FMP Proposal 2.0

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Joep Frens (DQI)
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January 2011

"*The virtue in nanotechnology consists in finding the golden mean that avoids both overly confident decisions to proceed and overly fearful restraint. That does not give a list of boxes to check off, but can promote a virtuous ethos in which research and development serves and protects people and the environment.*"
O'Mathuna (2010), Nanoethics, big ethical issues with small technology Ref. 1

INTRODUCTION

The field of industrial design has seen many changes and developments in its history. Innovations in technology bring forth new types of products with new interaction styles. Be it hand-crafted products and tools, more complex ones with mechanisms, towards electrical and the present day electronic products. New interaction styles offer new opportunities and challenges, which have consequences for the design process and the field of industrial design as a whole.

In present society there has been much debate on future implications of nanotechnology; the study of controlling matter on an atomic and molecular scale. In recent animations, several leading companies and designers tried to envision the kitchens and telephones of tomorrow, often based on Claytronics Ref. 2 ; Carnegie Mellon's future concept that combines nanoscale robotics and computer science. Their aim is to create individual nanometer-scale computers called Claytronic atoms, which can interact with each other to form tangible 3D objects. Claytronics is programmable matter, meaning the atoms can be controlled, repositioned and function as part of an ensemble, with the ensemble as a whole being capable of a higher function. With the ever increasing speeds of computer processing as predicted in Moore's Law, the promise of Claytronic technology has become possible in the near future.

A demonstration of the BMW Gina Ref. 3 , a concept car finalized in 2008, constructed using textile fabric skin on a frame of metal with carbon wires attached allowing the car to change its form, broadened the view on the possibilities and implications of the morphing capabilities of Claytronics. It was not so much the technology of the BMW Gina car that raised interest, but rather the vision behind it: it implied a new take on car design, materials and flexibility. Not only did it challenge conventional processes in development and production, it also allowed to look beyond what was once set in stone. Ultimately it encouraged to look for cross-segmental solutions by integrating new materials and pioneering constructions into the creative design process.

The hype cycle (Gartner, 1995 Ref. 4) employs some acute insights into human behaviour to characterize how perception relates to the actual maturity of a new technology. Gartner has used hype cycles to characterize the over-enthusiasm or "hype" and subsequent disappointment that typically happen with the introduction of new technologies. Hype cycles also show how and when technologies move beyond the hype, offer practical benefits and become widely accepted.

We are now at the stage App. A in which the promise of nanotechnology is beginning to be realized and where ethical, social and political dimensions are only beginning to receive the scrutiny they require (O'Mathuna, 2010) Ref. 1 . However, new application areas cannot be derived from new technological possibilities alone, but a direction for technological progress needs to be defined from a design point of view which enables a critical look through explorations of what is necessary and wanted.

As Wensveen (2005) Ref. 5 put it: "*When product development is pushed by technology two potential dangers occur. One is that the technology can push intelligent products into an un-intelligible interaction with the user. The other danger is that product developers focus on what is technologically possible instead of what is technologically desirable for people.*"

Imagine a world where the shapes of all objects around you would be able to change on the fly. Envision a future where nanotechnology and morphing become ubiquitous and blend in with the physical environment of the everyday. Is it desirable that objects change shape? And if so, does the functional and morphological appearance adjust according to the context, the intentions of the user or the manner of holding the object? Does form follow function, context or action? How do we design for this new sense of reality, this new dynamic world?

One day society will look back on our crude, static appliances and wonder how we survived without programmable matter catering to our needs.

It is the goal of this graduation project to explore how to design for a new interaction paradigm that is proposed as 'morphing interaction'.

OPPORTUNITY

Interaction

Interaction is a property of present interactive products that unlike form is not directly designable. The interface of an interactive product provides the link between user and a product's functionality. So to design for interaction is to design the form-properties of a product that compromise the interface. Form-properties, which are divided into those that one can act upon; controls, and those that provide product reactions; feedback elements, need to be designed in respect to people and their skills; cognitive, perceptual-motor and emotional skills (Overbeeke et al. 1999) Ref. 6 . Non-unification of action and function results in non-intuitive interaction. As the shape of objects can change on the fly in the proposed future (morphing), the user needs guidance in his actions by information towards the intended function and vice versa.

Information-for-use

People can use products because products offer information-for-use. This information can be afforded in many ways and differs in level of abstraction of how it relates to our bodily skills. Products crafted before the industrial revolution were simple and straight-forward in use. The information-for-use was and is very directly available in the expression of the form – how the product could be operated could be read from its form. These products relied for their functionality on the skills of the people that used them, and as the functionality was not completely fixed in the design of the product, they were therefore multi-interpretable in use. In use, the functionality takes shape (Frens, 2005) Ref. 7 .

Where earlier interaction styles were a consequence of the technology that they incorporated, while this is still the case for morphing interaction, the interaction-style is now designable but above all variable and depending on presumably different factors than before.

Physical representation

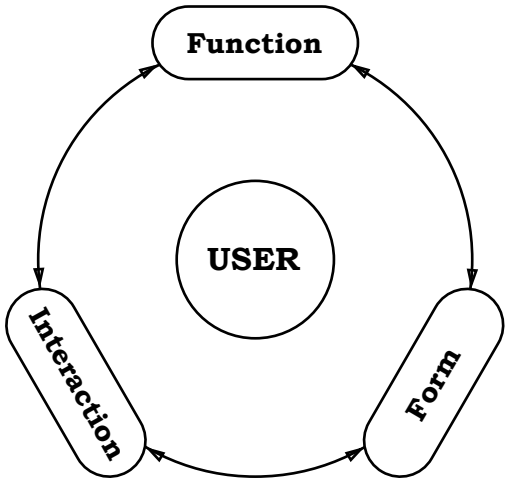
When the digital merges with the physical world, our perceptions of space, time and the physical become a play with reality. As morphological properties do not impose specific forms or interactions for a design, it allows for an abundance of functionalities. The freedom of form that will be inherent to these products might not inform the user about the physical actions. Meaningful actions, forms and states will need to be created, where a harmony between human physicality, interface and physical representation is needed.

Especially while interacting with non-electronic objects, they have always depended primarily on the tangibility of the product. Accessing and understanding the functionality of these products is based on their ability to be touched and the way they are touched. The interaction relies on doing things with the product. In contrast to the introduction of electronics and computerization into products, the interaction presumably shifts back to addressing our perceptual motor skills instead of appealing to our cognitive skills.

Form follows function?

As the interaction relies on doing things with the product, could it be that with morphing interaction, action creates form? And in that sense, as the function of a product is related to the action that is performed, can we really separate action from the context it is in? Is it desirable for objects to have a specific function or do they become like the Swiss Army knife, harbouring a collection of special-purpose tools?

When conducting research through design, knowledge on interaction, products and on the process of designing these products is generated. Products are designed and scenarios are performed and evaluated to explore implications of theory in context. The assumption underlying the research through design approach is that knowledge gained from these products and scenarios of use, through experimentation, can be generalized in the form of design specifications for future products and in new theory or framework.



CONTEXT

Inspired by Binder's Exemplary Design Research (2006) Ref. 8 as a tool to gear towards a design case for the research through design approach chosen was to design for the experience of using cutlery. The context was chosen to enter the discussion in critical dialogue in which rapidly increasing development in nanotechnology gives rise to an expectation that cannot be fulfilled yet, while the real challenge is to envision a future where nanotechnology and morphing objects become ubiquitous and have to blend in with the physical environment of the everyday. The design space needed to be a specific accepted product or tool used every day, in order to put people in control of morphing interaction. 'New' technology will be introduced through 'old' familiar things.

Cutlery was chosen because it comes in many shapes and forms and refers to any hand implement used in preparing, serving, and especially eating food. Utensils are available for specific types of food and in recent times, utensils have been made already combining the functionality of pairs of cutlery, e.g. the spork - spoon and fork.

More importantly, it is a product with a simple and controllable functionality which makes it easier to research the relationship between form, functionality, context and actions; ultimately exploring a new language of form that stems from the introduction of new technology.

DESIGN PROCESS

The design process for this project is based on the reflective transformative design process Ref. 9 , the process that is also part of the industrial design curriculum. It is very much applicable for several reasons. My project aims at new and mostly unexplored areas, requiring lots of explorations, try-outs and short cycles of analysis and design.

As the main goal revolves around developing the theory of morphing interaction, the design process of the project consists of constant switching between generating knowledge by exploring and creating tools and methodology, putting them into practice in design iterations, and reflecting upon action to shape the theory at which point the cycle starts again.

Tools and methodology that are explored are further developed during brainstorm-, design- and reflective sessions with co-designers, ranging from industrial design students to experts on interaction and innovative technologies or products. In doing so, the morphing interaction theory unfolds and grows, feeding the iterative product design cycles which in turn provide feedback for the exploration of the tools. As the concept takes shape and the methodology expands, the main focus of the graduation project – how to design for a new interaction paradigm that is proposed as 'morphing interaction' – becomes elaborate.

Deliverables

Morphing interaction theory

- Proposing the term 'morphing interaction'. (How it came to being. How it differs from other interaction styles. What it aims at.)
- Discussion in detail.

Methodology

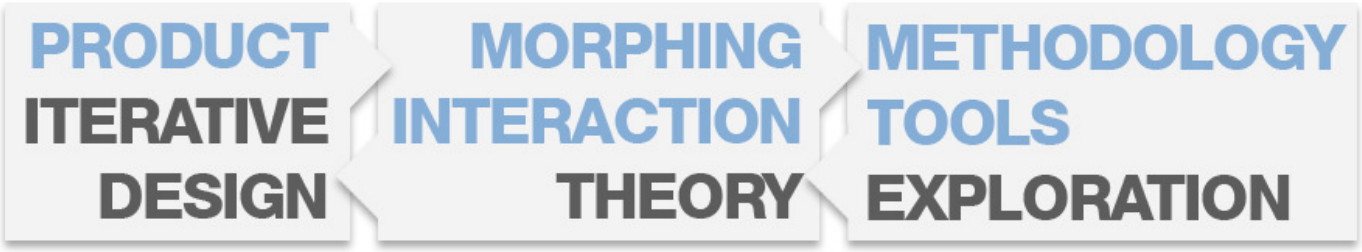
- To design a new kind of interactive products a new design process is needed. An overview of properties of interactive products (e.g. form, interaction, function, context) that play a role in the design process is made.
- Explanation what is means to explore these properties and the relations between them.
- Presentation of range of tools and methodology that form the design process of how to design for morphing interaction.

Product design

- Wide selection of products, ranging from low-fidelity prototypes based on early iterations, to mid-fidelity prototypes, capable of clearly communicating the details of the interaction.
- The outcome of the final iterative design, which puts the developed theory and tools into practise. An experiential interactive prototype, incorporating simple present-day techniques to demonstrate the theory of morphing interaction.

Planning

Due to the abstract nature of the reflective transformative design process, with its many iterations and constant switching between the pillars, a guideline is proposed to reach an agreement when deliverables should be finished. See App. B . As the design process moves along, iterations become more intense until all three pillars come together, where the final iterative design starts: the creation of an experiential interactive prototype.



Designers are the user

Users in my project are at the same time the experts that I will consult; they are the designers of future products that use the framework I will propose. Design action and user/expert involvement will therefore be a constant intertwinement of reflective sessions where methodology, design thinking and the tweaking of the framework to be developed are discussed.

Client

What is important is that partners are involved in the project - partners that have an interest in a good and relevant outcome which they can benefit from, but also which they have contributed to. Partners that have an interest in maintaining a high quality for the project, while at the same time indirectly taking care of a non-utopian view on the matter. Currently, I can find all of this in the experts that are profoundly connected to the project, but with the assistance of Ministerie van Nieuwe Dingen Ref. 10 , plans are in the making to take the project to an even higher level by drawing in a partner like RoyalVKB Ref. 11 , Moooi Ref. 12 or Droog Ref. 13 .

Tools exploration

The meetings with the designers have to be structured for them to be meaningful and constructive. As it is envisioned now, each session will have a theme to address. To motivate discussion and guide the process, a dichotomy, dilemma or question is presented in which a scenario of the experience of using cutlery is acted out using the to be developed tool. A scenario can be as small as picking up an object as to perform an action. Examples of dilemmas or questions are: "Can we really separate action from context?", "Does form really follow function or does it follow action/context?" and "Does context influence function?".

Stop motion in general seems to be a good tool to achieve an impression of a scenario over time. It is an animation technique to make a physically manipulated object appear to move on its own. The object is moved or altered in small increments between individually photographed frames as to create the illusion of morphing or movement when the frames are played as one continuous sequence. Depending on the scenario to be executed, a different base material can be selected for their ease of repositioning.

Since the animations are shot frame-by-frame, they rely on creative material selection and rigging. For example, transformation is usually achieved by swapping an object with a different but resembling item between frames. A tripod is almost always used so that the background does not seem to shift. Simple, effective animations can be made in just a few hours. A digital camera or webcam and free movie- or animation-editing software (like AnimatorDV Simple+ Ref. 14) are enough to start.

After each session, findings and reflections are documented and critically analysed to provide input for the morphing interaction theory. The scenarios act as inspiration for new iterations and tasks for further exploration of the methodology.

Base materials for methodology	Present day technologies for final concept
• Clay • Iron wire • Lego or any other constructive set • Sand or seeds • 3D models (possibly in combination with a Cubby-like device)	• Sensors and actuators • Responsive polymer • Polymorph plastic • Dielectric elastomers • Zoetrope animation

Example technology

Cubby (Djajadiningrat, 1999) Ref. 15 is a virtual reality system using consumer software where objects come to life using three projectors. Images on the screens are coupled to head movements of the user, creating a sense of 3D. The objects projected can even be 'touched' and manipulated using a pen.

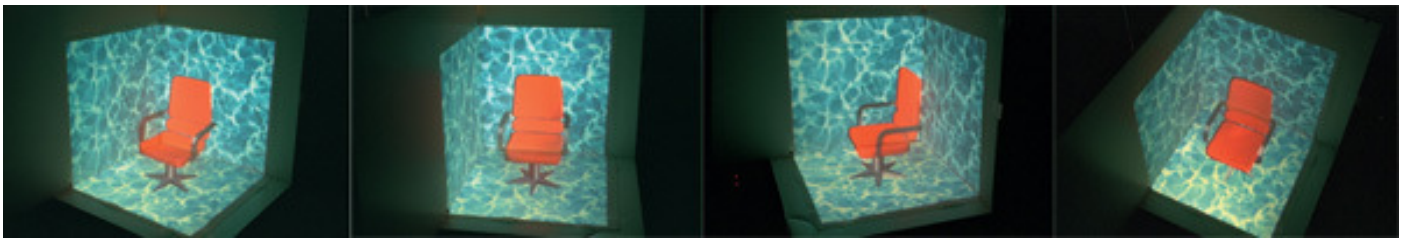


Figure 1: Djajadiningrat's Cubby system

Nanofutures: sensual interfaces (Woebken, 2007) Ref. 16 is a small Royal College of Art project that focused on the potential of nanotechnology, creating more manipulative prototypes such as organic electronics using seeds as a simulation for smart dust displaying the potential of stop-motion.

Figure 2: Chris Woebken's Nanofutures: sensual interfaces animation

STOP-MOTION

Claymation exploration

Over the course of three days three different scenarios were worked out, concentrating on mimicking behaviour, context awareness and new functionalities. The scenarios were too set apart to focus on a particular design question to investigate, but served as part of exploration of stop motion in general and stop motion clay modelling.

The tool proved to be labour-intensive (depending on the quality to achieve), but because of the amount of time it takes to capture one frame, micro details in the interaction can be observed that would normally escape the notice.

Interaction analysis

It is during the creation of the stop motion while experimenting with the scenario that the analysis of the interaction happens. Actions that are normally performed in a split second are now carefully executed and recorded in a time span that ranges in minutes. Even considering how to approach an object to grasp it brings forth a careful analysis of the various possibilities and consequences.

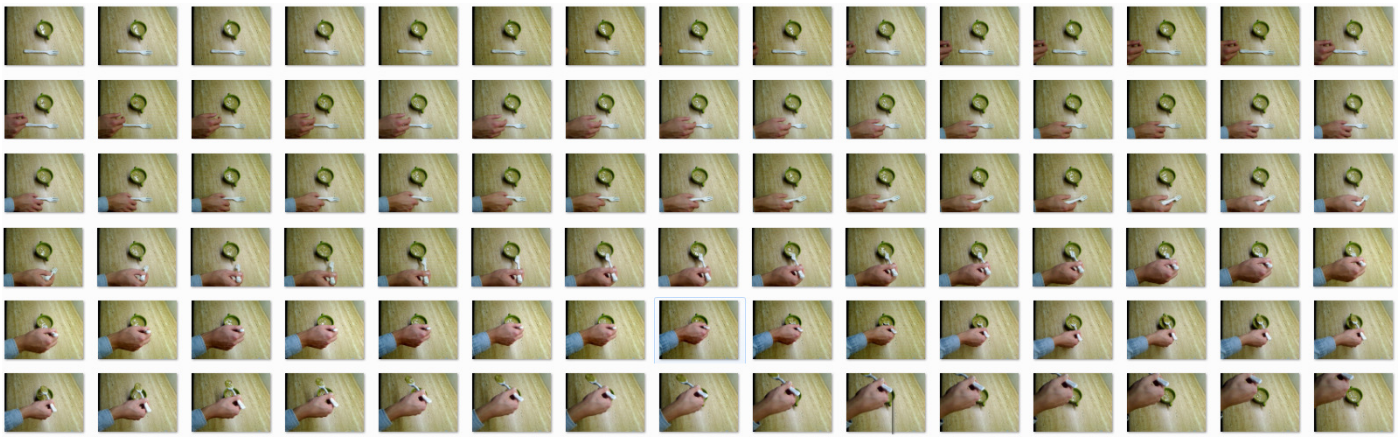
In the scenario that is shown below, a fork is picked up, placed in a bowl to ladle out hot soup, and morphs into a spoon while it is submerged in the soup. From just this simple scenario that normally would last no more than two seconds, various interesting aspects can be analyzed and used to further develop the theory of morphing interaction.

First, the fork is picked up. Analysing the shape of the object gives information-for-use. It tells how the fork can be operated and from experience of use the fork is grasped in a certain manner. However, at this point the intentions are to eat soup, so one would want it to become a spoon. To let it become the spoon, the initiative to grab the object, the exact positioning of the hand and the meticulous placement of fingertips give information towards the intended use. Form follows action.

Then, when the object is picked up, the details in the movement towards the bowl again give information towards the intended use. After all, prodding would entail a fork – meaning a downward movement, while a spoon would be linked to ladling – meaning a sideways scooping motion. Form follows action.

Then, at the exact moment the fork touches the hot soup, the object receives information about its context. A hot liquid could imply a spoon is needed. Especially when combined with prior indicators like grip or motion. Form follows context.

Figure 3: Setup of a claymation exploration



SUCCESS CRITERIA

The final result will be to discuss findings and recommendations I have on designing for morphing interaction. How I believe how morphing interaction can work, what the role of the designer is in this and what tools I have created, tested and implemented that form the methodology to do so.

The outcome of the final iterative design, which puts the developed theory and tools into practise, is no more than an experiential interactive prototype, incorporating simple present-day techniques to demonstrate the notion of morphing interaction.

As Industrial Design focuses on designing desirable products that humanise new and existing technologies and create value for society, with any outcome the graduation project is a success. Even if morphing interaction proves to be undesirable, the benefits from an industrial design point of view may be to find different ways for nanotechnology to blossom or preserve the development of undesirable products.

Conclusions

Discuss findings and recommendations I have on designing for morphing interaction. How I believe morphing interaction can work, what the role of the designer is in this and what tools I have created, tested and implemented and what is needed.

Strengths as a designer

I see designing as a medium to positively transform our everyday world, to create a better place to live in. Being the humble individuals we are, we are used to believe the opposite, that we cannot enforce major changes. By creating new intelligent products, systems and services, we are able to improve the way users interact with their environment.

Seeing myself as a designer wanting to improve society, with a stronger focus on the theory behind it, preferred contexts of application in recent years have been to improve human well-being by especially therapeutic or psychological means, integrated in designs that are able to reinforce or change the way things are perceived around us. The central theme has been the motivational and emotional user experience; taking all human values and needs seriously, preferably with a hands-on approach to designing. Designs can be technologically advanced, but I envision products to be straightforward in form and aesthetics, leaving an almost magical interaction.

I have a fascination for the way people bond with a product, how a mass-produced article can still be unique and personal to its user; the way we associate ourselves with products, the way of interaction, sometimes almost as if they were humans. In my opinion the user-product interaction shifts towards the intuitive and natural, reflecting salient aspects of human communication. This project not only fits my vision perfectly (as well as defining the core of our department of Industrial Design), but it allows me to grow and explore new areas that feed my individuality.

ITERATION 1

Pre approval meeting

Joep Frens (DQI) – Expert meeting on interaction in general to get more focus in the project. As Joep wrote a thesis on the proposed interaction paradigm that is called rich interaction, he was consulted to get more insights on generating knowledge to support the framework. Joep advised to take a thorough look at the output of the to be designed product, as the technology was non-existing. The success criteria would be important, as both context and the to be achieved goals would need to be clear. Also mentions of Fabian Hemmert's Ref. 17 adaptable phone and Tom Djajadinigrat's Cubby device would further broaden my knowledge on the subject.

Joris van Gelder (Next Nature) – Expert meetings on how to create a theory on a new interaction as his final master project concerned magical interaction. Joris advised to take a look at the impossibilities and to imagine a world where the technology is already realized. What would be the archetype of a chair if physical laws don't apply? As a result, he motivated me to research possibilities of testing unrealistic objects in an unrealistic world: to go to a virtual world where rules could be bent. Especially the core of an object, the eidos, received special attention which lead me to focus on and question the interaction possibilities of objects. Also, as CEO of Ministerie van Nieuwe Dingen, a design firm that specializes in moving from qualities in an innovative technology (developers) to a marketable product (brands), he's currently interested in pairing my graduating project with a relevant brand.

Koert van Mensvoort (Next Nature) – Coach- and expert meetings on the virtue of nanotechnology, tuning the vision of morphing interaction, getting the right focus in the proposal. From the start, Koert was interested in the futuristic hyperrealistic reality that I proposed (with mentions of Jean Beaudriar). As this new reality would be constructed, he questioned how humans would cope with the dynamics of it all. To make the project more realistic, I would need to find out what it was that I was looking for exactly. Again, the essence of an object, the archetype, would come to play. The sentience of an object, how we feel and perceive, what the implications and advantages of this proposed future would be would let me make choices in my project. Became my coach halfway the semester.

Oscar Tomico (DQI) – Coach- and expert meetings on the project as a whole, the proposal and morphing interaction. Oscar advised to focus on the practicality and feasibility of the project. To look at the planning within five months, to know what my end product or end result would be. Lead me towards making a choice about finding a proper context to design in. As our conversations evolved I discovered that designers of future products that incorporate morphing interaction are the users in my project – not the person wielding my cutlery.

Ministerie van Nieuwe Dingen – Contact with RoyalVKB, project guidance, developing the notion of how to contact a client in the best possible way.

Dutch Design Week – Nanotechnology debate, ethics, products.

Literature - Ryhänen, T. et al (2010). Nanotechnologies for Future Mobile Devices. - Schummer, J. (2006). Nanotechnology challenges. - O'Mathúna, Dónal P. (2009). Nanoethics.

ITERATION 2

Post approval meeting

Ministerie van Nieuwe Dingen (Jan-Hein van Twist and Joris van Gelder) – Helped with concretizing and narrowing down the project – making sense of the essence of the project; as a pitching expert (Jan-Hein), assisted in communicating the project to various audiences including proposed clients.

Stop motion claymation – See chapter on claymation. Reflection, interaction analysis, positioning of fingers on the spoon and fork, questions that arise.

ITERATION 3

Post assessment meetings – near future

Ministerie van Nieuwe Dingen (Jan-Hein van Twist and Joris van Gelder) – Setting up contact with Moooi, Droog, RoyalVKB. Further assistance on how to move from technology to innovation to a final product.

Elise van den Hoven – Expert meeting on adaptation.

Joep Frens (DQI) – Expert meeting on interaction principles, developing a framework and interaction styles.

Miguel Bruns Alonso (DQI) – Expert meeting on how his current research on how adaptive cutlery addresses eating behavior could be combined with my work.

REFERENCES

Ref. 1 O'Mathúna, D. (2010). Nanoethics : big ethical issues with small technology.

Ref. 2 Carnegie Mellon Claytronics
http://www.cs.cmu.edu/~claytronics/

Ref. 3 BMW GINA
http://bmw.tv/com/home/showVideo.do?articleID=1193&spaceID=2

Ref. 4 Linden, A., & Fenn, J. (2003). Understanding Gartner's hype cycles. Gartner. R-20-1971

Ref. 5 Wensveen, S.A.G. (2005). A tangibility approach to affective interaction. Delft: TU Delft.

Ref. 6 Overbeeke, C.J., Djajadiningrat, J.P., Wensveen, S.A.G., and Hummels, C.C.M. (1999) Experiential and respectful. Proceedings of Useful and Critical, UIAH Helsinki.

Ref. 7 Frens, J.W. (2006) Designing for Rich Interaction: Integrating Form, Interaction, and Function. Eindhoven University of Technology, Eindhoven, the Netherlands.

Ref. 8 Binder, T., & Redström, J. (2006). Exemplary Design Research. Paper presented at the Design Research Society Wonderground International Conference, Lisbon, Portugal.

Ref. 9 Hummels, C. and Frens, J. (2008). Designing for the unknown: A design process for the future generation of highly interactive systems and products. In: A. Clarke, M. Evatt, P. Hogarth, J. Lloveras and L. Pons. New perspectives in Design Education Volume 1. Proceedings of the 10th International Conference on Engineering and Product Design Education, Barcelona, Spain, 4-5 September 2008, pp. 204-209.

Ref. 10 Ministerie van Nieuwe Dingen
http://www.mvnd.nl

Ref. 11 RoyalVKB
http://www.royalvkb.com

Ref. 12 Moooi
http://www.moooi.nl

Ref. 13 Droog
http://www.droog.nl

Ref. 14 AnimatorDV Simple+
http://www.animatordv.com

Ref. 15 Djajadiningrat, J.P., Smets, G.J.F., & Overbeeke, C.J. (1997). Cubby: a multi-screen movement parallax display for direct manual manipulation. Displays, 17, 191-197.

Ref. 16 Chris Woebken's nanofuture
http://chriswoebken.com/nano_project.html

Ref. 17 Hemmert, F. et al. (2008). Dynamic Knobs: Shape Change as a Means of Interaction on a Mobile Phone. In: CHI '08: Extended Abstracts on Human Factors in Computing Systems. 2309-2314.

APPENDICES

App. A

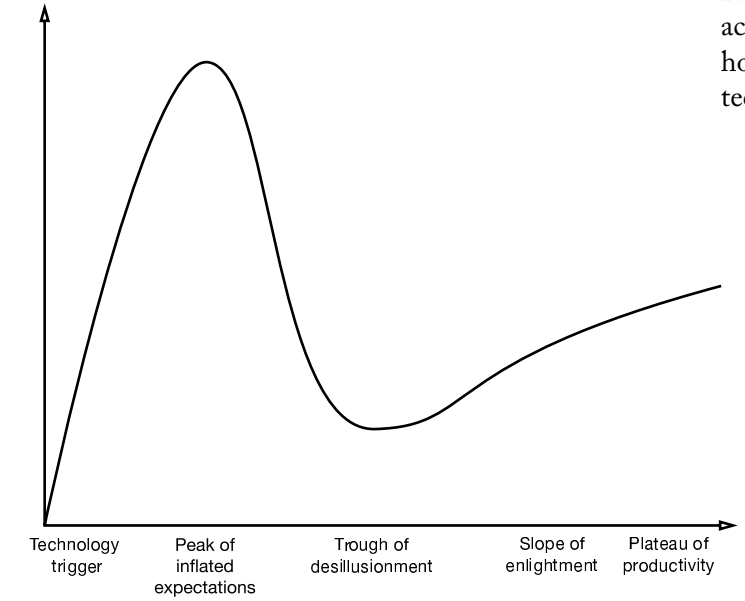


Figure 2: The hype cycle (Gartner 1995) employs some acute insights into human behavior to characterize how perception relates to the actual maturity of a new technology.

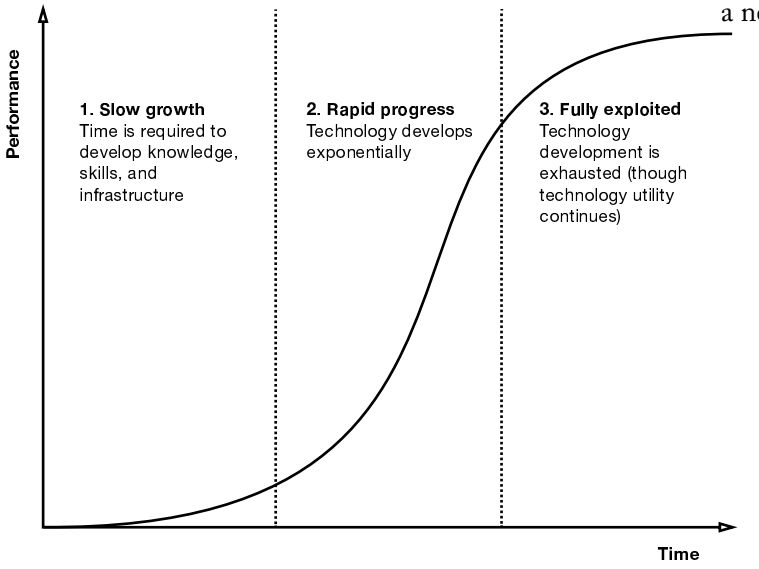


Figure 3: The development in the actual performance of a new technology is commonly described by an S-curve.

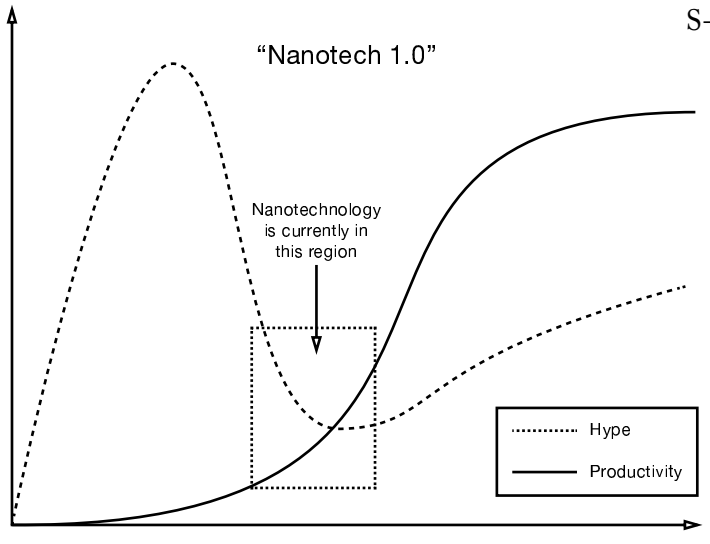
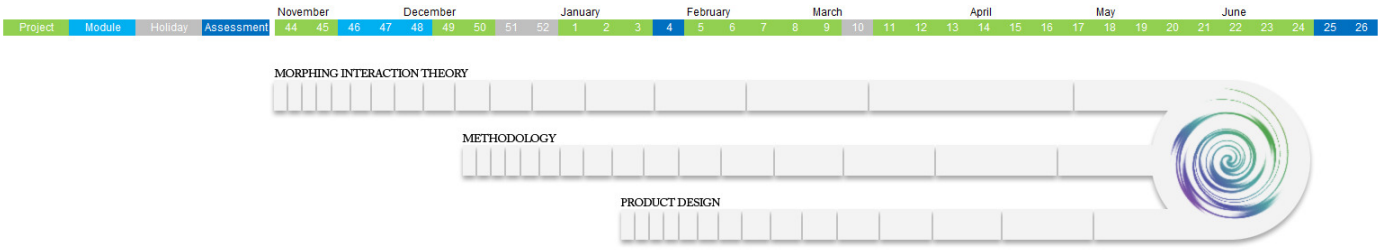


Figure 4: Positioning of nanotechnology, relative to the S-curve and the hype cycle.

App. B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MORPHING INTERACTION THEORY
METHODOLOGY
PRODUCT DESIGN