



Flanders
State of the Art

Research in Flanders
Thematic Paper



Industrial Design

For this thematic paper we talked to:



Chris Baelus, professor Product Development, Faculty of Design Sciences, University of Antwerp

© Jesse Willems



Lieven De Couvreur, coordinator of Design for (every)one, Howest, University College West Flanders, and PhD researcher at the department of Industrial System & Product Design at the faculty of Engineering and Architecture, Ghent University, in cooperation with the TuDelft Medisign group



Dries De Roeck, PhD researcher Product Development, Faculty of Design Sciences, University of Antwerp



Oliver DeWolf, researcher and coordinator of Design for Impact, Howest, University College West Flanders



Liesbeth Huybrechts, research coordinator at the Media, Arts and Design (MAD) Faculty in Genk, LUCA School of Arts/KU Leuven



Alexis Jacoby, researcher Product Development, Faculty of Design Sciences, University of Antwerp



Stijn Verwulgen, research coordinator Product Development, Faculty of Design Sciences, University of Antwerp

More information

Product Development, University of Antwerp:
www.designresearch.be

Industrial Design Center, Howest, University College West Flanders:
www.industrialdesigncenter.be

The Media, Arts and Design (MAD) Faculty:
www.mad-fac.be

Design for Impact:
www.designforimpact.be

Design for (every)one:
www.designforeveryone.howest.be

Dementielab:
www.dementielab.be

Thematic papers

The goal of the thematic papers is to present Flemish scientific research internationally. They focus on fundamental and applied research.

The thematic papers are published by Research in Flanders, a project run by Flanders Knowledge Area.

The project Research in Flanders is funded by the Flemish Government, Department of Foreign Affairs.

Flanders Knowledge Area supports, through different projects, the internationalization of higher education in Flanders, Belgium.

www.researchinflanders.be
www.flandersknowledgearea.be

Industrial Design

Innovating the future

Industrial design is a discipline that innovates the future. It is part of the industrial designer's job to spot trends, opportunities, social dynamics and technologies that no one else sees, and combine them in a new and useful product or service. And although stylish and expensive products for an exclusive public are part of industrial design, the field of study casts its net much, much wider.

'An industrial designer aims to help people in whatever way possible,' explains Dries De Roeck, PhD researcher of Product Development at the Faculty of Design Sciences of the University of Antwerp. 'That can be with an app that lights up your table or with a tool that helps you make the right decisions. An industrial designer aims to make things smooth, fun and useful. But that isn't easy,' says De Roeck. 'Because *fun* isn't that easy to measure.'

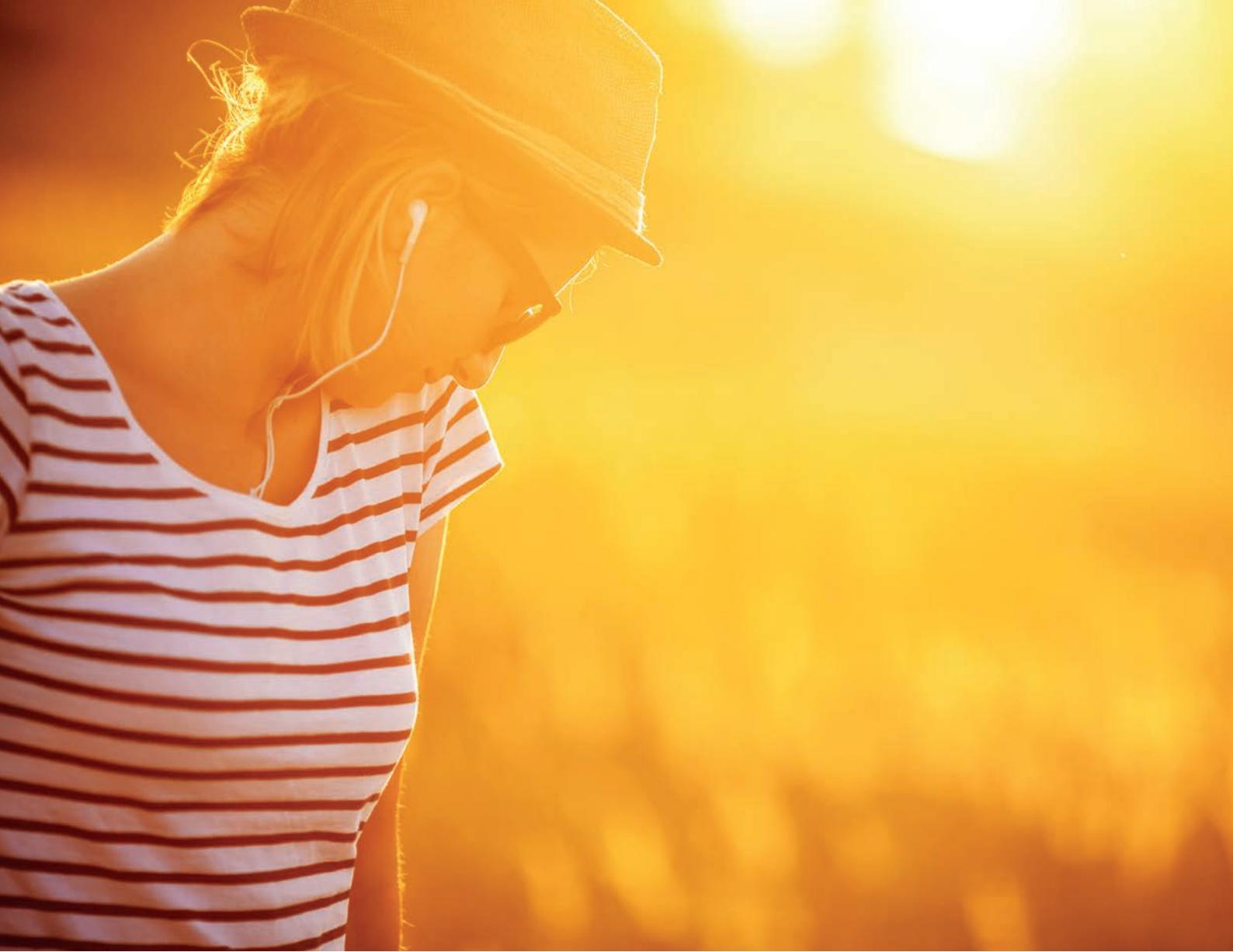
Industrial design research in Flanders

Industrial designers research a myriad of problems, solutions, products and niches. In Flanders, however, we tend to focus on six domains and approaches.

- **Feasibility and manufacturability:** how can we make certain products or services, and is it even possible with our knowledge of technology and materials?
- **Human-centred design:** how do people interact with products? Who are the end users, and is the product useful for this group? How is the product experienced by the users?
- **Economical approach in design:** innovation of new business- and software models.
- **Sustainable design:** research that focuses on sustainable environments as well as a sustainable society.
- **Methodology research:** how do we innovate? How to enlarge the chances of success in an innovation cycle? How can we manage innovation in an early stage of the process?
- **Future research:** what does a product mean today? How does it work and function in our society? Can we expect new techniques and visions?

WHAT'S IN A NAME?

An industrial designer is a designer, a developer, a creator and an engineer in one, so it is difficult to name him/her. He or she is known as design engineer, product designer or just designer, depending on the part of the innovation process he/she is working on and depending on who you ask. So what's in a name? In this article we name them all collectively as industrial designers.



PROBLEMS AND SOLUTIONS

‘Thanks to research in industrial design,
your future helmets, earphones and protective clothing
will fit better’

Industrial designers provide solutions to a myriad of problems. ‘Product design is still too broadly understood as the development of a new product’, says Alexis Jacoby, researcher Product Development at the Faculty of Design Sciences of the University of Antwerp. ‘But we also discover new opportunities and solutions for services, systems and organisations and use different processes and methods to decide whether it is useful to innovate’.

What is industrial design exactly?
‘Industrial design is the activity that ensures that new products with added value will be released’, says Alexis Jacoby. ‘Industrial design studies the function and form of products – and the connection between product, the different stakeholders and the environment’. Liesbeth Huybrechts, research coordinator at the Media, Arts and Design (MAD) Faculty in Genk, LUCA School of Arts/KU Leuven, adds: ‘It is a research domain that questions trends, problems and opportunities and looks for solutions for a specific group of stakeholders’.

‘And industrial designers are technical artists’, completes Lieven De Couvreur, coordinator of Design for (every)one, Howest, University College West Flanders. ‘Creativity and technical knowledge are both

very important in our domain and that balance makes it interesting and fun to work in industrial design’.

A mathematical model of the human body

Why is industrial design research important? One of the reasons is that thanks to this research, your future helmets, glasses, earphones and protective clothing will fit better. The problem: ergonomic tables for clothing and other wearables are made out of a limited set of parameters that are measurable with compass and ruler. These tables don’t always provide the right correlations or the best fit for the product.

‘Together with a research team at the Vision Lab (Department of Physics, University of Antwerp), we are building better mathematical models of the human body’, says Stijn Verwulgen, research coordinator of Product Development at the faculty of Design Sciences of the University of Antwerp. ‘We scan and compare different human heads. All the scans are then digitalised and put together, so we can find better ways to parameterise the human head. In other words: we try to create the perfect medium head with easy-to-adapt parameters’.

‘That is useful for a couple of reasons’, says Chris Baelus, professor

of Product Development at the Faculty of Design Sciences of the University of Antwerp. Firstly: the product company will be able to put a set of your personal parameters in the design of a safety helmet, after which the product can be made to a perfect fit.

Secondly, it will be possible to make new ergonomic tables and directives that replace the standard sizes small, medium, large and extra-large. The research will show new correlations between different people, so it will be possible to adapt the tables and directives to fit a bigger group of users. In other words: your average medium t-shirt or running shoes will show a better fit because they are built with better ergonomic data.

From problem to solution

An industrial designer works on the thin line between products and services that already exist and products and services that don’t yet exist. ‘It isn’t easy to train people for problems that don’t yet exist’, says Lieven De Couvreur, PhD researcher and coordinator of Design for (every)one, Howest, University College West Flanders. Therefore industrial designers use specific ways to get to the bottom of the problem and solve it.

1. Prototyping iteration. ‘To get to know the problem, just build it’.

There is always great uncertainty as to whether a new design will actually do as desired. A prototype is used to allow industrial designers to explore alternatives, test theories and confirm performance prior to starting full scale production.

‘You learn and solve problems through prototyping’, says De Couvreur. ‘By making a product and throwing it into reality, you notice what works and what doesn’t. Prototyping iteration is a kind of trial and error: make a prototype, see if it works, collect the feedback, make a new prototype, see if it works, collect the feedback and so on,... till you have solved the problem’.

2. Co-design. ‘Let the users find the right solution for the problem’.

Co-design is a process by which industrial designers empower, encourage and guide users to develop solutions for themselves. By encouraging the user and the trained designer to create solutions together, the final result will be more appropriate and acceptable to the user. The second part of this paper will provide more information on co-design.

3. Observation. ‘Social scientist with a twist’.

‘With this technique, we observe people to get to know their problems’, says Liesbeth Huybrechts, research coordinator at the Media, Arts and Design (MAD) Faculty in Genk, LUCA School of Arts/KU Leuven. ‘We live with the users and observe the way they deal with products, materials and the world’.

When observing, industrial designers are social scientists, but with a twist. Huybrechts: ‘Social scientists will only observe. An industrial designer will interact with his audience, bring up solutions to a problem and make prototypes to make his ideas tangible. There is a dialogue going on’.

The MAD faculty is working on a project called *Dementielab*. The project designs and shares low-tech tools to assist patients with dementia to live a longer qualitative life in their home environments. Not so easy. Huybrechts: ‘It is too abstract to ask people with dementia “Do you like to colour?”. So we lived with them for a longer period of time and through observation and research we developed new means of interaction that are different from speech. Sometimes it is better to make the colour book and observe the result, than to ask the users if they like to colour’.

More information

Dementielab:

www.dementielab.be

© MAD Faculty, LUCA School of Arts/KU Leuven



THE INNOVATION PROCESS: THE PROBLEM/ SOLUTION CYCLE

Industrial designers need to get from a problem to a solution. Let's take a deeper look at this problem/solution cycle, also known as the innovation process, and at the four different industrial designers that are involved in it.

Step 1. Front end

The company is not yet (fully) aware of any opportunities. So the industrial designer looks for undefined problems and opportunities. After which he envisions a solution and begins to look for ways to solve the problem. He talks with stakeholders and sets up his research plan.

'The front end is the first phase in the innovation process and very important for the future success of a product', says Chris Baelus, professor Product Development, Faculty of Design Sciences, University of Antwerp. 'It is also

called the *fuzzy* front end but with our methodology research we want to get the *fuzzy-component* out, by using specific techniques that enhance the chances of success.'

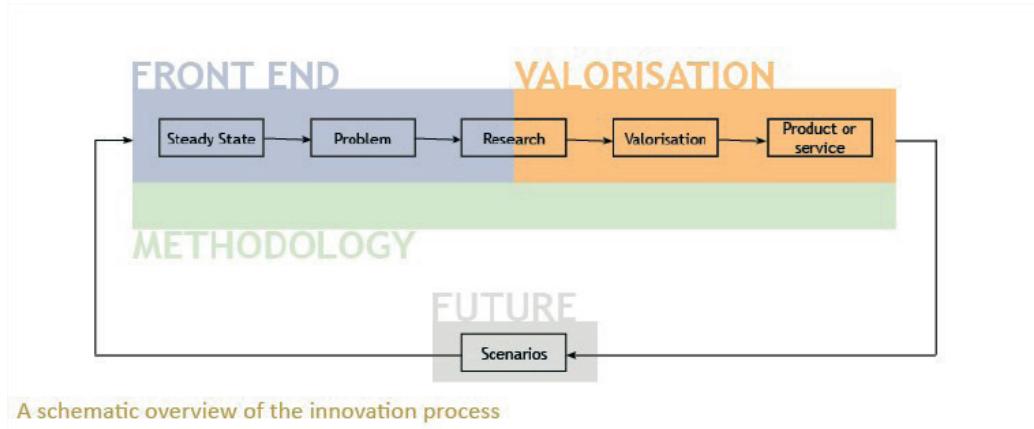
'A lot of the front-end developments are based on previously undetected possibilities of new technologies', says Stijn Verwulgen, research coordinator Product Development at the faculty of Design Sciences of the University of Antwerp. 'For example: a company develops a new material, like a specific kind of memory foam, but they don't know what to do with the result. The industrial designer will start researching the product opportunities, fitting it in with users and look for ways you can bring the product to the market.'

During this phase, the industrial designer combines engineering, design and business skills. Stijn

Verwulgen: 'The front end happens in a structured, controlled manner. And that's important. You don't use gut feeling, but you use market potentials and knowledge about users and technology'.

Step 2. Tech transfer

The industrial designer takes an idea, existing product or service, and tries to create or enhance it for a specific target audience. He already knows what the key features in the product have to be since that was established in the front end phase. Now, the industrial designer has to make the translation between the academic research and the needs of the market and his users. 'The power of the industrial designer is that he/she is able to bridge the gap between research and the commercial product', says Chris Baelus.



An illustration of tech transfer is the development of a device suited for intradermal injection (that is injection under the skin). Studies have shown that vaccination in the intradermal layer provides an improved immune response in comparison to injection in the muscle. The lack of devices to allow for intradermal injections led to the set-up of a multidisciplinary team including academic researchers, designers, engineers and users. The project ultimately led to the construction of useful prototypes.

Alexis Jacoby, researcher Product Development at the Faculty of Design Sciences of the University of Antwerp, explains: 'The goal of the industrial designer is not to make the product ready for production, but to use all the gathered knowledge and information to define and design a product concept of which the

feasibility, desirability and usability have been verified so it can lead to a new, real world product.'

Step 3. The future

The product is made, the design finished, the service is in place. Enter the third type of industrial designer: the conceptual thinker. Not so much hindered by technology, this kind of industrial designer looks into the future and tries to spot trends and opportunities. Opportunities that will one day lead to the start of a new innovation cycle. This *future* phase sounds more mystical than it really is. Liesbeth Huybrechts, research coordinator at the Media, Arts and Design (MAD) Faculty in Genk, LUCA School of Arts/KU Leuven, explains: 'It is possible to create an imaginary future of – let's say – medical appliances, with techniques of

storytelling and scenarios that activate the imagination. With these techniques we can anticipate certain innovations and spot them well in advance'.

Step 4. Methodology research

The fourth type of industrial designer tries to streamline the entire innovation cycle from front end to future thinking by developing methodologies, tools and processes anyone in the design chain can use. Developing these different methodologies and tools is one of the main research topics in Flanders. The third part of this paper will provide more information on methodology research.



© Design for Impact, Howest, University College West Flanders

CO-DESIGN: LET THE USERS FIND THE SOLUTION FOR THE PROBLEM

Co-design is one of the ways to get from problem to solution. It supports the idea that when the trained designer and the user are encouraged to create solutions together, the final result will be more appropriate and acceptable to the user. Co-design is often used by trained designers who recognize the difficulty in properly understanding the cultural, social or usability scenarios encountered by their user. In co-design the industrial designer has to let go of his design and ideas and let the people work on the project while supporting and guiding them.

It is a very powerful tool because the design process is made up of unexpected events. The way people act on these events is crucial for the end result. The nice thing about co-design is that - because the users design the product themselves - people are willing to make certain sacrifices to make the product or service happen. If they would buy the same product in the shop they would not be willing to make the same sacrifices.

Design for (every)one

Lieven De Couvreur, coordinator of Design for (every)one, Howest, University College West Flanders, and his team create products for people with a disability who have

a practical problem or desire. For example, they worked together with a man who, due to his disability, was not able to look up. The research team designed prism glasses, which enabled the person to look up without having to tilt his head. They work on a specific solution for a specific problem.

De Couvreur: 'For one of the projects of Design for (every) one, we worked together with a man in a wheelchair. We tried to figure out what would help him the most. Apparently, the thing he hated was that, due to his spasms, he wasn't able to eat ice-cream with his son anymore. So designer and user started working on a solution together. Prototypes were made and materials tested, until there was an end product'. During the process both groups - designer as well as user - had to adjust their expectations to make the product happen, but everybody liked the result. Because of the process of co-design, you notice that the users become ambassadors for your product.'

Cardboard beehives in Ethiopia

Is it possible to put our skills and abilities as an industrial designer to good use in developing countries? That was what Oliver DeWolf, researcher and coordinator of

Design for Impact, Howest, University College West Flanders, wanted to know when he started Design for Impact.

'We go to developing countries and work in extreme conditions, together with the local community', explains DeWolf. In such a scenario it is difficult to understand the cultural or social context, so the people have to be involved from the start of the design process.

Let's take a look at a case in Ethiopia: the country has five million beekeepers, but they don't have enough beehives and the country doesn't export its honey because the product doesn't meet European standards. 'So the question was if we - together with our partners - could design a cheap, sturdy and easy to assemble hive that meets the norms of the African bee', says DeWolf.

'The first problem was that of material. In Ethiopia you can't cut trees for wood because of the strict timber policies. So we needed different materials. We tried to make hives from cow dung - they also use it to build houses - but the honey became impure. Now we do experiments with cardboard hives.'

The project also experiments with moulds instead of complete hives.

With the help of these moulds, people can build their own hives out of paper pulp. And a mould could also solve the problem that measurements or local production techniques aren't standardised.

'A Belgian bee expert evaluated the thirty beehive models we designed,' says DeWolf. 'Three models were selected to be tested in Ethiopia by our partners and local researchers.' The team members will have to see what works and if the local people have the skills to handle the hives. In the future, the researchers will collect feedback and with that feedback, Design for Impact will start a new prototype iteration.

DeWolf: 'We are also experimenting to see if it is possible to design from a distance. Is it possible to draw a beehive in Belgium and send the technical drawings to Ethiopia? Can the Ethiopian people build the beehives? Can they collect meaningful feedback and send it to us? That would be extremely useful.'

More information

Design for Impact:

www.designforimpact.be

Design for (every)one:

www.designforeveryone.howest.be



© MAD Faculty, LUCA School of Arts/KU Leuven

METHODOLOGY RESEARCH

‘Methodologies enhance the chances of success,
but they don’t guarantee it’

Design problems are often ill-defined. There is no prescribed way forward; they involve stakeholders with different perspectives and have *no right or optimal* solution. Hence the importance of methodology and process in the industrial design research.

Design the design process with meta-design

Unlike physics or chemistry where you have a strict set of laws of nature you can't ignore, there are no such laws in industrial design. Alexis Jacoby, researcher of Product Development at the Faculty of Design Sciences of the University of Antwerp: 'We are never sure our innovation process will lead to a desired outcome. That is a commodity we don't have. We have to work with methodologies that enhance our chances of success, but they don't guarantee it.'

One of the main research topics in Flanders is trying to develop different methodologies which enable the designers to focus on all aspects of innovation and improve their chances of success.

These methodologies and toolboxes are created by meta-designers, who aim to create a framework in which different people with different fields of expertise and skills can work together on the same product or service.

About abstraction layers

The tool Dries De Roeck has been developing during his PhD is a clear example of meta-design. By creating a so-called *abstraction layer* he develops a framework which enables engineers and designers to

work together without the problem of jargon or lack of technical skills. 'Technical engineers and designers have their own set of skills and jargon,' explains De Roeck. 'In real life they have to work together and that isn't always easy'.



One of the ways to reach this goal is to make use of templates, which allow the designer to formulate a concept as a linear progression of events. In this way, designers can express conceptual ideas in a format that is more familiar for an engineer. The designer could, for example, use predefined words as *DETECT*. The different steps that belong to the word *DETECT* are written down in a manual. The designer can use the *DETECT*-word to describe his idea without having to know what the technical implications are. The engineer can look in the manual for the necessary technical steps involved with the word *DETECT*.

On the other hand, if an engineer wants to say that the designer has to incorporate a motion sensor in his design, he can just say that the design has to be able to *DETECT*. The designer then knows what needs to be done.

Meta design of co-design

Another example of a tool, is *MAP-it* from the MAD faculty. Liesbeth Huybrechts, research coordinator at the Media, Arts and Design (MAD) Faculty in Genk, LUCA School of Arts/KU Leuven, explains: ‘*MAP-it* is a mapping method and toolkit to mediate co-design processes. It enables designers to moderate co-design processes through workshops in which people from diffe-

rent backgrounds collaboratively reflect on and set up new projects. More specifically, *MAP-it* is a low-tech toolkit that contains stickers and background maps. It intends to construct a common language among participants.’

THE FUTURE OF INDUSTRIAL DESIGN



As much as industrial designers try to look into the future and into the ways we will use and interact with products or services, they still have their own future to look into. How does the future of industrial design look like?

Future 1: 'I believe in a multidisciplinary future' says Alexis Jacoby

Internet businesses realised early on that they needed a multidisciplinary team to create *killer apps* that would win customers. Likewise, an industrial designer can't develop specific products like new surgical tools on his own. For such projects he needs help from psychologists, caretakers and doctors.

'Innovation has many faces', says Alexis Jacoby, researcher Product Development at the Faculty of Design Sciences of the University of Antwerp. 'People with a business and management background don't know much about product design, but their business views will result in more innovative business opportunities and better commercialising of products and services. We need more collaboration between different disciplines. Real innovation comes from more integration.'

Future 2: Shift from product to service

'We are experiencing a change from

pure product design to product service design and user experience design', says Chris Baelus, professor Product Development at the Faculty of Design Sciences of the University of Antwerp. Product service design, designs the entire ecosystem of a service and product. A typical example is the iPod (a product) which is linked to the iTunes store (a service). In this case, the physical product is a kind of manifestation or tool to use the service. 'The basics of our research and design methodologies still hold in this evolving area, but we will need to continuously adapt our methods and approaches to these new challenges'.

Future 3: The future is open source

'I believe in a future of local design and personal manufacturing', says Lieven De Couvreur, coordinator of Design for (every)one, Howest, University College West Flanders. 'Low volume manufacturing is possible nowadays thanks to the technology of 3D printing, CNC milling and laser cutting. These are all techniques with a low start-up cost that enable us to make personal products without a big price tag. These products can compete with mass production as we know it.'

And De Couvreur follows through on his own vision: 'All the designs and drawings from the Design for (every)one projects are available

online, so an entire community can use and adapt these designs to their own needs. We hope that people will upload the personally adapted designs so you get some sort of evolutionary design. Each new design will stand on the shoulders of the old one'. One place where this is happening, is the Fab Lab (see sidebar).

Oliver DeWolf from Design for Impact also believes in the future of open source design: 'With the rise of cheap 3D printers and laser cutters it is already possible for someone with little knowledge to load a technical drawing onto his or her computer and produce the whole design. One of the challenges in the open source story and in unlocking all the possibilities of this idea will be to let non-designers think as designers'.

Future 4: The future will follow the demands of society

'The future of industrial design will always adapt itself to the demands of society', says Liesbeth Huybrechts, research coordinator at the Media, Arts and Design (MAD) Faculty in Genk, LUCA School of Arts/KU Leuven. 'In the beginning we focused on interactive design. Nowadays we focus more on sustainable design like the *Dementialab* project. Research will always go with the flow and follow the challenges and demands of society'.

RISE OF FAB LABS AND OPEN SOURCE DESIGN

In Star Trek, they have a machine that produces everything from a nice cup of coffee to a computer. ‘Wouldn’t it be cool if everybody had a Star Trek replicator?’ Neil Gershenfeld, professor at MIT technical university, mused. And the Fab Lab was born.

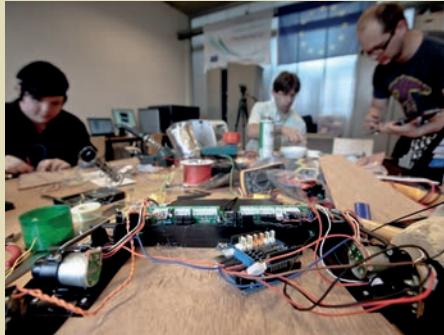
The concept took the entire world by storm, including Flanders. Fab Lab is short for fabrication - or fabulous - lab and is a small-scale workplace with high-tech computer-aided machines like a 3D printer, a CNC milling machine, and a laser cutter. It is a place where you can make (almost) everything. Almost, because the machines are too small to work with metal, but they are perfect to work with wood, plastics, paper, cardboard, et cetera...

And what's more: everybody can use it for free.

Free, if you respect the open source philosophy

Free to use? Yes. But there are some rules and gentlemen's agreements involved. The one thing a Fab Lab asks in return for the free use of the machines is that you put your designs online, open source.

The designs are protected under a creative commons licence, so nobody can commercialise them, but you have to allow individuals to use and adapt them for personal use. To learn and to enhance.



© Fab Lab Genk

As each Fab Lab in the entire world has more or less the same machines, everything that is made in a Fab Lab in Flanders can be made in Fab Labs throughout the entire world. This enables a whole worldwide community to share files and designs, and produce the designs locally.

Fab Labs in Flanders, and how to use them

Flanders has its share of Fab Labs. The University of Ghent has one, but also the MAD faculty in Genk, the KU Leuven, and the University of Antwerp, and they are all open to the general public, as long as you follow the Fab Lab charter:

1. You can use the Fab Lab to make almost anything (that doesn't hurt anyone); you must learn to do it yourself, and you must share use of the lab with other users.
2. Training in the Fab Lab is based on doing projects and learning from peers; you're expected to contribute to documentation and instruction.

You're responsible for:

3. Safety: knowing how to work without hurting people or machines.
4. Cleaning up: leaving the lab cleaner than you found it.
5. Operations: assisting with maintaining, repairing, and reporting on tools, supplies, and incidents.

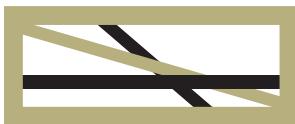
Interested? More Fab Lab information:

The designs are available for everybody. The information is mostly available in the Dutch language.

<http://www.fablab-leuven.be/>
(Dutch)

<http://www.fablabgenk.be/>
(Dutch)

<http://www.timelab.org/en/workspace> (English)



FLANDERS KNOWLEDGE AREA



RESEARCH IN FLANDERS



Author: Toon Verlinden

The thematic papers are published by Research in Flanders, a project run by Flanders Knowledge Area.

The project Research in Flanders is funded by the Flemish Government, Department of Foreign Affairs.

Flanders Knowledge Area supports, through different projects, the internationalization of higher education in Flanders, Belgium.

Ravensteingalerij 27 – bus 6
1000 Brussel
T. + 32 (0)2 792 55 19
www.FlandersKnowledgeArea.be

D/2015/12.812/2



WALLONIE

EDITIONS

1. Materials Science
2. Urban Planning
3. Industrial Design
4. Research in Times of Crisis

