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DESIGN MANAGEMENT FOR COMPANIES FROM THE MECHATRONICS SECTOR

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1. Introduction

Companies from the mechatronics sector are in continuous search for new methods and tools to differentiate their products from the competition. Increasing the quality and performance or reducing costs is no longer sufficient. CEO's explain that low end competitors, often from the BRIC countries, are their biggest treat since they eat away their market share from below. Clearly there is a need to shift towards the "creation of value" to increase customer bonding and the trivialisation of the cost argument. For this reason, the use of design as a strategic instrument gains interest. However tools and methods designed for the specific needs and characteristics of the mechatronics sector are not widely available yet. This is reflected in the low percentage of companies who actually use techniques such as brand identity (56%[4]) and physical appearance and charisma (53%[4]), although these are typical instruments that can be used to valorise design.

To fulfill this need, Agoria, the Belgian federation of the technological industry, is executing a two-year project (2009-2010) to translate generic tools and methods on design management into specific ones for the mechatronics sector. This paper will report the intermediate findings of this research project with the discussion of 4 of the 10 topics: roll-out of a design strategy, branding, communities in product development and perception of quality.

2. Method

2.1 Project outline and methodology

Although design management techniques are not commonly applied by companies from the mechatronics sector, a large variety of tools, methods and best practices from other sectors are available in literature [Best 2006]. However, they are not or insufficiently tailored for this specific target group and are therefore uninspiring. The aim of this research project is to list the tools and methods that are applied by members from the target group, to gather best practices and to define the specific success factors for the sector when a mechatronics company decides to apply one of the proposed techniques.

At the start of the project 11 leading companies from the Flemish mechatronics sector were asked to join an expert group. These companies were representative for the sector in size and product range. Members include Bekaert, Bombardier Transportation, Atlas Copco, Punch Graphix, Case New

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[4] Based on a survey executed by Flanders InShape in 2008 at 119 Flemish companies, the figures given are the results for the mechatronics sector. These figures only indicate the % of companies who have done some thinking in this area and do not comment on the quality or level of implementation.

Holland, LVD, Barco, Picanol, Eliet, Dibo and GEA Courtoy. Through an in-depth intake interview the company's processes (related to design management) were mapped and a first list of tools and methods was created. In a second phase, the 11 companies were invited to follow a guided experience exchange workshop where an international expert worked with the companies around one of the 10 predefined topics of design management. The results of 4 of these topics will be discussed in this paper. The conclusions of this project will be published in a booklet to be distributed to all members of the target group in Flanders.

2.2 Research objectives

The main goal of this research is to gather insights how mechatronics companies can befenit from the implementation of design management, based on the experience of some leading market players. On the one hand this research should result in a toolbox of methods that are directly implementable by mechatronics companies and on the other hand in some strong arguments to convince B2B companies to consider the use of design and design management for their business.

2.3 Target group

The target group of this project consists out of companies from the mechatronics sector (machinery) in Flanders. This group consists out of 243 companies among which 88% SME's who are specialized in the production of tooling equipment, textile machinery, agricultural machinery, hydraulic and pneumatic machines, gears and transmission elements, shipbuilding, engineering, pharmaceutical machinery, etc. The mechatronics sector in Belgium is responsible for a yearly turnover of 8.6 billion Euros with an export rate of 75%. The sector employs 38 000 employees. Flanders represents 65% of these figures. Given the high export figures, this sector needs to compete on a global market.

A successful competitive position goes hand in hand with the ability to develop new successful technology intensive products at a high pace that fulfill customer demands and with a realistic view on business reality. Companies from the target group are continuously looking for methods to improve their product development process and to enlarge the success of their products.

2.4 What makes the target group different?

When reviewing literature [Best 2006; Kootstra 2006; Borja de Mozata 2003], most examples of good design management are found in the B2C market or service industry. Alessi, IKEA, Vitra, Kartell, BMW are just a few of the design-driven brands often referred to in literature. However, the characteristics of the companies in the Flemish mechatronics sector are completely different. The table below summarises the differences.

Table 1. Specificity of the Flemish mechatronics sector

Main examples in literature	Mechatronics sector in Flanders
B2C	B2B
Consumption goods (shorter lifetime)	Investment goods (longer lifetime)
Large batches	Small batches
Incremental changes in technology	Break-through technological research
High-end and low-end quality	Mainly high-end quality
Threatened by cheap copies	Threatened by low-end competitors working their way up
Market driven	Technology driven

The absence of an individual customer, making the (sometimes impulsive) buying decision from his heart, such as present in a B2C environment, causes the most reluctance towards the application of design in B2B markets. Managers often argue that the buying decision for B2B products is made based on numbers and specs by a whole management team not by one crazy individual. However, examples exist of managers buying nice machines to make their production hall look better for

potential customers that come to visit, etc. Additionally, the small batches and intensive technological developments result in a high priority for engineering or quality and automatically in a low priority for design.

3. Results

The results of this research project are based on real life company experiences. Due to confidentiality reasons, the company names are not included in this paper.

3.1 Roll-out of a design strategy

More and more companies realise that their machines don't look nice. However, the path from scratch to design excellence is studded with many hurdles.

3.1.1 State of the art

The roll-out of a design strategy is like any other change management process. It starts with a company deciding to transform from "non-design driven" into "design driven". From this point it can be treated as any other change management process using a multiple of tools. A very rigid one is Kotter's eight stage change process where change is pushed through a series of phases, each lasting a considerable period of time [Kotter 1996]. Critical mistakes in any of the phases can have a devastating impact on the momentum of the change process. The first 4 stages aim at unfreezing all stakeholders:

1. Establishing a greater sense of urgency
2. Creating a guiding coalition
3. Developing a transformational vision and strategy
4. Communicating the change vision

The next 3 stages force the change to happen:

5. Empowering a broad base of people to take action
6. Generating short-term wins
7. Consolidating gains and producing even more change

The last step goals at freezing the change in the minds of the stakeholders:

8. Institutionalizing new approaches in the culture

Although this process is very participative, it requires clear *leadership* to initiate this process. Something that should not be confused with *management*. The table below lines out the difference between both *management* and *leadership*.

	Management	Leadership
Direction:	Planning and budgeting, Keeping eye on bottom line	Creating vision and strategy, Keeping eye on horizon
Alignment:	Organizing and staffing, Directing and controlling, Create boundaries	Creating shared culture and values, Helping others grow, Reduce boundaries
Relationship:	Focusing on objects-producing/selling goods and services, Based on position power, Acting as boss	Focusing on people-inspiring and motivating followers, Based on personal power, Acting as coach, facilitator, servant
Personal Qualities:	Emotional distance, Expert mind, Talking, Conformity, Insight into organisation	Emotional connections (Heart), Open mind (Mindfullness), Listening (Communication), Nonconformity (Courage), Insight into self (Integrity)
Outcomes:	Maintains stability	Creates change, often radical change

Figure 1. Comparing management and leadership
[based on Kotter 1996; Rost 1993 and Dumaine 1993]

Create a sense of urgency, recruit powerful change leaders, build a vision and effectively communicate it, remove obstacles, create quick wins, and build on the momentum; these steps are indispensible to make the change part of the organizational culture.

Once the change process is initiated, different steps can be identified on the path to design excellence. The Danish Design Center (2007) translated these steps into the Danish Design Ladder grouping companies into 4 clusters according to their level of implementation of design:

Step 1:   No design
Step 2:   Design as styling
Step 3:   Design as process
Step 4:   Design as strategy

Research has proven that mainly companies on steps 3 or 4, can actually benefit from the implementation of design.

3.1.2 A tool for the mechatronics sector

Despite the fact that change management seems easy to overcome if the above mentioned procedure is followed, rarely the absence of a good and structured plan is the root of a design management roll-out problem. Experiences of the mechatronics companies show that, especially for introducing design thinking, the persuasion of leaders is crucial to force change. And especially this phase is failing in most companies. If no "design leaders" can be found, it is mostly because top management believes that "design thinking" is something that lives in the CAD room or in the worse case between the ears of a designer. Despite all the roadmaps to implement change in design thinking, a first step is for top management to learn the language of designers as much as designers needs to learn the language of top management. Only then, designers will manage to grow up to senior management level where they will have the power and the opportunity to show the leadership to implement design thinking in their enterprises.

3.1.3 Why this method works

As stated above, the mechatronics sector is characterised to be technology driven. Therefore the priority for design is low as far as design is seen merely as the styling of a machine (step 2 of the design ladder). It is a misconception however that design will only affect the look and feel of the product. Design thinking goes much more into depth and affects the business processes in their overall approach towards product development. Changing this mindset is the first step towards a design-driven company, and many fail if they don't manage to do this. Comparing multiple mechatronics companies on design management, the following boundary conditions seem indispensible to be successful:

1. The company should have access to a fully educated designer with experience in industry (in-house or outsourced)
2. The designer should get responsibility and decision power in the product development process as a specialist in any other discipline
3. Designers should be able to grow in the company hierarchy upto top management
4. Top management should learn the speak the language of the designer as much as the designer should learn to speak the language of the manager.

Only then, companies will manage to reach the 4rd step of the design ladder.

3.2 Branding

3.2.1 State of the art

A brand aims at creating the impression by the potential costumer that the product or service has certain qualities or characteristics that make it special or unique. Therefore a brand is a valuable element for advertising since it demonstrates what the brand has to offer in the market. A good brand convinces customers that the higher price of the product or service is justified by convincing them making them believe that the added value of the product is much higher than that of the competing product or service. In many B2C products this results in fancy logos, websites and advertising

campaigns. However, brand promises are not always kept. Thinking of the Dyson DC21 vacuum cleaner: users on the internet state that the performance of the product is very good (read suction power is high) but the design and engineering is rather poor. Despite the fact that Dyson states that their vacuum cleaner is easy to use and highly performing, some users abominate the telescopic wand that collapses when it shouldn't, the kinking of the hose which results in no suction at all, the cumbersome head which makes it difficult to vacuum stairs, the too short electric cord etc[5]. For these users the brand promise is not fulfilled and it is unlikely that they will consider a Dyson again next time their vacuum cleaner is up for replacement. In a market where lot sizes are going up to millions and the distance between consumer and producer is rather large, one dissatisfied customer more or less will not influence the sales figures drastically. In a B2B market where producers often generate 80% of their sales with less than 10 customers, one more or less makes the difference between profit or loss. Fulfilling brand promise is therefore very important.

3.2.2 A tool for the mechatronics sector

Despite the fact that brand promise is of capital importance, branding is by many B2B companies often seen as the creation of a logo, a website and a special house style for letters and envelopes. But creating a brand goes much more into depth than merely graphical adjustments. Starting from the company history and values, a well defined vision for the future and clear company identity should be created. Only then the brand will function as a resource in the creation of unique products. For example, brand values such as 'customer orientation', 'solution driven', 'visual quality', 'user friendliness and easy use' can define the direction of the research in the future. Attention could go to the interface of the machine such that learning time of operators is minimised (user friendliness), a modular set-up such that customers can tailor their machine according to their needs (solution driven), a process of working with lead users to define technology needs (customer orientation) and the use of robust interfaces and high-quality materials (visual quality). This way of using a brand as input for the innovation process, also called brand driven innovation, is able to create a relevant brand promise. However, as much as this promise is based on the companies' values, it is about the customer or end users values. Hence a good understanding of the customer's context is essential: understanding your customer's customer, understanding the value chain of which you are part etc. Creating a brand can then be done in three steps:

1. Defining how you want to build a brand and with whom (who are the customers)
2. Creating content for your brand, what is the brand story and the brand promise?
3. Deciding on the form or which ways you want to capture the brand.

It is only in this last step that the creation of logos or ads becomes relevant. However in a B2B context, of all touch points between customer and producer the most intensive one that lasts for the longest time is the product. Therefore the translation of the brand values into design features can be an interesting step to take. Branding through product design can then be seen as a way to convey meaning through aesthetics. To do so, a 5 step approach can be used.

1. Look at competitors: what do they convey and how?
2. Look at yourself: what works in your portfolio and what doesn't?
3. Gather good examples of others translating various brand values into aesthetics (also in other industries)
4. Make mood boards collecting pictures illustrating the do's and don'ts for your brand values
5. Distil design guidelines based on these collections

To avoid a scattered image of the companies' products, a distinction can be made according to the level of detail. Mood boards can be made on the aesthetics of the product, the way of interaction between operator and machine, the performance of the machine, the construction method and the meaning.
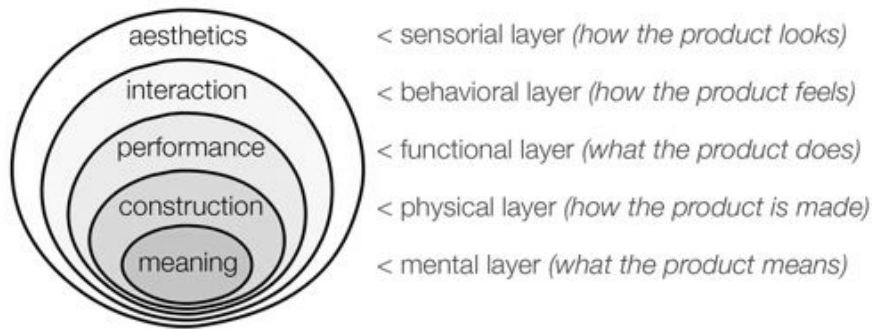
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[5] http://www.shopping.com/xPR-Dyson-DC21~RID-530832#tabAnchor

Figure 2. 5 layers of branding [Roscam 2009]

To illustrate this procedure, the example will be given of machine building company that, based on the above methodology, defined their brand values as: "user friendliness, solution driven, added value for the customer, visual quality, empathy and personal approach". Based on this, mood boards were made collecting good and bad examples of how these values could be physically translated into the product design.

Figure 3. Illustrating the mood board creation process

In a last step, conclusions were drawn on what made these "good" or "bad" examples. For the main shape of the machine the guidelines 'to do' can be summarized as:

- Go for clear and 'readable' shapes with a correct balance between professionalism and accessibility.
- Where possible, make use of repetition in the shapes (which gives it a calm atmosphere)
- Aim for open structures (if save), to underline the feeling of quality (the operator can see what goes wrong, maintenance is much easier etc.)
- Go for a feeling of balance and calmness to draw the attention to the operating panel (hide cables and tubes).

Figure 4. Extract from the 'do's' mood board

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The guidelines 'to avoid' are summarised as:

- Avoid unmeaningfull cubistic shapes
- No unnecessary details, organic shapes or curves
- Avoid the use of plastic covers
- Avoid little legs under the machine (they can give a feeling of instability)

Figure 5. Extract from the 'don'ts' mood board

3.2.3 Why this method works

Companies in the mechatronics sector have a small customer base. Additionally they have products with longer lifetimes which makes the product the most intensive touch point between customer and producer. A close involvement of the user and a profound knowledge of their wishes and expectations help mechatronics companies to align their brand promise and in the end to keep customers satisfied. Secondly, to make brand values clear to the users, the translation into the design features of the product is much more effective than uniquely working on the communication. Moreover, working with mood boards helps engineers and technically skilled people to explain a latent feeling about how the product should look like. It helps them analyse competitors in a structured way and come up with some generally excepted guidelines that can be followed by each involved in the product development process. Moreover, it avoids discussions about personal taste on what is beautiful and what not and brings them back to the core of the machine, the functionality and performance.

3.3 Communities in product development

Communities in product development are preferably digital platforms were ideas are collected that can function as input for future developments.

3.3.1 State of the art

More and more companies start to use communities to involve their customer in the product development process. LEGO launched an online community called *LEGO Factory* were customers can design, share and buy their own customized LEGO models. If the proposed configuration is picked up by many others, this model becomes a real offer by the LEGO Company. Nike has a similar business model called NikeID were customers can customise colours and subscripts of shirts, shoes, etc. Both examples give the customer a feeling of importance and influence on the product development process, were in reality this is nothing more than the customisation of highly designed products by a closed design office.

3.3.2 A tool for the mechatronics sector

For the mechatronics sector the situation is slightly different. Products are complex and batch sizes are rather small, with makes the use of communities to change colours or details abundant. Moreover, customisation of features is an intrinsic part of the competitive advantage of most machines builders in Belgium. Communities are being used on a totally different level in the mechatronics industry. Not the clients are invited to join the digital platforms to feed the product development process but the workers from the entire company are addressed from management to supporting departments, operators to after sales.

In practice two different models are used. The first is a basic idea generation platform were all employees can voluntarily post ideas. The posts are not open to read for all community members but directly send to executive staff who will evaluate and implement the idea if relevant. Hence, the creator looses the control over his idea upon submission. Employees are rewarded with a financial bonus if the idea is executed, depending on specific criteria. The more the idea deviates from the working environment of the employee, the higher the bonus. Hence a product improvement suggested by a designer is hardly rewarded were the same idea from an operator of the lathe is highly rewarded.

The second model, which is more participative, functions as a real community were employees can again post ideas about product development or process improvements, but now the ideas are rated by the community members. The more an idea is evaluated positively, the more the ranking of the idea rises. If ideas clearly float over the blurry cloud, it is isolated into a project were a dedicated project teams, often including the idea creator, can then work on the idea to make it more specific. To guide the creative process into the good direction, innovation managers or top management can post priorities on the community. Ideas addressing these main concerns will more likely be picked out to be developed further than others. The rewarding system is based on peer recognition were employees can earn a certain social status when they are very active on the community.

3.3.3 Why this method works

The first passive model, works as a digital idea box. The closed system with financial rewarding system and decisions made by management is a typical tool for small companies without a clear innovation culture. Ideas are treated as property and not as common ground for the company. The second model, which is far more participative, will only work in large companies with an important innovation culture. A certain critical mass is required to evaluate ideas to avoid personal preference. Additionally, the importance of peer recognition grows with the size of the community.

3.4 Perception of quality

According to Garvin [Garvin 1988] quality can be expressed in 8 dimensions: reliability, durability, conformance, serviceability, performance, features, aesthetics and perceived quality. This last dimension can be defined as customer's opinion of a product's ability to fulfil his or her expectations. It is not primarily related to the actual excellence of the product, but is based on the product's appearance, the firm's current public image, consumer's experience with the firm's other products, and the influence of the opinion leaders and consumer's peer group.

3.4.1 State of the art

In general it can be concluded that all features in the product should be consistent to the 6 first dimensions of quality. Handles should look durable, identification labels should look conformal to the regulation, product structures should look stable and reliable etc. However, attention for the 'perceived quality' can strengthen a positive feeling by affecting subjective characteristics.

Generally, perception of quality can be translated into some basic ground rules. Some examples:
- Honest materials: don't use cheap plastic to imitate aluminium or stainless steel
- Weight: if the weight of a product is inconsistent with the expectations, this has a negative impact on the perception: very light base parts can give the impression of "toy"-like instead of solid
- Fragility: the size of buttons or handles should be adjusted to the use environment. Very fragile or slim handles don't give a durable impression in a rough environment.

3.4.2 A tool for the mechatronics sector

The above described ground rules are rather basic for the mechatronics sector. In general for machinery, the first 6 dimensions of Garvin's description of quality are priority dimensions, which make aestetics and perceived quality disappear on the background. However, these aspects can have a positive influence on the use experience of the machine, the total cost of ownership or the companies' brand value. The activities to improve the customer perceived quality can be positioned in a 4-by-5

matrix according to the touch points vs. the level of detail of Customer Perceived Quality (CPQ), resulting in 20 action points. The x-axis defines the scope or touch points between the customer and producer: product, communication, environment and behavior. The y-axis defines the level of detail such as aesthetics, interaction, performance, construction and meaning.

	Product	Communication	Environment	Behaviour
Aesthetics	Physical appearance of your product	Housestyle: Symbols, company logo's, stationery, website etc.	Packaging, presentation of the democenter, company booth on a fair, welcome center etc.	Influence behavior by making the users/clients *feel important*
Interaction	Ease of operation of your product	Interaction through the website, online Q&A's, possibilities to ask questions and to get online help	Level of interaction at company booth (e.g. life demonstration of your product)	Influence behavior by increasing the *users/client pride*
Performance	Performance of your product (eg. non-explicit requirements)	Performance of the communication channels: speed of up and downloads, available website, …	Fit between machine and environment or the environment and the expectations of the user	Increase efficiency of the user/client
Construction	Material selection or texture (stainless steel vs. painted steel)	Selection of information carriers (type of paper, ads, etc.)	Material selection in company building or demo room (stainless steel vs. steel, natural glass vs. plastic)	Influence behavior by making things easy for the user/client
Meaning	The story behind the product fits (honesty) or the properties of your product are clear.	Operator/machine interface can intuitively be operated	Translation of brand values	Company image (brand) and 'brand promise'

Figure 6. 4-by-5 matrix showing the dimensions of customer perceived quality with examples

To make this matrix clear we will focus on 4 examples of specific use by mechatronics companies.

Performance – environment

Manufacturers can improve the performance of the products' environment by designing the input and output areas of the machine such that transportation throughout the shop floor is minimised. For example, by positioning the input and output zones on one straight line on the same height, it becomes easier to couple this machine to others into a complete production line. Depending on the situation, adjustable input or output levels can be an advantage such that the customer can adjust the machine to the specific line configuration.

Meaning – Communication

"Communication" can interpreted as the communication *of* or *about* the machine. In the first case, working on the meaning of the communication will influence the way buttons or touch screens are positioned such that an operator can work with the machine in an intuitive way. The meaning of the communication should be obvious and understandable without further explanation.

Interaction – Product

Closely related to the meaning of the communication is the interaction with the product, which includes the ease of operation. Has the handle an ergonomic shape, are buttons placed with sufficient place between them, is the angle of the touch screen sufficient to make easy reading possible etc.

Construction – Behaviour

The construction of the machine parts can influence operators to keep their machine clean. E.g. if wood chips are stuck in each corner during milling, the cleaning of the machine will take more time compared with a machine without dust corners having one flat surface. The former machine will motive the operator to keep his machine nice and tidy compared to the latter one. In this way, machine builders can influence the behaviour of operators to improve the perceived quality of the machine once it is in use.

3.4.3 Why this method works

Focussing solely on aesthetics or perceived quality as such is not appealing for machine builders. If one succeeds in proving the economic benefit of the required efforts, the case is completely different. Arguments such as increasing user friendliness, making production cheaper by redesigning the covers, reducing TCO by making maintenance easier, reducing service cost since less questions are asked about the interface etc. are directly to translate into monetary value. Moreover, these aspects improve customer bonding which is important in a market where substitution purchases are only made after 10 to 20 years.

4. Future research

This research will continue with the investigation of 6 other design management topics:

'Collaboration with designers', 'Lean innovation', 'Design Requirement Engineering', 'Stake holder analysis and Lead users in practice', 'Technologies to make machine visually attractive' and 'Value of design'

For each of these topics, the currently available methods and tools will be made practical for companies from the mechatronics sector.

5. Conclusions

This paper presents the partial results of a project executed by Agoria, the federation of the technological industry in Belgium, to translate generic tools and methods of design management into specific ones for the mechatronics sector. The intermediate findings on 4 topics are presented: roll-out of a design strategy, branding, communities in product development and perception of quality. From each subtopic it can be concluded that the mechatronics sector is too specific to just implement generally known techniques. Due to the specific nature of the sector (B2B, technology driven, small batches, investment goods,...) design is perceived to be too expensive by machine manufacturers. Only if direct benefits can be proven, companies are motivated to do an effort. The methods presented in this paper have proven their benefits and are directly usable for the mechatronics sector.

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