7).** The suitability of design was confirmed by sensory integration therapist Marijana Marković; through potential uses, she pointed out the advantages and disadvantages of the proposed solution. This was followed by more iteration and finally the detailing of the final solution.

Figure 8:
Sensory dome



Proposed Solution

The sensory dome is a product that gives children with sensory processing disorder a space to relax, learn and play, as well as to retreat from disturbances **(figure 8).** It can be used at home or in various public spaces.

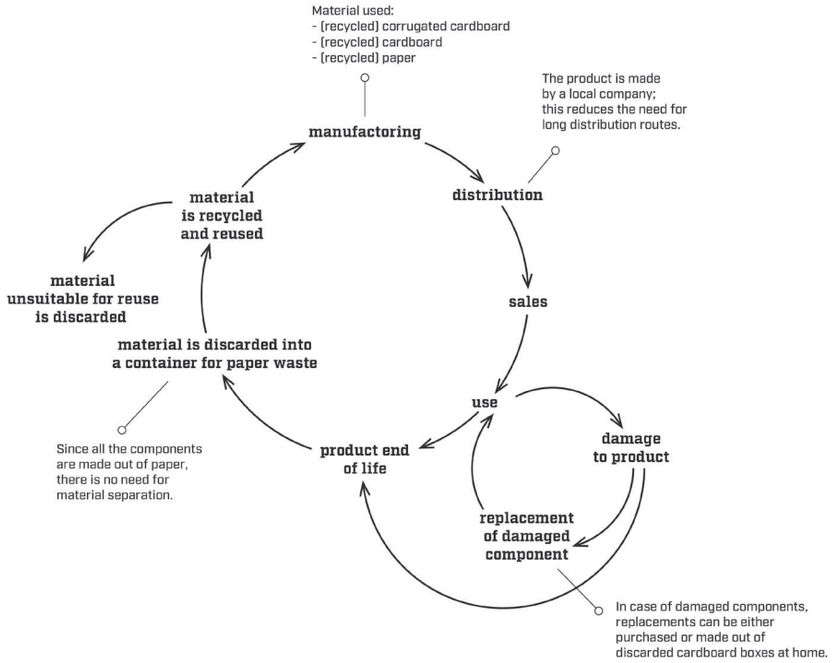
It is assembled from triangular elements made of corrugated cardboard and paper of different colours and textures, as well as cardboard links which permit assembly into different configurations. It can be completely closed off, have windows or be open on one side. The component parts can be assembled into three-dimensional shapes other than a dome. Assembling the dome is an activity that the child can perform together with his or her parents or peers and which stimulates the development of social, motor and cognitive skills.

Children with this disorder often have issues with proprioception, that is, the perception of their own body in space. The limited space offered by the dome can help them improve this facility.

The dome is not just a space, however; it can also be used as an accessory for play. The different colours and textures of the triangles can be exploited by coming up with guided games in which the child has the task

of identifying related or opposite properties. The fact that the triangles are blank, on the other hand, offers the child an opportunity for customisation. The dome can also be used as a goal for the child to attempt to roll or kick the ball into. The game can be refined further, for example by having the child roll a ball between triangles of the same colour. The only limitation in using the dome is the child's imagination.

Diagram of the redesigned process



Advantages of the proposed solution

- it adapts to the needs of the individual and can be used in several different ways,
- the product can be made out of recycled materials,
- if any of the component parts get damaged, they can be bought and replaced individually, or even made at home from waste cardboard,
- the product can be disassembled, which simplifies recycling and facilitates material circulation after the end of the product's life.

Literature and Sources

Brand, Andrew, Katie Gaudion, *Exploring Sensory Preferences: Living Environments for Adults with Autism,* The Helen Hamlyn Centre for Design, Royal College of Art, London 2012.

Brand, Andrew, *Living in the Community: Housing Design for Adults with Autism,* The Helen Hamlyn Centre for Design, Royal College of Art, London 2010.

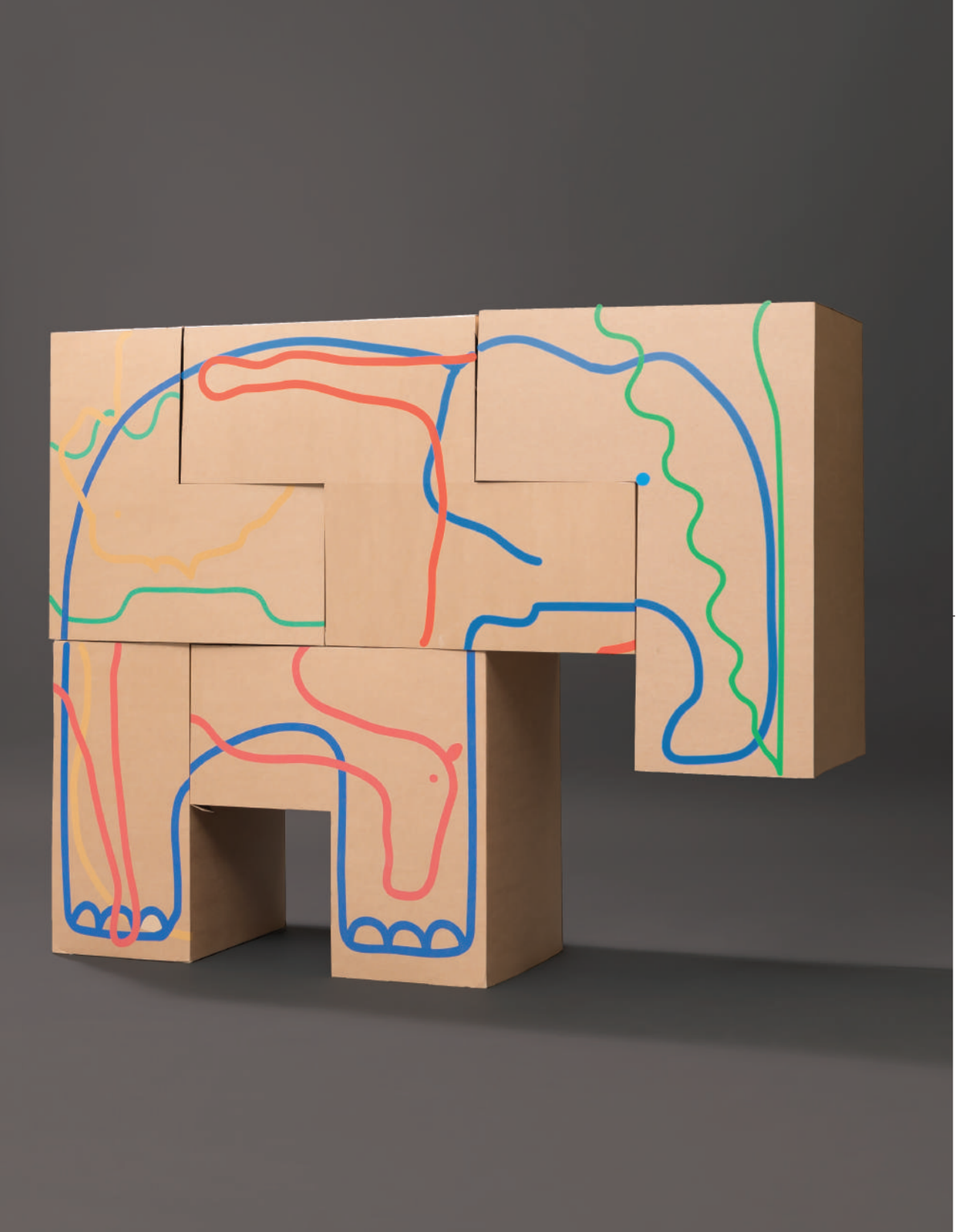
Çetin Sultanoğlu, Saliha, Neriman Aral, "Sensory integration disorder", *Education in the 21st Century: Theory and Practice,* Irina Koleva et al. (eds.), St. Kliment Ohridski University Press, Sofia 2015, pp. 374–381.

Gopal, Arathy, Jayaprakash Raghavan, "Design interventions for sensory comfort of autistic children", *Autism – Open Access,* 8:1, 2018, www.omicsonline.org/open-access/design-for-sensory-comfort-of-autistic-children-2165-7890-1000227.pdf (1 December 2018).

Has, Michael, et al., *Design and Management for Circularity – the Case of Paper,* World Economic Forum, January 2016, www3.weforum.org/docs/WEF_Design_Management_for_Circularity.pdf (20 October 2018).

Munari, Bruno, *The Tactile Workshops,* Maurizio Corraini s.r.l., Mantova 2014.

New 74% paper recycling target set for 2020, European Paper Recycling Council, 11 May 2017, www.paperforrecycling.eu/new-74-paper-recycling-target-set-for-2020/ (22 October 2018).



Zoobox

DESIGN:

Jera Tratar

DOMAIN:

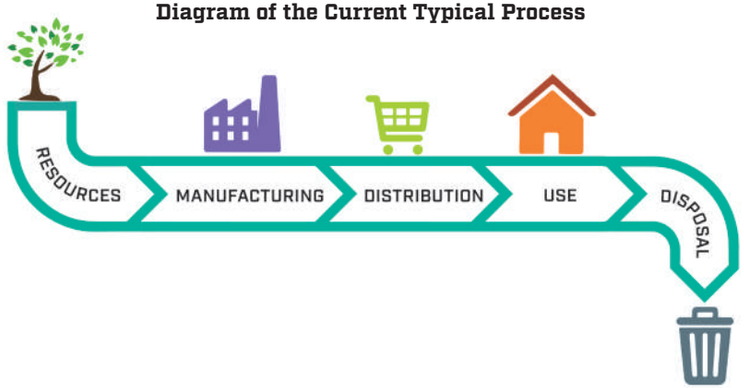
children's toys

Zoobox is a children's toy that can be assembled. It encourages motor development, strengthens spatial orientation and stimulates imagination.

Starting Point/Background of the Identified Problem
The toys market is incredibly saturated. Parents spend considerable amounts of money to satisfy their child's (typically short-lived) wishes. Furthermore, as much as 90% of toys are plastic, which in most cases can not be recycled (80% of the toys are produced in China).

Another problem is the fact that toys are usually discarded after only a few years of use. This means that as many as 10 million perfectly serviceable toys are discarded each year on a global basis.

Diagram of the Current Typical Process



The Analytical Research and Product Development Process
Paper offers a lot of potential for children's play. It is one of the first materials that children express their creativity with, as well as one of the most common. In light of children's toys' typically short lifespan, paper also offers an environmentally more benign alternative that, through careful design, can easily be made durable, strong and safe to use.

I chose children aged 5 and up as the target audience. In this age bracket, play and appropriate selection of toys are crucial for individual development and for learning through the exploration of the environment **(figure 1).** I have also deliberately designed the toy to be suitable for both sexes, as this represents a further benefit for children's

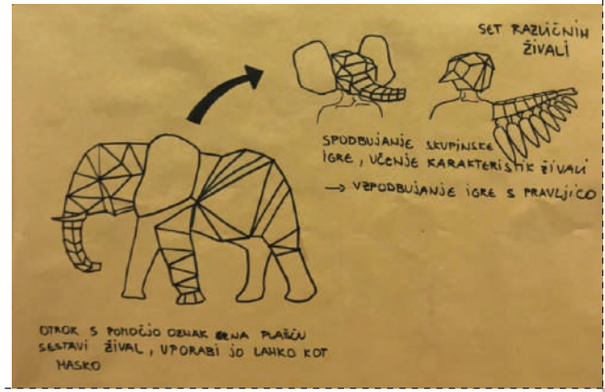
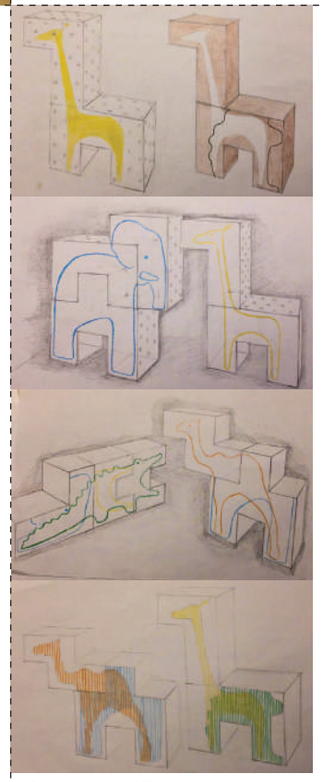


Figure 1: Exploring the animal world in paper form

development. An additional research focusing on how children in the chosen age group play at home revealed the problem of excessive amounts of time spent interacting with digital screens. Spending time passively like that can lead to acute dependence on the device; in the long run, this can also increase the likelihood of developing mental problems and give rise to tendency towards addiction.

Drawing on these findings, I set out to design a toy that would facilitate a number of uses and a type of play requiring the movement of the whole body (primarily at home, but not excluding kindergartens, where such toys that build on interaction could be used to help children integrate into the new environment and community). In designing the toy, I wanted to avoid the use of adhesives. Through testing, I came up with a way of solving this by assembling and slotting the panels into cubes. The individual elements of the toy are additionally joined with round magnets located in the corners. This way, I was able to replace three magnets with a single one, while also exploiting the magnetic force to make it easier to align the elements. Further tests were carried out in order to decide what size the cubes should be (after testing, they were reduced in size by 20% to ease manipulation) and come up with stacking methods and ways to ensure the recognisability of the abstract, schematic representations of animal characters **(figures 2–4).**



Figures 2–4: Different variations of stacking the cubes and animal outlines

Proposed Solution

Zoobox is a toy offering a fun and three-dimensional challenge of assembling outlines of animals. The cardboard cubes are deliberately designed to be large. This way, we give children the chance to improve their motor and spatial recognition skills and create their own play space, while also stimulating their creative thinking along the way. Some of the surfaces have been deliberately left open in order to allow children to place small toys into the cubes or even hide themselves inside them.

The cardboard cubes draw inspiration from the popular digital game of Tetris; at first glance, there is no apparent connection between them and the elephant, giraffe and crocodile. Yet the coloured outlines on their surface suggest a veritable zoo hidden behind the seemingly ordinary cardboard boxes. Interwoven coloured outlines of animals allow children to explore in order to try untangling them and figuring out what animal they represent **(figure 5).** This way, the toy strengthens children's cognitive abilities and spatial intelligence. Moreover, once they have managed to assemble an individual animal, they can colour it, add their own drawings or physically attach elements. Finally, they can ask themselves: what else can you achieve by thinking outside the box?

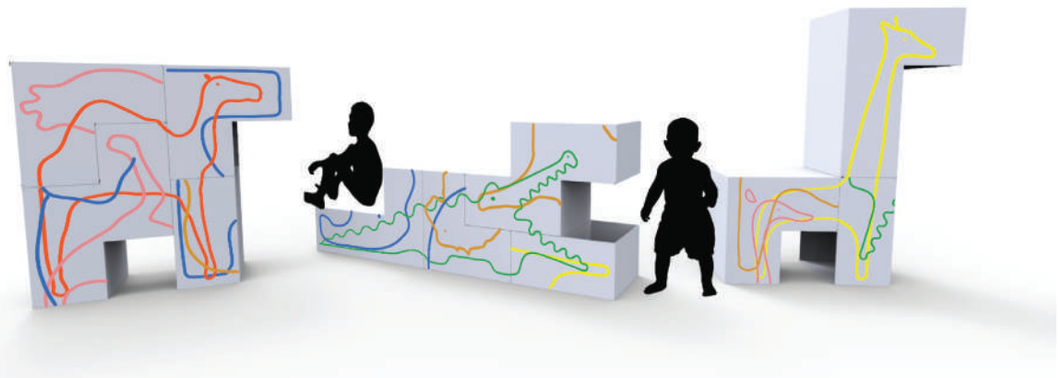


Figure 5: A demonstration of the diverse possible uses of the product

Diagram of the redesigned process

Advantages of the proposed solution

- use of a child-friendly biodegradable material
- numerous and diverse possibilities for the use of the product
- through flat packing, the product is efficient and simple to transport, as well as store
- the toy is designed to be easy to disassemble and fully recycle

Literature and Sources

Bhattacharjee, Dibakar, Muhammed Kamrul Islam, "Development of a paper recycling process", *Proceedings of the 15th Annual Paper Meet*, February 2014, The Institution of Engineers, Dhaka, Bangladesh. Available at: Researchgate, www.researchgate.net/publication/270877262_DEVELOPMENT_OF_A_PAPER_RECYCLING_PROCESS (13 December 2018).

Ivić, Ivan, *Razvojni koraki: pregled osnovnih značilnosti otrokovega razvoja od rojstva do sedmega leta* [Developmental stages: an overview of the basic characteristics of a child's development from birth to the age of seven], Inštitut za psihologijo osebnosti, Ljubljana 2002.

Jenett, Angelica, "How Your Child's Next Toy Can Help You Be Part of the Circular Economy", *Medium,* 23 July 2018, https://medium.com/tackling-toy-tyranny/how-your-childs-next-toy-can-help-you-be-part-of-the-circular-economy-bde8c772b910 (10 December 2018).

Korhonen, Jouni, Antero Honkasalo, Jyri Seppälä, "Circular Economy: The Concept and its Limitations", *Ecological Economics*, vol. 143, January 2018, pp. 37–46. Available at: www.sciencedirect.com/science/article/pii/S0921800916300325#! (2 November 2018).

Marjanovič Umek, Ljubica, *Razvoj otroške risbe* [Drawing Development in Children], Znanstveni inštitut Filozofske fakultete, Ljubljana 2004.

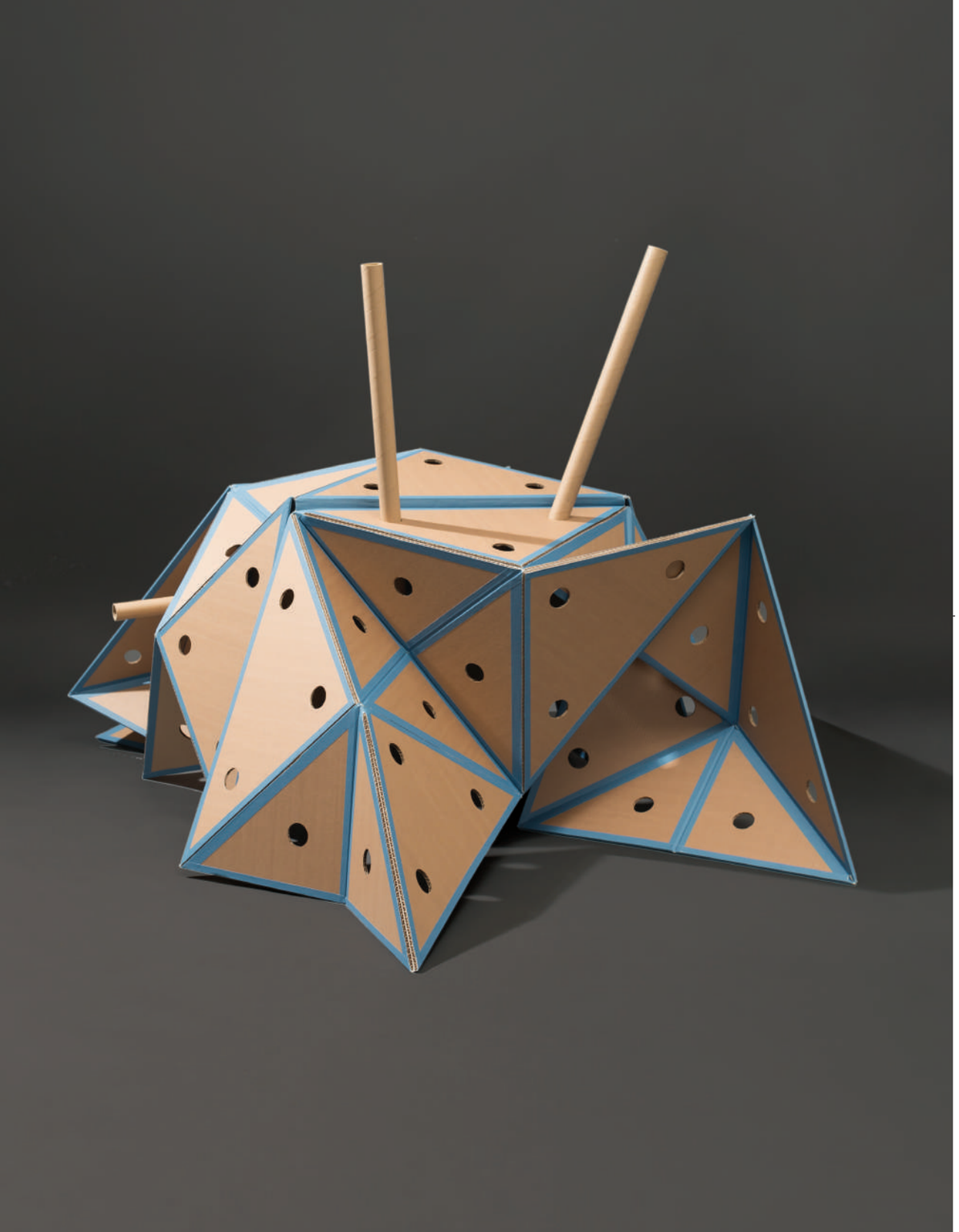
Miller, Susan A., Ellen Booth Church, Carla Poole, "Ages & Stages: How Children Learn to Solve Problems", *Scholastic,* 2018, www.scholastic.com/teachers/articles/teaching-content/ages-stages-how-children-learn-solve-problems/ (26 November 2018).

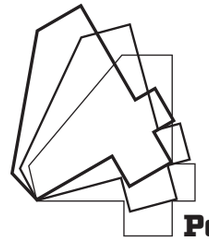
Oksman, Olga, "Are gendered toys harming childhood development?", *The Guardian,* 28 May 2016, www.theguardian.com/lifeandstyle/2016/may/28/toys-kids-girls-boys-childhood-development-gender-research (26 November 2018).

Sivevskaa, Despina, Sonja Petrovskaa, Oliver Cackov, "Role of the Game in the Development of Preschool Child", *Procedia – Social and Behavioral Sciences,* October 2013, no. 2, pp. 880–884. Available at: www.researchgate.net/publication/260815121_Role_of_the_Game_in_the_Development_of_Preschool_Child (26 November 2018).

Vitelli, Romeo, "Does Your Child Have a Digital Addiction?", *Psychology Today,* 23 November 2017, www.psychologytoday.com/us/blog/media-spotlight/201711/does-your-child-have-digital-addiction (25 November 2018).

"'Wasted': Greening the plastics-heavy toy industry", *CBC Radio,* 5 January 2018, www.cbc.ca/radio/day6/episode-371-iran-nuclear-deal-plastic-toy-waste-kaepernick-bitcoin-bunkers-spotify-vs-composers-and-more-1.4470486/wasted-greening-the-plastics-heavy-toy-industry-1.4470526 (26 November 2018).





Polygami

DESIGN:

Neža Medved

DOMAIN:

healthy child development

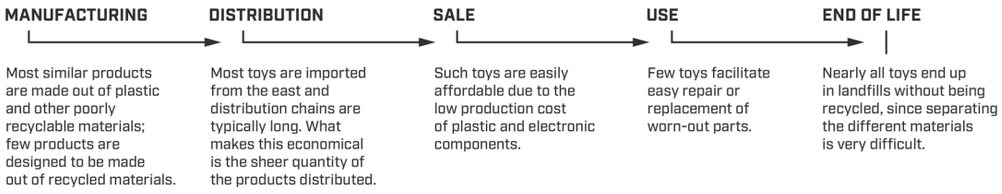
Polygami is a toy that stimulates a child's creativity, helps in the development of spatial intelligence and motor skills and facilitates exploration and development of the child's imaginary space.

Starting Point/Background of the Identified Problem

In her publication *Otrokova igra* (Child's Play), education counsellor Sabina Žnidaršič defines a toy as "any object that the child can utilise as an accessory for play". She adds that "all children need material and toys that stimulate physical and cognitive development". Likewise, it is an unavoidable fact that toys have a short lifespan (especially in kindergartens, due to frequent use). Yet despite that, toys are seldom made out of cardboard—a material that is both safe and environmentally more benign to dispose of or reprocess, which is important in light of toys' short lifecycles.

Building on these starting points, I focused my research on toys and kindergarten equipment, while deliberately setting out to actively involve pre-school children and employees. The planning process was built around modern education approaches, the choice of cardboard as the material, and the fact that when it comes to toys, what a child can do with it is more important than what the toy is capable of as such.

Diagram of the Current Typical Process



The Process of Analytical Research and Product Development

A thorough analysis of the various methods and approaches used in the education of pre-school children was followed by in-depth interviews. The first one was with kindergarten teacher Bernarda Strniša, from *Mojca* kindergarten, who works with children aged 4 to 6. She explained their process of education, which topics they cover and what types of toys the children play with, including whether any of them are made out of natural materials.

The second conversation was with two teachers from a private Montessori kindergarten *House children Bežigrad* In addition to the detailed interview, I also conducted thorough contextual observations of children **(figure 1).** Children played using well-designed educational toys, the key benefit of which was that they facilitated multiple ways of playing and using them. In my observations I also focused on the specifics of Montessori education, the teachers' attitude towards the children, to the children's responses and behaviour during play and to the layout of the spaces.

Figure 1: Contextual observation at *Hiša otrok Bežigrad*

The research showed that in addition to play (which is the main instrument of experiential learning), encouraging movement also has an important role in developing the perception of space and spatial relationships. Through movement, children explore, familiarise themselves with their surroundings and gain experience. Young pre-school children are more successful at developing mental models of objects' shape if they have the opportunity to practice motor manipulation of objects.

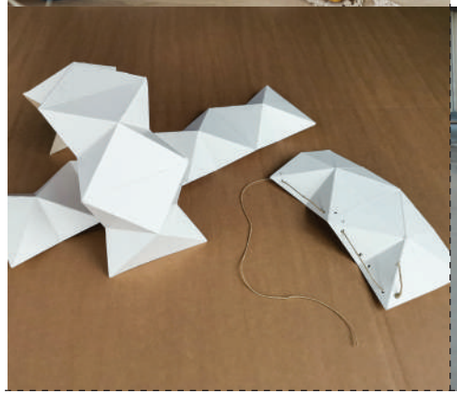


Figure 2: Exploring shapes through models using the origami technique

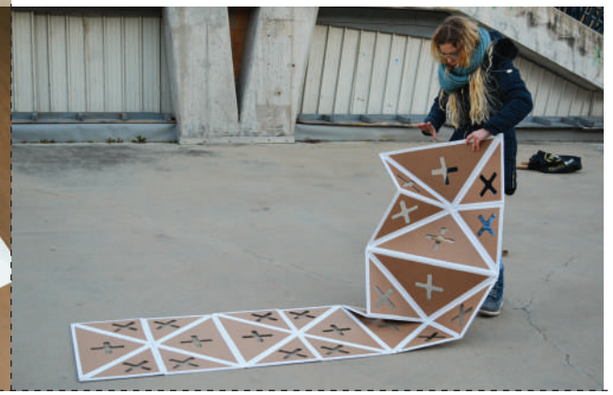


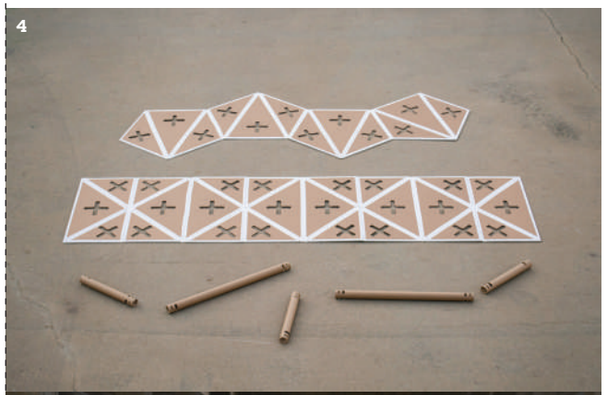
Figure 3: Full-scale testing

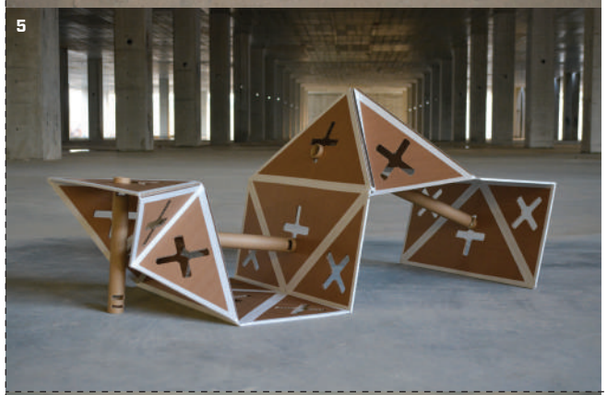
Building on these findings, I constructed several different scale models. In my research, I focused on the origami technique, which involves the transformation of a planar shape into a spatial object **(figure 2).** In the next step, I constructed the chosen concept at full scale and tested it **(figure 3).** On the basis of testing, I iterated the design until I arrived at the final product.

Proposed Solution

Polygami is a cardboard toy, or playing accessory, that encourages children's creativity through constructive play. It allows children in kindergartens to discover new skills and abilities with the help of their teachers. As they play, children practice various motor and other skills, weaving together reality and a rich imaginary world along the way. They strengthen their creativity by playfully moving elements around, shaping and changing their configurations. They are empowered to build a unique imaginary space, since the abstract form of the product does not suggest a specific final shape; it challenges the children with its deliberate ambiguity and flexibility, encouraging the development of mental associations with more or less realistic images, a more or less enclosed space.

The toy is made of corrugated cardboard and paper tubes. The triangular surfaces are joined with a textile band, forming two different folding patterns **(figure 4).** The panels have circular cut-outs designed to receive the paper tubes. These serve as columns that join the structure together and support it. The folding patterns can also be joined and assembled without the use of tubes **(figures 5 and 6).**





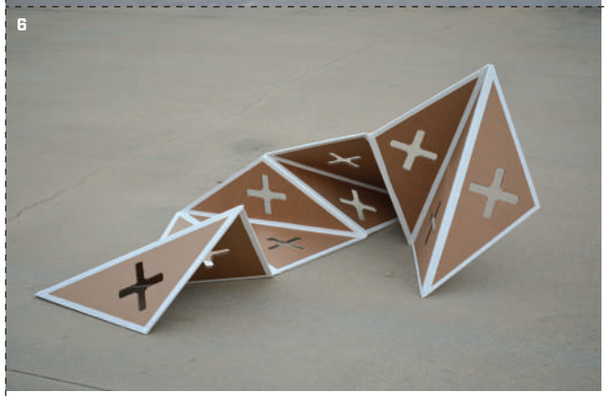
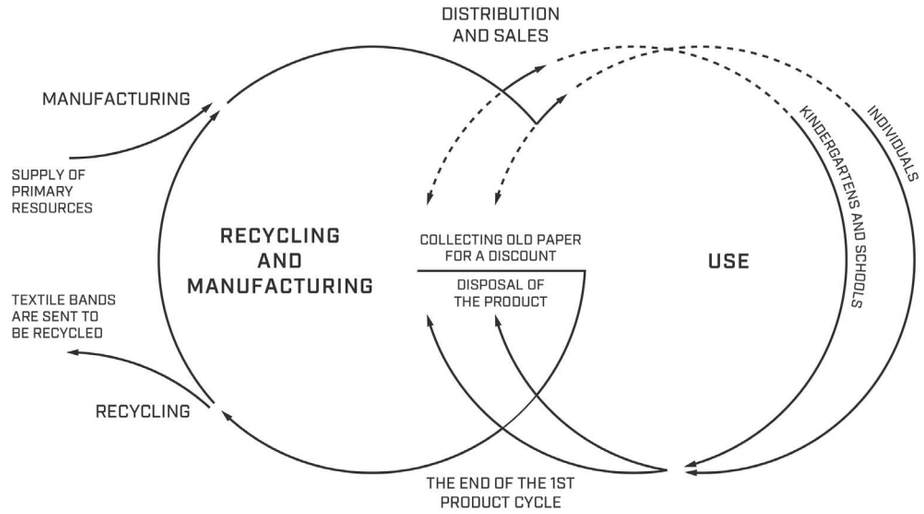


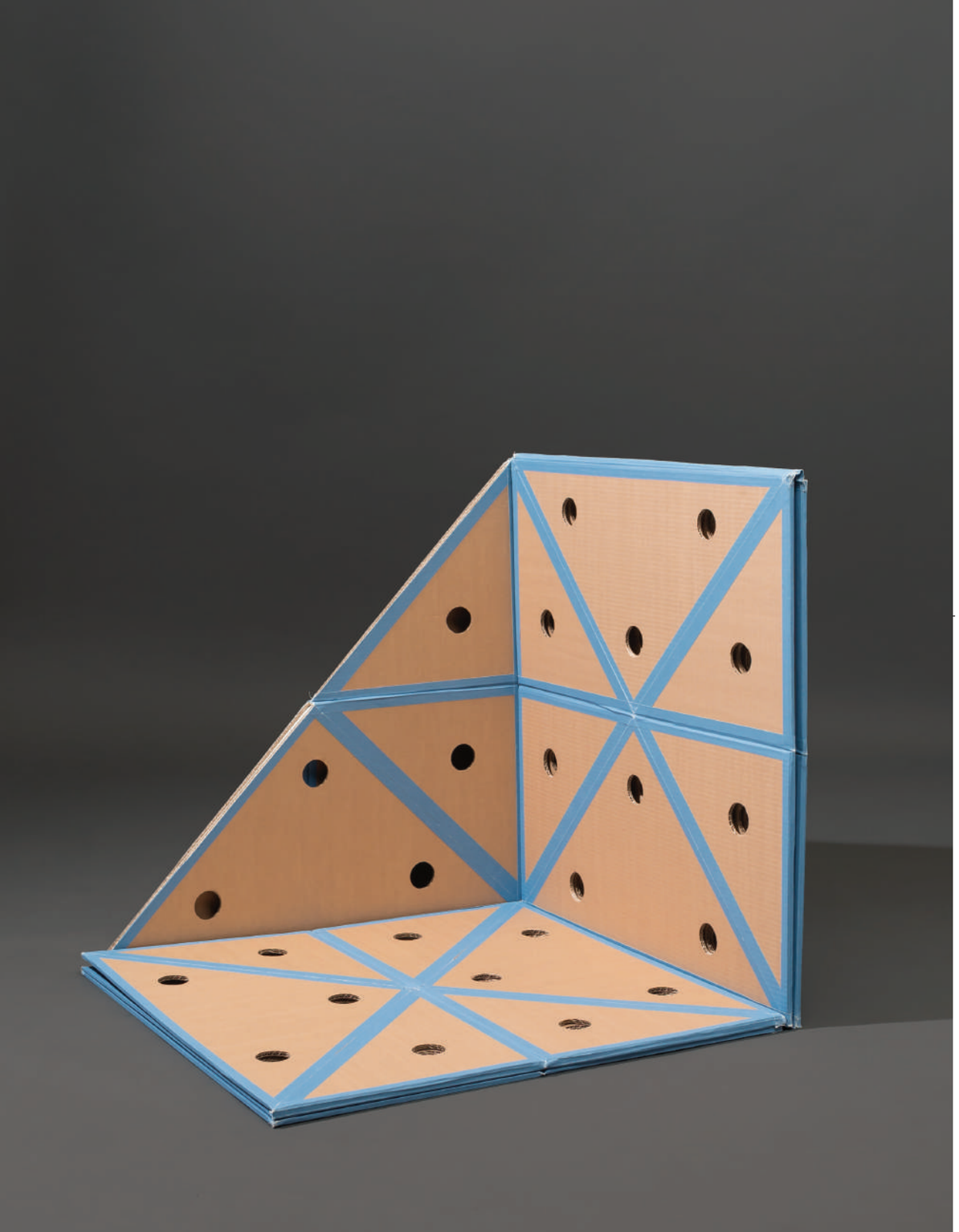
Figure 4: The triangular panels assembled into different folding patterns
Figures 5 and 6: Different folded configurations, one with the paper tubes, the other without

Diagram of the redesigned process



Advantages of the proposed solution

- the product is constructed out of paper intermediate products and bookbinding bands
- the simplicity of its design means that it is easily repairable by anyone if it gets damaged
- in addition to the product itself, we have also envisioned a service that encourages the users to collect paper for recycling
- the amount of material used and the price of the product are low considering its size



Literature and Sources

Bahovec, Eva D., et al., *Kurikulum za vrtce* [Kindergarten Curriculum], Strokovni svet RS za splošno izobraževanje, Ljubljana 1999, www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/podrocje/vrtci/pdf/vrtci_kur.pdf (12 December 2018).

Program vrtca montessori [Montessori Kindergarten Curriculum], Montessori inštitut, Ljubljana 2013, www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/Razvid/Vrtci_statistika/Programi/Program_montessori.pdf (12 December 2018).

Projektno delo z lutko (PDL) [Project Work with a Doll (PDL)], Vrtec Trnovo, https://vrtectrnovo.si/projektno-delo-z-lutko/ (1 December 2018).

Ustvarjamo Domišljijo: novosti 2018 [Creating Imagination: What's New in 2018], Satko, Ljubljana 2018, http://site-317310.mozfiles.com/files/317310/Novosti_2018-2019.pdf (4 December 2018).

Vidmar, Anja, *Številske in prostorske predstave pri učencih z gibalno oviranostjo in lažjimi motnjami v duševnem razvoju* (magistrsko delo) [Numerical and spatial cognition of students with physical disabilities and mild intellectual disabilities], Pedagoška fakulteta, Ljubljana 2017, http://pefprints.pef.uni-lj.si/4555/1/Anja_Vidmar_magistrsko_delo_kon%C4%8Dna_verzija.pdf (12 April 2019).

Žnidaršič, Sabina, *Otrokova igra* [Child's Play], www.oshjh-staritrg.si/files/2013/03/OTROKOVA_IGRA.pdf (8 December 2018).

Paper + Bioplastic

DESIGN:

Eva Garibaldi

DOMAIN:

new materials from (and uses of) nonrecyclable paper

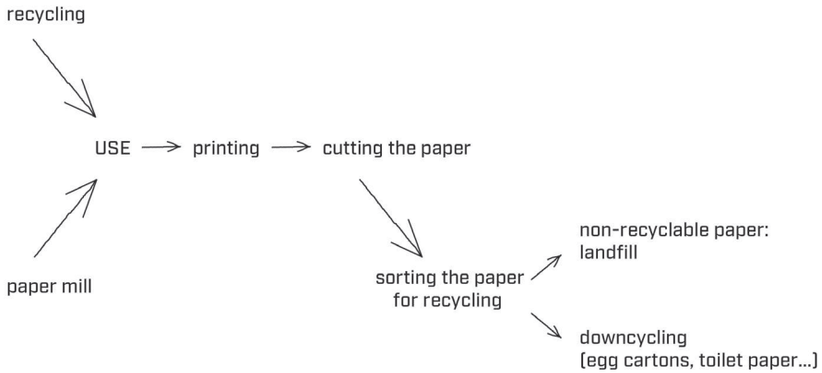
The Paper + Bioplastic project revolves around discovering and generating new (so far untapped) potentials of nonrecyclable paper.

Starting Point/Background of the Identified Problem

When we think about recycling paper, the focus is very rarely on the massive amounts of paper that ends up landfilled due to being nonrecyclable. Due to the short cellulose fibres it consists of, shredded paper is one of those nonrecyclable types of paper. It can only be *downcycled,* transformed into products with lower added value, such as egg cartons, tissues and toilet paper. This significantly shortens the paper's lifecycle and makes the subsequent sorting process more difficult.

The Paper + Bioplastic project takes the opposite perspective to the problem, making what is currently considered to be nonrecyclable waste the main focus of research.

Diagram of the Current Typical Process Involving Nonrecyclable Paper



The Process of Analytical Research and Product Development

In the course of my research, which was focused on finding opportunities for extending the lifecycle of nonrecyclable paper, I identified, on the basis of my findings, an opportunity in creating a biocomposite material. Another crucial factor that I actively included in my research was the "do-it-yourself", or DIY, approach. This approach was evident both in the experimental phase, which followed the preparation of the biocomposite, as well as in my desire to freely disseminate the knowledge required for the production of new material.

After a table-top research and the acquisition of basic information on the topic of preparing bioplastic, I came up with some starting recipes for the preparation of the mixture **(figure 1).** In the first phase of the experiment, I was mainly interested in the mechanical properties of the material. I performed extensive testing to find answers to the following questions: how do I achieve a higher material strength? How do I achieve material flexibility? How is the material processed? Is it resistant to water? What can I add to improve its mechanical properties? Is the material biodegradable and can it be composted? Can it be used for casting? How is it dried?

In my testing, I discovered that very few ingredients are required for the formulation of the new material. The first experiments resulted in thin plastic films that were made by mixing bioplastics with various forms of paper or paper pulp **(figure 2).** During the process, in addition to formulating the recipes, I also developed and improved methods for producing and drying the new material. I developed and tested the following recipes:

- 1: bioplastics + paper pulp
- 2: bioplastics + drained paper pulp
- 3: bioplastics + drained paper pulp dried in a mould
- 4: bioplastics + torn shredded paper
- 5: bioplastics + shredded paper
- 6: bioplastics + knitted shredded paper
- 7: bioplastics + randomly oriented shredded paper
- 8: paper pulp coated with bioplastic
- 9: pure starch bioplastic (an unsuccessful experiment)

Figure 1: Ingredients and implements for making the material (photo: Kristjan Dekleva)

Figure 2: Results of the experiments (photo: Kristjan Dekleva)

Figure 3: Optimised recipe No. 3 (photo: Kristjan Dekleva)
Figure 4: Recipe testing notes; the starting point for the making of the "cookbook" Paper + Bioplastic
Figure 5: "Do-it-yourself" approach

#4

Namen testiranja:
Ali se bo novonastali material ob manjši količini vode hitreje posušil?

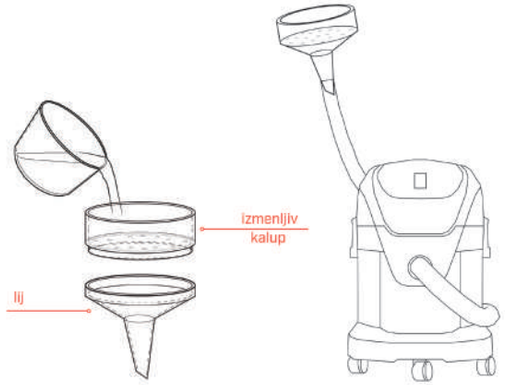
Sestavine:
40 ml destilirane vode
5 ml kisa
5 g glicerola
5 g moke
50 g razrezanega papirja

Ostali pripomočki:
večje steklo
manjša stekla, s katerimi pokrijem material
silikonska kuhalnica

Priprava:
Razrezani papir pregledam, odstranim tujke, kot so na primer sponke, in ga natrgam na manjše kose (5–8 mm). Na majhnem ognju zmes kuham po izhodiščnem receptu 1. Opazujem gostoto materiala, ki ob toploti postaja vedno bolj gost in lepljiv. Končni produkt s silikonsko kuhalnico namažem na steklo. Namen je preprosteje pridobiti gladko površino materiala.

Natrgan papir.

Mešanica za bioplastiko z dodanim papirjem.



After the first successful experiments, I selected three recipes for further development and testing (Nos. 1, 2 and 4). I followed this with the optimisation of recipes through additives, such as natural dyes, and other ingredients, like seeds **(figures 3 and 4).**

The second, experimental phase was focused on finding ways to create larger building blocks from the selected and optimised recipes. With the help of the Pulp and Paper Institute, a production method was devised that adapts the vacuum-filtering process for the "do-it-yourself" approach. This method involves pouring the material into a two-part 3D-printed mould (the lower part functions as a funnel, the upper part forms the shape)

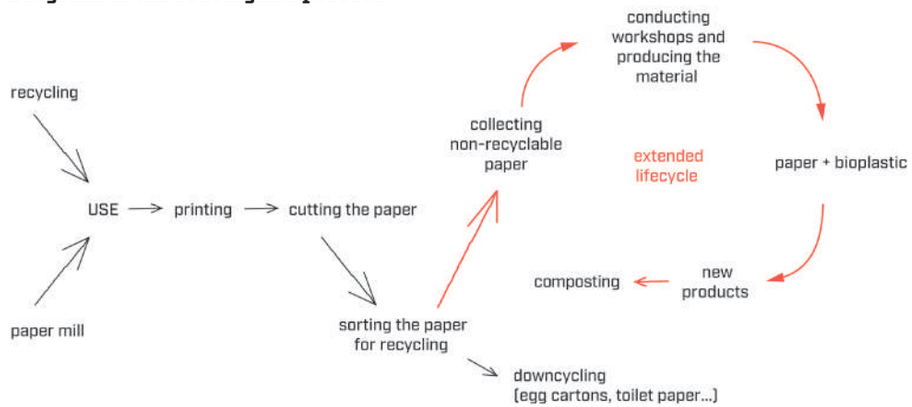
Figure 6: A potential product made out of the paper + bioplastic material

that is then attached to a water filtration water cleaner that sucks out water from the material **(figure 5).**

Predlagana rešitev

In its eponymous book, the Paper + Bioplastic project—building on DIY and circular design principles—offers users simple recipes for making new (compostable) material. The simple production of new biocomposite using the recipes employs the principle of learning through play, with the aim of making toys, such as children's playing blocks **(figure 6).** The project thus provides educational institutions for pre-school children with a fun new way of teaching the principles of the circular economy and about the importance of materials and sustainability. Workshops are intended for pre-school children, since this is the age when skill transfer is most effective. Through learning and games, the project likewise encourages creativity, research and empowerment through new skills.

Diagram of the redesigned process



Advantages of the proposed solution

- enables an extra life cycle for nonrecyclable paper
- the development of a simple "do-it-yourself" approach using conventional materials for the production of a new, biodegradable biocomposite
- in comparison with existing educational toys, this newly designed project has a significantly lower environmental impact: Ecoliser's calculation shows that the environmental impact of Paper + Bioplastic is nearly four times lower than, for example, Lego; the key advantage against other toys is the product's compostability
- the open-source nature of the project
- a new approach to educating users about the circular economy
- encouraging creativity and research

Public Presentations of the Project

Presentation at the main European circular economy conference by the European Circular Economy Stakeholder Platform, 6–7 March 2019, Brussels. Organiser: Circular Change, Centre for Creativity, European Circular Economy Stakeholder Platform – ECESP – Annual Conference 2019.

Creative & Circular exhibition, from 18 April to 5 May 2019, Museum of Architecture and Design, Ljubljana. Organiser: Circular Change, Centre for Creativity, Museum of Architecture and Design.

Presentation at the 4th international circular economy conference *Circular Change,* 16–17 May 2019, Maribor. Organiser: Circular Change.

Literature and Sources

Atmodiwirjo, Paramita, F. Istiani, Noor Fajrina, "Children as 'Interior Architects': Creative Learning and Exploration of Classroom Furniture", June 2014, www.researchgate.net/publication/303836890_Children_as_Interior_Architects_Creative_Learning_and_Exploration_of_Classroom_Furniture (22 November 2018).

Cecchini, Cecillia, "Bioplastics made from upcycled food waste. Prospects for their use in the field of design", *The Design Journal: An International Journal for All Aspects of Design,* no. 20, Taylor & Francis Group, 2017, pp. S1596–S1610.

Design and Management for Circularity – the Case of Paper, World Economic Forum, 2016, https://bit.ly/2zkTdZz (1 April 2019).

Dunne, Margaret, "Bioplastic Cook Book", *Issuu,* July 2018, https://issuu.com/nat_arc/docs/bioplastic_cook_book_3 (4 November 2018).

"How to Recycle Shredded Paper", *Earth911,* https://earth911.com/recycling-guide/how-to-recycle-shredded-paper/ (27 November 2018).

Howe, Emily, "The Re-invention of Molded Pulp", February 2010, www.iopp.org/files/public/HoweEmilyRIT.pdf (20 November 2018).

Lange, Alexandra, "Design Notes, Episode 10. Architecture critic Alexandra Lange explores the design of childhood—from the sandbox to the street", *Google Design,* November 2018, https://design.google/library/alexandra-lange-design-of-childhood-interview/ (16 November 2018).

Liew, Kang Chiang, Khor, Lian Kim, "Effect of different ratios of bioplastic to newspaper pulp fibres on the weight loss of bioplastic pot", *Journal of King Saud University – Engineering Sciences,* no. 27, King Saud University School of International Tropical Forestry, Malaysia 2013, pp. 137–141.

Ribul, Miriam, "Recipes for Material Activism", *Issuu,* April 2014, https://issuu.com/miriamribul/docs/miriam_ribul_recipes_for_material_a (4 November 2018).

Solanki, Seetal, *Why Materials Matter. Responsible Design for a Better World,* Prestel, Munich 2018.

"The Skinny on Recycling Shredded Paper", *Recycle by City,* www.recyclebycity.com/chicago/brief/the-skinny-on-recycling-shredded-paper (27 November 2018).

Van der Leest, Emma, *Form Follows Organism: The Biological Computer,* Willem do Kooning Academie, Rotterdam 2016.

When newsprint becomes...

DESIGN:

Miha Hain

DOMAIN:

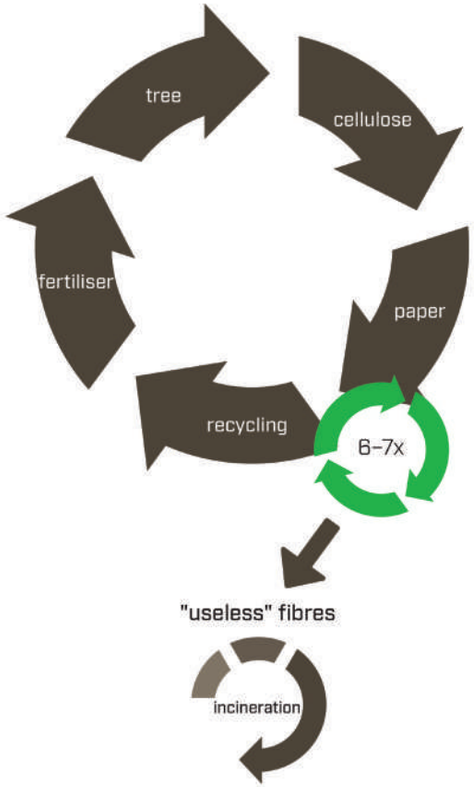
new materials from (and uses of) nonrecyclable paper

... a chair, proving in practice that recycled newsprint is a structurally and aesthetically suitable material for manufacturing furniture.

Starting Point/Background of the Identified Problem

The research focused on the issue of recycled paper. In the recycling process, the paper is mechanically processed, which leads to tearing of cellulose fibres—the most important constituent of paper. As a consequence, paper can only be recycled 6–7 times before the cellulose fibres end up too short and their mechanical properties no longer appropriate for further processing into paper and other cellulose derivatives. The resulting raw material ends up as a source of energy in incineration plants, or it can live out its last life cycle as a fertiliser.
On the basis of these findings, I examined (assisted by Gregor Lavrič and Barbara Šumiga from the Pulp and Paper Institute) the possibilities for giving cellulose fibres an additional life cycle.

Diagram of the Current Typical Process



The Process of Analytical Research and Product Development

In the analytical-research phase, my focus was on thoroughly researching the material and its properties while simultaneously familiarising myself with the circular economy in the pulp and paper industry. In my investigation of the material itself and the circular economy, I was particularly interested in the ultimate fate of the raw material once it is completely degraded—the cellulose fibres that mechanical processing has made too short for further recycling. I was interested in the properties of what might, at first glance, be considered as a useless material.

Figures 1 and 2: Manufacturing moulds for checking the consistency of the mixture used in the final prototype

Figures 3 and 4: Manufacturing the first prototype with a crudely shaped seat

It turned out that critically degraded cellulose fibres can be combined with other environmentally friendly materials and processed into a material suitable for further design. By choosing the right materials in correct proportions, the desired material properties can be actively designed into a new, environmentally sound composite.

In the prototype phase—in view of the primary goal, which was to transform a seemingly unusable material into a composite suitable for manufacturing furniture—I combined the nonrecyclable paper fibres with starch and water. I tested the resulting paste for its structural, chemical and aesthetic properties **(figures 1–4).** The tests showed that the new composite is eminently suitable for manufacturing furniture.

Proposed Solution

The chair is made out of recycled cellulose fibres that are unsuitable for being further processed into paper. A mixture of fibres, starch and water is poured into the mould, in which it is dried at a temperature of 80°C. In the process, crosslinking of cellulose and starch occurs, and the water evaporates. Once dried, the casting features very good structural properties and as such is a suitable material for designing chairs or other pieces of furniture **(figure 5).**

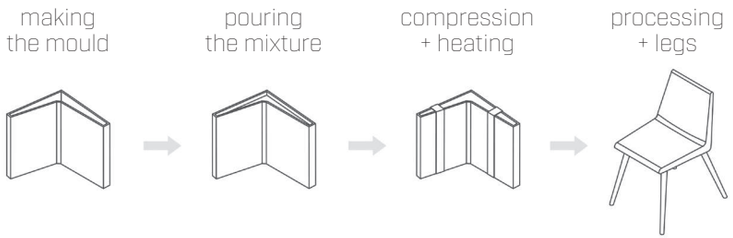
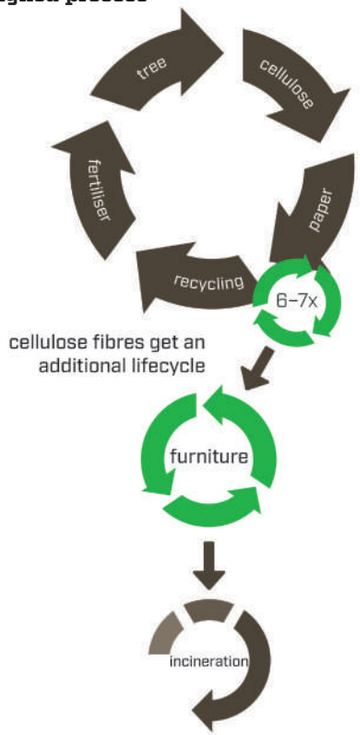


Figure 5: Developing the prototype manufacturing process

The design of the chair was mainly influenced by the properties of the wet cellulose mass and the characteristics of the manufacturing process itself. The moulding process enabled exploration of organic forms, a fact I exploited to achieve good ergonomics of the seat. In the design process, I also took advantage of the good tactile properties of the composite mixture. The result was an extremely lightweight and compact chair, suitable for indoor use **(figure 6).**

Figure 6: A chair made out of recycled newsprint

Diagram of the redesigned process



Advantages of the proposed solution

- an additional life cycle of the basic raw material in the circular economy of pulp, paper and their derivatives
- proves that short, critically degraded cellulose fibres remain usable as a raw material and are as such not suitable for incineration
- a completely recyclable product whose disposal is not problematic for the environment

Public Presentations of the Project

The project was presented in the following article: Gregor Lavrič, "ICP, strokovni partner v novoustanovljeni interdisciplinarni verigi pohištva iz papirja / ICP, an expert partner in the new value chain for paper furniture", *Papir – Revija slovenske papirne in papirno predelovalne industrije,* 2019.

Literature and Sources

Andrés, Federico N., Loreley B. Beltramini, Anabela G. Guilarducci, Melisa S. Romano, Nestor O. Ulibarrie, “Lightweight Concrete: An Alternative for Recycling Cellulose Pulp”, *Procedia Materials Science,* 8 (2015), Centro de Investigación y Desarrollo para la Construcción y la Vivienda (CECOVI), Universidad Tecnológica Nacional, Facultad Regional Santa Fe, Santa Fe 2015, pp. 831–838. Available at: www.sciencedirect.com/science/article/pii/S2211812815001431 (25 November 2018).

Schuetze, Christopher F., “The Circular Economy of Recycled Paper”, *The New York Times,* 18 November 2014, www.nytimes.com/2014/11/19/business/energy-environment/closing-the-loop-on-recycled-paper.html (14 October 2018).

Sukalich, Kathryn, “Everything You Need to Know About Paper Recycling”, *Earth911,* July 2016, https://earth911.com/business-policy/business/paper-recycling-details-basics/ (19 October 2018).

Webster, Ken, *The Circular Economy: A Wealth of Flows,* 2nd Edition, Ellen MacArthur Foundation Publishing, New York 2017.

User- and Environment-friendly Polling Station Equipment

DESIGN:

Simon Bregar

DOMAIN:

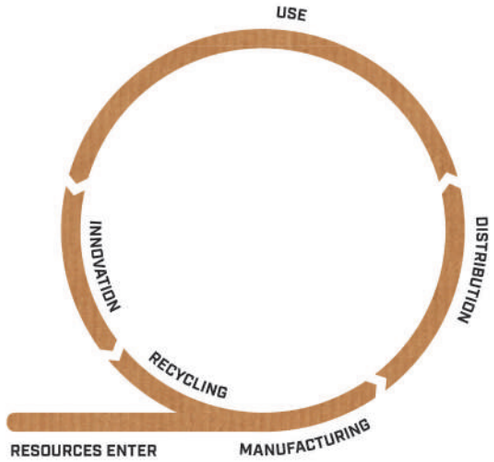
extending the useful life of a product

The project offers an answer in the form of improvements to the existing polling station equipment. The integrated approach of the newly designed solution provides voters with a suitable and effective experience at the polling station; at the same time, the new design features a significantly reduced environmental impact.

Starting Point/Background of the Identified Problem

Organising an election is an extremely complex political process. Even though every election involves a huge number of users, the associated planning is, on many levels, rather superficial. This includes a mediocre user experience that is only partially deliberately designed, as well as the existing election infrastructure, which is single-use only. This means that every election, we discard more than 10,000 pieces of cardboard election equipment

Diagram of the Current Typical Process



The Process of Analytical Research and Product Development

In the first phase of the project, I researched the basic concepts and principles of the circular economy and circular design. I focused on understanding the crucial mechanisms employed by circular-economic and design logic to achieve sustainable solutions.

During my user and functional research, my primary focus was on circular economy, with the basic purpose of reducing material consumption and extending the lifespan of the existing product—a product that does not end its life in a landfill, but is instead recycled for another life cycle. In my case, this was polling station equipment.

I carried out contextual observation and user experience mapping in the field; observation took place in the course of an entire election day in the 2018 local elections. This was complemented by an online questionnaire for voters. I divided the investigation of the election process into three stages: preparation of the polling station, the polling process itself and finally the tidying up of the polling station **(figures 1–3).**

Figures 1–3: Contextual observation and user experience mapping

The crucial findings from contextual observation and user experience mapping indicated a considerable amount of improvisation, a general lack of standardisation in the polling station equipment, inadequate measures for ensuring visual accessibility for different age groups, lack of visual and design identity, and inappropriate material selection **(diagram 2).**

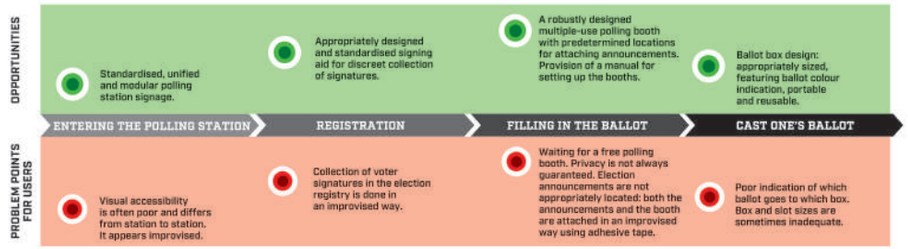


Diagram 2: Visual representation of the user experience in the 2018 local election

I identified the primary stakeholders in the voting process—voters, members of the electoral committee and municipal employees. I designated the decision makers in competent state institutions, such as the National Electoral Commission, as secondary stakeholders.

In the course of my research I also sought out information on polling station equipment abroad, obtaining data on more than ten countries. The findings indicated that in nearly all cases, the polling station equipment is standardised and the level of improvisation is lower. Several types of materials from which polling station equipment was made could be identified—from plastic, through canvas and cardboard, to wood. Polling station equipment is often designed to be reused; even cardboard

equipment, in some cases, gets returned to a central depository.

After concluding the research, I commenced the design phase and started creating the concept design; in parallel, I prototyped and tested several different options for using the material.

With respect to material, I settled on five- and three-layer corrugated cardboard. In terms of the processing technology, I projected the use of UV-printing and cutting and folding on the oscillating knife cutter **(figure 4).**

Figure 4: Prototyping

Proposed Solution

The proposed solution consists of standardised polling station equipment, along with a prescribed way of setting up and using the polling station. Coherent visual elements tie the polling station equipment together on both the functional and the visual level, imbuing it with a sense of unity and accessibility.

The redesigned polling station equipment consists of the following elements:

- modular polling station signage **(figure 5)**
- a polling booth **(figure 6)**
- the ballot box **(figure 7)**
- a signature aid for voter registration **(figure 8)**

With respect to circular economy, the proposed solution addresses and solves the following quantitative factors: in Slovenia, each election requires more than 3,000 polling stations. By redesigning the existing equipment and infrastructure and deliberately introducing reuse, we avoid the disposal of more than 10,000 pieces of polling station equipment (5 tons of waste paper) with every election. As a result of the estimated threefold improvement in the lifespan of the product, the redesigned equipment is expected to save approximately 10 tons of corrugated cardboard.

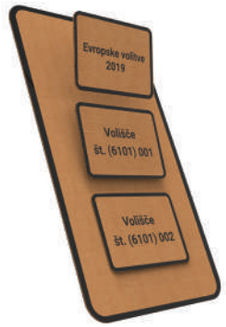


Figure 5: Modular polling station signage

Figure 6: A polling booth

Figure 7: A ballot box

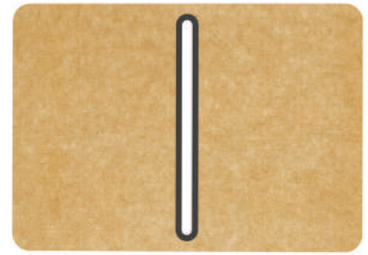
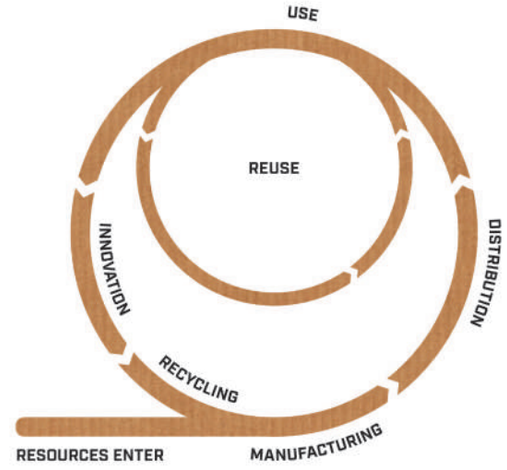


Figure 8: Signing aid for voter registration signatures

Diagram of the redesigned process



Advantages of the proposed solution

- increasing and extending the useful life of the product by increasing its quality and thus also its durability
- the product's ability to be recycled, as well as produced from recycled material
- replacing old-fashioned, linear thinking patterns with the logic of circular economy (a practical demonstration at the level of a state institution) with the resulting reduction of the environmental impact
- user experience improvements

By saving roughly 10 tonnes of corrugated cardboard and assuming an average of about 50% recycled paper content in corrugated cardboard, we estimate that we will spare the environment the following burdens[1]:

- consumption of wood: 20.14 tons (equivalent to about 133 trees),
- total energy consumption: 232 million kJ (equivalent to the annual energy consumption of approximately 262 domestic refrigerators),
- CO_2 emissions: 53.7 tonnes (equivalent to the amount of CO_2 produced by year-round operation of 10 cars),
- water usage: 613.24 m^3 of water (equivalent to the annual water consumption of approximately 117 domestic washing machines),
- solid waste generated: 1.95 tons (equivalent to the total amount of solid waste produced in a single day by 980 people).

Literature and Sources

Bogataj, Tanja, *Connected for Growth: Transition to a Green Economy in Slovenia,* Ministry of the Environment and Spatial Planning of the Republic of Slovenia, Ljubljana 2016, www.vlada.si/fileadmin/dokumenti/si/projekti/2016/zeleno/Transition_to_a_Green_Economy_in_Slovenia.pdf (20 November 2018).

Key Statistics 2017: European Pulp & Paper Industry, CEPI, Brussels 2018, www.cepi.org/system/files/public/documents/publications/statistics/2018/210X140_CEPI_Brochure_KeyStatistics2017_WEB.pdf (1 February 2019).

"Evropa snuje pot v krožno gospodarstvo, kaj pa mi?", *ebm.si,* July 2014, https://ebm.si/zw/o/2014/evropa-snuje-pot-v-krozno-gospodarstvo-kaj-pa-mi (6 November 2018).

Paper Calculator, https://c.environmentalpaper.org/ (12 April 2019).

Roadmap towards a Circular Economy in Slovenia, Ministry of the Environment and Spatial Planning of the Republic of Slovenia, Ljubljana 2018, https://circulareconomy.europa.eu/platform/sites/default/files/roadmap_towards_the_circular_economy_in_slovenia.pdf (20 November 2018).

Zeleno kot razvojni potencial Slovenije [Going Green as a Development Potential for Slovenia], Vlada RS, www.vlada.si/teme_in_projekti/prehod_v_zeleno_gospodarstvo/ (20 November 2018).

1 Calculating the environmental burden of paper production: *Paper Calculator,* https://c.environmentalpaper.org/ (12 April 2019).

Šiva

DESIGN:

Gregor Stražar

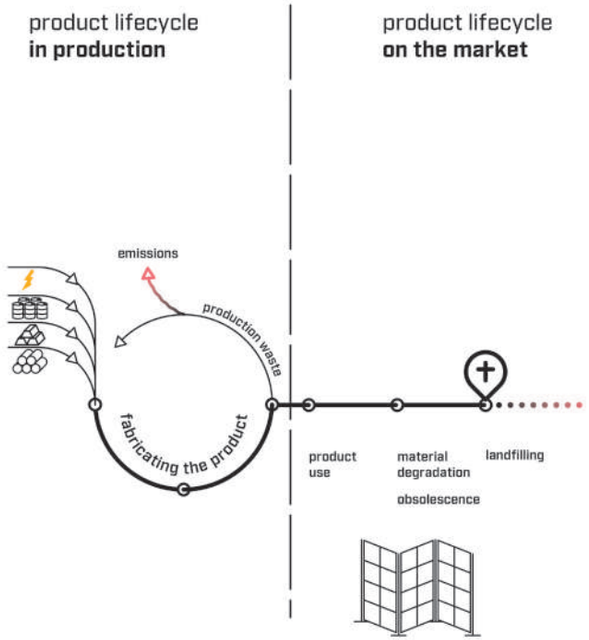
DOMAIN:

open spaces

Šiva addresses the issue of loss of concentration in improperly designed open-plan coworking spaces. The partition is designed to facilitate flexible, modular construction of soundproofed private spaces.

Starting Point/Background of the Identified Problem
Quality intellectual work requires concentration. This is impossible to maintain if we are constantly surrounded by environmental disturbances from our surroundings (noise, inappropriate lighting and visual noise). The purpose of the assignment was to develop a product based on the principles of circular design that will be capable of reducing disturbances inherent to open floorplans.

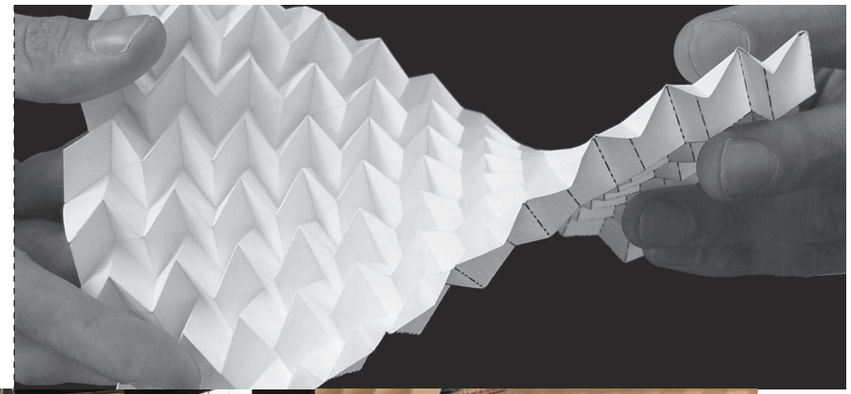
Diagram of the Current Typical Process



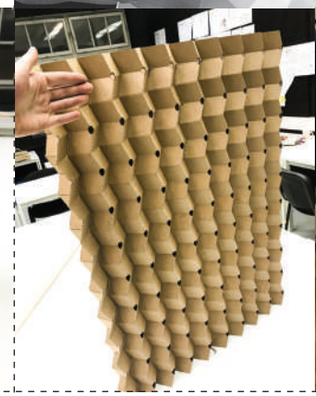
The Process of Analytical Research and Product Development
The essence of the research was in coming up with folding methods and dynamics appropriate for the chosen material. Through various tests in various situations I identified the optimal ways to utilise the structural and design principles of three-layer cardboard. In addition, I directed my research into figuring out a self-supporting form that would allow modular assembly and achieve damping of noise and sound reflections.

In searching for the optimal form, I used parametric 3D-modelling software, which allowed me to find the most suitable form for optimal folding and assembly by changing the various parameters **(figure 1).**

Figure 1: Investigation of folding methods



Figures 2–4: The first prototype and test module for building a partition wall



I also conducted tests on a module for assembling a partition wall **(figures 2–4).** The tests included checking whether laser perforation causes cracks to form at the folds, investigating different joining techniques and finding out how to avoid the use of spacers for easier folding of the material. It turned out that pins are not the best option for vertical joining. As a result, I used a Velcro strip (a hook-and-loop fastener) as the joining element in the next iteration of the model.

Proposed Solution

Šiva is made out of cardboard; another possibility is to use single-faced corrugated cardboard. The design is derived from origami—more precisely, the miura fold. This type of folding is characterised by being able to fold into the smallest possible volume, as well as being biaxially symmetrical, which facilitates joining **(figure 5).**

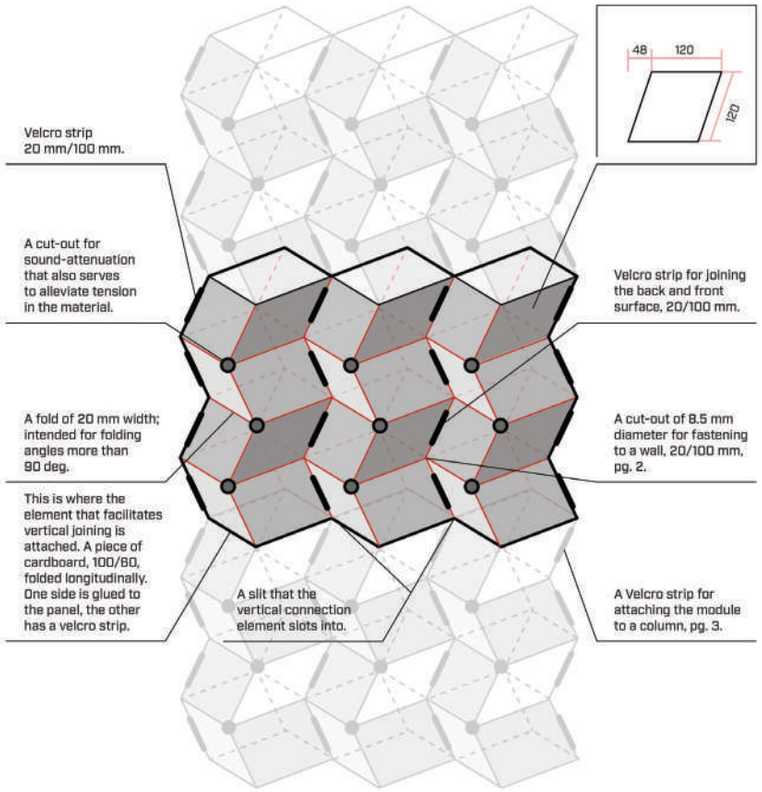


Figure 5: A schematic view of the product

A similar system is presently used in the design of solar panels for spacecraft. This material topography will also soon be adopted in the automotive industry and the nanorobotics field. This folding method likewise creates a texture consisting of geometrical shapes **(figure 6);** these affect noise reflection and the damping of reflections, while the cut-outs in the panel form a Helmholtz resonator that helps damp sound further **(figures 7 and 8).**

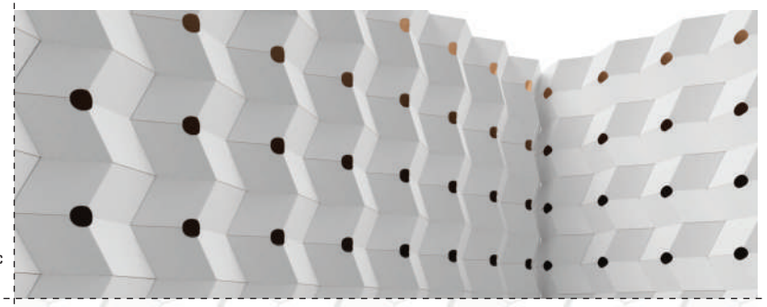
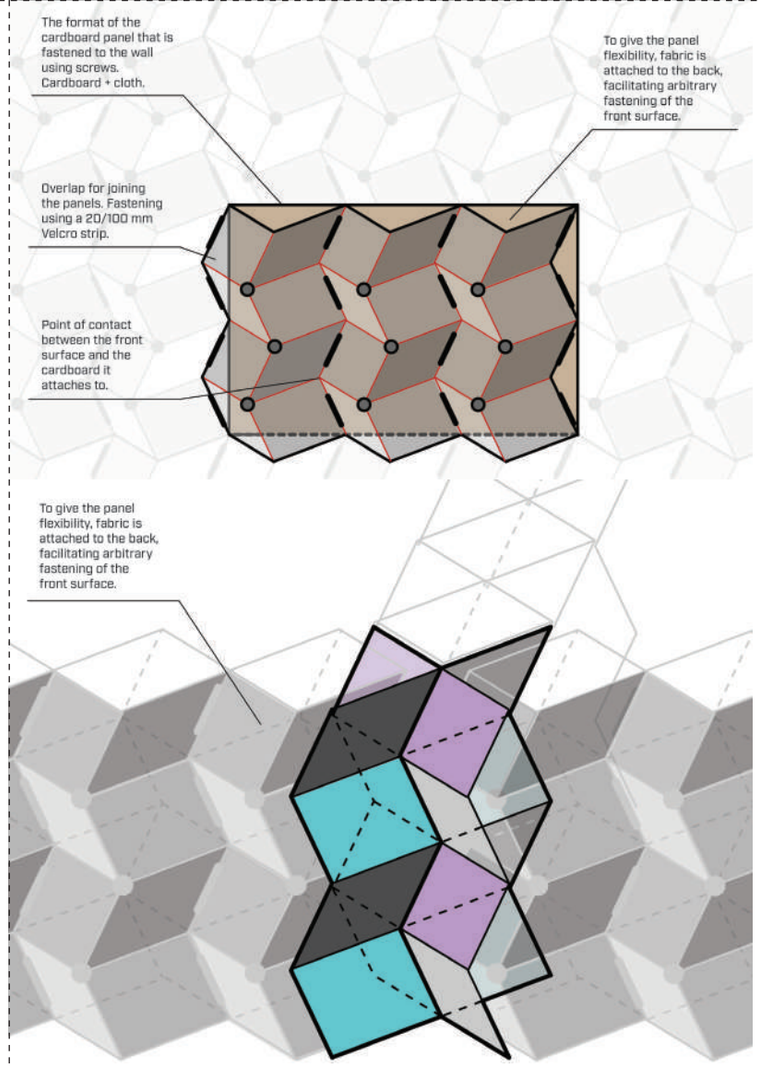


Figure 6: The resultant texture based on geometric shapes



Figures 7 and 8: A schematic use case illustration: fastening to a wall in order to damp sound reflections and joining together multiple panels of a self-supporting partition wall by using column

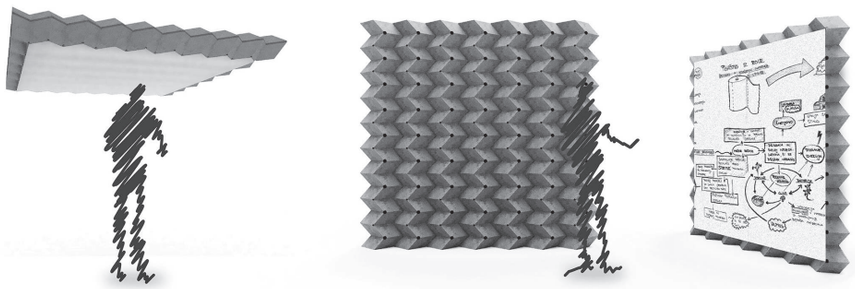
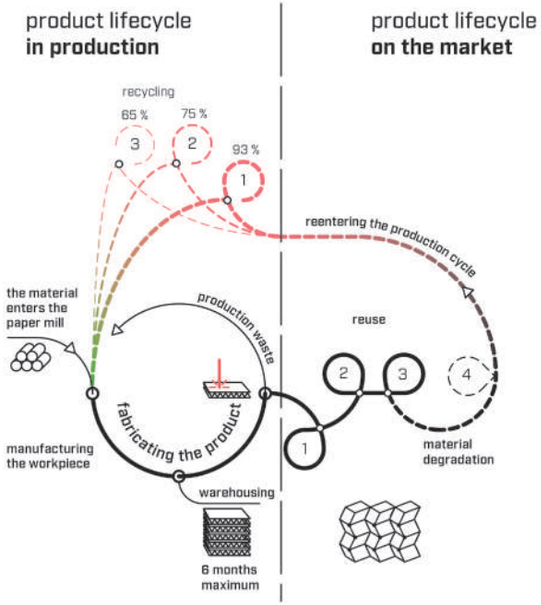


Figure 9: An illustration of different uses

An additional advantage of the designed structure is that it can be repurposed for different uses. It is fundamentally meant for noise reduction, but in open-plan offices, it can also hold a projection screen or brackets for various kinds of image material; it can also be printed on. Another option is to convert it into a LED-panel. Components can be used individually or assembled into a larger structure **(figure 9).**

Diagram of the redesigned process



Advantages of the proposed solution

- low financial risk involved in industrialising the product
- good material utilisation with respect to the standard cardboard workpiece dimensions
- lower environmental burden in the industrial process in comparison to existing solutions
- using structural principles to facilitate reuse
- simple removal of components once the product enters the recycling loop

Literature and Sources

Great Big Story, "See a NASA Physicist's Incredible Origami", *YouTube,* 16 March 2017, www.youtube.com/watch?v=DJ4hDppP_SQ&feature=youtu.be (14 November 2018).

Newport, Cal, *Deep Work: Rules for Focused Success in a Distracted World,* Grand Central Publishing, New York 2016.

Nishiyama, Yutaka, "Miura Folding: Applying Origami to Space Exploration", *International Journal of Pure and Applied Mathematics,* vol. 79, no. 2, 2012, pp. 269–279, https://ijpam.eu/contents/2012-79-2/8/8.pdf (12 November 2018).

Val

DESIGN:

Andraž Rudi Vrhovšek

DOMAIN:

open spaces

A module of a system
for noise management
in open spaces or heavily
aged premises.

Starting Point/Background of the Identified Problem

Noise saturation in partially or completely open-plan spaces inhibits the users' concentration and makes individual work difficult. Research results show that in the otherwise highly popular open-plan layouts in office, educational and coworking spaces, as well as spaces intended for fairs or exhibitions, the issue of noise is rarely considered. This despite the fact that a high level of noise saturation reduces work productivity by as much as 66%. In addition, frequent and long-lasting exposure to noise leads to stress and other afflictions, as evidenced by a 70% increase in sick leave and medical treatment, and just as importantly, less work being done. Today, in the European Union, noise results in 40 billion euro of additional annual expenses, both in the economy and in terms of healthcare costs.

As a result of these findings, the question of whether a material like cellulose can become part of the field of psychoacoustics, which deals with the perception of sound and the effects that sound has on people, became one of the primary guidelines for further research and design.

Diagram of the Current Typical Process

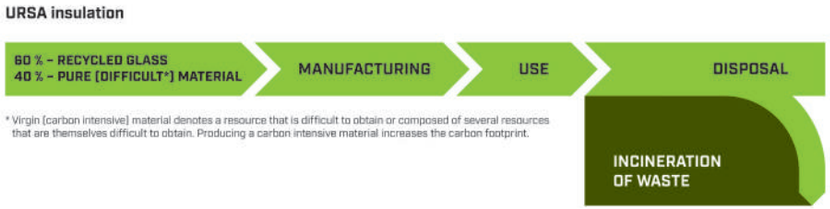


Diagram 1: Production of glass wool, rock wool or plasterboard requires five different pure (heavy) materials and the resulting end product is impossible to reuse or recycle.

The Process of Analytical Research and Product Development

The research took several directions. The first direction was to use contextual observations to investigate how work is done in spaces with semi-open and fully-open floorplans and how any associated issues are addressed **(figure 1).** It turned out that due to the large surfaces, sounds propagate through the space rapidly, reflecting off the walls and causing noise saturation as a consequence.

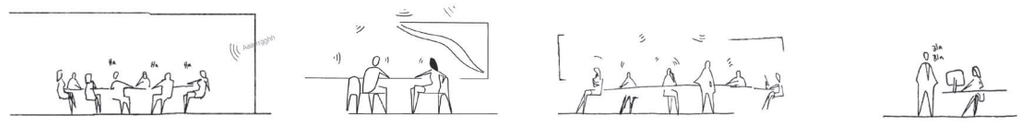


Figure 1: Sketches from contextual observations

The second research direction involved the examination of and familiarisation with the material. The findings showed that cellulose obtained from newsprint can be processed into an insulating material with excellent soundproofing properties. Assist. Prof. Boštjan Lesar, a wood protection expert from the Department of Wood Science and Technology at the Biotechnical Faculty of the University of Ljubljana, researched the effects that additives (borates) in cellulose-based insulation have on the material and on humans. Further testing at the Laboratory for Technical Acoustics, Pumps, Compressors and Fans at the Faculty of Mechanical Engineering of the University of Ljubljana also provided evidence that, in addition to having excellent thermal insulation properties, the new material mixture also features extraordinary absorption properties and can, accordingly, be used as a soundproofing material.

The third research direction investigated the possibilities for installing insulation material in the interior **(figure 2)** with the aim of replacing plasterboard. To ensure a high-enough degree of sound absorption, factors that are essential for the design of the elements were also researched. On the basis of physical data, the structure/composition of the element was constituted. The observations also showed that to permit the use of modules in a system, the modules need to be designed to be adaptable, since the sound absorber's placement in space is extremely important. The aforementioned findings all resulted from research done at the Laboratory for Technical Acoustics, Pumps, Compressors and Fans at the Faculty of Mechanical Engineering.

Later, a test run of the cellulose moulding process was performed at the Pulp and Paper Institute. At the laboratory of the Faculty of Mechanical Engineering they tested the samples prepared at the institute. Tests of the cardboard envelope were carried out at the DS Smith company. In these tests we verified the suitability of the chosen material and the design of the joining elements.

Throughout the development process, adherence to circular design principles was continually verified, with the emphasis on extending the useful life of the paper material by at least two cycles. The additives we include and the process of recycling into a soundproofing material do not in any way contaminate the newly prepared material mixture—quite to the contrary, they promote the process of natural biodegradation at the end of the material's lifespan.

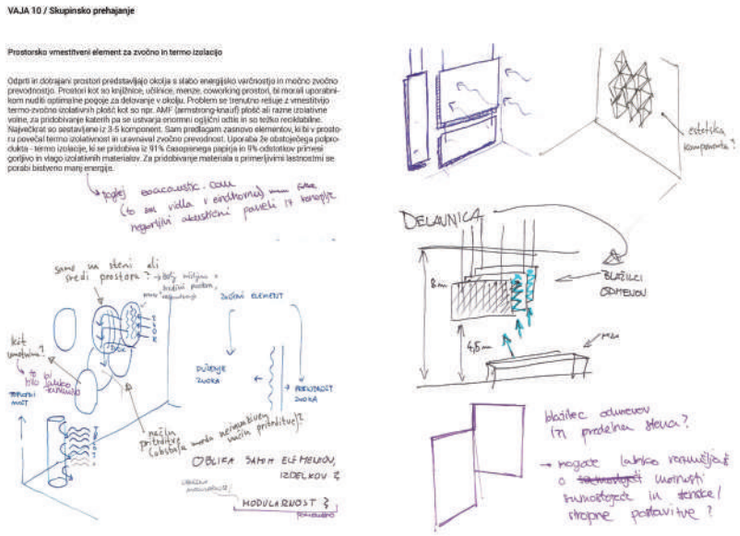


Figure 2: The group passing exercise

Figure 3: The module of 760 x 650 mm size is the desktop version of the soundproofing partition; the 1520 x 650 mm size is intended for spaces where people tend to be sitting down; the large 1900 x 860 mm module is designed to serve as a partition in open spaces, like fairgrounds. It is used to create a quiet environment inside noise-saturated halls or large rooms. The 2280 x 1025 mm model is intended for completely partitioning spaces and creating entirely new rooms.

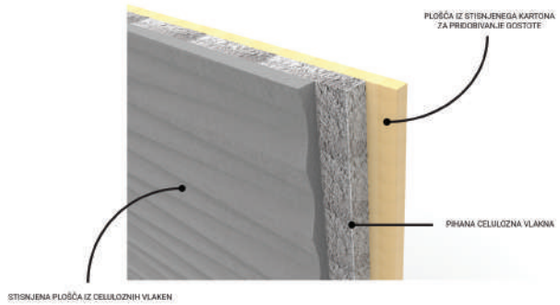


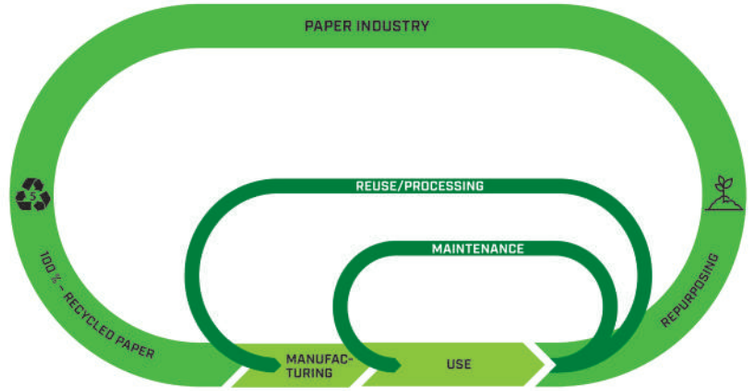
Figure 4: A schematic view of module composition

Proposed Solution

The four modules of different heights are designed to be used in various ways in an open-plan space **(figure 3).** The modules can be used to assemble partition systems and isolated spaces.

An individual module consists of a moulded cellulose core and a surface layer of corrugated cardboard **(figure 4).** Made out of moulded cellulose-based material, the core serves to absorb the sound; the cardboard facing layer meanwhile protects the core and serves to join modules together. The cellulose padding comprises a moulded compressed cellulose layer that defines the element shape and increases the sound-absorbing surface, as well as a filler consisting of blown cellulose insulation that acts as the primary sound-absorbing element in the module. Since this is a material used primarily for thermal insulation, an additional idea came up, involving the conversion of sound vibrations into heat energy. A new type of element would thus be created, one that could serve as heat insulation in poorly isolated spaces (this step is still in the testing phase).

Diagram of the redesigned process



Advantages of the proposed solution

- the manufacturing process for our insulation material has a carbon footprint 42% smaller in comparison to rock or glass wool production
- in terms of its insulating properties, the material is comparable to rock or glass wool, with the difference being that it is made from natural materials
- the cellulose-based thermal insulation material is derived from waste newsprint that had, by that point, already been recycled five times
- by using recycled newsprint in a module of 1500 x 650 mm size, 27.2 kilograms of virgin raw material necessary for the production of new paper are saved
- by processing into yet another product, the paper lifespan is extended by two cycles
- the product is compostable after use

Literature and Sources

"12 Ways Noise Affects Worker Well-being and Productivity", *Resonics,* January 2016, https://resonics.co.uk/12-ways-noise-affects-employee-wellbeing-health-productivity/ (7 November 2018).

Asdrubali, Francesco, Anna Laura Pisello, Francesco D'Alessandro, F. Bianchi, Matteo Cornicchia, Claudia Fabiani, "Innovative cardboard-based panels with recycled materials from the packaging industry: thermal and acoustic performance analysis", *Energy Procedia,* no. 78, November 2015, pp. 321–326. Available at: https://doi.org/10.1016/j.egypro.2015.11.652 (23 November 2018).

Bilban, Marjan, "Vpliv hrupa na človeka" [The Effect of Noise on Humans], *Delo + varnost: revija za varstvo pri delu in varstvo pred požarom,* vol. 50, no. 5 (2005), pp. 13–22.

"Building insulation materials 2: 'Natural' / Organic", *GreenSpec,* www.greenspec.co.uk/building-design/insulation-plant-fibre/ (5 December 2018).

"Building insulation materials: Mineral", *GreenSpec,* www.greenspec.co.uk/building-design/insulation-mineral/ (5 December 2018).

Burattia, Cinzia, Elisa Bellonia, Elisa Lascaro, Giovanna Anna Lopez and Paola Ricciardi, "Sustainable panels with recycled materials for building applications: environmental and acoustic characterization", *Energy Procedia,* no. 101, November 2016, pp. 972–979. Available at: https://doi.org/10.1016/j.egypro.2016.11.123 (23 November 2018).

Horrall, Thomas R., "Background Sound Level & Uniformity Preferences in the Open Office", *Cambridge Sound Management,* http://cambridgesound.com/wp-content/uploads/2013/02/Background-Sound-Level-and-Uniformity-Preferences-in-the-Open-Office.pdf (3 January 2019).

Kunič, Roman, "Carbon footprint of thermal insulation materials in building envelopes", *Energy Efficiency,* June 2017, DOI: 10.1007/s12053-017-9536-1, (25 January 2019).

Lesar, Boštjan, Miha Humar, "Borove spojine za zaščito lesa – I. del: Zgodovina in toksične lastnosti" [Boron compounds for wood preservation. Part I: History and toxic properties], *Les 59* (2007), pp. 176–179.

Lesar, Boštjan, Miha Humar, "Borove spojine za zaščito lesa – II. del: Vezava v les ter fungicidne in insekticidne lastnosti" [Boron compounds for wood preservation. Part II: Fixation in wood and fungicidal and insecticidal properties], *Les 59* (2007), pp. 216–222.

Oseland, Nigel, Paige Hodsman, "Planning for Psychoacoustics: A Psychological Approach to Resolving Office Noise Distraction", *Journal of Corporate Real Estate,* vol. 20, no. 4, pp. 260–280, https://doi.org/10.1108/JCRE-08-2017-0021 (7 December 2018).

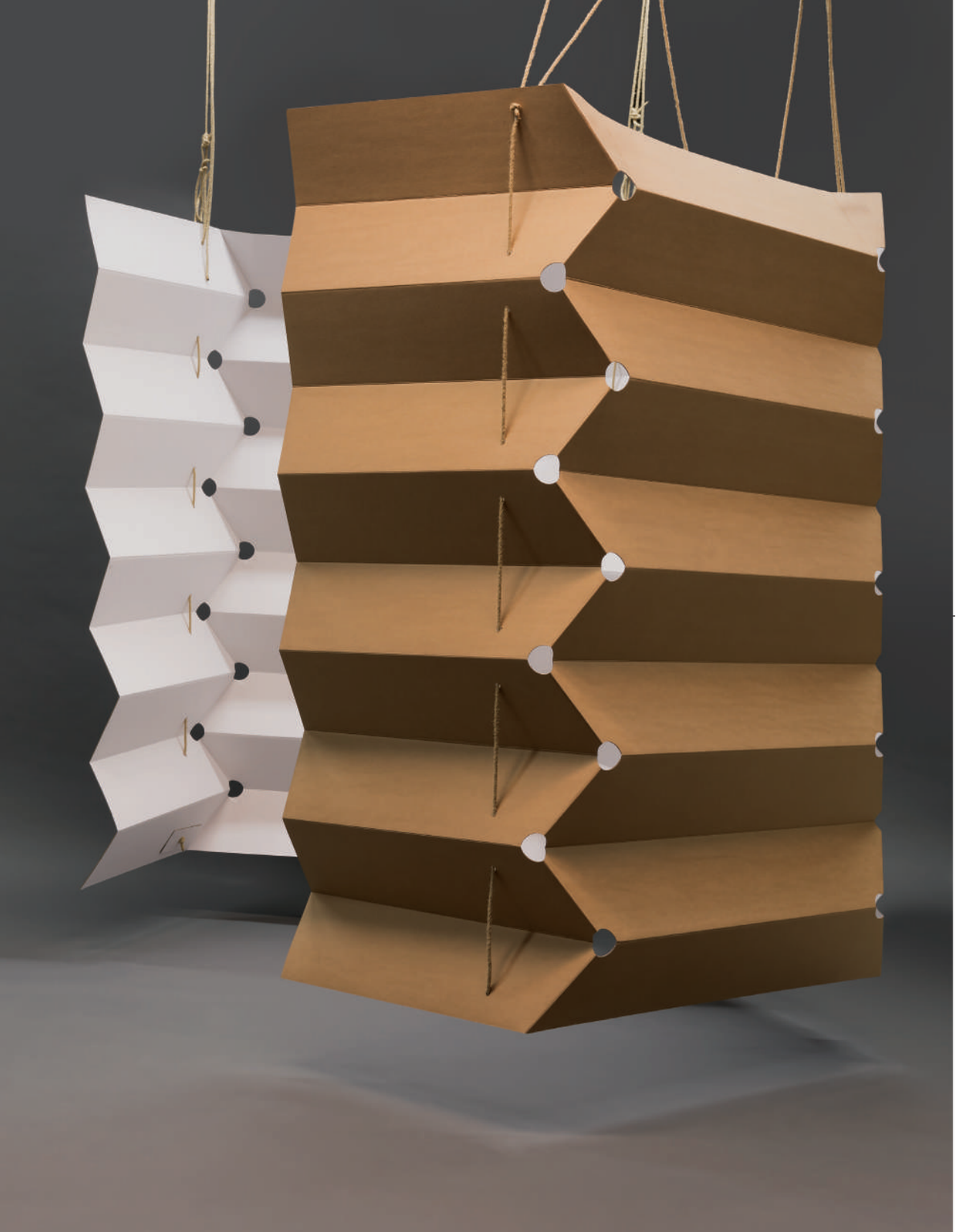
Paper Calculator, https://c.environmentalpaper.org/individual.html (April 12, 2019).

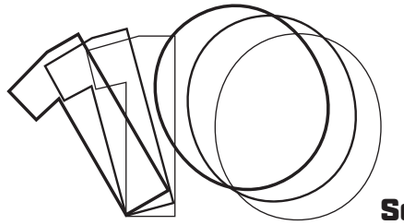
Rossing, Thomas D., F. Richard Moore and Paul A. Wheeler, *The Science of Sound,* Addison-Wesley Publishing Company, Boston 1990.

Santos, António, Rogério Simões and Ofélia Anjos, *Relation Between Wood Density and Paper Properties of Some Hardwood Species,* Instituto Politécnico de Castelo Branco, Castelo Branco 2008. Available at: https://repositorio.ipcb.pt/bitstream/10400.11/2160/1/2008%20wood%20density.pdf (17 November 2018).

Secchi, Simone, Francesco Asdrubali, Gianfranco Cella, Elisa Nannipieri, Antonella Rotil, Irene Vannucchi, "Experimental and environmental analysis of new sound-absorbing and insulating elements in recycled cardboard", *Journal of Building Engineering,* vol. 5, March 2016, pp. 1–12.

Utamia, Sentagi Sesotya, Dhany Arifianto and Ainun Nadiroh, "Study on the Effect of Partition Heights in Open Plan Office to the Privacy and Distraction Level Utilizing Computational Fluid Dynamics", *Procedia Engineering,* vol. 170, 2017, pp. 195–201.





Senta and Sipha

DESIGN:

Simon Izidor Rozman

DOMAIN:

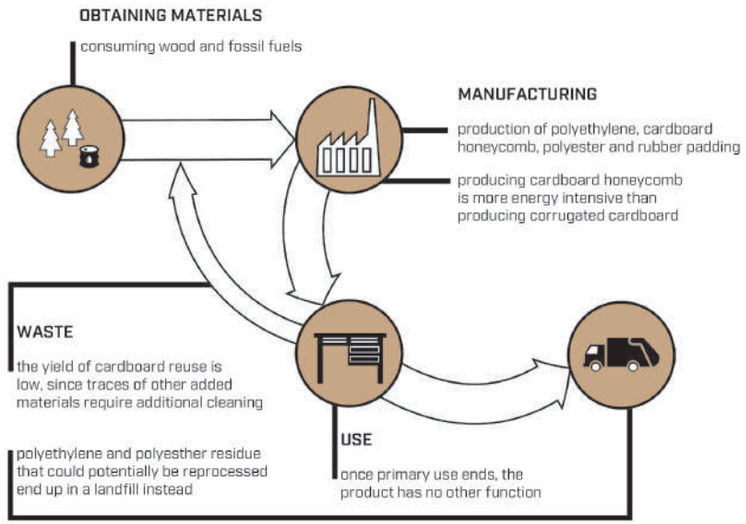
odprte pisarne

With the aim of improving work productivity and employee well-being, Senta and Sipha folding partition screens can be used to create separate spaces and make it possible for individuals in open-plan offices to focus on their work.

Starting Point/Background of the Identified Problem

In contrast with group work, focused individual work is often mentioned as the most important component of work effectiveness in open-plan offices. On the other hand, focused individual work is the type of work that is least facilitated by open-plan offices, as current workspace types have not been able to ensure suitable conditions to facilitate smooth transitions between focused individual work and collaborative/group work. Current attempts to solve this problem do not employ circular design principles—they utilise material combinations that preclude recycling and as a result end up in bulky waste at the end of their service.

Diagram of the Current Typical Process



The Process of Analytical Research and Product Development

After getting acquainted with the properties of paper, a search for suitable use cases began, for which contextual observation proved to be the key technique. Environment research consisted of observing people at work at the open-plan premises of the *Poligon Creative Centre* and the *Ljudje* studio **(figures 1 and 2).** Observations carried out in spaces with open floorplans revealed an increase in disturbances in the form of ambient noise and a reduction of privacy in individual work.

Figures 1 and 2: Contextual observation

Next came an in-depth examination of the impacts and consequences of environmental disturbances on individual work in layouts emphasising open workspaces. External influences in the form of privacy intrusions by co-workers, ambient conversations and visual and digital disturbances were found to negatively impact work effectiveness, contributing to employee dissatisfaction in the long run. In the future, workspace layouts will have to facilitate various forms of both focused individual work and group work. This assumption also represented the starting point of the design.

Proposed Solution

Senta and Sipha folding partition screens offer a cost-effective solution for supporting diverse working scenarios in spaces with open floorplans Senta **(figure 3)** is a folding workplace that lets you escape distractions

Figure 3: Senta in use in its extended form

Figure 4: Sipha in use in its extended form

to focus on individual work. In addition to providing better privacy, it blocks visual disturbances and reduces the effect of ambient noise. The alternative configuration provides space for a telephone call or a one-on-one meeting. Sipha **(figure 4),** by contrast, acts as a divider. It partitions the space into smaller compartments, facilitating large meetings, brainstorming or other types of collaborative work while by reducing disturbances due to ambient speech and visual distractions for those not participating in the group work.

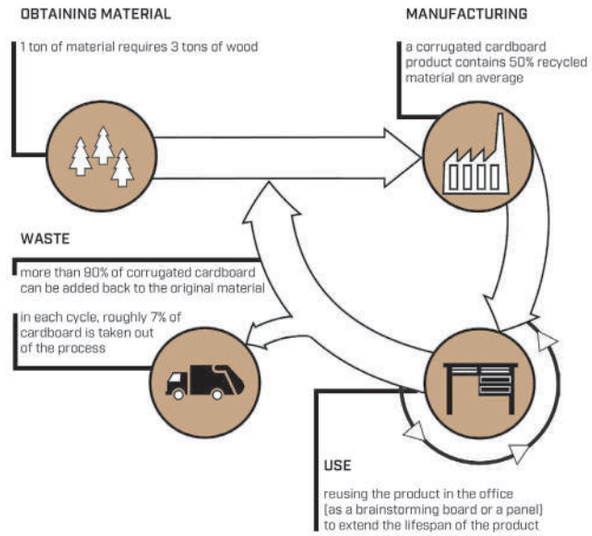
Cardboard has several advantageous physical properties that both products utilise. It is lightweight enough that it can simply be hung from the office ceiling; the low weight also simplifies subsequent handling. The ability of cardboard to be folded also allows the products to fold away **(figures 5 and 6),** which means they require very little space when not in use. Good reflective properties reduce the amount of noise within the newly formed space. At the end of the primary use cycle, both products can be hung on a wall and repurposed as a brainstorming board. By combining multiple layers of cardboard, the wall-hung structure with perforations acquires acoustic insulation properties and can be used as a sound-absorbing panel.

The Senta and Sipha folding partitions are most suited to start-ups, which in the beginning tend to face inescapable limitations in terms of space and finances, but they are also useful for other types of companies when they are in the process of moving to new, incompletely furnished premises. The products' versatility satisfies the requirements of individual and group work and diverts businesses away from buying large pieces of furniture that would only be used for a short time and subsequently discarded.

Figures 5 and 6: Sipha (left) and Senta (right) in their collapsed form

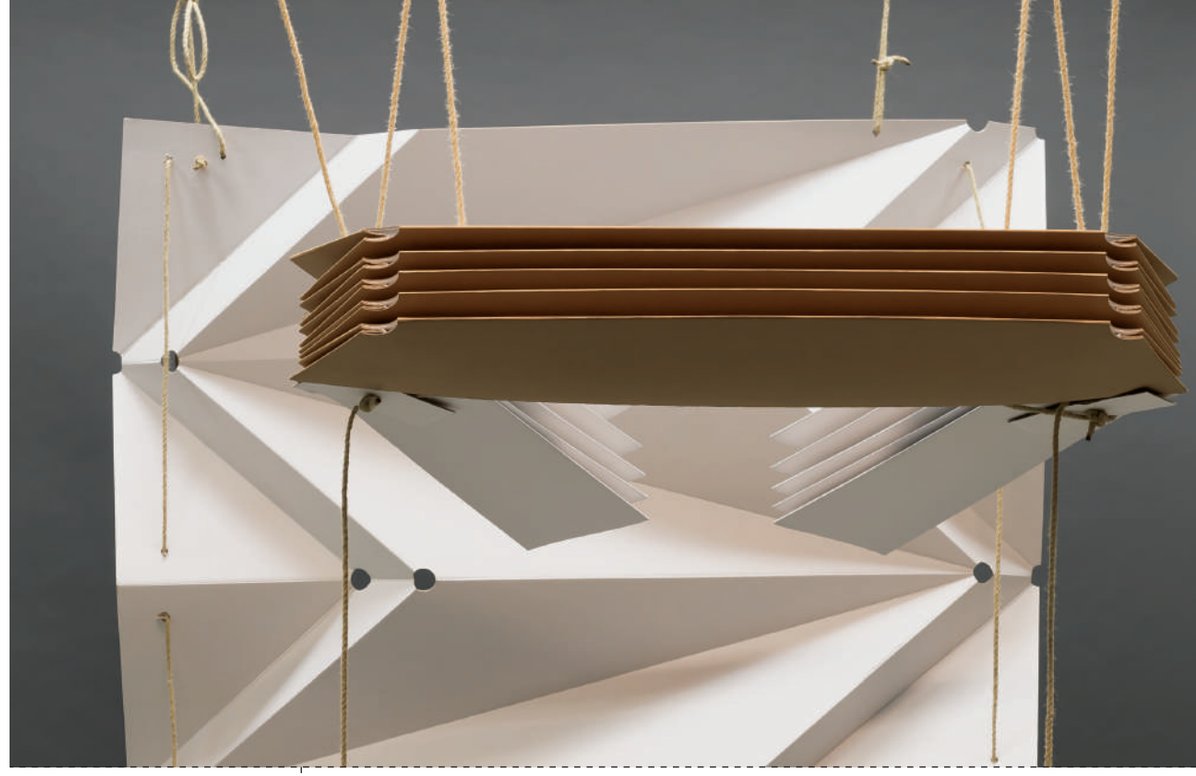
By being able to adapt to various situations that arise within open-plan offices, the folding partitions facilitate what is projected to become the workplace of the future by permitting and emphasising the importance of focused individual work while actively supporting collaborative and group work approaches.

Diagram of the redesigned process



Advantages of the proposed solution

- The principles of circular design are fulfilled by virtue of the product's additional life cycle in an office environment, either in the form of a board or a soundproofing panel, as well as by the possibility of reuse in other companies whenever there is a need for a collapsible partition.
- Reducing the use of other materials that similar products are currently made out of. The products are designed to not require the use of any textile elements, rubber edge treatments or acoustic foams. The Ecoliser calculator estimates the environmental burden of the corrugated-cardboard-based product at 1296 mPt (Eco-Indicator points); a similar product that is currently on the market, made out of cardboard with other additions, is estimated at 14767 mPt. The environmental pressure is therefore reduced by more than 88%.
- Very pure use of corrugated cardboard due to the low number of additional elements; this leads to an increased recycling rate, since it avoids the need for additional cleaning of the material.
- Adding recycled material to the virgin material reduces the need for extracting natural resources. The recyclability of corrugated cardboard can exceed 90%. An individual piece can enter the recycling loop up to five times before the cellulose fibres are left too short for further use. This also reduces waste accumulation in landfills, contributing to a reduction in the pollution of water and air and a decrease in methane emissions associated with anaerobic decay.



Literature and Sources

Calisi, Christopher, Justin Stout, "Stop Noise from Ruining Your Open Office", *Harvard Business Review,* March 2015, https://hbr.org/2015/03/stop-noise-from-ruining-your-open-office (16 November 2018).

Ellermeier, Wolfgang, Karin Zimmer, "The psychoacoustics of the irrelevant sound effect", *Acoustical Science and Technology,* vol. 35, no. 1, 2014, pp. 10–16.

Future-Proofing the Start-up Office: Building Agile Workspaces for Fast-Growing Companies, Knoll Workplace Research, Knoll, 2013, www.knoll.com/document/1352994147511/WP_FutureProofingTheStartupOffice.pdf (5 December 2018).

Meng, Han, Marie Annick Galland, Mohamed Ichchou, Olivier Bareille and Tianjian Lu, "Small perforations in corrugated sandwich panel significantly enhance low frequency sound absorption and transmission loss", *Composite Structures,* no. 182, 15 December 2017, pp. 1–11.

My Work in a We World, Gensler Research, 2015, www.gensler.com/uploads/document/418/file/My-Work-in-a-We-World.pdf (22 November 2018).

Oldman, T., P. Rothe, "Noise and its impact on productivity, importance of variety in open plan spaces and Plantronics' 'Soundscape' building", *Leesman Review,* no. 17, 2015.

Oseland, N., P. Hodsman, "Planning for Psychoacoustics: A Psychological Approach to Resolving Office Noise Distraction", *Workplace Unlimited,* Saint-Gobain Ecophon, 2015.

Park, Soon-Hong, "Acoustic properties of micro-perforated panel absorbers backed by Helmholtz resonators for the improvement of low-frequency sound absorption", *Journal of Sound and Vibration,* September 2013, vol. 332, no. 20, KSLV Structures & Materials Team, Korea Aerospace Research Institute (KARI), pp. 169–184.

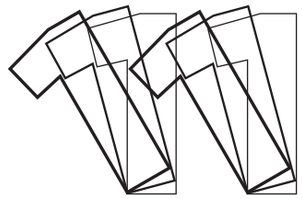
Secchi, Simone, Francesco Asdrubali, Gianfranco Cellai, Elisa Nannipieri, Antonella Rotili and Irene Vannucchi, "Experimental and environmental analysis of new sound-absorbing and insulating elements in recycled cardboard", *Journal of Building Engineering,* no. 5, March 2016, pp. 1–12.

Shafaghat, Arezou, Ali Keyvanfar, M. Salim Ferwati and Tooran Alizadeh, "Enhancing staff's satisfaction with comfort toward productivity by sustainable Open Plan Office Design", *Sustainable Cities and Society,* no. 19. 2014, pp. 151–164.

Spence, David, "Modern Workforces Require Flexible Design: 6 Ways Flexible Working is Influencing the Traditional Office", *OfficeSpace Blog,* April 2016, www.officespacesoftware.com/blog/flexible-workforces-require-flexible-design-6-ways-flexible-working-is-influencing-the-traditional-office (15 November 2018).

Tompkin, Gervais, "Survival of the Focused", *GenslerOnWork,* November 2013, www.gensleron.com/work/2013/11/11/survival-of-the-focused.html (8 November 2018).

What we've learned about focus in the workplace, Gensler Research, 2012, www.gensler.com/uploads/document/306/file/Focus_in_the_Workplace_10_01_2012.pdf (25 November 2018).



Papertray

DESIGN:
Jakob Koncut

DOMAIN:
smoking cessation

A set of single-use games aids the user in redirecting the urge to smoke into tearing, crushing and deforming cardboard.

Starting Point/Background of the Identified Problem

Data from the European statistical office Eurostat shows that in 2016, the percentage of smokers in Slovenia was slightly above the European average (24.2%) According to the National Institute of Public Health, more than half of all smokers wish to quit, but for many of them, the first few attempts are unsuccessful. Experts indicate that, while there are ways of assisting the process of smoking cessation, no aids currently exist that would help with redirecting attention away from the urge to smoke.

Diagram of the Current Typical Process

manufacturing	distribution	sale	use	end of life
The product is fabricated from plastic and metallic components.	Transporting the products from countries with cheap workforce to countries with high consumption.	Low product price thanks to mass production and cheap workforce.	Using the product until it breaks or is rendered obsolete by the rapidly changing trends.	The product ends up in a landfill; its complex material composition makes recycling difficult.

The Process of Analytical Research and Product Development

Learning about the principles of circular economy was followed by in-depth research of the material. In addition to examining the various properties of paper, I also investigated possible fields of its application. I was particularly attracted to cardboard—a material that has a low environmental impact, is 100% recyclable and suitable for products with a short lifespan. I decided to design a product that is intended to be destroyed, disposed of and recycled after use.

In my search for ways to exploit the aforementioned properties of the material, I focused on researching the use of therapeutic destruction in alleviating stress and

psychological overload. In the course of the research, I recognised that cardboard offers an opportunity to design a product that would aid people in the process of quitting smoking. I obtained further relevant information by conducting interviews with former and current smokers, as well as a substance abuse counsellor.

Crucial findings obtained from the interviews and an in-depth examination of the topic of smoking cessation show that smoking is a psychological addiction and that the urge to smoke a cigarette is often connected to long-standing habits and rituals associated with smoking. Experts believe that in those moments, the urge to smoke a cigarette is most easily restrained through redirection of attention. This can be accomplished in many different ways, with most of them involving physical activity. Even so, there is a distinct lack of devices meant to facilitate that. According to the interviewed counsellor, stress-relief toys, such as squeeze balls, come closest to the idea.

I used this information as a guide in designing the final solution. During the design phase, I experimented with various cardboard thicknesses, dimensions, card shapes and ways for the user to utilise the cardboard as the object of attention to the maximum extent possible **(figures 1 and 2).** Out of a number of different solutions, I picked out six that best fit the above guidelines.

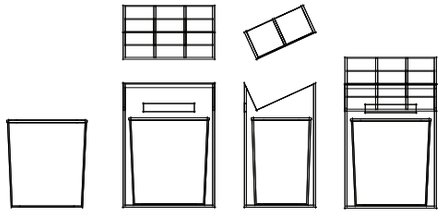
Figures 1 and 2: Testing deformation and delamination of cardboard depending on its thickness

Proposed Solution

The result is a set of cardboard cards of various thicknesses that the user can tear, crush, fold or otherwise deform according to instructions **(figure 4).** The product consists of two components; one is the stand and the other is the insert that holds the games **(figure 3).**

The shape and appearance of the stand is designed to attract attention, encouraging the user to interact. It contains a waste bin which the game may discarded into once the user is done with it. The product is made out of recycled material that features no films, laminates or coatings and only the minimum of printing, in order to simplify recycling.

The designed product is primarily intended for people wishing to quit smoking, but it may also be used by stressed-out individuals, as its functionality is similar to that of stress relief toys. It is supposed to be used mainly in various public institutions and companies' premises, where it may be placed in smoking rooms, atriums, next to entrances and elsewhere in places where smokers typically gather. The product could be used by institutions and companies to promote a healthy way of life, playfully admonishing smokers regarding the negative effects of smoking while simultaneously offering them an alternative and an encouragement to quit the habit.



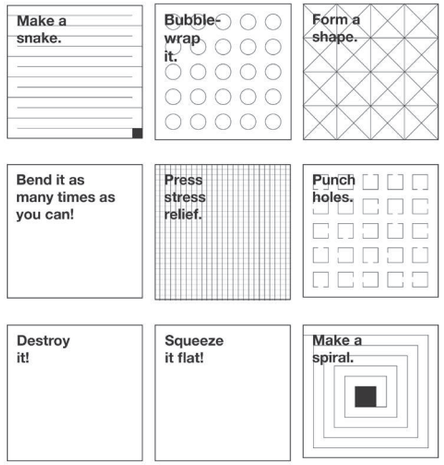
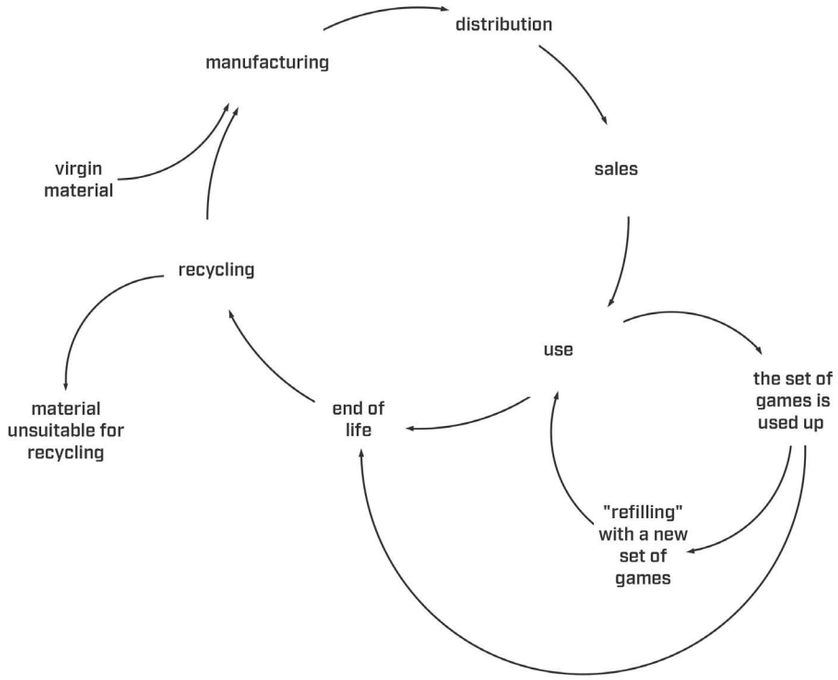


Figure 3: The products consists of a stand, a replaceable insert with games and a waste bin where the user can discard the games after use
Figure 4: Designing cutting patterns and product graphics

Diagram of the redesigned process



Advantages of the proposed solution

- the first product deliberately addressing this issue: the promotion of healthy living, education about the consequences of smoking, motivating smokers to quit
- the possibility of using the product in various public spaces
- the possibility of replacing the cards once a set is used up
- 100% material recycling rate

Literature and Sources

Ali, Mir M., Aliaksandr Amiachluk, Lauren R. Heller, "The Influence of Physical Activity on Cigarette Smoking Among Adolescents: Evidence from Add Health", *Nicotine & Tobacco Research*, vol. 17, no. 5, 5 May 2015, pp. 539–545, https://doi.org/10.1093/ntr/ntu171 (23 November 2018).

Circular Economy Concept, Ellen MacArthur Foundation, www.ellenmacarthurfoundation.org/circular-economy/concept (15 October 2018).

"Commonly used techniques for destruction therapy", *Health Profession*, www.health-profession.com/articleprint.aspx?ucod=396&acod=217 (10 November 2018).

Destruction Therapy, The British Association of Anger Management, www.angermanage.co.uk/destruction-therapy/ (10 November 2018).

Golden, Bernard, "Should You Visit an Anger Room?", *Psychology Today*, 7 May 2017, www.psychologytoday.com/us/blog/overcoming-destructive-anger/201705/should-you-visit anger-room (10 November 2018).

Hughes, John R., "Motivating and Helping Smokers to Stop Smoking", *Journal of General Internal Medicine*, 18(12), December 2003, pp. 1053–1057, www.ncbi.nlm.nih.gov/pmc/articles/PMC1494968/ (25 November 2018).

New 74% paper recycling target set for 2020, European Paper Recycling Council, 11 May 2017, www.paperforrecycling.eu/new-74-paper-recycling-target-set-for-2020/ (15 October 2018).

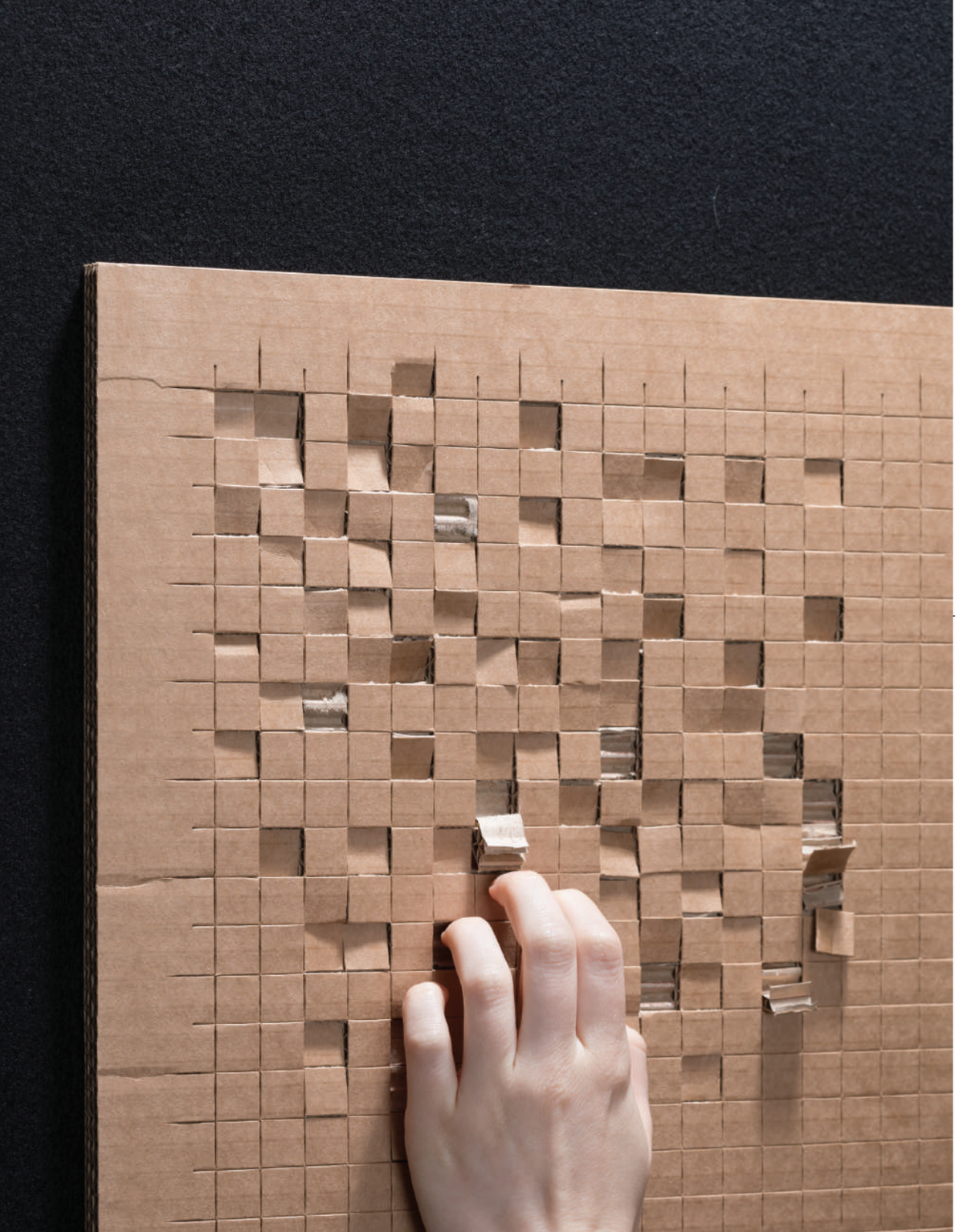
Quit Smoking, NHS, 2018, www.nhs.uk/live-well/quit-smoking/10-self-help-tips-to-stop-smoking/ (25 November 2018).

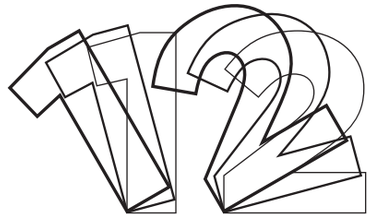
S čimprejšnjo opustitvijo kajenja za pomembno izboljšanje zdravja [Significant improvement of health through quitting smoking as early as possible], Nacionalni inštitut za javno zdravje, 5 June 2017, www.nijz.si/sl/s-cimprejsnjo-opustitvijo-kajenja-za-pomembno-izboljsanje-zdravja (20 November 2018).

STA, "V Sloveniji kadi skoraj petina ljudi" [Almost a fifth of Slovenians smoke], *Primorske novice*, 7 December 2016, www.primorske.si/2016/12/07/v-sloveniji-kadi-skoraj-petina-ljudi (26 November 2018).

"Steps to Manage Quit Day", *Smoke Free*, 2018, https://smokefree.gov/quit-smoking/getting-started/steps-to-manage-quit-day (29 November 2018).

Treviño, Lara A., et al., "Physical Activity as a Coping Strategy for Smoking Cessation in Mid-Life and Older Adults", *Addictive Behaviors*, Elsevier, 2014, pp. 885–888, https://academic.oup.com/ntr/article-abstract/17/5/539/1032029?redirectedFrom=fulltext (5 December 2018).





Destructive Play

DESIGN:

Lin Gerkman

DOMAIN:

mental health

The project explores destructive play in children and provides a solution. It gives them an opportunity to release tension and explore the boundaries of their physical strength and of the transformative potential of aggression in an environmentally acceptable way.

Starting Point/Background of the Identified Problem

There are virtually no products deliberately designed to be used by children in destructive play. This creates an opportunity in the field of play therapy to develop a product that would allow users to aggressively test their strength and provide them with a harmless way of channelling their inner tension. The product would be suitable for use in the context of play therapy, as well as for non-therapeutic use at home or in play spaces.

Therapists currently use various improvised objects for this purpose; that is, as objects lacking a definite function and only meant to facilitate emotional expression: fine sand, newsprint and tissues, as well as selected sets of conventional toys (plastic dolls, plastic guns, swords). The sets consist of various materials that are not reused after the end of their useful life; they are typically not recycled either, due to their complex composition.

Diagram of the Current Typical Process

use of primary material → product manufacturing → distribution → sales → use (destruction) → landfilling or destroying the discarded products

The Process of Analytical Research and Product Development

An examination of different types of interiors along with their characteristics and specific requirements while learning, along the way, about the properties of paper and the possibilities for its use, was followed by researching manufacturing processes. This included examining everything from production approaches to recycling processes (e.g. deinking), as well as identifying various parameters that affect the mechanical properties of paper (e.g. coatings, printing). Finally, there was an analysis of opportunities for material circulation, followed by researching what type of product would best utilise the identified characteristics.

I decided to focus my research on products that facilitate destruction in a way that is not harmful to the environment. The product would be intended for animals or children and designed to exploit the recyclability and mechanical properties of the chosen material (its lifespan, the structure of the associated intermediate products). Next came a more thorough investigation of toys meant for animals and children that are already made,

Figure 1: Do Hit chair (design: Niels van Eijk, Droog, 2000); an example of using aggressive deformation as a transformative force
Figure 2: Woodcut graphic on misumi paper, Eldridge Street 2.0 (author: Christiane Baumgartner, 2015, Alan Cristea Gallery); an example of a simple linear raster
Figure 3: A tree used by the Buddhist monks of the Shaolin monastery to train finger strength

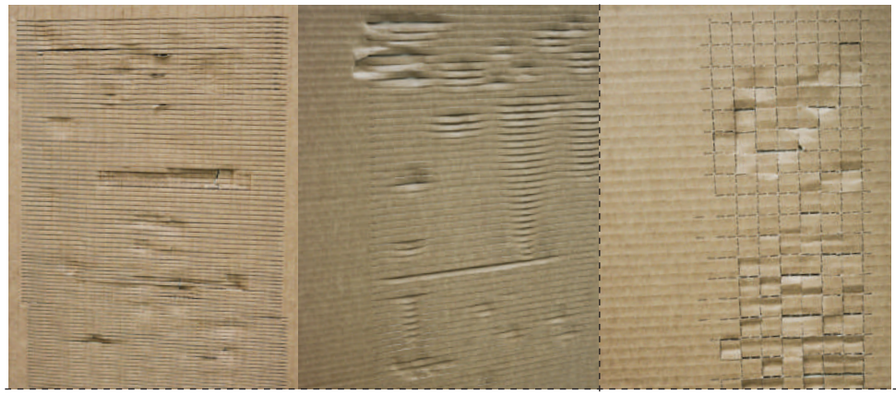
or could be made, from paper **(figures 1–3).** Having analysed the identified possibilities, I decided on a product that addressed the area of mental health in children through exploring the potential of aggressive play. It turned out that this field offers a greater potential for innovation and significant opportunities for adding value.

On the basis of the chosen focus I conducted interviews with three specialists in the field in question—a psychologist, a psychiatrist and a pedagogue—who deal with the topic of aggressive play in children aged 3–12. Using the information obtained in the interviews and from research, I formulated the starting points **(diagram 2)** for further product design.

What role does destructive play have in children's development?
What kind of toys/accessories are currently used, what are their characteristics?
What form does destructive play take depending on interpersonal relationships?

Diagram 2: Key characteristics of destructive play

Manual crafting of prototypes and initial testing was followed by designing patterns. These were prototyped using a cardboard cutter **(figures 4–6)** and improved along the way on the basis of quick tests. Subsequent iterations followed after verifying the designs with the specialists. The creation of the prototype was followed by end-user testing.



Figures 4–6: Test patterns using a cardboard cutter: pattern perpendicular to corrugation direction (left); pattern parallel to corrugation direction (middle); complex patterns (right)

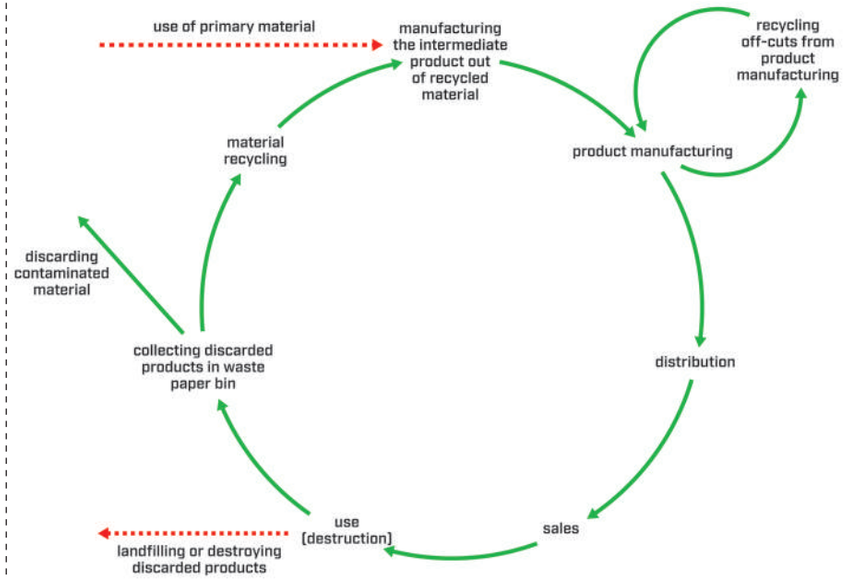
Proposed Solution

The product is designed to facilitate aggressive play in the process of play therapy in cases of emotional and behavioural issues in children. It can be used in play therapy centres, kindergartens, schools, and at home.

The solution is a cardboard surface meant to be destroyed. The structure of the seven-layer cardboard is weakened through a pattern of slits that reach to the back layer (the liner), which helps preserve the integrity of the product. Using their fingers, hands, toys, implements or other body parts, the user punctures the initially uniform structure, leaving their impression. The surface can be destroyed and torn up, but it can also be used for colouring, drawing and painting. The product lacks a clearly defined function, in order not to excessively steer or limit the user in terms of their emotional expression. It allows the user to explore the material through destroying it, while developing a sensibility for form in the process. In being reshaped, the product reflects the process of abandoning old patterns to

create new ones, helping the user learn how to use aggression as a force of transformation. The product is made entirely out of recycled material and can itself be fully recycled. Due to the nature of the product and its use, there are no demands in terms of material properties that would require the use of primary material.

Diagram of the redesigned process



Advantages of the proposed solution

- the product fulfils the need for a functionally undefined object to be used for destructive play
- a novel type of destructible, environmentally acceptable product employing a closed recycling loop
- its planar nature makes for simple manufacturing
- material use and yield are very favourable and as a consequence, the manufacturing costs are extremely low
- the product is very straightforward to recycle due to it consisting of a single piece of uncoated cardboar

Literature and Sources

Boulton, Michael J., "Children's abilities to distinguish between playful and aggressive fighting: A developmental perspective", *British Journal of Developmental Psychology,* vol. 11, no. 3, pp. 249–263.

Chanh Thuc, Dao, "The Study Plays Fighting to Cope with Children Aggression at Primary School", *Orthopaedics and Sports Medicine,* Giang University, Vietnam 2018, https://lupinepublishers.com/orthopedics-sportsmedicine-journal/pdf OSMOAJ.MS.ID.000134.pdf (11 December 2018).

Freud, Sigmund, *Beyond the Pleasure Principle,* The International Psychoanalytical Press, London 1922.

Goff, Karen Ellen, "The relation of violent and nonviolent toys to play behaviour in pre-schoolers", *Retrospective Theses and Dissertations,* Iowa State University, Ames 1995, https://lib.dr.iastate.edu/rtd/10781 (5 December 2018).

Hansen Sandseter, Ellen B., "Affordances for Risky Play in Preschool: The Importance of Features in the Play Environment", *Early Childhood Education Journal,* vol. 36, no. 5, pp. 439–444.

Kennedy-Moore, Eileen, "Do boys need rough and tumble play?", *Psychology Today,* 30 June 2015, www.psychologytoday.com/us/blog/growing-friendships/201506/do-boys-need-rough-and-tumble-play (4 December 2018).

Kidrič, Martin, *Kartonažerska dodelava,* UL, Naravoslovnotehniška fakulteta, Oddelek za tekstilstvo, Ljubljana 2007, www2.grafika.ntf.uni-lj.si/uploads/media/KartonazerskaDodelava.pdf (10 November 2018).

"Kids and Violent Play: An Education World e-Interview with Jane Katch, Author of a Book About Children's Violent Play", *Education World,* www.educationworld.com/a_issues/issues/issues165.shtml (5 December 2018).

Parry, Wynne, "Battling the Boys: Educators Grapple with Violent Play", *Live Science,* August 2009, www.livescience.com/8514-battling-boys-educators-grapple-violent-play.html (4 December 2018).

Pellis, Sergio M., Vivien C. Pellis, "Rough-and-Tumble Play and the Development of the Social Brain", *Current Directions in Psychological Science,* vol. 16, no. 2, pp. 95–98.

Slaughter, Anne-Marie, *Design and Violence,* The Museum of Modern Art, New York 2015.

Smith, Peter K., Rebecca Smees, Anthony D. Pellegrini, "Play fighting and real fighting: Using video playback methodology with young children", *Official Journal of the International Society for Research on Aggression*, vol. 30, no. 2, pp. 164–173.

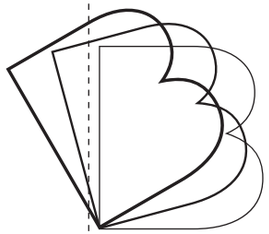
Tannock, Michelle T., "Rough and Tumble Play: An Investigation of the Perceptions of Educators and Young Children", *Early Childhood Education Journal,* vol. 35, no. 4, pp. 357–361.

Tremblay, Richard E., "Aggression", *Encyclopaedia on Early Childhood Development,* www.child-encyclopedia.com/aggression/introduction/why-play-fighting-can-be-good-children (1 December 2018).

VanFleet, Risë, *Child-Centered Play Therapy,* Guilford Press, New York 2010.

Webb, Amy, "The science behind play-fighting—and why it's not all bad", *Motherly,* www.mother.ly/child/the-science-behind-play-fightingand-why-its-not-all-bad (10 December 2018).


Evropske vo
2019
Val/Wall
rabniku in okolju
zna volilna
struktura
Papir + bioplastika



Bibliography

"12 Ways Noise Affects Worker Well-being and Productivity", *Resonics,* January 2016. Available at: https://resonics.co.uk/12-ways-noise-affects-employee-wellbeing-health-productivity/ (7 November 2018).

Ali, Mir M., Aliaksandr Amiachluk, Lauren R. Heller, "The Influence of Physical Activity on Cigarette Smoking Among Adolescents: Evidence from Add Health", *Nicotine & Tobacco Research,* vol. 17, no. 5, 5 May 2015, pp. 539–545. Available at: https://doi.org/10.1093/ntr/ntu171 (23 November 2018).

Andrés, Federico N., Loreley B. Beltramini, Anabela G. Guilarducci, Melisa S. Romano, Nestor O. Ulibarrie, "Lightweight Concrete: An Alternative for Recycling Cellulose Pulp", *Procedia Materials Science,* 8 (2015), Centro de Investigación y Desarrollo para la Construcción y la Vivienda (CECOVI), Universidad Tecnológica Nacional, Facultad Regional Santa Fe, Santa Fe 2015, pp. 831–838. Available at: www.sciencedirect.com/science/article/pii/S2211812815001431 (25 November 2018).

Asdrubali, Francesco, Anna Laura Pisello, Francesco D'Alessandro, F. Bianchi, Matteo Cornicchia, Claudia Fabiani, "Innovative cardboard-based panels with recycled materials from the packaging industry: thermal and acoustic performance analysis", *Energy Procedia,* no. 78, November 2015, pp. 321–326. Available at: https://doi.org/10.1016/j.egypro.2015.11.652 (23 November 2018).

Atmodiwirjo, Paramita, F. Istiani, Noor Fajrina, "Children as 'Interior Architects': Creative Learning and Exploration of Classroom Furniture", June 2014, www.researchgate.net/publication/303836890_Children_as_Interior_Architects_Creative_Learning_and_Exploration_of_Classroom_Furniture (22 November 2018).

Ayan, Özlem, *Cardboard in architectural technology and structural engineering: A conceptual approach to cardboard buildings in architecture* (doctoral dissertation), ETH Zürich, Zürich 2009. Available at: www.research-collection.ethz.ch/handle/20.500.11850/151987 (22 October 2018).

Bahovec, Eva D., et al., *Kurikulum za vrtce* [Kindergarten Curriculum], Strokovni svet RS za splošno izobraževanje, Ljubljana 1999. Available at: www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/podrocje/vrtci/pdf/vrtci_kur.pdf (12 December 2018).

Barthes, Roland, "Non Multa Sed Multum", *Cy Twombly: Fifty Years of Works on Paper,* Schirmer/Mosel, Munich 1976.

Bhattacharjee, Dibakar, Muhammed Kamrul Islam, "Development of a paper recycling process", *Proceedings of the 15th Annual Paper Meet,* February 2014, The Institution of Engineers, Dhaka, Bangladesh. Available at: Researchgate, www.researchgate.net/publication/270877262_DEVELOPMENT_OF_A_PAPER_RECYCLING_PROCESS (13 December 2018).

Bilban, Marjan, "Vpliv hrupa na človeka" [The Effect of Noise on Humans], *Delo + varnost: revija za varstvo pri delu in varstvo pred požarom,* vol. 50, no. 5 (2005), pp. 13–22.

Bogataj, Tanja, *Connected for Growth: Transition to a Green Economy in Slovenia,* Ministry of the Environment and Spatial Planning of the Republic of Slovenia, Ljubljana 2016, www.vlada.si/fileadmin/dokumenti/si/projekti/2016/zeleno/Transition_to_a_Green_Economy_in_Slovenia.pdf (20 November 2018).

Boulton, Michael J., "Children's abilities to distinguish between playful and aggressive fighting: A developmental perspective", *British Journal of Developmental Psychology,* vol. 11, no. 3, pp. 249–263.

Brand, Andrew, Katie Gaudion, *Exploring Sensory Preferences: Living Environments for Adults with Autism,* The Helen Hamlyn Centre for Design, Royal College of Art, London 2012.

Brand, Andrew, *Living in the Community: Housing Design for Adults with Autism,* The Helen Hamlyn Centre for Design, Royal College of Art, London 2010.

"Building insulation materials 2: 'Natural' / Organic", *GreenSpec.* Available at: www.greenspec.co.uk/building-design/insulation-plant-fibre/ (5 December 2018).

"Building insulation materials: Mineral", *GreenSpec.* Available at: www.greenspec.co.uk/building-design/insulation-mineral/ (5 December 2018).

Burattia, Cinzia, Elisa Bellonia, Elisa Lascaro, Giovanna Anna Lopez and Paola Ricciardi, "Sustainable panels with recycled materials for building applications: environmental and acoustic characterization", *Energy Procedia,* no. 101, November 2016, pp. 972–979. Available at: https://doi.org/10.1016/j.egypro.2016.11.123 (23 November 2018).

Calisi, Christopher, Justin Stout, "Stop Noise from Ruining Your Open Office", *Harvard Business Review,* March 2015. Available at: https://hbr.org/2015/03/stop-noise-from-ruining-your-open-office (16 November 2018).

Cecchini, Cecillia, "Bioplastics made from upcycled food waste. Prospects for their use in the field of design", *The Design Journal: An International Journal for All Aspects of Design,* no. 20, Taylor & Francis Group, 2017, pp. S1596–S1610.

Çetin Sultanoğlu, Saliha, Neriman Aral, "Sensory integration disorder", *Education in the 21st Century: Theory and Practice,* Irina Koleva et al. (eds.), St. Kliment Ohridski University Press, Sofia 2015, pp. 374–381.

Chanh Thuc, Dao, "The Study Plays Fighting to Cope with Children Aggression at Primary School", *Orthopaedics and Sports Medicine,* Giang University, Vietnam 2018. Available at: https://lupinepublishers.com/orthopedics-sportsmedicine-journal/pdf/OSMOAJ.MS.ID.000134.pdf (11 December 2018).

Chapman, Jonathan, *Emotionally Durable Design: Objects, Experiences and Empathy*, Earthscan, London 2005.

Circular City – Shaping our Urban Future, The Central Denmark Region and European Regional Development Fund, 2018. Available at: www.circularitycity.dk/wp-content/uploads/2018/05/Circularity-City-Book-Digital.pdf (18 October 2018).

Circular Economy Concept, Ellen MacArthur Foundation. Available at: www.ellenmacarthurfoundation.org/circular-economy/concept (15 October 2018).

"Commonly used techniques for destruction therapy", *Health Profession.* Available at: www.health-profession.com/articleprint.aspx?ucod=396acod=217 (10 November 2018).

Design and Management for Circularity – the Case of Paper, World Economic Forum, 2016. Available at: https://bit.ly/2zkTdZz (1 April 2019).

Destruction Therapy, The British Association of Anger Management. Available at: www.angermanage.co.uk/destruction-therapy/ (10 November 2018).

Dunne, Margaret, »Bioplastic Cook Book«, *Issuu,* July 2018. Available at: https://issuu.com/nat_arc/docs/bioplastic_cook_book_3 (4 November 2018).

Ellen MacArthur Foundation and Granta Design, *Circularity Indicator: An Approach to Measuring Circularity (Methodology),* 2015. Available at: www.ellenmacarthurfoundation.org/assets/downloads/insight/Circularity-Indicators_Methodology_May2015.pdf (1 May 2019).

Ellen MacArthur Foundation and IDEO, *The Circular Design Guide,* 2016. Available at: www.circulardesignguide.com/ (3 October 2018).

Ellen MacArthur Foundation and IDEO, *The Circular Design Guide: Worksheets, 2016.* Available at: www.circulardesignguide.com/resources#worksheets (3 October 2018).

Ellen MacArthur Foundation, *Growth Within: A Circular Economy Vision for a Competitive Europe,* SUN (Stiftungsfonds für Umweltökonomie und Nachhaltigkeit), Ellen MacArthur Foundation and McKinsey Center for Business and Environment, 2015. Available at: www.ellenmacarthurfoundation.org/publications/growth-within-a-circular-economy-vision-for-a-competitive-europe (1 May 2019).

Ellen MacArthur Foundation, *Towards a Circular Economy: Business Rationale for an Accelerated Transition,* 2015. Available at: www.ellenmacarthurfoundation.org/assets/downloads/publications/TCE_Ellen-MacArthur-Foundation_26-Nov-2015.pdf (1 May 2019).

Ellen MacArthur Foundation, *Towards the Circular Economy: Economic and Business Rationale for an Accelerated Transition,* vol. 1, 2013. Available at: www.ellenmacarthurfoundation.org/assets/downloads/publications/Ellen-MacArthur-Foundation-Towards-the-Circular-Economy-vol.1.pdf (15 October 2018).

Ellen MacArthur Foundation, *What is the Circular Economy,* 2017. Available at: www.ellenmacarthurfoundation.org/circular-economy/what-is-the-circular-economy (5 October 2018).

Ellermeier, Wolfgang, Karin Zimmer, "The psychoacoustics of the irrelevant sound effect", *Acoustical Science and Technology,* vol. 35, no. 1, 2014, pp. 10–16.

"EPA Reports 9.8 Million Tons Per Year in Furniture Waste", *Reuters,* 6 May 2011. Available at: www.reuters.com/article/idUS126369713020110506 (12 November 2018).

Escobar, Arturo, *Designs for the Pluriverse: Radical Interdependence, Autonomy, and the Making of Worlds,* Duke University Press, Durham and London 2016.

Eser, Sonja, *Circular Design: Gestaltung der Kreislaufwirtschaft,* Buch am Erlbach, 2015. Available at: http://circular-design.eu/automatisch/ (20 October 2018).

European Commission, *Circular Economy: Implementation of the Circular Economy Action Plan,* 2019. Available at: http://ec.europa.eu/environment/circular-economy/index_en.htm (2 May 2019).

European Commission, *Closing the loop: Commission delivers on Circular Economy Action Plan* (European Commission – Press release), 2019. Available at: http://europa.eu/rapid/press-release_IP-19-1480_en.htm (2 May 2019).

European Commission, *Ecodesign Working Plan 2016–2019,* 2015. Available at: http://ec.europa.eu/growth/industry/sustainability/ecodesign_en (2 May 2019).

"Evropa snuje pot v krožno gospodarstvo, kaj pa mi?", *ebm.si,* July 2014. Available at: https://ebm.si/zw/o/2014/evropa-snuje-pot-v-krozno-gospodarstvo-kaj-pa-mi (6 November 2018).

Freud, Sigmund, *Beyond the Pleasure Principle,* The International Psychoanalytical Press, London 1922.

Future-Proofing the Start-up Office: Building Agile Workspaces for Fast-Growing Companies, Knoll Workplace Research, Knoll, 2013. Available at: www.knoll.com/document/1352994147511/WP_FutureProofingTheStartupOffice.pdf (5 December 2018).

Godina Košir, Ladeja, Niko Korpar, Janez Potočnik, Robert Kocjančič et al., *Roadmap Towards the Circular Economy in Slovenia,* Ministry of the Environment and Spatial Planning of the Republic of Slovenia, Ljubljana 2018. Available at: www.mop.gov.si/fileadmin/mop.gov.si/pageuploads/medijsko_sredisce/2018/05_Maj/04_SJ_Kazipot/18_05_04_SJ_Kazipot_EN.pdf (2 May 2019).

Goff, Karen Ellen, "The relation of violent and nonviolent toys to play behaviour in pre-schoolers", *Retrospective Theses and Dissertations,* Iowa State University, Ames 1995. Available at: https://lib.dr.iastate.edu/rtd/10781 (5 December 2018).

Golden, Bernard, “Should You Visit an Anger Room?”, *Psychology Today,* 7 May 2017. Available at: www.psychologytoday.com/us/blog/overcoming-destructive-anger/201705/should-you-visit anger-room (10 November 2018).

Gopal, Arathy, Jayaprakash Raghavan, “Design interventions for sensory comfort of autistic children”, *Autism – Open Access,* 8:1, 2018. Available at: www.omicsonline.org/open-access/design-for-sensory-comfort-of-autistic-children-2165-7890-1000227.pdf (1 December 2018).

Great Big Story, “See a NASA Physicist's Incredible Origami”, *YouTube,* 16 March 2017. Available at: www.youtube.com/watch?v=DJ4hDppP_SQ&feature=youtu.be (14 November 2018).

Hansen Sandseter, Ellen B., “Affordances for Risky Play in Preschool: The Importance of Features in the Play Environment”, *Early Childhood Education Journal,* vol. 36, no. 5, pp. 439–444.

Has, Michael, et al., *Design and Management for Circularity – the Case of Paper,* World Economic Forum, January 2016. Available at: www3.weforum.org/docs/WEF_Design_Management_for_Circularity.pdf (20 October 2018).

Holzer, Dominik, Richard Hough and Mark Burry, “Parametric design and structural optimization for early design exploration”, *International Journal of Architectural Computing,* vol. 5, no. 4, Melbourne 2008, pp. 625–643. Available at: https://cumincad.architexturez.net/system/files/pdf/ijac20075403.pdf (25 October 2018).

Horrall, Thomas R., “Background Sound Level & Uniformity Preferences in the Open Office”, *Cambridge Sound Management.* Available at: http://cambridgesound.com/wp-content/uploads/2013/02/Background-Sound-Level-and-Uniformity-Preferences-in-the-Open-Office.pdf (3 January 2019).

“How to Recycle Shredded Paper”, *Earth911.* Available at: https://earth911.com/recycling-guide/how-to-recycle-shredded-paper/ (27 November 2018).

Howe, Emily, “The Re-invention of Molded Pulp”, February 2010. Available at: www.iopp.org/files/public/HoweEmilyRIT.pdf (20 November 2018).

Hughes, John R., “Motivating and Helping Smokers to Stop Smoking”, *Journal of General Internal Medicine,* 18(12), December 2003, pp. 1053–1057. Available at: www.ncbi.nlm.nih.gov/pmc/articles/PMC1494968/ (25 November 2018).

Info entrepreneurs, *Use design in your business,* 2009. Available at: https://m.infoentrepreneurs.org/en/guides/use-design-in-your-business/ (2 May 2019).

Ivić, Ivan, *Razvojni koraki: pregled osnovnih značilnosti otrokovega razvoja od rojstva do sedmega leta* [Developmental stages: an overview of the basic characteristics of a child’s development from birth to the age of seven], Inštitut za psihologijo osebnosti, Ljubljana 2002.

Jenett, Angelica, “How Your Child’s Next Toy Can Help You Be Part of the Circular Economy”, *Medium,* 23 July 2018. Available at: https://medium.com/tackling-toy-tyranny/how-your-childs-next-toy-can-help-you-be-part-of-the-circular-economy-bde8c772b910 (10 December 2018).

Kennedy-Moore, Eileen, “Do boys need rough and tumble play?”, *Psychology Today,* 30 June 2015. Available at: www.psychologytoday.com/us/blog/growing-friendships/201506/do-boys-need-rough-and-tumble-play (4 December 2018).

Keuc, Albin, *Odpadki: problem ali izziv? Poročilo o izvajanju zakonodaje in doseganju strateških ciljev,* [Waste: A Problem or a Challenge? A report on the implementation of legislation and achievement of strategic goals], Umanotera, Ljubljana. Dosegljivo na: www.umanotera.org/wp-content/uploads/2014/11/Odpadki_priloznost-ali-izziv.pdf (30 April 2019).

Key Statistics 2017: European Pulp & Paper Industry, CEPI, Brussels 2018. Available at: www.cepi.org/system/files/public/documents/publications/statistics/2018/210X140_CEPI_Brochure_KeyStatistics2017_WEB.pdf (1 February 2019).

Kidrič, Martin, *Kartonažerska dodelava,* UL, Naravoslovnotehniška fakulteta, Oddelek za tekstilstvo, Ljubljana 2007, www2.grafika.ntf.uni-lj.si/uploads/media/KartonazerskaDodelava.pdf (10 November 2018).

“Kids and Violent Play: An Education World e-Interview with Jane Katch, Author of a Book About Children’s Violent Play”, *Education World.* Available at: www.educationworld.com/a_issues/issues/issues165.shtml (5 December 2018).

Korhonen, Jouni, Antero Honkasalo, Jyri Seppälä, “Circular Economy: The Concept and its Limitations”, *Ecological Economics,* vol. 143, January 2018, pp. 37–46. Available at: www.sciencedirect.com/science/article/pii/S0921800916300325#! (2 November 2018).

Kunič, Roman, “Carbon footprint of thermal insulation materials in building envelopes”, *Energy Efficiency,* June 2017. Available at: DOI: 10.1007/s12053-017-9536-1, (25 January 2019).

Lange, Alexandra, “Design Notes, Episode 10. Architecture critic Alexandra Lange explores the design of childhood—from the sandbox to the street”, *Google Design,* November 2018. Available at: https://design.google/library/alexandra-lange-design-of-childhood-interview/ (16 November 2018).

Lesar, Boštjan, Miha Humar, “Borove spojine za zaščito lesa – I. del: Zgodovina in toksične lastnosti” [Boron compounds for wood preservation. Part I: History and toxic properties], *Les: revija za lesno gospodarstvo* [Wood industry & economy journal], vol. 59, no. 7-8, Zveza društev inženirjev in tehnikov gozdarstva in lesarstva Slovenije, Ljubljana 2007, pp. 176–179.

Lesar, Boštjan, Miha Humar, “Borove spojine za zaščito lesa – II. del: Vezava v les ter fungicidne in insekticidne lastnosti” [Boron compounds for wood preservation. Part II: Fixation in wood and fungicidal and insecticidal properties], *Les: revija za lesno gospodarstvo* [Wood industry & economy journal], vol. 59, no. 9-10, Zveza društev inženirjev in tehnikov gozdarstva in lesarstva Slovenije, Ljubljana 2007, pp. 216–222.

Liew, Kang Chiang, Khor, Lian Kim, “Effect of different ratios of bioplastic to newspaper pulp fibres on the weight loss of bioplastic pot”, *Journal of King Saud University – Engineering Sciences,* no. 27, King Saud University School of International Tropical Forestry, Malaysia 2013, pp. 137–141.

Lloyd Wright, Frank, “The Cardboard House”, *The Future of Architecture,* Horizon Press, Michingan 1953, pp. 387–398.

Marjanovič Umek, Ljubica, *Razvoj otroške risbe* [Drawing Development in Children], Znanstveni inštitut Filozofske fakultete, Ljubljana 2004.

McDonough, William, Michael Braungart, *Cradle to Cradle: Remaking the Way We Make Things,* North Point Press, New York 2002.

McDonough, William, Michael Braungart, *The Hannover Principles: Design for Sustainability,* 1992. Available at: www.mcdonough.com/wp-content/uploads/2013/03/Hannover-Principles-1992.pdf. The edition published on the 20th anniversary of the first publication is available here: www.mcdonough.com/writings/the-hannover-principles/ (5 May 2019).

Meng, Han, Marie Annick Galland, Mohamed Ichchou, Olivier Bareille and Tianjian Lu, “Small perforations in corrugated sandwich panel significantly enhance low frequency sound absorption and transmission loss”, *Composite Structures,* no. 182, 15 December 2017, pp. 1–11.

Meyer, Hannes, “Building”, *The Industrial Design Reader* (1928), Carma Gorman (ed.), Allworth Press, New York 2003.
Miller, Susan A., Ellen Booth Church, Carla Poole, “Ages & Stages: How Children Learn to Solve Problems”, *Scholastic,* 2018. Available at: www.scholastic.com/teachers/articles/teaching-content/ages-stages-how-children-learn-solve-problems/ (26 November 2018).
Morad, Abdel-Kader, Ahmed Atef Faggal and Yara S El-Metwally, *Efficiency of Corrugated Cardboard as a Building Material,* October 2012, Research Gate. Doi: 10.13140/RG.2.2.24879.53927 (20 October 2018).
Munari, Bruno, *The Tactile Workshops,* Maurizio Corraini s.r.l., Mantova 2014.
My Work in a We World, Gensler Research, 2015. Available at: www.gensler.com/uploads/document/418/file/My-Work-in-a-We-World.pdf (22 November 2018).
New 74% paper recycling target set for 2020, European Paper Recycling Council, 11 May 2017. Available at: www.paperforrecycling.eu/new-74-paper-recycling-target-set-for-2020/ (22 October 2018).
Newport, Cal, *Deep Work: Rules for Focused Success in a Distracted World,* Grand Central Publishing, New York 2016.
Nishiyama, Yutaka, “Miura Folding: Applying Origami to Space Exploration”, *International Journal of Pure and Applied Mathematics,* vol. 79, no. 2, 2012, pp. 269–279. Available at: https://ijpam.eu/contents/2012-79-2/8/8.pdf (12 November 2018).
Oksman, Olga, “Are gendered toys harming childhood development?”, *The Guardian,* 28 May 2016. Available at: www.theguardian.com/lifeandstyle/2016/may/28/toys-kids-girls-boys-childhood-development-gender-research (26 November 2018).
Oldman, T., P. Rothe, “Noise and its impact on productivity, importance of variety in open plan spaces and Plantronics’ 'Soundscape' building”, *Leesman Review,* no. 17, 2015.
Oseland, Nigel, Paige Hodsman, Planning for Psychoacoustics: A Psychological Approach to Resolving Office Noise Distraction”, *Workplace Unlimited,* Saint-Gobain Ecophon, 2015.
Papanek, Victor, *Design for the Real World: Human Ecology and Social Change,* Academy Chicago Publishers, Chicago 1992.
Paper Calculator, https://c.environmentalpaper.org/ (12 April 2019).
Park, Soon-Hong, “Acoustic properties of micro-perforated panel absorbers backed by Helmholtz resonators for the improvement of low-frequency sound absorption”, *Journal of Sound and Vibration,* September 2013, vol. 332, no. 20, KSLV Structures & Materials Team, Korea Aerospace Research Institute (KARI), pp. 169–184.
Paron-Wildes, A. J., “Sensory stimulation and autistic children”, *InformeDesign,* vol. 6, no. 4, University of Minnesota, pp. 1–4. Available at: www.informedesign.org/_news/apr_v06r-pr.pdf (28 November 2018).
Parry, Wynne, “Battling the Boys: Educators Grapple with Violent Play”, *Live Science,* August 2009, www.livescience.com/8514-battling-boys-educators-grapple-violent-play.html (4 December 2018).
Peek, Nadya, “Press-fit Geodesic Dome”, *Infosyncratic,* 16 September 2008, http://infosyncratic.nl/weblog/2008/09/16/press-fit-geodesic-dome/ (12 December 2018).
Pellis, Sergio M., Vivien C. Pellis, “Rough-and-Tumble Play and the Development of the Social Brain”, *Current Directions in Psychological Science,* vol. 16, no. 2, pp. 95–98.
Program vrtca montessori [Montessori Kindergarten Curriculum], Montessori inštitut, Ljubljana 2013. Available at: www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/Razvid/Vrtci_statistika/Programi/Program_montessori.pdf (12 December 2018).

Projektno delo z lutko (PDL) [Project Work with a Doll (PDL)], Vrtec Trnovo. Available at: https://vrtectrnovo.si/projektno-delo-z-lutko/ (1 December 2018).
Puech, Henri-Charles, “Gnosis and Time” (1951), *Man and Time. Papers from the Eranos Yearbooks,* Joseph Campbell (ed.), Bollingen Series XXX/3, Princeton 1983.
Quit Smoking, NHS, 2018. Available at: www.nhs.uk/live-well/quit-smoking/10-self-help-tips-to-stop-smoking/ (25 November 2018).
Raworth, Kate, *Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist,* Random House Business Books, London 2018.
Ribul, Miriam, “Recipes for Material Activism”, *Issuu,* April 2014, https://issuu.com/miriamribul/docs/miriam_ribul_recipes_for_material_a (4 November 2018).
Roadmap towards a Circular Economy in Slovenia, Ministry of the Environment and Spatial Planning of the Republic of Slovenia, Ljubljana 2018. Available at: https://circulareconomy.europa.eu/platform/sites/default/files/roadmap_towards_the_circular_economy_in_slovenia.pdf (20 November 2018).
Rossing, Thomas D., F. Richard Moore and Paul A. Wheeler, *The Science of Sound,* Addison-Wesley Publishing Company, Boston 1990.
S čimprejšnjo opustitvijo kajenja za pomembno izboljšanje zdravja [Significant improvement of health through quitting smoking as early as possible], Nacionalni inštitut za javno zdravje, 5 June 2017. Available at: www.nijz.si/sl/s-cimprejsnjo-opustitvijo-kajenja-za-pomembno-izboljsanje-zdravja (20 November 2018).
Santos, António, Rogério Simões and Ofélia Anjos, *Relation Between Wood Density and Paper Properties of Some Hardwood Species,* Instituto Politécnico de Castelo Branco, Castelo Branco 2008. Available at: https://repositorio.ipcb.pt/bitstream/10400.11/2160/1/2008%20wood%20density.pdf (17 November 2018).
Schuetze, Christopher F., “The Circular Economy of Recycled Paper”, *The New York Times,* 18 November 2014, www.nytimes.com/2014/11/19/business/energy-environment/closing-the-loop-on-recycled-paper.html (14 October 2018).
Secchi, Simone, Francesco Asdrubali, Gianfranco Cellai, Elisa Nannipieri, Antonella Rotili and Irene Vannucchi, “Experimental and environmental analysis of new sound-absorbing and insulating elements in recycled cardboard”, *Journal of Building Engineering,* no. 5, March 2016, pp. 1–12.
Sekulić, Branko, *Structural cardboard: feasibility study of cardboard as a long-term structural material in architecture* (master’s thesis), Universitat Politècnica de Catalunya, Barcelona, 2013. Available at: http://hdl.handle.net/2099.1/21603 (20 October 2018).
Shafaghat, Arezou, Ali Keyvanfar, M. Salim Ferwati and Tooran Alizadeh, “Enhancing staff’s satisfaction with comfort toward productivity by sustainable Open Plan Office Design”, *Sustainable Cities and Society,* no. 19. 2014, pp. 151–164.
Sivevskaa, Despina, Sonja Petrovskaa, Oliver Cackov, “Role of the Game in the Development of Preschool Child”, *Procedia – Social and Behavioral Sciences,* October 2013, no. 2, pp. 880–884. Available at: www.researchgate.net/publication/260815121_Role_of_the_Game_in_the_Development_of_Preschool_Child (26 November 2018).
Slaughter, Anne-Marie, *Design and Violence,* The Museum of Modern Art, New York 2015.
Smith, Peter K., Rebecca Smees, Anthony D. Pellegrini, “Play fighting and real fighting: Using video playback methodology with young children”, *Official Journal of the International Society for Research on Aggression,* vol. 30, no. 2, pp. 164–173.
Solanki, Seetal, *Why Materials Matter. Responsible Design for a Better World,* Prestel, Munich 2018.

Šooš, Timotej et al., *Slovenian Development Strategy 2030,* Government Office for Development and European Cohesion Policy, Ljubljana 2017. Available at: www.vlada.si/fileadmin/dokumenti/si/projekti/2017/srs2030/en/Slovenia_2030.pdf (2 May 2019).

Spence, David, "Modern Workforces Require Flexible Design: 6 Ways Flexible Working is Influencing the Traditional Office", *OfficeSpace Blog,* April 2016. Available at: www.officespacesoftware.com/blog/flexible-workforces-require-flexible-design-6-ways-flexible-working-is-influencing-the-traditional-office (15 November 2018).

STA, "V Sloveniji kadi skoraj petina ljudi" [Almost a fifth of Slovenians smoke], *Primorske novice,* 7 December 2016. Available at: www.primorske.si/2016/12/07/v-sloveniji-kadi-skoraj-petina-ljudi (26 November 2018).

Steffen, Will, Katherine Richardson et al., "Planetary Boundaries: Guiding human development on a changing planet", *Science,* vol. 347, 13 February 2015, no. 6223. DOI: 10.1126/science.1259855 (1 May 2019).

"Steps to Manage Quit Day", *Smoke Free,* 2018. Available at: https://smokefree.gov/quit-smoking/getting-started/steps-to-manage-quit-day (29 November 2018).

Sukalich, Kathryn, "Everything You Need to Know About Paper Recycling", *Earth911,* July 2016, https://earth911.com/business-policy/business/paper-recycling-details-basics/ (19 October 2018).

SVRK, *Slovenia's Smart Specialisation Strategy,* December 2017, Government Office for Development and European Cohesion Policy, Ljubljana, 2017. Available at: www.svrk.gov.si/fileadmin/svrk.gov.si/pageuploads/Dokumenti_za_objavo_na_vstopni_strani/S4_dokument_V_2017EN.pdf (2 May 2019).

T. H., "Povprečni Slovenec letno zavrže več kot 10 kg še uporabnih stvari" [In a year, an average Slovenian throws away more than 10 kg of items that are still usable], *MMC RTV SLO,* 12 June 2015. Available at: www.rtvslo.si/okolje/novice/povprecni-slovenec-letno-zavrze-vec-kot-10-kg-se-uporabnih-stvari/367361 (10 November 2018).

Tannock, Michelle T., "Rough and Tumble Play: An Investigation of the Perceptions of Educators and Young Children", *Early Childhood Education Journal,* vol. 35, no. 4, pp. 357–361.

"The Lancaster Care Charter", *Design Issues,* vol. 35, no. 1, winter 2019, MIT Press, Cambridge MA 2019.

"The Skinny on Recycling Shredded Paper", *Recycle by City.* Available at: www.recyclebycity.com/chicago/brief/the-skinny-on-recycling-shredded-paper (27 November 2018).

Thorpe, Ann, *The Designer's Atlas of Sustainability: Charting the Conceptual Landscape through Economy, Ecology, and Culture,* Island Press, Washington 2007.

Tompkin, Gervais, "Survival of the Focused", *GenslerOnWork,* November 2013. Available at: www.gensleron.com/work/2013/11/11/survival-of-the-focused.html (8 November 2018).

Tonkinwise, Cameron, "'I prefer not to:' Anti-progressive Designing", *Undesign: Critical Practices at the Intersection of Art and Design,* Gretchen Coombs, Andrew McNamara and Gavin Sade (eds.), pp. 74–84, Routledge, London and New York 2018.

Tremblay, Richard E., "Aggression", *Encyclopaedia on Early Childhood Development,* www.child-encyclopedia.com/aggression/introduction/why-play-fighting-can-be-good-children (1 December 2018).

Treviño, Lara A., et al., "Physical Activity as a Coping Strategy for Smoking Cessation in Mid-Life and Older Adults", *Addictive Behaviors,* Elsevier, 2014, pp. 885–888, https://academic.oup.com/ntr/article-abstract/17/5/539/1032029?redirectedFrom=fulltext (5 December 2018).

UN, *Sustainable Development Goals,* 2015. Available at: www.un.org/sustainabledevelopment/sustainable-development-goals/ (7 October 2018).

Ustvarjamo Domišljija: novosti 2018 [Creating Imagination: What's New in 2018], Satko, Ljubljana 2018. Available at: http://site-317310.mozfiles.com/files/317310/Novosti_2018-2019.pdf (4 December 2018).

Utamia, Sentagi Sesotya, Dhany Arifianto and Ainun Nadiroh, "Study on the Effect of Partition Heights in Open Plan Office to the Privacy and Distraction Level Utilizing Computational Fluid Dynamics", *Procedia Engineering,* vol. 170, 2017, pp. 195–201.

Van der Leest, Emma, *Form Follows Organism: The Biological Computer,* Willem do Kooning Academie, Rotterdam 2016.

VanFleet, Risë, *Child-Centered Play Therapy,* Guilford Press, New York 2010.

Vidmar, Anja, *Številske in prostorske predstave pri učencih z gibalno oviranostjo in lažjimi motnjami v duševnem razvoju* (magistrsko delo) [Numerical and spatial cognition of students with physical disabilities and mild intellectual disabilities], Pedagoška fakulteta, Ljubljana 2017. Available at: http://pefprints.pef.uni-lj.si/4555/1/Anja_Vidmar_magistrsko_delo_kon%C4%8Dna_verzija.pdf (12 April 2019).

Vitelli, Romeo, "Does Your Child Have a Digital Addiction?", *Psychology Today,* 23 November 2017. Available at: www.psychologytoday.com/us/blog/media-spotlight/201711/does-your-child-have-digital-addiction (25 November 2018).

Vovk, Sandi, *Izdelava izolacijskih plošč iz celuloznih vlaken* (diplomski projekt) [*Production of Insulation Panels From Cellulose Fibers* (B.Sc Thesis)], Biotehniška fakulteta, Ljubljana 2015.

"Waste statistics: Statistics Explained«, *Eurostat,* 2018. Available at: https://ec.europa.eu/eurostat/statistics-explained/pdfscache/1183.pdf (5 May 2019).

"Wasted': Greening the plastics-heavy toy industry", *CBC Radio,* 5 January 2018. Available at: www.cbc.ca/radio/day6/episode-371-iran-nuclear-deal-plastic-toy-waste-kaepernick-bitcoin-bunkers-spotify-vs-composers-and-more-1.4470486/wasted-greening-the-plastics-heavy-toy-industry-1.4470526 (26 November 2018).

WDO – World Design Organisation, *Definition of Industrial Design,* 2015. Available at: https://wdo.org/about/definition/ (2 May 2019).

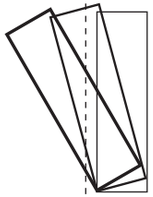
Webb, Amy, "The science behind play-fighting—and why it's not all bad", *Motherly.* Available at: www.mother.ly/child/the-science-behind-play-fightingand-why-its-not-all-bad (10 December 2018).

Webster, Ken, *The Circular Economy: A Wealth of Flows*, 2nd Edition, Ellen MacArthur Foundation Publishing, New York 2017.

What we've learned about focus in the workplace, Gensler Research, 2012. Available at: www.gensler.com/uploads/document/306/file/Focus_in_the_Workplace_10_01_2012.pdf (25 November 2018).

Zeleno kot razvojni potencial Slovenije [Going Green as a Development Potential for Slovenia], Vlada RS. Available at: www.vlada.si/teme_in_projekti/prehod_v_zeleno_gospodarstvo/ (20 November 2018).

Žnidaršič, Sabina, *Otrokova igra* [Child's Play]. Available at: www.oshjh-staritrg.si/files/2013/03/OTROKOVA_IGRA.pdf (8 December 2018).



Index

In the book *Papiro-logía,* the new paradigm of circular design is presented in an innovative and clearly understandable way, using sound scientific terminology. It also delves into the possibility of establishing an interdisciplinary paper furniture supply chain while reporting on new approaches to design education—a result of knowledge exchange among the expert and scientific partners of the project. This is one of the pioneering examples of a type of work that attempts to actively influence the prevailing mentality in order to accelerate the development of circular design, while summarising the objectives of ongoing efforts to minimise waste, the basic purpose of which is to reduce resource extraction. Serving as a reference and supplemental material for university-level studies, it can contribute to the understanding of the principles of circular economy. This also makes it a practically essential reading for the wider professional community—having been acquainted with the topic, they can focus on educating the general public.
Dr Boštjan Bugarič

The monograph *Papiro-logía: Circular Design and the Use of Paper in Interior Design* represents a significant contribution to development and innovation in renewable materials in the circular economy. The examples it presents provide an important springboard for further research in this field. The monograph illustrates wonderfully how important interdisciplinarity is in the creation of new knowledge. In a time when great international efforts are dedicated to increasing the utilisation of renewable materials and finding ways to use them in products designed according to the cradle-to-cradle concept, the significance of this monograph extends beyond national boundaries.
Dr Andreja Kutnar

9 789619 471319 >