Schimpf, S. and Sturm, F. (2010): Art and R&D: a conceptual approach on how art can support the product development process. Proceedings of the R&D Management Conference, Manchester, UK, 30.06 – 2.07.2010.

Art and R&D: a conceptual approach on how art can support the product development process

Sven Schimpf[1] and Flavius Sturm[2]

[1]Sven.Schimpf@iao.fraunhofer.de
[2]Flavius.Sturm@iao.fraunhofer.de
All at the Fraunhofer Institute for Industrial Engineering (IAO), Competence Center R&D Management, Nobelstrasse 12, DE-70569 Stuttgart, Germany

Until the 18th and 19th century, the terms art and technique were used synonymously (Brümmer, 1999). Some of the most renowned artists, such as Leonardo da Vinci, excelled also as forward-thinking scientists. Since then, the borderline between these terms developed increasingly towards a focus on objective and rational product creation on the one hand and the creation of subjective and emotive artefacts on the other. However, we found that some companies today show that bringing together art and technique (or technology) can be a key for generating products that fire people's enthusiasm and therefore set themselves apart from their competitors' counterparts.
This paper analyses the interaction between art and R&D through the identification of the role of art in the product development process. Therefore, the three process dimensions of input, process support and output are considered, each with several exemplary cases where art and R&D interact.

1. Art and R&D

"Technology is more closely related to art than to science – not only materially, because art must somehow involve the selection and manipulation of matter, but conceptually as well, because the technologist, like the artist, must work with many unanalysable complexities" (Smith, 1981).

At a first glance, the product development process and the process of creating art are very similar to each other. Both aim at creating something new and often unique. Despite this similarity, they highly differ in their objectives and their motivation. R&D processes aim at the development of products or processes which are commercially successful. Art is more focused on the individual expression of its creator.

During the last decade, R&D and especially product development got significantly more management attention (Verworn, 2003). Making the right choices in the early phases of product development has become as important as using resources efficiently during all phases of product development. We also know that the availability of information and the amount of creativity preliminary to detailed product or process design are highly influential for the success of the later phases in the product life-cycle(Atik, 2007). The interdisciplinary integration of art and R&D has the potential to create both, more groundbreaking and out-of-the-box solutions and more efficient and effective R&D processes. However, there is only little insight available on potential interfaces between these disciplines and on how they can be best applied in business environments.

To enable the theoretic analysis of the potential usage of art in R&D and more specifically in the product development process, this paper is structured from a process perspective into input, process support and finally outcome. Based on this perspective, the usage of art in the product development process is analysed and described in more detail in the following chapters. For a better understanding, the starting point for this analysis is the introduction of some definitions related to art and R&D.

2. Some Definitions

Due to the multitude of disciplines and viewpoints on art and R&D, no commonly shared definitions of art and R&D have emerged yet. Thus, the following paragraphs aim at showing a small share of existing definitions that are used as a baseline for this paper.

2.1 What is Art?

Early definitions of art, which are highly influenced by artists such as Leonardo da Vinci or Albrecht Dürer, use the terms of art and technique almost synonymously. Since then, there are many ongoing discussions on how to define and differentiate art from adjacent activities. Examples for possible definitions are the following (see Brümmer, 1999):

- Artwork is a matter of making oneself heard.
- Art aims at getting people to think.
- Art is a way of communication. It creates images, figures or illusions, inexpressible by words.
- Art is what was previously inexistent in the world in its form.

This list can be extended but some of the characteristics described within these examples continuously recur in the different definitions. A major factor that is able to differentiate art from science or research and development is that for art, factual data and validity play only a secondary role. To allow a more practical usage of the term art within this work and its linkage to the product development process, the definition through its artefacts leads to a clearer picture of the what art can be in this context. Artefacts, as an outcome of the artistic process generally include literature, music, architecture, performing arts and visual or fine arts. These artefacts and the ability to create these are considered in more detail for a first investigation how they can support the product development process.

2.2 R&D and the Product Development Process

R&D is generally differentiated into R&D aimed at gaining knowledge, R&D oriented towards application and industrial R&D (Weule, 2002). This paper focuses on the categories of applied and industrial R&D and more specifically on the development of products. Therefore a generic product development process is considered as a basis for the definition of R&D in this paper. It contains the six phases of (1) planning, (2) concept development, (3) system-level design, (4) detail design, (5) testing & refinement and (6) production ramp-up (see Figure 1). These phases can be described in more detail as follows (see also Ulrich & Eppinger, 2004):

1. *Planning*: The planning phase in the product development process includes the identification of opportunities, the evaluation and prioritisation of projects including their planning and the adaptation of the project portfolio to the R&D project portfolio.
2. *Concept development*: The phase of concept generation includes the clarification of the problem, the internal and external search and exploration of potential solutions and finally the development of product concepts.
3. *System-level design*: Within this phase, selected concepts are adapted to the overall product system in which it will be produced and applied. This includes the overall orientation of the design towards manufacturing, usability, and integration on a system level.
4. *Detail design*: The detail design phase includes the complete specification of product details. This includes technical details of the product and linked production processes as well as the preparation of the market launch.
5. *Testing & refinement*: Prototypes are tested and validated in this phase. This allows the further refinement of the product specification towards technical and market requirements.
6. *Production ramp-up*: Within this phase, the product is produced on the intended production system. The transition from production ramp-up and the final production process is an iterative process of continuous system improvements.

Throughout this product development process, various methods exist to enhance the efficiency and effectiveness of product development. However, there is no explicit approach existing how to bring together art and the R&D process to create a beneficial and structured interaction between both. This interaction is analysed in more detail in the following chapters.

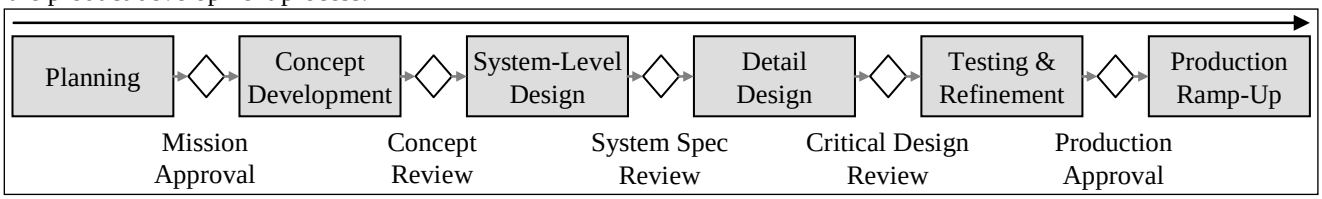

Figure 1: Generic Product Development Process (Ulrich & Eppinger, 2004).

3. Interaction between Art and R&D

Based on the definition of art, R&D and the product development process, both, the nature of the process and the nature of the outputs can be used for the differentiation. Art is generally more oriented towards the creation of symbolic artefacts through subjective or emotive processes whereas R&D and the product development process can cover both, symbolic and material outputs but is performed in a more objective and rational process (Tether, 2005). This relation between art and R&D and their orientation towards function and expression is shown in Figure 2.

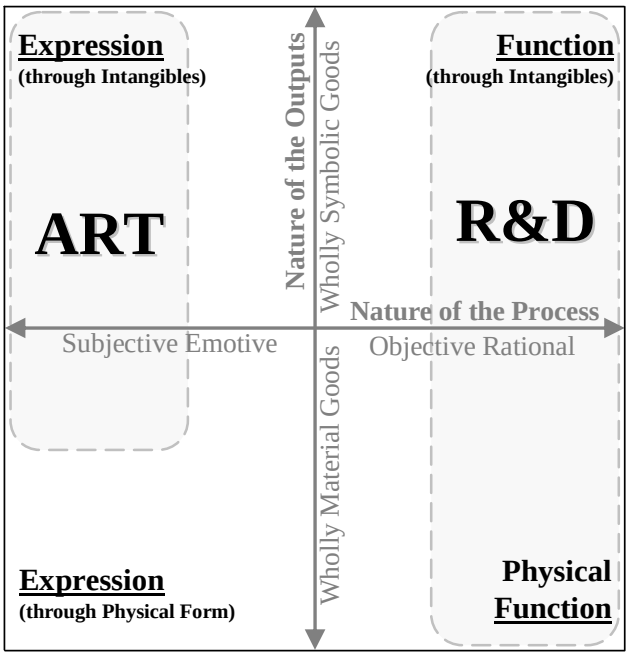

Figure 2: Differentiation of art and R&D through the nature of the process and the nature of the outputs (adapted from Tether, 2005).

By means of stakeholders in both disciplines, artists are in most cases described as creative persons. Their focus lies on the creation of something new (and existing) due to various reasons. Researchers and developers have in most cases a technical background and aim at resolving specific problems. Furthermore, R&D is generally performed as a collaborative task following a rather objective and rational process in a defined hierarchal structure and budget outlines.

As this paper looks at the interaction between art and R&D with a R&D management background, art is considered as a medium to support the product development process. This partial perspective aims at the analysis of potential improvements of the product development process and does not analyse the potential benefit for art through the application and usage of input from R&D.

3.1 Art as valuable Input for the Product Development Process

Input to the product development process in the context of this paper considers mainly the input into early product development phases (see Figure 3).

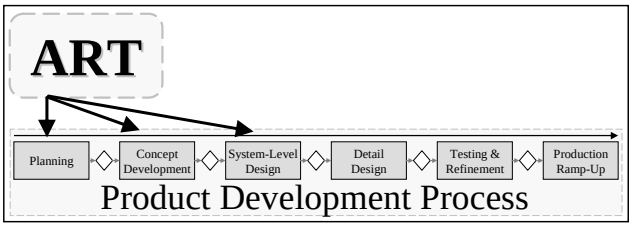

Figure 3: Art used as input for the product development process.

Some of the general objectives of artists are to perform creative processes, to overcome traditional barriers and finally to create something previously inexistent. Barriers to overcome can include mental as well as social or organisational barriers. Overcoming barriers can be translated by the term of “out-of-the-box thinking”. In this metaphor, the edges of a box symbolise the boundaries of one’s problem-solving potential. This problem-solving potential is often limited in the sense that people tend to rely overly on experience, i.e. solutions that have worked in other contexts. However, these solutions are often not sufficient to create truly innovative products. The involvement of (unbiased) artists in interdisciplinary teams or workshops in early product development phases can enhance idea and concept development and enable products that go far beyond existing solutions.

Furthermore, artefacts as described in chapter 2.1 can be used in a structured way to inspire researchers and developers to identify new ideas or concepts. A common example is the usage of artwork in creativity techniques for the creation of analogies or metaphors (see also Higgins & Wiese, 1996). Another way is to continuously monitor relevant artworks such as science fiction movies or literature to identify new and disruptive (often technological) ideas or concepts. In the area of research and development in virtual reality (VR), a potential approach is the continuous monitoring of the usage of VR in science-fiction movies.

Beyond supporting the mere generation of ideas, the principles of art can also be directly applied to product development for the creation of new concepts and solutions. An example is the application of origami principles to create foldable or resource-efficient products based on the principles of traditional folding techniques (Bischof, 2009). The principles of origami allows the creation of multiple forms without the necessity of bonding through rivets or adhesives. Futhermore, it enables new designs and foldable solutions.

The process dimension of art as an input for the product development process enables R&D to enhance product development towards the creation fo subjective and emotive products and to integrate a way of thinking that is more focused on expression through tangibles and physical form. A starting point for linking art and R&D within this process perspective is the orientation towards design which, according to the nature of the process located between art and R&D (see Tether, 2005).

3.2 Support the Product Development Process

Process support is difficult to differentiate from the process input if you speak about the relationship between two disciplines. In this case, the support of the product development process through art and its artefacts is differentiated by the process input through a high level of interaction between both and a continuous (and not selective) support of the product development process. Examples for artefacts in this process dimension are the R&D workspace, architectural design or the continuous support of artists throughout the product development process (see Figure 4).

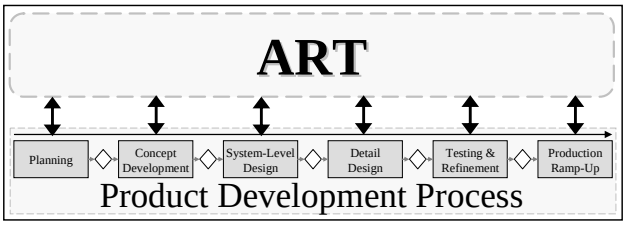

Figure 4: Art used as a continuous process support in the product development process.

Creativity plays a special role, especially in early R&D process phases. Triggers for creativity include the following factors (Amabile, Conti, Coon, Lazenby, & Herron, 1996)(Oldham & Cummings, 1996):

- Challenging tasks: task that go beyond the current capability of employees and that require new concepts or solutions.
- Freedom of action: sufficient freedom to enable the development of creative solutions.
- Sufficient resources: availability of personal and financial resources and time to fulfil a creative task.
- Organisational support: support by the organisation, the management and the working group.
- Diversity: involvement of different disciplines, age groups and bodies of experience.
- Physical environment: work environment, building architecture and interior design.

Especially the physical environment is an aspect in which art is often integrated to enhance creativity and out-of-the box thinking. This includes special buildings for research and development such as the Blizzard Building of the Institute of Cell and Molecular Science in London, UK or the Research and Innovation Center of the BMW Group in Munich, DE (see Linz, 2007).

Beyond the building, the interior design is a key factor that influences the working climate and can guide the R&D department towards a reflection of the organisational strategy. This can vary from specific paintings on the walls up to the creation of complete “artistic” workspaces such as the Google development centre in Mountain View, CA or in Zürich, CH (see also Vise & Malseed, 2006). Beyond triggering creativity, one of the major objectives of this form of interaction of art and R&D is to trigger communication between researchers and developers. Through the importance of information transfer within the R&D department, this is a major factor that allows enhancing the effectiveness and efficiency of the product development process.

In addition to the influence of art in the R&D workspace, art is often used to support the product development process by visualising textual information resulting from the different product-development phases. The artistic visualisation thereby goes beyond the visualisation of quantitative data or prototypes towards the creation of metaphors in sketches or images to enhance product development results. The objective is to increase understanding and memorisation of key results and to gain insights into different perspectives of the results.

The continuous support of the product development process through the involvement of artists and the presence of their artefacts can considerable influence the working climate and the common culture in R&D. Furthermore, it establishes a long-term relationship between artists, researchers and developers which can provide a baseline for all other kind of collaborations within the product development process.

3.3 Outcome of the Product Development Process

The performance of R&D is in most cases evaluated based on the outcome of the product development process. This outcome is refined and tested for production and therefore does not depend on any creative input from outside the product development process. However, through the smooth borderline between art, design and R&D, the outcome of the product development process can be linked to art by its nature. This is especially the case if the product aims at the expression through its intangible value (see Figure 2). This paragraph considers the overlap between the R&D outcome and art through its nature (see Figure 5).

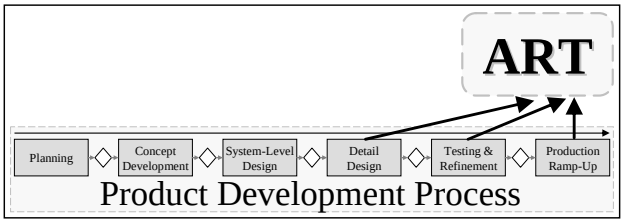

Figure 5: Art as an outcome of the product development process.

The most common relation between the outcome of the product development process and art is when a product is defined as an artefact of art. Various examples can be seen in the museums of modern art around the world. Often, these products are defined as design works and thereby in between art and R&D on the axes of the nature of the product (Brümmer, 1999). Another linkage of products and art is when artists use common products in their artefacts. However, this usage of products is not always applied in a positive way but can also express criticism towards a specific product or industrial company.

Rhe relations between the outcome of the product development process and art are not always visible at a first glance. It becomes increasingly popular, that the outcome of the product development process and especially of its early phases is used as an object of photography or other artistic disciplines. This is applied especially for the documentation of sequences, performances or for the visualisation of results that do not represent the intended outcome of the R&D activity. An example for the artistic documentation of scientific research and development are creativity or photo competitions with the focus on R&D results.

The definition of the outcome of the product development process as art is a common matter of discussion. Some declare the nature of the process of R&D as a contradiction to the nature of the process of art and thereby deny the possibility that art can be an

outcome of the product development process. Despite that, there are artists, researchers and developers and especially designers who succeed to create products with a subjective and emotive expression in a product development process that is tied to industrial R&D.

8. Conclusions

The structured usage of art in R&D and more specifically in the product development process is able to support the different phases of the product development process in various ways. Through examining the role of art along different phases of the R&D process, a number of different beneficial approaches have been identified and classified.

To create a more structured linkage between art and R&D, an empirical analysis of the current state is required to further develop the points of interaction with the highest potential. This would allow creating a beneficial partnership between artists, researchers and developers to generate products with both, an intangible and symbolic value and a physical and intangible function.

9. References

Amabile, T. M., Conti, R., Coon, H., Lazenby, J., & Herron, M. (1996). Assessing the work environment for creativity. *Academy of Management Journal, 39*, 1154-1184.

Atik, A. (2007). Entscheidungsunterstützende Methoden für die Entwicklung umweltgerechter Produkte.

Bischof, T. (2009). Falten, knicken, produzieren. *Brandeins, 12/09*, 88-89.

Brümmer, H. (1999). *Die Sache mit der Kunst - Annährungsversuche eines Ingenieurs an die Malerei des 20. Jahrhunderts*.

Higgins, J. M., & Wiese, G. G. (1996). *Innovationsmanagement: Kreativitätstechniken für den unternehmerischen Erfolg*. Berlin: Springer.

Linz, B. (2007). *Science Spaces - Architecture & Design*. Köln: Daab.

Oldham, G. R., & Cummings, A. (1996). Employee creativty: Personal and contextual factors at work. *Academy of Management Journal, 39*, 607-634.

Smith, C. S. (1981). *A search for structure: selected essays on science, art, and history*. Cambridge, Mass.: MIT Press.

Tether, B. (2005). The Role of Design in Business Performance. *Design*. Manchester. Retrieved from http://www.bis.gov.uk/files/file14796.pdf.

Ulrich, K. T., & Eppinger, S. D. (2004). *Product Design and Development*. Boston: Mc Graw Hill.

Verworn, B. (2003). Die frühen Phasen der Produktentwicklung am Beispiel des Maschinenbaus und der Elektrotechnik. In C. Herstatt & B. Verworn, *Management der frühen Innovationsphasen* (pp. 273-298). Wiesbaden: Gabler.

Vise, D. A., & Malseed, M. (2006). *The Google Story: Inside the Hottest Business, Media, and Technology Success of Our Time*. London: Pan Books.

Weule, H. (2002). *Integriertes Forschungs- und Entwicklungsmanagement*. München: Hanser.