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A Design Perspective For IoT Products. A case study of the Design of a Smart Product and a Smart Company following a crowdfunding campaign.

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Abstract: This paper analyses the role of Design in the development of smart and interactive products for the consumer market, a context in which technology is the leading component. The outcomes are often tech gadgets lacking meaningful value for users and thanks to the democratization of production methods and crowdfunding platforms their diffusion is exponential. By presenting the case study of Thingk - a company derived from a crowdfunded project - this paper highlights how the user feedback gathered during crowdfunding impacted the design process and the evolution of the final product.

Keywords: User Centred Design, Internet of Things, Smart Products, Physical interaction, Crowdfunding

1. A Digital and Smart Future

Today's technological advancement and digital disruption is exponentially changing almost everything. We observe the rise of Servitization (Bains, Laightfoot, 2013), Digital Economy (Elder-Vass, 2016), Digital Transformation (Innovation Value Institute, 2014), Smart Products, Internet of Things and Internet of Everything (Evans, 2012). Innovation affects all aspects of our life, from the way people interact, communicate and live in new environments and smart cities, to the way the economy and businesses evolve with automated machines and intangible services.

Some of the most interesting and relevant transformations are related to how communication is more than ever continuous and global among people and objects, and how the boundaries between tangible and intangible, hardware and software, private and public blur and dissolve (Loukides & Bruner, 2014).

As the new generations are constantly reshaped by the tools and technologies that arise (Turkle, 2012), so is the product design discipline, its methods, skills and challenges. Every modern product is becoming translated in a smart and embedded one with processing power, sensors and network capabilities, and is developed by design professionals or even by makers (Anderson, 2012).

Could a functional product become a market success? Could a smart product be developed without design intervention? Could a designer become an entrepreneur?

In this context, aided by the democratization of technologies that made possible and feasible to make/produce (almost) anything (Gershenfeld, 2012) from bits to atoms, a new specific culture emerges, and with that new possibilities linked to the digital fabrication potential. This is also related to the speed of growth and development of technology itself (Moore's law), and the new widespread awareness of different processes like Artificial Intelligence (Stone, et al, 2016).

While the first wave of smart connected consumer electronics and wearables is progressively getting mainstream and more widespread (IDC, 2016), what however smart really means? The English word Smart means something stylish and with clean, tidy appearance, intelligent and able to react quickly, and something independent "working by computer" (Cambridge Dictionary, 2016). So by definition, embedded intelligence could be enough to make something that users would regard as smart and valuable. However, many existing smart products prove differently (MappingTheIoT, 2015) and suffer what Morozov would call Solutionism

"the act of recasting all complex social situations either as neatly defined problems with definite, computable solutions or as transparent and self-evident processes that can be easily optimized" (Morozov, 2013)

or technological Determinism (Brynjolfsson & McAfee, 2014): these empowered gadgets often appear as screen-based black-boxes with specific tasks that continuously notify users and gather data. The focal point of these devices is on technological performance and optimization, rather than on what users would need and appreciate, or the aesthetic and tangible quality of the product and interaction. Many smart products may be regarded as attempts and experimentations, still unripe for the complexity of the consumer market. However, in the literature and among professionals there are signs of a shared visions of possible scenarios in which networked products would co-exist and be accepted by people in the "connected everyday" (Giaccardi, 2015).

2. Humanizing technology and Designing for Desirability

Users are the starting point of design and Human Centred Design in particular, analyzing their habits, gestures, rituals, needs and aspirations may allow designers to conceive modern solutions and proposals that merge digital and physical aspects within an aesthetic impact.

The development of domestic smart networked products that consider the market trends (Gartner, 2015), need to follow a "User Driven innovation" approach. The process of "free revealing" is made by lead users that experience needs not yet felt by the majority of the consumers and decide to make adjustment themselves (Herstatt & Von Hippel, 1992). The User Innovation approach has been followed by big companies (Bosch-Sijtsema, 2015) and it is transversally accessible thanks to new communication technologies and platforms. Thanks to digital platforms it is now easier to establish a two-way dialogue between users and designers, facilitating co-design initiatives. Crowdfunding in particular has acquired an interesting role as enabler of User Innovation (Gonzalez, Bettiga, & Shao, 2014). The opportunities offered by crowdfunding platforms are several. First, crowdfunding is a way for innovators, designers, and lead users to develop their own ideas and possibly start their own business as entrepreneurs. Different models of crowdfunding campaigns give the possibility of raising funds for projects that, due to risks and uncertainties, would otherwise have struggled to be financed with more conventional methods.

Second, crowdfunding platforms have progressively become tools to test markets and users.

Campaign reception and funding success can be used as indicators to evaluate the economic potential of new concepts. The campaign itself becomes a powerful marketing tool, in which potential users are engaged in diffusing ideas and making them viral. Different success stories, like the e-ink watch Pebble, prove that innovative products with a good design quality, developed by multidisciplinary groups supported by crowdfunding campaigns may become new recognized brands and enterprises.

Crowdfunding platforms foster communication between project developers and active end users - the project backers - enabling designers to build on the basis of direct feedback during the whole process. The case study presented will demonstrate how users may influence the outcome of this process.

Regarding the design of smart connected products, personalized insight and user experience should let designers be able to combine the external co-creation and internal resources (Bartl, 2009) with the aim of humanizing technology and developing solutions that are not only accepted by end users but also desired.

One of the key points that “Silicon Valley Innovators” (Morozov, 2013) often miss is that people do not usually want the technology itself, but the results it achieves. Semmelhack expresses this concept well when he affirms that “if the application is successful, then the technology itself becomes invisible. The device becomes a friend, something to rely on, a capable partner” (Semmelhack, 2013).

The Design role into humanizing technology is twofold and deals with desirability and awareness. Technology is brought closer to the end users, so they can perceive the product’s qualities from its aesthetic, material and interactive point of view.

Apple products have often been compared to fashion accessories (Kilchii, 2015) and are a perfect example of the power of design in shaping user’s perception. Their communication celebrates the value of aesthetics, materials and finish, and instead of highlighting the technical features, it focuses more on user scenarios and how those devices will enter seamlessly into users’ lives.

This is one way in which design could humanize technology, by making it invisible and letting people only aware of its purposes, with a familiar, engaging language.

Identifying the right problem and clearly communicating the value of smart products are two other key points for the IoT consumer electronics industry. In particular when tangible objects are augmented by a digital and immaterial counterpart, the value of the physical part must be clarified and highlighted.

Even UX designers are progressively noticing the importance of products’ tangibility (Blaase, 2015) because the boundaries between material and digital life are often permeable. It may be argued that “we spent 30 or more years moving from atoms to bits; now it feels like we’re pushing the bits back into the atoms” (Loukides & Bruner, 2014). It’s not only that; IoT devices have the opportunity of being augmented products that blend tangibility and software intelligence, and that processing power allows them to be interactive and interact with users in more valuable ways than just remote screens and displays. More than ever, there is the opportunity to experiment and “imagine less intrusive ways of integrating technology in our lives” (Giaccardi, 2015). Smartphones have an important role as bridges for IoT products, but screen-only interaction is not always perceived as rewarding. People are often ashamed of being tethered and dependent on their devices (Turkle, 2012), and may feel the need to “disconnect” for a digital detox pause.

Back in the past, when technology was not so ubiquitous and affordable, designers focused more on products' affordability and interaction. Today smart devices need designers to refocus on interaction and shape real smart experiences. Behaviour and habits change, and interaction possibilities grow exponentially when they become multi-device, spanning across physical and digital touchpoints, and potentially nonstop (Brugnoli, 2015). Devices may be regarded as peers that autonomously engage in dialogue and real conversation with users without the need of remote, screen-based interfaces (Krishna, 2015). Smart designed objects will interact with users in the right moment, at the right time, offering relevant and desirable content in the most intuitive way, and won't need attention, they'll disappear when not needed. As stated by Weiser in 1991 when discussing about embedded computers "They weave themselves into the fabric of everyday life until they are indistinguishable from it". (Weiser, 1991)

This is linked with the idea of calm technology, that relies on periphery attention and isn't the core of the user experience, "Its goal isn't to make you spend time with it. Its goal is to disappear into the infrastructure, to be ignored". (Loukides & Bruner, 2014)

The acclaimed TV series Black Mirror (Black Mirror, 2011) shows how tech-centered scenarios may deeply prove dystopic and undesirable, and how technology could shape our society. Designers working with technology should dedicate their effort into developing seamless solutions in which technical opportunities are seized to achieve valuable and desirable experiences for both individuals and society (Brynjolfsson & McAfee, 2014).

Designers can foresee a future where we go back to the basis of the design practices, rediscovering the centrality of tangible products and physical interactions.

The tangible, analogic and mechanical products of the first industrial revolution progressively got embedded with technology and displays, and then constantly got dematerialized, connected with dashboards and apps and controlled through mediated interaction. Now technology enables designers to go back to direct, tangible interactions with products that are augmented and connected, a natural blend of hardware and software

3. What smart kitchen gadgets should look like. The Think case

This section reflects on how design could augment traditional products, give value to their tangible qualities and interactions, and on the impact of user contribution on shaping their final design.

We are going to use the company Think as an example, a startup that blends design, engineering, production and marketing, able to exploit its ecosystem to realise new ideas in the field of Internet of Things.

In 2014 the company launched a crowdfunding campaign (Think, 2014) through the Indiegogo platform to raise funds for Gkilo and Clogk: a smart scale and a timer which are capable of interacting with each other through an app. The design of these products focused on new ways of interaction between users and objects, rather than merely magnify object's functionality. That was also the hybrid idea behind the name "Think", a fusion of Thing and Think, a new concept for products based on Natural User Interface and Internet of Things. Their goal was to introduce an actual brand, featuring a high technological factor, connected to a design-oriented approach fit for the IoT background in the "Design Made in Italy" area.



Figure 1. The first prototypes of Gkilo and Clogk made for the crowdfunding campaign.

The two products Gkilo and Clockg were equipped with touch interfaces and accelerometers, Natural User Interfaces (NUI) that enabled natural gestures to access product functionalities and to engage with each other.

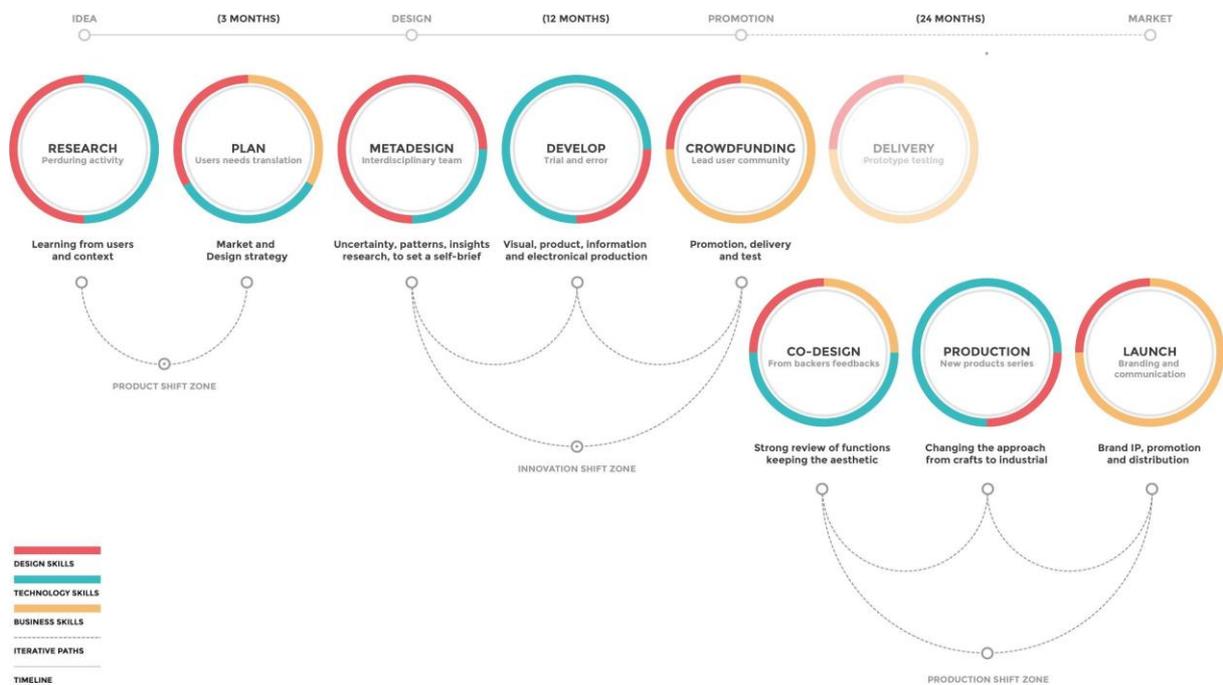


Figure 2. The Design Process Map of Think, and how the process evolved after the crowdfunding campaign.

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The design process of Think products unfolded in several stages. The project team followed a traditional design innovation pattern, starting with an idea followed by a metadesign research that helped delineate a set of desirable functions and conceptualize the different behaviours that these augmented products would have. The selected set of functions was broad and exploited digital technologies (an app) to amplify the product performance.

Then a Concept was created and tested in a developing phase. Ideas were evaluated by a multi-disciplinary team with a strong mix of competences: Product Design, Engineering, Computer Science and User Experience. The concept focused on NUI and were tested using innovative components, validating the design choices delineated in pre-production phase.

Crowdfunding

Following conceptualisation Think prepared to launch a crowdfunding campaign. Before the launch, everything was defined with great attention to detail: each hypothesized solution, with its material moodboards, had to be sustainable and of high quality from a Design, Electronics and Engineering point of view. This was before the campaign, when a self production / custom made business model was previewed.

The crowdfunding campaign turned out to be a success as it raised 107% of the target funds on Indiegogo(\$53.441) by April 2014. However, as shown in Figure 2 the end of the campaign traced the beginning of a longer process. After three year, in April 2017, the product development was close to delivery stage and Think launched the product at the 2017 Milan Furniture Fair.

The Indiegogo crowdfunding platform allowed to reach an early-adopters community that deeply influenced the final output of the process: the functions of the products were completely re-designed, whilst preserving the aesthetic value. The early-adopters were distributed globally but were still specifically related to Design and Technology. The international community received and tested about 200 prototypes, giving feedback on the functionalities, on the chosen materials and on the User Experience.

The target audience was mainly comprised of people in European countries (Italy, Germany and France, countries historically relevant to Design products) with an age group between 25 to 45 years old.

The co-design process

The early adopters became essentially pro-sumers: enabled by an iterative design process and suggesting details variations, creating customizations or completely new versions of the final object and its app. The most relevant product feedback related to the use of real wood veneer, and the addition of wireless charging. Feedback was used to improve the device more than Think expected. Instead of two different products with limited functions it was decided to merge both functions (Gkilo + Clogk) into a single product named "Slab!", which was a bit more complex but more meaningful and with a better balance between price and functionality. A new upgraded hardware was enough to absolve both the timer and scale functions. A more precise NUI was developed and a capsense button was added near the led display. Before the re-design, the scale was completely symmetrical, but after the crowdfunding the position of the display was arranged to give an orientation to the product and to guide users into the different functions.

Now Slab! is a perfect scale with an easy to use interface and a fully functional timer. This also allowed the team to invest in a rechargeable system optimizing the development and the cost.

Working on the basis of the precise feedback gathered thanks to the crowdfunding community, Think was able to define a completely new product, closer to user expectations and desires.

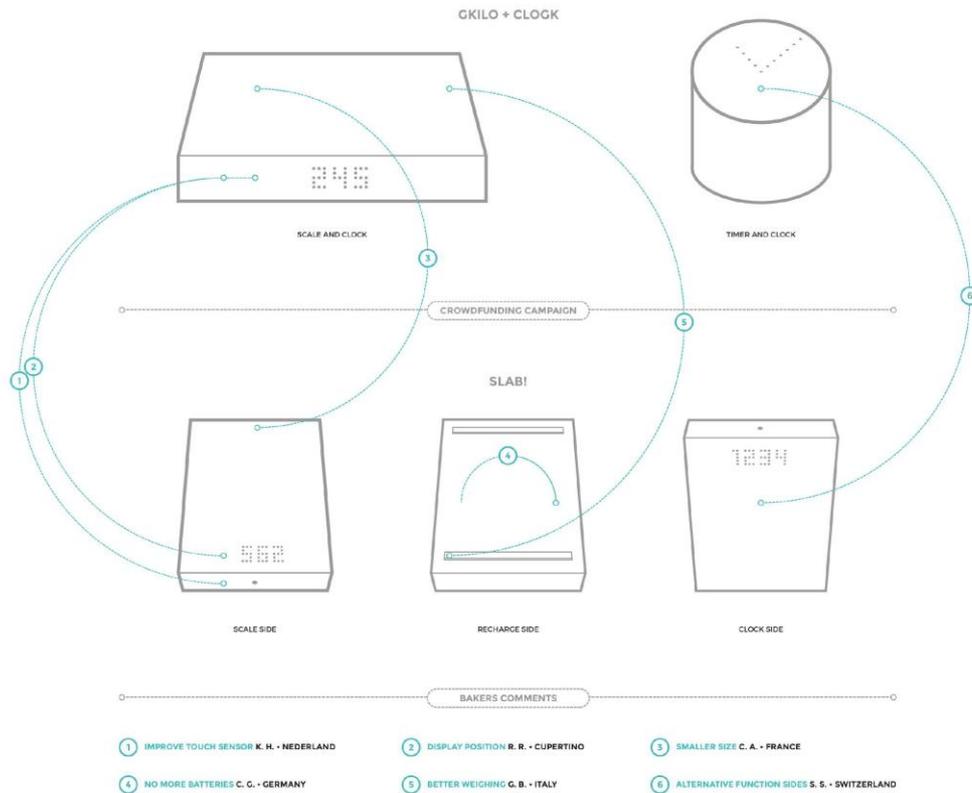


Figure 3. This infographic shows how the products changed after the user feedback received from the crowdfunding campaign.

NUI and Interaction

The new, improved smart kitchen scale “Slab!” is nestled in a CNC-milled wooden slab that hides a LED display and let its light shine through.

Slab! at first glance looks lifeless and silent, but after a brief tangible interaction it reveals its functions: it is a smart kitchen scale that transforms in a timer depending on the position that it assumes. If let resting on a working plane, a simple interaction with its surface will be enough to weigh anything, and brushing the touch sensor marked on Slab!’s short side will enable users to tare.

When Slab! is oriented vertically, an embedded gyroscope will transform the product in a timer, and the display might be easily set by interacting with the touch sensor. Visual and audible indicators will signal users when the selected time is over. These functions have been designed to be autonomous from smartphones or other devices.

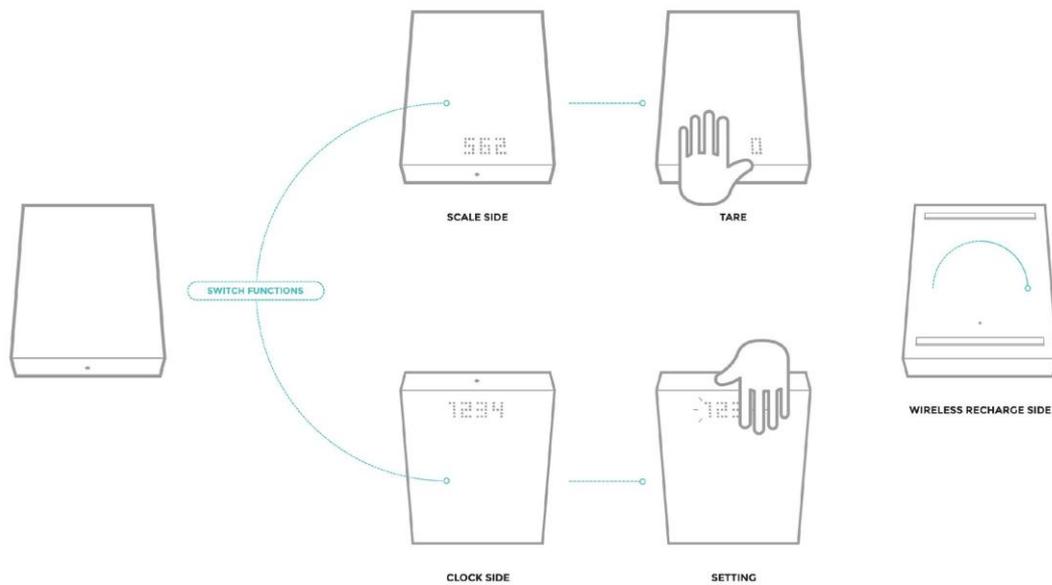


Figure 4. The main functions / gestures of the Slab! Digital Scale.

When Slab! is connected to the Think app, its functions are amplified, creating new scenarios. There are multiple functions aimed at food preparation and cooking. For example the app suggests adaptive defrosting based on food weight and volume, and the app simplifies some operations like weight conversions and scales. User generated data will also provide information about personal food consumptions and habits of different users. The Bluetooth technology embedded in Slab! will also provide the opportunity for the object to “talk” and communicate with future Think products, creating a domestic network of accessories that can interact among themselves.

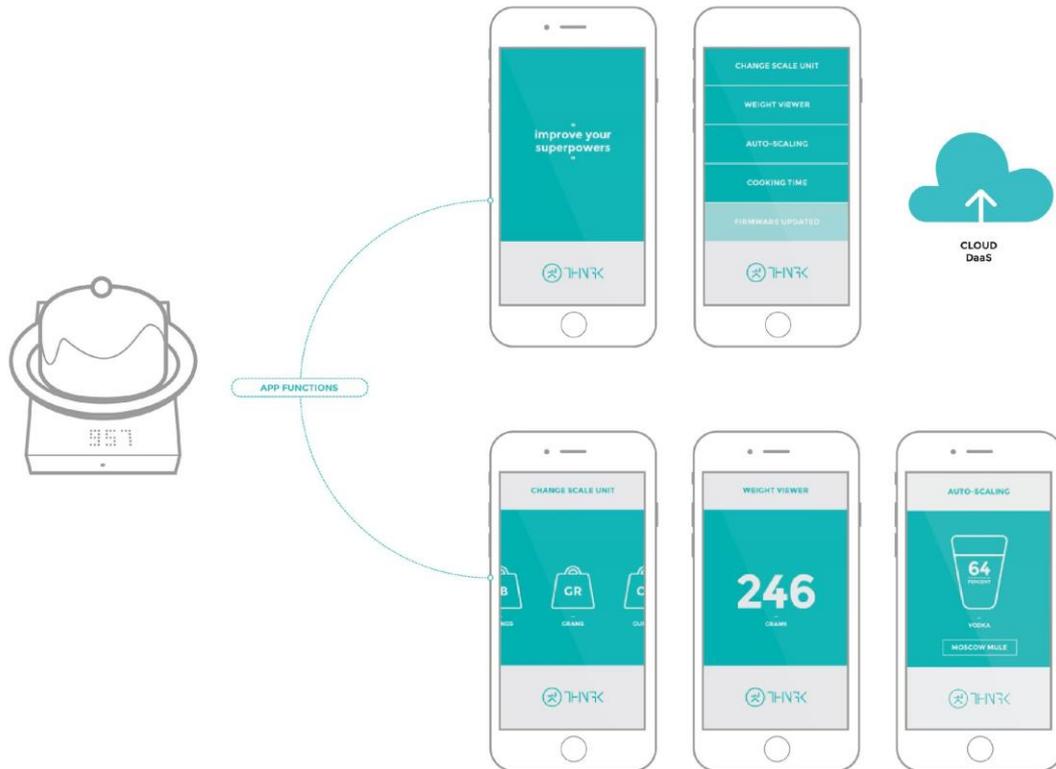


Figure 5. The main tasks improved on the Mobile and Tablet APP the for Slab! Digital Scale.

In Slab!’s case study, its shape takes a leading role, because through it the artefact defines how to be interacted with and how to relate with users. The design decision of hiding the technology and its complexity inside a container that is apparently natural and inanimate was conscious. The choice of surfaces was oriented to familiar materials such as wood, marble and aluminium, to allow the camouflage of the objects in all living environments.

In this way Slab! does not stand out as an highly evident “shiny smart gadget” but is more familiar and reserved, switching on and reacting only when it is needed, and blending out and disappearing when it is not.

The surface of the object is meant to be its communicative skin, able to exchange perceptive experiences to highlight information which is otherwise hidden inside it. The object itself becomes increasingly dynamic and “alive” by relating with the context.

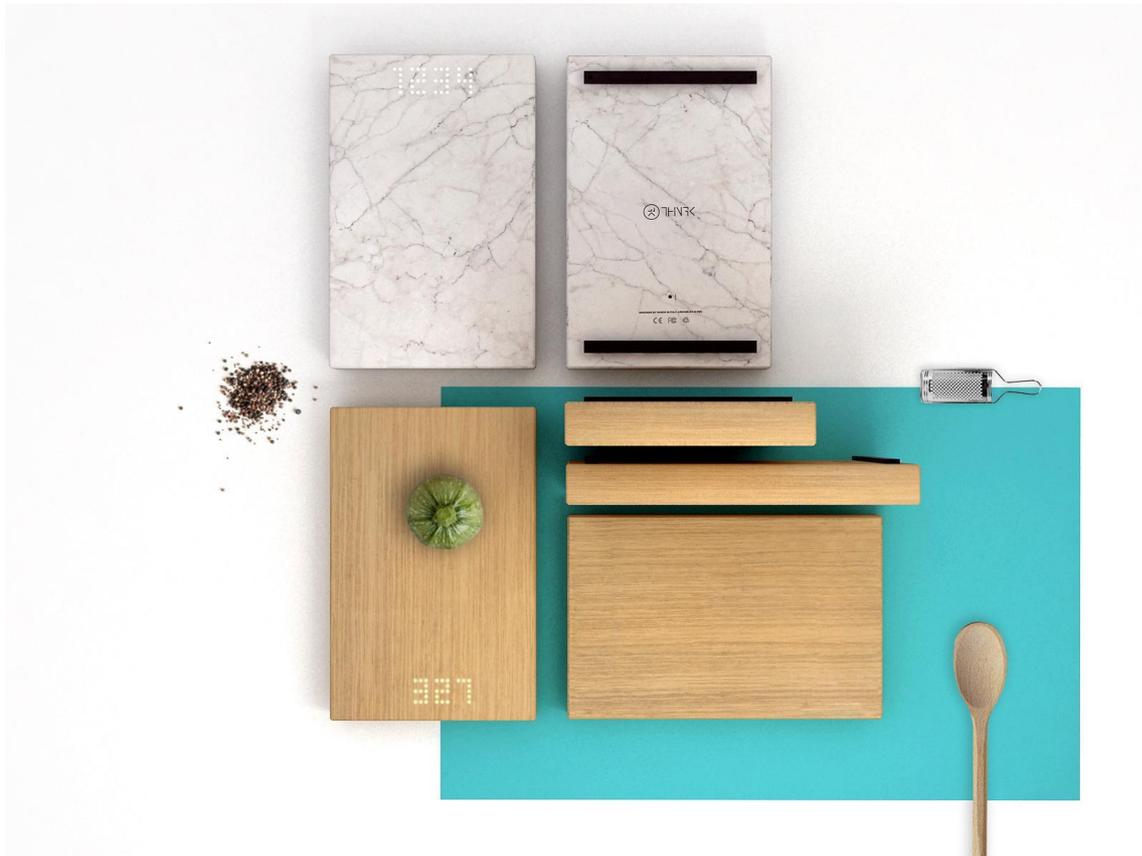


Figure 6. The new design of Slab! For its promotion at the 2017 Milan Design Week.

Production: from craft / DIY approach to an Industrial production

Think initially imagined the product development in digital fabrication with the addition of a few handcrafted details. However, today's technological advancement and quality of finish does not allow for the creation of a limited number of products at a low cost. The FDM 3D printing is not quick or accurate enough, whereas the SLA method is too expensive. In addition, it is difficult to keep a constant look and feel with handcrafted details. Therefore, we gathered the lessons learnt from the prototypes and decided to resort to industrial production. The product was re-engineered and the custom made electronics was boosted by including an accelerometer to read the different positions of use, a low energy Bluetooth 4.0 module to communicate with the APP and other objects, an enhanced touch sensor and a 5000 mAh battery rechargeable wirelessly. We also added four stands that increased weight accuracy and a new laminated and milled wood shell which allowed to read the integrated LED display.

Conclusions

The design of a smart networked product is a complex process that calls for new guidelines, practices, and tools for responsible design in a connected world (IoT Design Manifesto, 2016).

New design methods are oriented to strengthen the ties with users, in order to let designers be guided by their feedback during the whole design process. In particular, when users are included in the product research and promotion phase, they can steer and influence deeply the output of the process. In this perspective, crowdfunding platforms give designers the opportunity to engage with an active community of users that can test, evaluate, design ideas and offer relevant insight, both on the meaning and functions of the product, and on tangible and intangible interactions.

The case study, as a result of a contemporary approach to the User Centred Design practice, demonstrates that it is possible to design meaningful technological products by working on aesthetics, with the will of mediating between technology and performance to achieve a transversal user acceptance. In the case presented the user feedback suggested to have a completely working product, although not connected. This is an important question that highlights the fact that an app is not enough to make a product smart. A product today is smart when its interface and functions are connected to real user needs and habits.

In the Think case the idea of camouflaging smart technology inside archetypical and basic shapes is one of the strong points of the product and the gradual discovery of functions creates a relatable user experience.

And the last thing to evaluate is that, even a good idea is not enough without the capabilities to develop a product with a good aesthetic, and that integrates technological components. After crowdfunding, with real user feedback and funding, the next step is to switch to an entrepreneurial and industrial point of view. The Think case demonstrates this: crowdfunding created a new product that inherited from the previous versions the look and aesthetic, and that forged the members of the Think team into becoming competent professionals about industrial processes, design qualities, technical specifications and product logistics. From startups to real entrepreneurs.

A lot of crowdfunded products fail after a successful campaign because users don't leave enough time for the delivery of a better version of the product. The fundamental lesson learned from the case is that before starting a crowdfunding adventure, even if the design is well defined and makes the product desirable, it is strongly necessary to focus on engineering aspects of the developing phase before delivery and launch in the market. But without a good design, if the product only offers a function, maybe it is better not even starting the adventure.

As stated in a Wired article (Stinson, 2014) about Think products that in a provocative way concluded with this statement:

“This in theory is a great idea, but it does make you wonder how the devices will know how rare you prefer your meat. Best case scenario, these gadgets will save you some time. But if nothing else, they'll look fantastic on your counter.”

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