

EXPLOITING EMOTIONS FOR SUCCESSFUL PRODUCT DESIGN

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ABSTRACT

The ever-increasing competitiveness in product design is resulting in *good product functionality* and *usability* no longer being sufficiently effective differentiators in the market place. As a result stakeholder's attention is shifting to other product attributes such as the pleasurable emotions experienced during interaction. *Designing for product-emotions* is a relatively new emerging field in product design which is however being accredited increasing importance because of its new product development and marketing potential. This research paper reports the research being conducted at the Concurrent Engineering Research Unit (CERU) in the Department of Manufacturing Engineering (DME) at the University of Malta (UOM) via a research project entitled Demo. This research contributes to this field with the development of a phenomena model of product emotion elicitation that will lead to the future development of the required knowledge to provide an envisaged computational *Design for Emotion* (DFe) support for designers.

Keywords: product-emotions, supra-functional, DFX, product interface

1 INTRODUCTION

Design entails the process of goal oriented reasoning for practical problem solving [1] and is focussed on giving a *form* to a needed *function*, thus ending with the conception of a *product, system* or *service*. From this perspective, achieving *good functionality* is critical for the success of a product; however, this alone cannot ensure product market success since it does not necessarily lead to *purchase, use* or *acceptance* by customers [2]. Indeed the major advances registered in the field of product design and development during recent years, are resulting in many products becoming functionally and technically equivalent and hence hard to distinguish between for the customer. We are in fact in an age when companies can no longer compete on technology alone since most competitors have become equal in technical expertise. This is inevitably resulting in *functionality* and *usability* no longer being the determining attributes in customers' choice for product *purchase, ownership* and/or *usage*.

While *good functionality* and *usability* are still of primary importance, companies are seeking other means in order to gain a complete edge on the market place since stakeholders are today shifting their product related decisions on other highly selective criteria. Such criteria are termed *supra-functional* meaning beyond the functional and are often associated with the stakeholder's *cultural, emotional, social, inspirational* and *tribal* needs, with the *emotional* domain emerging as one of the most vital [3].

This research paper discloses the ongoing work within the *Demo (Research into Developing Design for Emotion Support)* research project at the University of Malta. Section 1 of the paper introduces the concept and need of product emotions while highlighting the problem background related to this research. The major intricacies encountered in emotion-driven design are reviewed next, followed by the input from design practice in Section 2. A critical review of the state-of-the-art DFe systems is then presented in Section 3 followed by an in-depth understanding of the phenomena of product emotions and the generation of the first DFe guidelines (Section 4). Finally some important conclusions and points of future work are made in Section 5.

1.1 Why Design for Product-Emotions?

Most human interaction with the material world involves emotions including user-product interaction, and products are nowadays being designed to attempt to address this emotional experience. It is no

longer sufficient for a product to function properly, be usable and efficient or have aesthetic appeal, but it must also provide positive emotional responses [4]. Indeed the area of product related emotions is becoming accepted as an important component of successful product design and a new member of the *design for X* (DFX) family. The primary reason behind this is that the design for the desired user product emotions provides the designer with a means for gaining a leading edge over competitors. Products are designed for the end users, so ensuring that the product interaction experience is as pleasant as possible becomes of critical importance for the success of the same product. The fact that products can evoke pleasure and elicit emotions is not in question [5]; there are products that we prefer to *buy, own* or *use* more than others. All of us experience different kinds of emotions when using different products. Some products even manage to elicit emotions inside us prior to their purchase, such as the *desire* for a pair of shoes we see in a shop window or else the *envy* we feel for our neighbour's brand new sports car. Other products actually manage to exhibit a '*personality*' and can result in consumers building ties and connections to these product personalities, in turn influencing their product purchase and ownership decisions. All this can be witnessed by the emotional bonds that consumers develop with some products that are judged to be important and are often among their favourite. This therefore suggests that if product designers succeed in designing products capable of stimulating pleasurable emotional bonding with their users, the lifespan of the same product might even increase since consumers choose to hang on to their products for a longer time. Also, such products become more appealing to customers thus providing that much desired competitive edge over other products on the market. The feelings elicited by a product during its pre- and post- purchasing phases can hence prove to be a determining factor for the success of the same product, thus graduating the *design of product emotions* as a highly potential and competitive differentiator in product design [6].

The collection of examples illustrated in Figure 1 help to understand the concept of emotions elicited by a number of everyday products. All of the products illustrated manage to elicit some kind of emotion upon user interaction such as the personality exhibited by the *Alessi corkscrew* line and the *Wheaton goblets* that can lead to *attraction* or *affection*. Similarly the extremely slim features of the *Motorola V3 Razor* mobile phone and the *Casio EX-S500* digital camera models can lead to *inspiration, satisfaction*, or even a *pleasant surprise* that all the parts and components in such devices can fit into such small spaces.



Figure 1. All products elicit emotions upon user interaction

So product interaction is indeed an emotional experience, and products are nowadays being designed to attempt to *address* and *influence* this emotional experience [3]. This however necessitates adequate design methods and tools that support such a DFX activity.

1.2 Highlighting the Design Problem

While evaluating user satisfaction and emotion can be difficult or at least extremely subjective [7], to actually design for satisfaction and emotion is considered (by some) even more unattainable. The major intricacies encountered in emotion driven design are attributed to the fact that product-emotions are *idiosyncratic*. This is because different people relate to different products in their own personal way, depending upon the product's characteristics and their own [2]. This hence implies that designing a product to suit many individuals is indeed a challenging task [8] since different individuals can have different responses to the same product.

An additional difficulty experienced in emotion-driven design is related to the fact that notwithstanding major work contributions in recent years, the domain of emotion-driven design is still in its infancy and large areas are still to be fully mastered. Indeed a lack of design knowledge is clearly evident, as is a complete understanding of the product emotion elicitation process. This therefore exposes a relevant *research gap* since there is still need to investigate the mechanisms involved during user-product interaction that successively give rise to the elicitation of product-emotions. For this purpose, a much needed, clearly defined, DFe framework for product designers is still lacking. Adequate DFe support will enable designers to overcome the intricacies encountered and cater for the *supra-functional* aspect of user-product emotional interaction as a means of improving the market competitiveness of their products [9]. All this hence further stresses the need of adequate methods to assist DFe.

1.3 Applications of DFe in Industry

Emotion-driven design has already managed to penetrate in industry although still on a relatively small scale. Several distinguished companies are investing resources in this new product design strategy. BMW has R&D teams focussing exclusively on improving the emotional experience of their customers through emotion-driven design, such as the *audibly* pleasing 'clicking' sound of the doors when shut closed, or else the similarly *audibly* pleasing 'ticking' sounds of the side-indicators when switched on [10]. Other companies namely Swatch™ publicly state that they consider themselves more of an *emotion* rather than a watch and accessories making company. Some firms intentionally make reference to their strategy of exploiting consumer emotions as is visible in different marketing campaigns (see Figure 2). All this hence indicates that even though still in its infancy, this research domain has an immense strategic, new product development and marketing potential for industry. At some point in the future the shift from product functionality/usability to enjoyment/pleasure will become a distinguishing criterion in product development as well as on the markets [3].



Figure 2. The design of product emotions has already penetrated the marketing scene

2 DEMO PROJECT

The main aim of the Demo project is that of developing computational DFe support that serves to provide assistance to designers undertaking a DFe strategy. The need for such design assistance is further supported by the results of a survey conducted amongst a number of design practitioners worldwide (see Figure 3). Results obtained indeed show that 100% of the participants questioned believe that *supra-functional* aspects should be given the necessary importance in product design (Q1). Of these, 94% consider themselves to already cater for such aspects during their design activities (Q2), while 92% of these (Q3) claim to do this out of their own free will. The 8% that do not cater for *supra-functional* design aspects claim that this is mainly due to *imposed company strategies* and the *lack of adequate design for emotion tools and methods* (Q4).

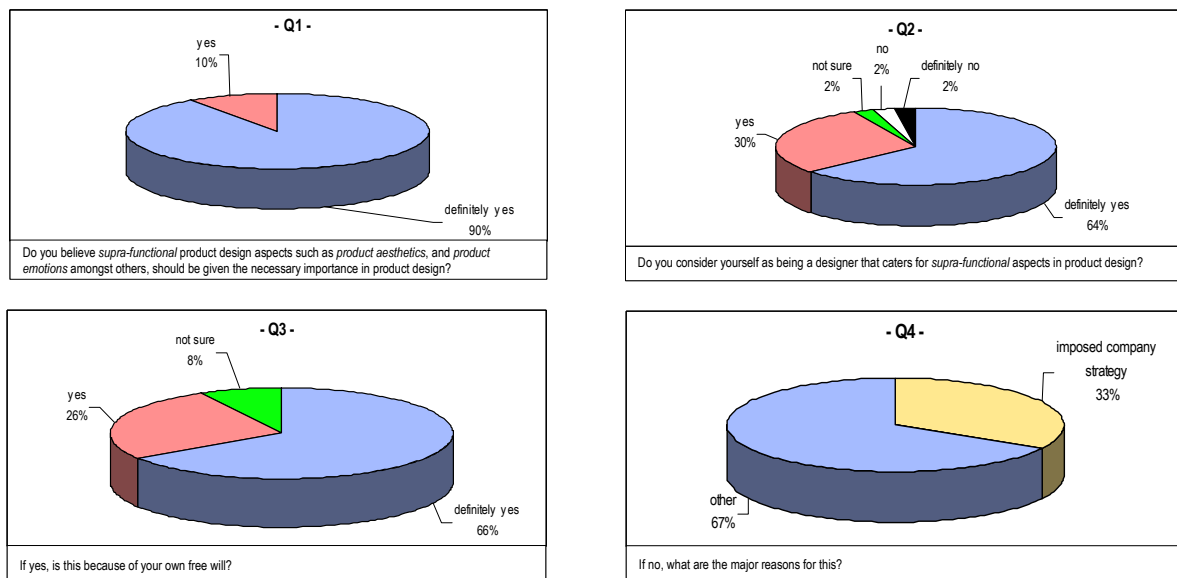


Figure 3. Results of the Demo survey conducted amongst product designers

The results hereupon presented stress on the need of an adequate support to assist designers in DFe mainly because existing systems have yet to reach a satisfactory level of assistance in order to fully support designers in *designing for emotion*. This lack of adequacy exhibited by the state-of-the-art emotion-driven design assistants is reviewed in Section 3.

3 STATE-OF-THE-ART DESIGN FOR EMOTION ASSISTANTS

Being linked to such a novel and uprising research area no publicly documented critical review of DFe assistants has been identified. A non-exhaustive, detailed literature search conducted has contributed to bringing forward six DFe assistants which are considered of major relevance in supporting a DFe strategy. These assistants have been selected since having also been acknowledged by the ever-growing *Design and Emotion Society* [11], they are most prominent in the DFe world.

3.1 Review Criteria

In order to ensure a professional critical analysis of the systems under review a set of criteria have been identified. These criteria are intended to better classify the properties of each system and at the same time also to define the desired properties of the Demo system under development. The systems will hence be reviewed on their ability in delivering DFe assistance in terms of the criteria presented and explained hereunder.

interface: The system can be *paper* or *computer* based. This means that the assistance can be presented as merely a set of printed guidelines on paper, or else interactively via the use of a computer program.

- delivery mode:* The modality of the delivery can be *proactive* or *passive*. A proactive assistance is an anticipatory kind of assistance i.e. an assistance that is able of identifying and dealing in advance with upcoming difficulties. A passive assistance is an inactive kind of assistance that is hence unable to anticipate upcoming difficulties and only provides subject independent support.
- timing:* The support can occur during the *early design phases* i.e. during the *task clarification*, *conceptual* and *early design phases*, during the *embodiment phases* and during the *detailed design phases* when a candidate solution has already been generated [12].
- design strategy:* The delivery can assist an *adaptive*, *development* and a *creative* design strategy.
- assistance type:* The assistance delivered can be addressed at supporting a *holistic* and a *specific* DFe activity.

3.2 Critical Analysis

A generic summary of the basic characteristics of the six systems under review in comparison to the criteria identified above is presented in Table 1.

Table 1. Summary of the basic characteristics of the six DFe systems reviewed

DFe Assistant	Review Criteria											
	Interface		Delivery mode		Timing (design phase)			Assistance Type		Design strategy		
	Paper	Computer	Proactive	Passive	Early	Embodiment	Detail	Holistic	Specific	Adaptive	Development	Creative
<i>Product Emotion Measure (PrEmo)</i>												
<i>Self Assessment Manikin (SAM)</i>												
<i>Real People</i>												
<i>I.D. Tool</i>												
<i>Tool for Product Sound Design</i>												
<i>HADRIAN</i>												

The following observations on the state-of-the-art DFe systems can therefore be made as based on the review criteria identified.

- Interface is mostly computer based* This is one of the better characteristics of the state-of-the-art since the majority of the systems reviewed deliver assistance via a computer interface. Computational use enables the designer to be assisted interactively and systematically during the design process hence improving the quality of the DFe delivery.

Delivery mode is not proactive

The delivery mode in the DFe assistants reviewed is almost always of a passive nature. This means that the majority of the current DFe systems provide an inactive kind of assistance and are unable to anticipate upcoming difficulties. The only tools that are capable of delivering assistance proactively are the *Tool for Product Sound Design* and *HADRIAN*. These systems are both capable of dealing with difficulties in advance.

Assistance is too late

The review also shows that none of the systems reviewed delivers assistance during the *early* stages of the design process. Assistance is delivered from the *embodiment* stage onwards, thus meaning relatively late in the design process, which can lead to lengthy and costly design iterations during later stages of the process.

Assistance is mostly holistic

The majority of systems reviewed deliver a *holistic* DFe support meaning that they address the intricacies of DFe from a generic perspective. Only the *Tool for Product Sound Design* delivers a *specific* DFe assistance as it focuses solely on the product sound.

A creative design strategy is not supported

No system of the six reviewed is capable of supporting a *creative* design strategy and hence the design of new products. This is regarded as the greatest drawback of the state-of-the-art that makes use of existing designs as basis for the emotion-driven design and the development of ‘new’ products.

The conclusions deduced from the critical review have been confirmed by another survey conducted amongst 42 DFe practitioners worldwide (see Figure 4). 46% of the participants involved in the survey claimed that the state-of-the-art DFe tools and methodologies *do not* and *definitely do not* well support designers (Q6). On the other hand 21% claimed that today’s design tools *do* or *definitely do* well support DFe with the remaining 33% *not sure* and hence not committing themselves to a definite answer. A *strong knowledge foundation* (33%), and a *complete understanding of product emotions* (26%) have been indicated (Q7) as the two major reasons for this. Another 24% and 17% attributed this inadequacy in DFe support to *other* reasons and a lack of *clarity* in DFe assistants respectively. Finally (Q8) 89% claim that there is (*yes* and *definitely yes*) need for new tools and methods to support DFe, with only 8% claiming to be *not sure* and 3% that there is *no* need for new DFe tools.

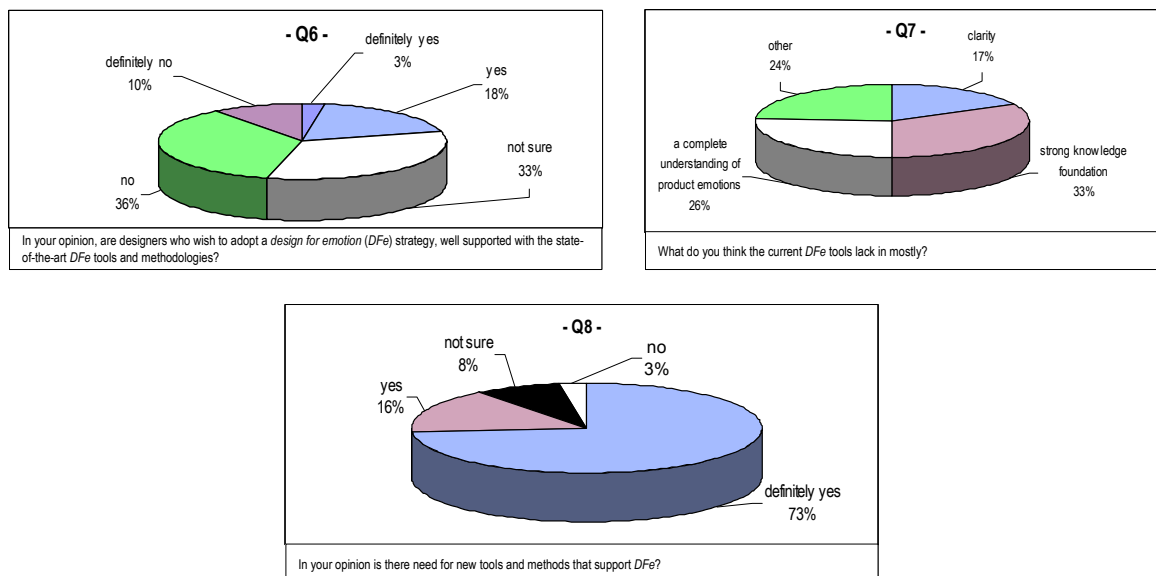


Figure 4. Results of the survey conducted amongst DFe practitioners

The input from *design practice* presented above serves to further stress the need of assistance while at the same time strengthening the envisaged design reality of the ongoing Demo project and consisting in the development of DFe support for product designers.

4 INVESTIGATING PRODUCT EMOTIONS

In order to attain such a reality there is need to fully understand the phenomena of product-emotions and the mechanisms involved in their elicitation. Only then can the necessary knowledge required for the development of the Demo system intended to support designers in emotion-driven design, be generated. This therefore means that a phenomena model [13] portraying the underlying mechanisms involved in product emotion elicitation plays a central role and leads to the generation of the required DFe knowledge.

4.1 Existing Product Emotion Phenomena Model

The model of product emotions developed by Desmet and Hekkert [14] (see Figure 5), has been used as basis for the state-of-the-art DFe support in design practice. It portrays the product-emotion process by considering the interaction of the person with the product. It is the appraisal of the product (which serves as a stimulus) with the person's concerns (i.e. *goals*, *standards* and *attitudes*) that gives rise to the emotion. Although valid, the model however does not deliver a complete understanding of the phenomena of product-emotion elicitation. The lack of comprehension of the totality of the product emotion elicitation process, such as that exhibited in the model, can be confirmed by the persisting difficulties witnessed by DFe practitioners.

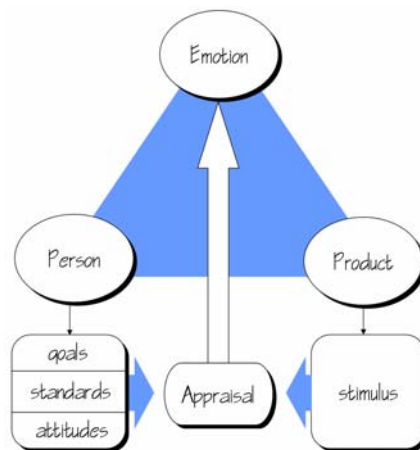


Figure 5. Desmet and Hekkert model of product emotion elicitation, reproduced from [14]

The majority of the work conducted so far within Demo has been focussed on attempting to understand the phenomena of product-emotion elicitation in its totality by focussing on the actual “meeting” of the product and the person, since it is this “meeting” that subsequently leads to the elicited emotions.

4.2 Understanding Emotions through the meeting theory

A product life meeting such as that involving the meeting between a user and a product (i.e. during user-product interaction) can be explained by the meeting theory of products [15]. A product life meeting is in fact defined as an activity that takes place when a *product (Pro)*, a *product life phase system (Sys)* and a *participant (Par)* take part in a joint action (see Figure 6).

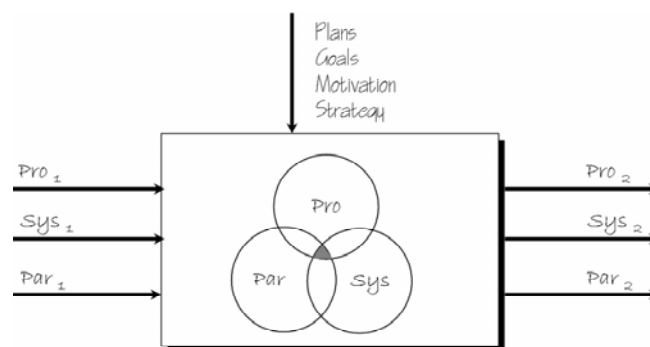


Figure 6. The meeting theory, adopted from [15]

This means that a product life meeting is not merely limited to the meeting between the user and a product but also incorporates the role of a product life phase system. This is that system that in a specific life phase realises the product transformation from an initial phase 1 to a final phase 2 as portrayed in Figure 6. The Figure better explains this theory by illustrating how the meeting of the three elements (*product*, *system* and *participant*) in state 1, as based on the participant's plans, goals, motivation and strategy results in the transformation of same three elements in a second state 2. It is however often difficult to define such meetings only by means of a specification, since for example the motivation of the participant is hard to specify.

4.2.1 A 'Complete' Emotional Product Meeting

The application of the above theory to the emotional interaction of users with products demonstrates that the current DFe reality lacks a complete understanding of the emotion elicitation process. The role of the product life phase system at the descriptive level is in fact missing and only the user and the product are incorporated. This hence brings forward the hypothesis that a complete DFe strategy must necessary include the role of a product life phase system for a complete understanding.

An important role during the elicitation of product emotions is occupied by the surroundings/environment. The environment can in fact be considered as a product life phase system since the participant and the product 'meet' within a particular environment that has an influence on the transformation of the three elements in the second state. The hypothesis being brought forward by the Demo project is hence that the elicitation of emotions occurs following the meeting between the product, the user and also the surroundings. Such meetings can take place during the total life cycle of the product from manufacturing to distribution, use and disposal [15], (see Figure 7), however it is during the phases of sales and use that the 'relevant' user-product contact is made.

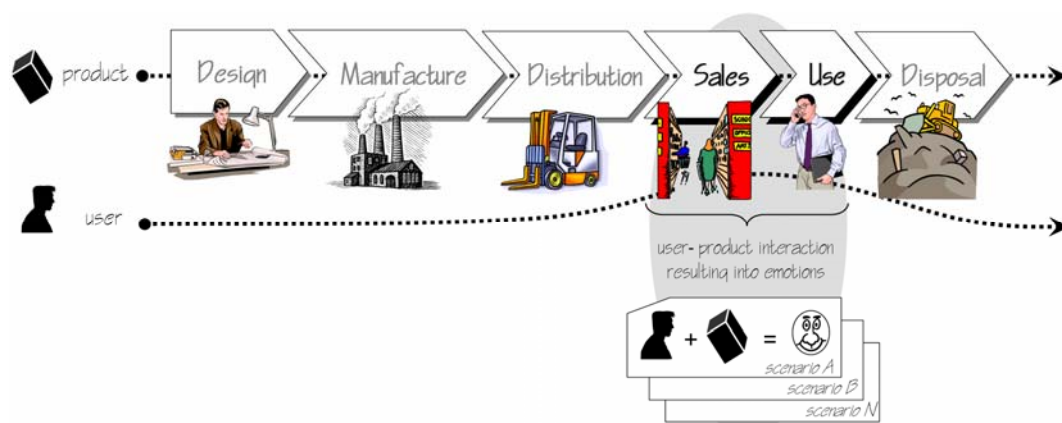


Figure 7. User-product interaction during 'sales' and 'use' leads to emotions

In this respect an area of relevance is human senses and the role that these occupy in our interaction with products. During our interaction with the material world senses serve as a medium that give rise to perceived sensations prior to appraisal with our personal concerns. Therefore investigating the role that senses occupy in the emotional user-product experience can potentially unearth new knowledge that could provide the basis for the development of the much needed design for product-emotion framework. The perception of a product which acts as a stimulus of emotions is within itself a multi-stage process in which senses occupy a key role. The emotional impact of a product is determined by how we see, hear, taste and feel it, i.e. by our sensations upon interacting with it. So senses occupy a major role in our interaction with products. They allow us to experience products on different levels since it is through our five senses (*sight*, *touch*, *hearing*, *taste* and *smell*) that we interact with a product. We feel its texture, we see its form-features, we smell its scent, etc. All that we learn about, and do with the product involves our five senses. In product interaction senses can be subdivided in two distinct categories; the *distance* and the *proximity* senses. Distance senses refers to those senses that can be perceived from a distance such as hearing, sight and smell, while proximity senses are those senses that can only be perceived through physical interaction with the artefact, such as taste and touch [16]. This thus suggests that 'the role of distance senses is fundamental for the success of a product' since this group of senses is likely to be employed all throughout the product interaction process.

4.3 A Prescriptive Product Emotion Phenomena Model

The suggested hypothesis leads to the setting up of a “*prescriptive*” DFe phenomena model. Although still based on that developed by Desmet and Hekkert, this model is better suited for the work conducted within this research as it portrays the emotional interaction process in its totality. The model (see Figure 8) demonstrates how the elicitation of product emotions depends upon three very important elements and their interrelationships. These elements include the:

- *stakeholder* – [Stk]
- *product* – [Pro]
- *environment* – [Env]

While any product emotion elicitation process is dependent on these three general elements, it is the variation in the relationships between the elements that makes the process highly subjective. The elicitation of product emotions can be looked at as a life phase process of the product that takes place upon the meeting of the user with the product in particular surroundings and hence during the *sales* and *use* phases of the product life cycle.

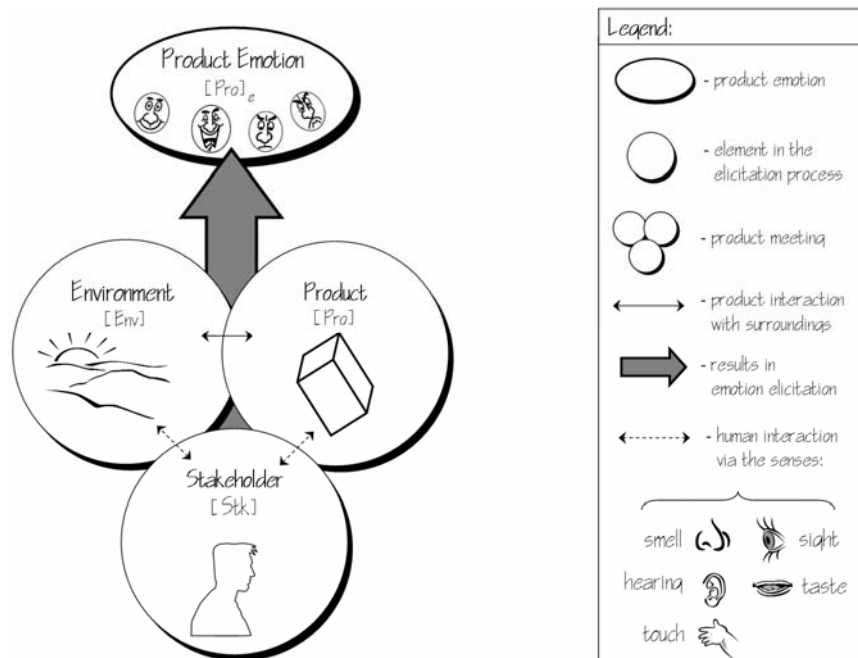


Figure 8. Phenomena model of product emotion elicitation

Differently to the “descriptive” standpoint, from a “perspective” point of view, the participant is now being referred to as the stakeholder rather than the user. The main reason for this is that the person interacting with the product must not necessarily be a user of the product but could be the purchaser. Since the interaction between these three elements results in the elicitation of the final emotion, product emotions can be defined as being a function of the interrelations between stakeholder, the product and the environment and can be summarised as:

$$[Pro]_e = f([Stk], [Pro], [Env])$$

Identifying the connections that exist between these three elements during interaction can provide designers with a means of developing a DFe framework that enables designers to address the main *supra-functional* need of product stakeholders. Therefore identifying the underlying function(s) $f(x)$ that lead to the elicitation of product emotions $[Pro]_e$ is of primary importance to this research.

4.4 DFe Knowledge

The generation of DFe knowledge can be looked upon as the direct consequence of a solid understanding of the product-emotion phenomena, and will serve as basis for the generation of the final Demo framework. Adequate DFe knowledge is in fact necessary to enable the development of the Demo means intended to support DFe.

The intent of this research work is that of delivering DFe support all throughout the design process, and hence the support delivered must be adequate to the different stages in the design process. This thus means that the DFe knowledge generated itself must be oriented towards the different stages of design and systematically presented in correspondence to the respective design stages. A hierarchical representation of the knowledge to be generated is presented in Figure 9. The figure shows how progress along the design process from the early design stages towards the more detailed design stages requires more detailed, low-level DFe knowledge compared to the high-level knowledge required for the initial stages.

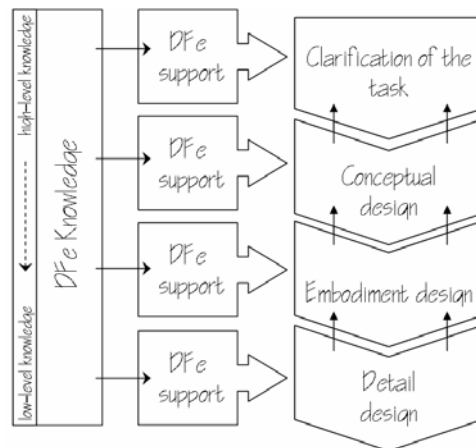


Figure 9. Variation in DFe knowledge and support required along the design process

The literature search together with the work conducted until now within this research have contributed to the identification and development of a number of generic high-level DFe guidelines, related to the following domains:

1. *Branding*;
2. *Product use-cues*;
3. *Product surprises*;
4. *Product sensory appeal*.

1 *Branding* The use of brand identification is one of the most powerful methods that can be adopted for designing emotional connections with products. Attaching a means of brand identification (such as for example the brand logo or the brand colour scheme) onto products (possibly also of a different brand) can be used as a means of enhancing a positive product experience. The emotional connections of users to successful brands hence provide designers with a means for DFe and the first of these high-level guidelines.

2 *Product use-cues* Products that are easy to use are often perceived as pleasurable by users, while conversely products that are difficult to use can lead to frustration or other similar negative emotional responses. Added to the increasing complexity in products and the functions that they fulfil, this can quite easily lead to such responses. Some products can in fact provide a very good function means, but are not appropriately designed to “suggest” or put forward their function and/or operation to the user. This hence brings forward a second DFe guideline that states that in order to stimulate positive emotions; design should include ‘use cues’ into products, i.e. product features that suggest to the user the correct product usage and operation. Such ‘use cues’ are intended to improve the user-product interaction experience especially during the initial moments of interaction that are known as being the most significant for the whole interaction process.

3 *Product surprises* Creating surprising products can be beneficial to the product interaction experience since a surprising artefact attracts attention and can hence evoke emotions. One method for inciting such surprises into products is that of using

sensory incongruity. The perception of a product is accomplished via senses (as portrayed in Figure 8) which however may not necessarily, all be used concurrently. This hence means that the perception of a product through one sense modality can create an expectation of what will be perceived by other sensory modalities at later stages. If however the sensory information perceived consecutively disconfirms the expectations formed upon the initial perception, a surprise reaction will result [16]. This means that such sensory incongruity can be intentionally included by designers into products as a further means of emotion-driven design.

- # 4 *Product sensory appeal* The hypothesis related to this final high-level DFe guideline was brought forward as a result of the ongoing development in the Demo project, and reads that “the emotional responses to products are largely influenced by the degree to which products appeal to human senses”. The development of the phenomena model has shown that senses occupy a primary role in product-emotion elicitation since they serve as a human interface with products and their surroundings. The hypothesis has been proven via a number of experimental exercises as presented in [9],[17], and that show that greater sensory connections in products result in the elicitation of higher intensity emotions. This thus means that product designers should appeal to senses to ensure that their products incite strong emotions.

Although deemed as valid, the above guidelines are however too high-level to be implemented directly in product design and more detailed knowledge is hence required. Notwithstanding this, the above presented guidelines still deliver a means of high-level support suited for early conceptual design to DFe practitioners. It is therefore recognised that in order to deliver embodiment and detailed design support more low-level knowledge is required. It is in fact one of the main aims of this research to unearth connections at the lowest level of the product constituents and hence between the *product's* basic characteristics (i.e. *structure, form, material, dimension, and surface* [18]) and *emotions*. As indicated in the phenomena model presented in page 9, such connections cannot be direct but must interrelate to the *stakeholder* and the *environment*.

5 CONCLUSIONS AND FUTURE WORK

As argued by Tomiyama [19], knowledge/information models are concerned with what elements should form part of the knowledge structure, and with how these elements should be related to each other and organised in order to result in codified knowledge. The elements involved in the elicitation of product-emotions have already been identified at the phenomenon level as the *stakeholder*, the *product* and the *environment*. To enable the determination of the above mentioned connections, there is therefore need to investigate the characteristics of each element and investigate their role in the emotion elicitation process. Only then shall the necessary DFe knowledge required be generated. Future work will hence be focussed on investigating these element characteristics and on bringing forward hypothesis for interrelationships between them to be tested at a later stage.

Notwithstanding the fact that considerable work remains to be completed in order to reach the design reality envisaged by *Demo*, the milestones reached to date provide a sound contribution towards the development of the intended framework. Indeed designing emotions is a highly interesting yet intricate field that without appropriate underlying specific theories and methodologies is difficult to implement. However the conclusions deduced from the research conducted in *Demo* are significant in this direction as they already deliver the first means for designers to design products that are not only useful, but also enjoyable.

Acknowledgments

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