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BEYOND LAMPSHADES – TEACHING UPCYCLING IN A MEANINGFUL WAY

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ABSTRACT
Upcycling reuses waste materials to create products of higher quality/value. While upcycling is commonly described as important from a sustainability perspective and frequently appear as a theme in design education, several aspects remain unaddressed: How upcycling is done, how much waste is repurposed and the overall environmental impact of upcycling activities are often not adequately assessed. This article explores these aspects based on experiences from upcycling teaching activities recently carried out: six upcycling thesis projects in Sweden, and two upcycling workshops in China. These different experiences make it clear that involving interested manufacturers is crucial if any effect is going to be obtained from the upcycling activities. Since the task of designing with waste is so undefined, restricting manufacturing options as well as a target user group helps narrow the possible solution space. To use "virgin" industrial waste makes the process easier, since the input material is known and clean. Upcycling post-consumer waste could have an even larger positive environmental effect, but it is difficult since there is a lack of reliable material information. To conclude, if upcycling is to be part of a sustainable design syllabus, it should be ambitious. In order to move beyond 'lampshades' and similar demonstrational cases, one needs to strive towards a systematic process and methodology for upcycling, as well as involve relevant stakeholders that can make use of the results. The aim should be 'industrial scale', and not one-of-a-kind solutions.

Keywords: Upcycling, education.

1 INTRODUCTION

Upcycling reuses waste materials to create products of higher quality/value. A study carried out in 2012 identified and analysed 57 examples of marketed products developed mostly from waste material (Ordoñez, Rexfelt, & Rahe, 2012). No descriptions of the methodology used could be found for the cases studied, indicating that upcycling was then focused on the experiential, not implementation. Nor did any of the examples have any analysis regarding their environmental effects. While upcycling is commonly described as important from a sustainability perspective, when it is done in small volumes its environmental impact is still comparatively low and in some cases requires intensive pre-processes that overweigh the environmental gain expected. When considering using upcycling in a sustainable design syllabus, it is vital that such uncertainties are addressed, in order to ensure results with positive impacts. This article explores these aspects through comparing recent experiences from upcycling teaching activities: A Swedish project and two workshops in China.

At Chalmers University in Gothenburg, six thesis projects were carried out within the research program "Waste to design" (W2D) during 2013-2014. This program aimed to document the upcycling process, identify its barriers and find suitable methods for it. This was done by having design students dedicate their master or bachelor thesis to do product development using discarded material obtained from a local industrial recycling company. The materials they could choose from where materials that the recycling company had no existing market for, covering both production waste and post-consumer waste. Within the program, a systematic methodological approach to upcycling was developed and applied, resulting in interesting product concepts (for more information about the W2D project results, see Ordoñez & Rexfelt, 2017). The market potential (and thereby their environmental effects) of the product concepts could not be validated, because of the lack of stakeholder engagement in the results.

Upcycling was done in this case without a ‘client’, resulting in the concepts not being developed further nor taken into production.

Figure 1. Upcycling workshops in China

At Tongji University, Shanghai and Jiangnan University, Wuxi, a different approach to upcycling was explored in 2014 and 2015 (figure 1). These events foresaw building international, sustainable R&D communities with academic and governmental support, using virgin industry leftovers as a basis for the creation of revenue generating products for serial production. The Guangzhou Low Carbon Emission Association has organized upcycling workshops that involve a number of industrial partners who provide waste raw material from their regular production, local universities who provide space and a framework of communication with other universities, accommodation, catering, and equipment, as well as staff from universities from other countries in China and the rest of the world who participate together with selected students at the expense of sponsoring institutions such as the British Council. International academia collaborated with Chinese industry and students to try to reduce waste by manufacturing other products. A percentage of materials normally discarded were used to create parallel income streams. These Chinese cases demonstrate the importance of involving relevant stakeholders, in order to obtain the potential environmental benefits associated with upcycling.
The following sections compare how these experiences differed on certain consideration for how upcycling was done, generating different results.

2 MATERIAL SUPPLY CONSIDERATIONS

In the Swedish case, students chose from material (figure 2) previously selected and gathered by the engaged industrial recycling company, so they did not have to clean or collect the material themselves. However, some of the material they could choose from was a specific type of post-consumer waste (e.g. polyurethane foam from vehicle seats, PVC from used cable sleeving) which meant that even though it was consistent it presented irregularities that created uncertainty in how the material properties have been altered during use. This meant that these materials had no specification sheet and were of variable quality. Some students in the Swedish project chose to use virgin industrial waste, because they could have better information of the material quality, and bypassed in this way the challenge of using post-consumer waste for upcycling.

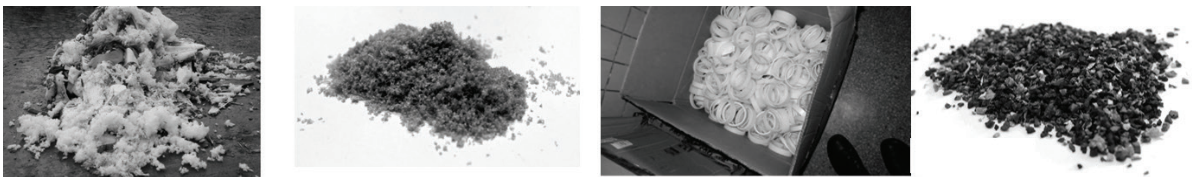

Figure 2. Examples of materials the students worked with in the upcycling cases. From left to tight they are: PUR-foam, Polyurea/PVC-foam, PVC cable roll cutoffs, PVC from cable sleeving

During the workshops in China the participants were allowed free selection of components from a body of provided, virgin industrial waste materials of consistent quality, which they were then supposed to turn into products with good market potential. The advantage of this sourcing was that all material tended to be clean, of predictable quality and quantity, and came with a full specification sheet. This waved the need for any cleaning action, which can be required with post consumer waste material, and which may have its own weaknesses regarding sustainability. It also reduced biological health hazards to participants, which may come with post-consumer waste.

3 STAKEHOLDER ENGAGEMENT

Even though the Swedish project was done in close collaboration with an industrial recycling company, the original manufacturers of the discarded materials to be used were not necessarily involved in the upcycling process. The students had access to large amounts of material if they wanted to use it for inspiration, prototyping or doing different material tests, but within the recycling company there was little expertise about the chosen materials and less information about the production processes that had made them. In the thesis projects where the students used pre-consumer industrial waste, they got in contact with the manufacturer and gained more information about the material and the production processes. However, the students that used post-consumer waste did not have the same possibility.
The workshops organized by Guangzhou Low Carbon Emission Association in Shanghai and Wuxi represented an opportunity to approach the upcycling process from the perspective of a product design agent embedded in the supply chain of manufacturing processes, rather than as an external agent without the ability to influence the development of items subject to upcycling at a later stage. The products developed from the industrial waste were then used by the providing industry partners to inform their own production of the primary products for added compatibility between the two. In other words, during these workshops in China, product designers not only upcycled raw material from industry, but had indirect input into the design of the primary products leading to the creation of the raw materials for the secondary products, so that there could be better suitability for upcycling later. This was facilitated by industry emissaries attending the workshops, monitoring the process, and evaluating the emerging secondary products for production suitability at their existing plants, as well as feeding back possible modification requirements to the primary products in order to better accommodate the needs of the secondary products.

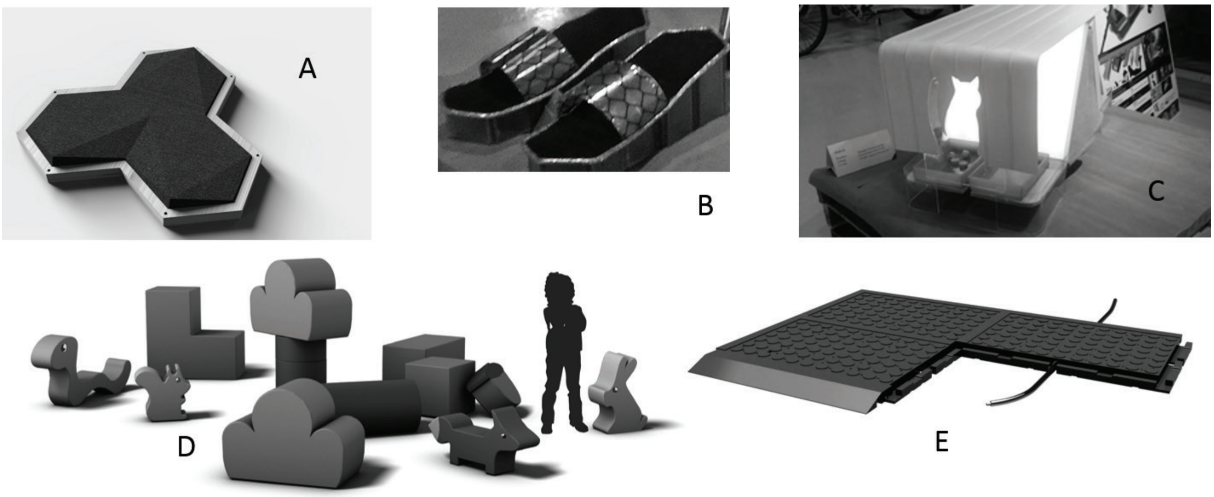

Figure 3. Examples of products designed in the upcycling cases. From A to E they are: A sound absorber, shoes, a cat shelter, soft toys and an outdoor floor system

The supply of the industrial raw materials and their availability being linked directly to the manufacturing volumes of the primary products meant that production planning of the upcycled products was linked to the production of the primary product, and a possible discontinuation of production of the primary product would also mean the discontinuation of the secondary product created from the industrial leftovers. The end of the production run of the primary product would therefore always cause the end of any secondary and tertiary product, as well.

4 ADDITIONAL OPPORTUNITIES FOR DESIGN

The Swedish project started by proposing materials to design students that currently represent a cost for the industrial recycler. Today recyclers have to pay to send this material to either landfill or incineration, so if they could give the material to anyone, they would already benefit. To use such material becomes an asset to the producer, rather than a cost. If design can make something useful from something that is currently a nuisance, it is not just helping solve the waste problem, but making a competitive business out of it. Waste is material that remains a missed opportunity for new product development. Although the materials offered by the recycling company are difficult to use and relocate, to learn how to address such challenges would give designers more work opportunities.

Since the development of products with industrial waste in the Chinese case linked a secondary product to the original one, it would benefit the design industry, as the replacement of one product would automatically require the replacement of another, resulting in a requirement for additional design work. In this way, the process as used during the workshops in China can provide a boost to the design industry by doubling the instances of new product development every time a new product is planned: Each new primary product would require design work to be carried out to also plan the secondary product, which could be carried out with superior predictability of parameters than any post-consumer waste approach, and it would actually ensure that every primary product has a viable secondary product. In theory, this process could be extended to include tertiary products and more, in which case the involvement opportunities for design work would multiply with each additional, planned lifecycle. In any event, this process ensures that virgin industry waste material, which would formerly have ended up unused, is turned into a fully marketable, secondary product of predictable quality, with possible profit to, and accountability of, the originator of the waste. It therefore also creates a situation wherein waste creators profit from their waste, and health impact of the upcycling process on its agents is controlled better due to the availability of full material specifications by the original manufacturer.

5 CHALLENGES FACED BY THE PARTICIPANTS

The primary challenge in both cases was to recognize potential in the provided materials, where students first need to understand the materials at hand and match them against potential applications. In addition to this, the students in the Swedish project also had to deal with irregular post-consumer materials and the lack of reliable material information for post-consumer materials. This made it harder for them to know how they could make use of the material and eventually provide a quality standard for the upcycled product they would suggest. Therefore the students aim to upcycle material into applications that could tolerate material variation and were not critical for health or overall performance.

In contrast, the Chinese workshops had full industry specification sheets for each material available, provided by the companies who had donated the waste material, so the workshops participants had a robust starting point for material exploration. It eradicated any uncertainty as to material characteristics, and enabled the participants to plan strategically. Since the source for more raw material was known and open to demand, possible shortages during the workshop as a result of overzealous testing and related sample destruction could always be remedied by requesting more material to the donating industry.

6 THE PROVIDED CONTEXTS

The students engaged in the Swedish project, were free to choose whatever application area they deemed relevant. This additional liberty for their product development process presented a challenge, since it is uncommon to not have a target user group or use situation to base the product development on. This lack of context was experienced as an additional challenge by the students, contributing uncertainty to the already difficult task of using a discarded material. It might be possible to discuss if some scenarios may be more beneficial than others for specific materials, so the choice of scenario might affect the upcycling process in a way that is not fully understood. However, having a context to develop upcycling for, should be preferred than having an open choice.

On both occasions, during the workshops in Shanghai and in Wuxi, the organising universities also provided a context to design for. During the workshops in China, the provided contexts to design for were, respectively, the needs of inhabitants of a residential compound for the elderly in Shanghai, and the needs of the inhabitants of a stretch of low-income residential area along Wuxi's river front. Both represented situations of impact on Chinese society, and a societal niche whose absorptive capacity was pre-established as being suitable for the implementation of solutions made from industrial waste due to factors such as income and values held by that segment of the population. As a result, workshop participants found themselves able to focus on clearly defined target users immediately. This step reduced the necessity to identify a need and target user group first, maximizing the time that could be spent developing the actual products, possibly resulting in better concept quality.

7 DISCUSSION

The variation in the considerations presented above will have a direct effect on the environmental impact that the upcycling activities may have. These considerations will facilitate or hinder upcycling initiatives to be developed and finally implemented. If an upcycling activity done for educational purposes is never implemented by a manufacturer, it will not have any direct positive environmental impacts. So, all the considerations that take these educational activities closer to real implementation are desirable (i.e. working with a defined manufacturer, under a controlled design process for a defined user group). These considerations narrow down the work space for design students to propose upcycling suggestions, and because of that they are a tradeoff that might sacrifice the full creative potential students and designers have. This tradeoff may theoretically mean that the best possible upcycling option might be disregarded because of the constrained condition in which the upcycling activity took place. We would like to argue however, that the best upcycling possible, is an implemented upcycling that has a direct measurable positive environmental impact.

7.1 What to upcycle?

Manufacturers will often try to optimize their production processes to minimize virgin material waste. However, such optimization is subject to production limitations and cannot always transcend to avoid waste generation. So, if virgin material waste occurs in a facility without the ability to recover it, the lifecycle of that material ends right there. By bringing in a creative instance, this unused resource is mobilized, and waste is avoided. Based on this viewpoint, the Chinese examples can be considered upcycling, since it elevates material destined for disposal to the status of a resource. It could be argued that stronger regulations around cleaner production should push a reduction in pre-consumer industrial waste, and upcycling is one type of strategy to help industry achieve such goals.

In the Chinese activities showcased here, only pre-consumer IW was used. This offers similar advantages to the designer as the use of fully virgin material, with the exception that the shape and configuration of the given material is predefined. Post-consumer IW, used in some of the Swedish theses had similar suitability, given that it was provided to the students clean and sorted. However, the material had an inherent irregularity that meant that the students could not be sure that all the material qualities were maintained. None the less, both pre-consumer and post-consumer industrial waste are more efficient to integrate into the manufacturing process than unsorted post-consumer waste.

An aspect seen as an advantage of parasitation is the generation of additional revenue from what would otherwise have been refuse. On the flipside of this, the process can make the initial development stage of the original industry product more cumbersome, if much circumspection is afforded to secondary or even tertiary lifecycles of that product's waste. This can reduce flexibility, and it may also be hampered by a company's limitations regarding which kinds of products they are comfortable putting their name on. This can lead to suboptimal utilisation of options – a problem not encountered when entirely independent, external agents apply themselves to the upcycling effort.

In summary, the characteristics of the type of material that is to upcycled will have a large effect on what challenges a designer face. If students for instance are given the task to upcycle post-consumer waste, they will most likely be forced to handle a lot of uncertainties due to irregularities and unknown qualities of the material.

7.2 Setting up the upcycling task

Based on the experiences from the Chinese case in comparison with the Swedish one, it can be concluded that stakeholder engagement is an important prerequisite for setting up a successful upcycling task for students. With a defined manufacturer, the quality, specifications, and supply chain of a materials are known, which reduces risk to the upcycling success. It will also make the task feel more 'real' to the students, and not like an 'interesting experiment'.

The experiences from the Chinese and Swedish cases also indicates that a defined user group could be a good idea, depending on the situation. A defined user group gives focus to an upcycling project, and may reduce the amount of time spent finding a worthy or suitable user group. For purposes of timing an educational event, as well as for the purpose of maximising development time, this is a boon. But it may result in conflicts if the material provided lacks suitability for the intended user group, thus

requiring a certain amount of strategic selection of materials as well as targeted user groups by those organising the activity. A defined user group could also result in that the best ways to upcycle a material is not discovered, due to the focus on the specific user group.
The tasks given to the students in the Chinese and the Swedish case had quite different timespans. Depending on how long the students are expected to work on the upcycling task, providing them with theoretical support regarding a suitable process and associated methods can be very valuable to them. In the Swedish case, where the upcycling task consisted of thesis projects, the students needed this. Based on that case, recommendations regarding such support is provided in Ordoñez & Rexfelt, (2017)

7.3 Environmental assessment

The environmental effects of the Chinese case is considered to be clearly positive while the effects of the Swedish cases is undecided, since none of the designed products have been produced (yet). Nevertheless, neither of the cases included any thorough analysis of the environmental effect. This may not always be needed, but it would be unwise to consider upcycling as inherently positive for the environment. The upcycling process could convey new aspects such as transports and additional industrial processes that offsets the environmental potential of upcycling. Therefore it could be a good idea to include specific requirements regarding environmental assessment in an upcycling task.

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