

Designing with residual materials

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Abstract

Many entrepreneurial businesses have attempted to create value based on the residual material streams of third parties. Based on 'waste' materials they designed products, around which they built their company. Such activities have the potential to yield sustainable products. Many of such companies remain in the more artistic domain, with relatively labor-intensive products, and small batch sizes. Moving beyond such small-scale activities would likely require a standardized innovation process. The design process for such residual material stream-based products, however, is somewhat different than regular mainstream industrial design engineering methodology. In this paper, a case study is presented based on one such company, with a portfolio of over 20 products, ranging from home & furnishing to kitchen & food services and ranging from office & work to event products. Based on historical projects, success factors for successful design with residual materials are determined. Results show, first of all, that particular attention needs to be paid to the consumer & market side of potential new projects. Second, products aren't automatically more sustainable, hence attention needs to be paid to ensure that resulting products are sustainable. Third, sourcing of residual material streams is of the utmost importance. Finally, manufacturing with residual materials provides an additional challenge. The resulting design approach is subsequently tested in a real-life project for an external client, substantiating the findings of the analysis of historical projects.

Keywords:

product development, residual material streams, waste, entrepreneurship

1 INTRODUCTION

EcoDesign has taken many forms. Designers have taken different perspectives on combining design and sustainability. They have started from existing products, which has led to classical EcoDesign [e.g. 1], they have proposed different ways of fulfilling the same functions as existing products (such as Product-Service Systems) and they have explored different philosophical approaches to design, such as cradle-to-cradle, and biomimicry [e.g. 2, 3]. There are also many examples of designers not starting with an existing product or function, but starting with a material or production technology. Here, one can distinguish an approach on working with basic materials which are deemed sustainable due to being renewable [e.g. 4, 5] or recycled, and designers working with discarded products, sub-assemblies and production waste streams.

The sustainability rationale behind product designs based on such residual material streams (RMS), is that materials and energy have been invested in the production of the objects. Re-using them as they are, is than the preferred option on the priority ladder (reduce, re-use, recycle), compared to recycling, incineration or landfill.

The focus of this paper is on this type of EcoDesign. Many of the current examples, see for instance the Ecodesign overview book by Fuad Luke [6], are rather conceptual, in the sense that they are more art than product design. Often they are therefore in an 'art'-price range. The current case study explores a case where this approach is elevated to a repetitive model, and a viable business, with affordable products.

2 THE CASE COMPANY

The company is called VerdraaidGoed!, abbreviated as VG. It is a one-year old design agency for serial products manufactured from residual materials. During its first year, VG focused on creating its own product portfolio as a showcase to convince potential clients. Now, VG is a company that mainly designs, manufactures and sells its own product portfolio. The material for the products comes from different kinds of RMS, offered by different parties. VG's products currently are sourced, designed, produced and sold in the Netherlands, preventing large transport distances. Manufacturing is done at sheltered workshops with good working conditions. At the same

time VG also designs and realizes products in commission of clients.

The current business plan is a mix of projects in commission and projects on own initiative. Selling their own product portfolio requires business activities, other than product design and realization. Additional partners, resources and strategies are required for proper distribution, marketing, sales and after-sales. The customer segments VG aims at are environmentally conscious consumers, companies and organizations. Over twenty products in the categories 'kitchen and food service', 'office', 'home & furnishing' and 'events', are currently offered. Figure 1 shows an example product.



Fig 1.: example product of VG.

3 APPROACH

To take this activity forward as a viable business model, certain knowledge and skills need to be developed. In collaboration with Delft University of Technology, a project [7] was executed looking both at the entrepreneurial aspects, the sustainability of products based on RMS (which will be the focus of a forthcoming publication) and the design process (which is the focus of this paper).

4 HISTORICAL CASES

The development of seven VG products was analyzed based on sales data and interviews with the initiator of VG. The initiator was selected as an interviewee because she has by far the most knowledge about the VG in the past year. Besides gathering business-relevant data, the aim of the interviews was to gather data concerning the design process and the sustainability analysis. The same interview was performed for each of the selected products separately, in order to obtain insights related to multiple types of products and projects.

The interviews were semi-structured. They were digitally recorded, and notes were made by hand. Shortly after the interviews, initial insights were listed for each product.

Another source of information was an excel file provided by VG, containing data about profit margins and selling prices. Other data was retrieved from the website.

The data was processed in three ways: A) stakeholder schemes, B) Efforts of VG and stakeholders in different activities. C) Revenues per sales channel. These results will be briefly discussed below.

- **Stakeholder schemes.** A stakeholder overview was made for each of the seven selected products. The partners that were involved in each of the phases 'development', 'sourcing', 'production & assembly' and 'marketing & sales' were investigated. The overviews provide insight in the following aspects of supply chain management:
 - The role of VG in the supply chain
 - The roles that stakeholders have and their involvement in parts of the project they are not necessarily responsible for.
 - The amount of stakeholders involved in the project and thus the complexity of the supply chain.
- **Efforts of VG and stakeholders for different activities.** The stakeholder overviews provide the basis for quantitatively assessing the effort VG has put in each type of activity. VG spends about 70% of its effort on project & product development, and about 30% on product realization.
- **Revenues per sales channel.** The revenues per sales channel were investigated based on the sales numbers. This analysis showed that the largest share of sales was generated by business to business sales.

In short, these overviews provide insight in the activities that are performed for the different projects, and by whom they are performed.

In the first place this led to a few general measures to reduce business complexity. Secondly, some key requirements for successful RMS-based entrepreneurship were identified.

The general measures for VG were:

- Take the client request as a starting point.
- Focus on specific markets and work with only a selection of RMSs to create a clear scope.
- Aim at B2B markets for the sales of the own product portfolio to increase the sales volumes.
- Create economies of scale through standardization of partner cooperation.

- Maintain the special attention for social responsibility and local sourcing & manufacturing.

The key requirements for a successful RMS-based business are:

On the level of Corporate Scope:

- Avoid markets that require difficult hygiene and safety certification.
- Include product realization as a core activity, because sourcing and manufacturing cannot be seen apart from RMS-based product development.

On the level of Tools & Resources:

- A supplier base that supplies a limited selection of residual materials with versatile applicability in product design.

On the level of Attitudes & Strategies:

- Close partner involvement and cooperation is required to meet client expectations, due to more uncertainties in the supply and manufacturing base.
- A focus on steady and reliable supplies of residual materials with specific attention to material and product flow optimization.

4.1 Sustainability

As mentioned above, a sustainability assessment of these historical designs was part of the project. For this assessment the eco-cost value ratio (EVR) was used to benchmark seven products of VG [8]. The main conclusion is that RMS-based design provides a large potential for sustainable design, but that it does not automatically lead to sustainable designs. So the following factors should be considered for sustainable RMS-based product design and realization:

- A proper organization of sourcing, transport and manufacturing. This can be achieved by following the entrepreneurial success factors as discussed above.
- A three-fold design strategy should be applied focused at maximizing the social responsibility, reduction of the eco-burden and optimization of the value.

5 PROPOSED DESIGN METHODOLOGY

Condensing the insights from the analysis above, two tools were developed. The first tool is a project selection tool, which can be used for selecting client requests for product development on their suitability for VG. This tool covers three main issues: the client, the market and the design scope. The client needs to 'connect' in some way to the notion of RMS-based products. Secondly the market segment the product has to be designed for should align with the existing focus of VG. Thirdly, the scope and experience VG has with materials and processes should align with the client request.

The second tool VG uses is the RMS-based design approach. In this tool, four focus points for successful RMS-based design are provided:

- 1) User- & market research: Gather insight in market requirements and expectations for application of residual materials in the product.
- 2) Sustainability: as discussed in the previous section.
- 3) Sourcing: The residual material is a key element in the design process. Supply security, legal issues and manufacturability need additional attention.
- 4) Manufacturing. In the design process, close mutual involvement with manufacturers is essential to meet client expectations for quality and delivery.

Besides these tools, seven points were identified that should make up the everyday mindset of VG. These are: Involvement & cooperation, Material & product flow optimization, scaling, standardization, fair & social, user & client feedback, and quality & appearance.

6 VALIDATION

In part II the two tools which were developed in part I are applied and evaluated through a design case. In the first place the Project Assessment Tool and secondly the four focus points for RMS-based design. Besides that, the usefulness of the Attitudes & Strategies for the designer was validated. The design case was performed for a real client of VG. It is a company that sells disposables for food presentation to wholesalers. The presentation products are intended for catering companies. The assignment was to develop a sustainable food presentation product, manufactured from residual material.

The following report of the design process is focused on the validation of the developed tools, not on the actual design outcomes.

6.1 Project assessment

The use of the project assessment tool appeared to be valuable for the project. Besides an advice for project selection, the tool also provided:

1. Guidelines for project improvement
2. Points of attention for the design process

The processing of the data from preliminary analysis should be split in two parts: 1) the data that is relevant for the decision to continue the project or not, and 2) the data that is relevant for later in the design process.

Finally, based on the evaluation, a criterion was added to the assessment tool. This criterion was: 'the current relation with the client.'

6.2 RMS-based design approach

From the evaluation, it can be concluded that the four focus points for RMS-based design indeed do make sense

for the designer. The activities, as prescribed in the four focus points, to a large extent exactly suited the need of the designer during the process.

Based on the evaluation, a more concrete guideline for the designer was developed. This provides the designer an overview of activities that should be performed in each phase of the project.

For the focus point Sustainability, EVR benchmarking [8] appears to be preferred, but not always essential. The threefold design strategy within the focus point Sustainability (maximizing the social responsibility, reduction of the eco-burden and optimization of the value) seems to provide sufficient guidance for the designer to come to a sustainable design. Quantitative EVR benchmarking provides a more refined guidance for the designer. The downside is that it takes more time. A trade-off has to be made.

6.3 Attitudes & Strategies

Being aware on the Attitudes & Strategies during the design process appeared to be supportive for the designer. Besides that, the Attitudes & Strategies appeared to be coherent with the four focus points. This means that there is a double check for the designer if he is aware on the Attitudes & Strategies as well as on the four focus points for RMS-based design. Finally, through evaluation on the design case, the Attitudes & Strategies became more concrete.

6.4 Supportive elements

Finally, four factors were identified which are supportive for successful implementation of the two tools and the Attitudes & Strategies.

- 1) Model making throughout the entire design process
- 2) Effective data management
- 3) Collegial involvement & evaluation
- 4) Being careful on relations.

7 DISCUSSION AND CONCLUSIONS

This project looked at a niche eco-design practice: the design of products based on residual material streams. It identified that, when taking this approach beyond the art domain, to a viable repetitive business model requires a standardized approach to selection and execution of projects. The proposed design approach is not hugely different from standard industrial design engineering approaches; however the relative importance of certain aspects does differ. This study identified these aspects, and also provided a tool for the selection of new projects.

8 FUTURE WORK

As mentioned in the paper, this project also consisted of a substantial EVR benchmarking [8] of several of the VG products. In this benchmark, the VG products were compared to similar, but regular products. Through this benchmark an assessment could be made of the actual sustainability of RMS-based products. This analysis will be developed a bit further, and published separately.

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