

# VISUAL THINKING IN DESIGNING A FUTURE MOBILITY RESEARCH AND EDUCATION STRATEGY

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## ABSTRACT

This paper discusses visual thinking in academic strategy design in the domain of human mobility. The strategic objective is to evoke cross-fertilisation in research and education between all stakeholders. We consider this holistic approach crucial in the education of future mobility designers, because the mobility industry is undergoing a similar transformation.

The holistic approach is driven by the growing demand for human mobility in the (near) future, which dictates that we must rebalance individual wants and collective means. In that, mobility design is becoming a mere rational system exercise, which wrongly surpasses human experience as a design objective, while that is crucial in eliciting the necessary behavioural change.

Despite the automotive industry's declining reason of being (in its current manifestation), its unrivalled expertise to synthesise the rational with the emotional is instrumental in designing for behavioural change. Cross fertilisation between transport modalities is how the automotive industry may reframe itself while mobility design as a whole will benefit from its specific expertise.

Strategy framing, design and implementation by means of a virtual laboratory, were facilitated by consecutive visuals. The first visual established common understanding of the strategic process, its scope and commitment. A second visual, based on context driven design, actively involved stakeholders to embrace the holistic framework and identify their respective positions therein. In a third, which is also the starting point for the HMI design of the digital platform, all elements are rearranged around a customer journey, so that design for behavioural change becomes the focal point.

*Keywords: Strategy design, mobility research & education, visual thinking, designing organisations*

## 1 INTRODUCTION

While our individual want for mobility is a core human hallmark, our collective needs are pressured by population-growth driven space limitations, climate change and scarcity of materials and resources. Reducing the physical impact of mobility, in its widest possible sense, is a core requirement.

Given the many stakeholders, the sheer volume of all components and their future interdependency, an integrated system's approach, which connects all mobility modalities and services, is paramount in designing mobility systems that facilitate human efficiency and improve human experiences, while eliciting sustainable behaviour.

This paper discusses how this cross-fertilisation is evoked, from the initial perspective of automotive design research and education, to the adoption of a holistic view in which automobility becomes, as much as other transport modalities, an integrated part of a larger mobility system. Visual thinking has played a key role in the three phases of this organisational change process; strategic reframing, strategy design, and strategy implementation.

### 1.1 External context

The automotive industry has reached unprecedented scale and mass manufacturing efficiency, derived from integrating the full scope of exact and social sciences, giving the automobile its essential presence and role in contemporary human mobility. In the aforementioned developments though, automobility has surpassed its epitome as an independent entity and must reinvent its reason of being, as an integral part of the integrated system's approach.

Future human mobility design is becoming a rational system design exercise, predominantly driven by logistics and technological developments, surpassing deeply rooted emotional automobility values i.e. brand identity and its derived status, the suggestion of adventure and exploration and so forth.

True human mobility solutions though, must build on these vital emotional values, as they are instrumental in inspiring the aforementioned behavioural change and how to elicit that. Designing for behavioural change demands connecting all transport modalities and services and their underlying sciences in a holistic approach.

## 1.2 Internal context

As academic researchers and educators, grooming the next generation of future-proof human (auto)mobility designers, we must be at the forefront of this paradigm change. We must embrace its complexity and adapt a similar holistic approach, evoking cross-fertilisation in research and education between departments, faculties and industrial partners.

Under the name People in Transit, human mobility is one of three strategic programmes of our Faculty of Design Engineering. Our mission in this strategic research domain is human centred by asking: *How can we provide people in transit a seamless experience across all underlying interlocking systems, fit for different types of travellers? By including various stakeholders, new technologies, digitisation and embracing the systems' complexity, the experience becomes the focus of the journey'*

Mobility research and education are facilitated through a large number of laboratories, spread out over the premises. These include Automotive Design facilities to design and test vehicle exterior and interiors on experience and comfort in e.g. autonomous driving, a Public Transport Laboratory where service and payment systems are being designed and tested, and an airplane fuselage for design and experimentation on boarding processes.

To facilitate the transition towards a holistic approach of mobility i.e. embracing complexity, a 'virtual laboratory' is being set-up in addition to these physical laboratories, to establish continuous and coherent interdisciplinary research. This virtual laboratory is being designed to actively evoke interaction between all involved parties, aimed at true mutual benefit, i.e. cross fertilisation. Mutual benefit will occur in obvious form, like sharing installations and research outcome, but is expected to go beyond in e.g. co-organising experiments to benefit multiple researchers. Most importantly the virtual laboratory must provoke academic and business stakeholders to cross domain boundaries, i.e. the boundaries between various transport modalities.

## 2 STRATEGIC REFRAMING

To visualise potential cross fertilisation in a complex organisation and beyond, available visual techniques such organisation flow charts do not satisfy, regardless of organisational structure e.g. hierarchical, matrix or even network [1]. They are static and display official and hierarchical connections between organisational bodies. Cross fertilisation by definition crosses those hierarchical boundaries.

To identify strategy components related to time, a visual was created. Horizontally a timeline displays strategic thinking, flowing from vision to mission, to strategy. Vertically three interrelated levels are depicted, inspired by context driven design processes such as VIP [2]. The upper level is the context level because a context determines the reason of being of any research or design project [3]. The middle level is that of the system and products (artefacts) form the lowest level.

Research topics are mapped out in the three levels to emphasise their meaning. Internal stakeholders are depicted below (laboratories i.e. researchers and educators) and external stakeholders are positioned above (industrial partners, national government and the EU). The visualisation of how stakeholders and research projects are connected is difficult because there is no hierarchy as in singular relationships, and none are constant over time. Unlike with a mind-map, in which the creation process is more important than the final visual outcome [4] because it facilitates an individual thinking process, this visual is intended to build understanding between involved parties, one cannot draw all exact connections while maintaining clarity. Nor would it contribute to the conversation as the purpose of this visual was to support strategic thinking and build a common understanding about what it means to 'embrace complexity'. To emphasise overall complexity rather than any specific connection an abstract image of a neural network was drawn.

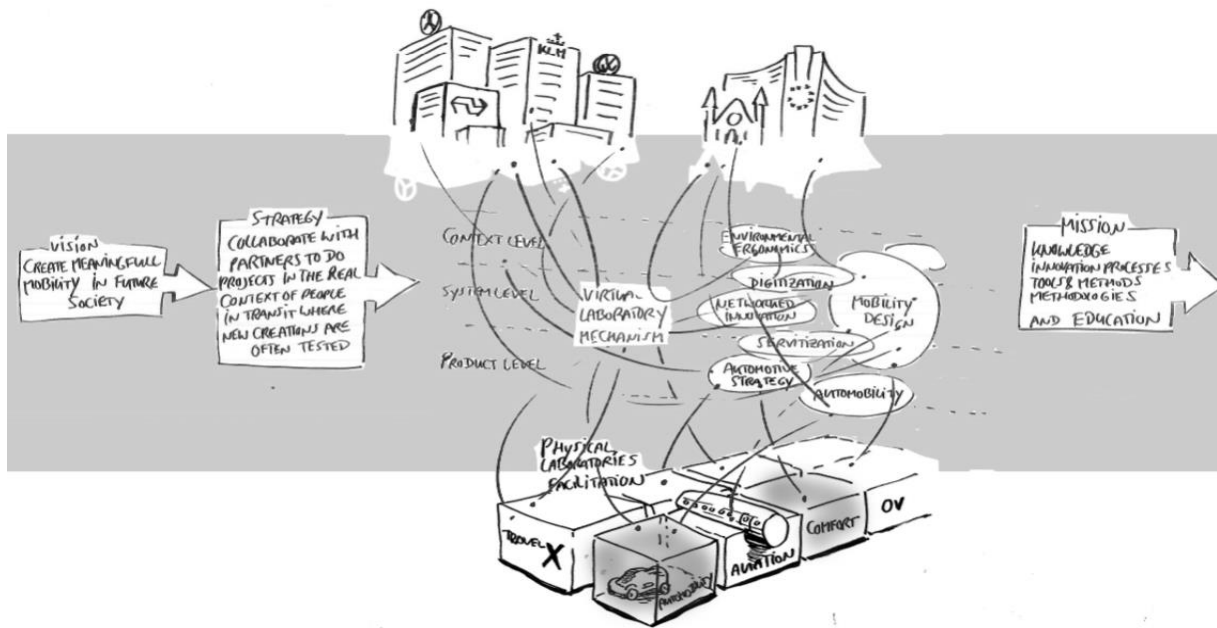


Figure 1. Visual thinking to bring order in strategic complexity

### 3 STRATEGY DESIGN

A second visual was constructed to enter talks with stakeholders about the positioning of their research in relation to the whole, to elicit their awareness of cross fertilisation potential. Existing management tools are designed to fit organisational structures [5], whose boundaries we are aiming to cross, and therefore not feasible. The two dimensions of the strategy visual as described in the previous paragraph (timeline and three levels) have been adapted. The timeline has been detailed and extended until 2040. Stakeholders in these negotiations have been asked to identify long-term (2040) and short-term (5 years) developments in human mobility, which they consider important for their research choices and planning, and interlinked education. As recognised, understanding context is as important as an understanding of technology in determining a product's, service or system's economic social sustainability i.e. its reason of being. Stakeholders participate actively, to assure a common understanding between disciplines [6]. They position their research, education and design projects in this framework, making their holistic relationships and opportunities to share knowledge, facilities and experimentation instantly visible. The idea is that, regardless on which level one operates (context, system or product), positioning research on both the timeline and its appropriate level, surfaces the coherence between all elements by which we identify cross fertilisation opportunities and maximise overall impact. Because both research and education (graduation projects) are embedded, instant implementation of research outcome into education accelerates the development of forefront mobility design and automobility design education, to ensure the employability of our future designers. The overarching long-term vision, which gives direction and connects projects, is likely to also identify research opportunities or the need to reframe existing research.

On *context level* projects we identify future human concerns, needs and desires. For example, to develop a future vision on the meaning of autonomous vehicles in society; develop an understanding about their role and potential competition with other transport modalities, or their social-psychological consequences like their potential to further blur the separation between work and private.

On *system level* we address the mediation between transport modalities, the mediation between machine data and cloud data connected i.e. the use of IoT technologies, or system design on e.g. luggage transfer scenarios and solutions for those traveling from or to an airport.

On *product level* actual vehicle development includes developing a vehicle entry design and design principles that connect interaction experience between transport modalities i.e. a range of vehicles (use clues, interfaces, connect experiences) and the research into and development of HMI to facilitate the transfer between levels of autonomous driving.

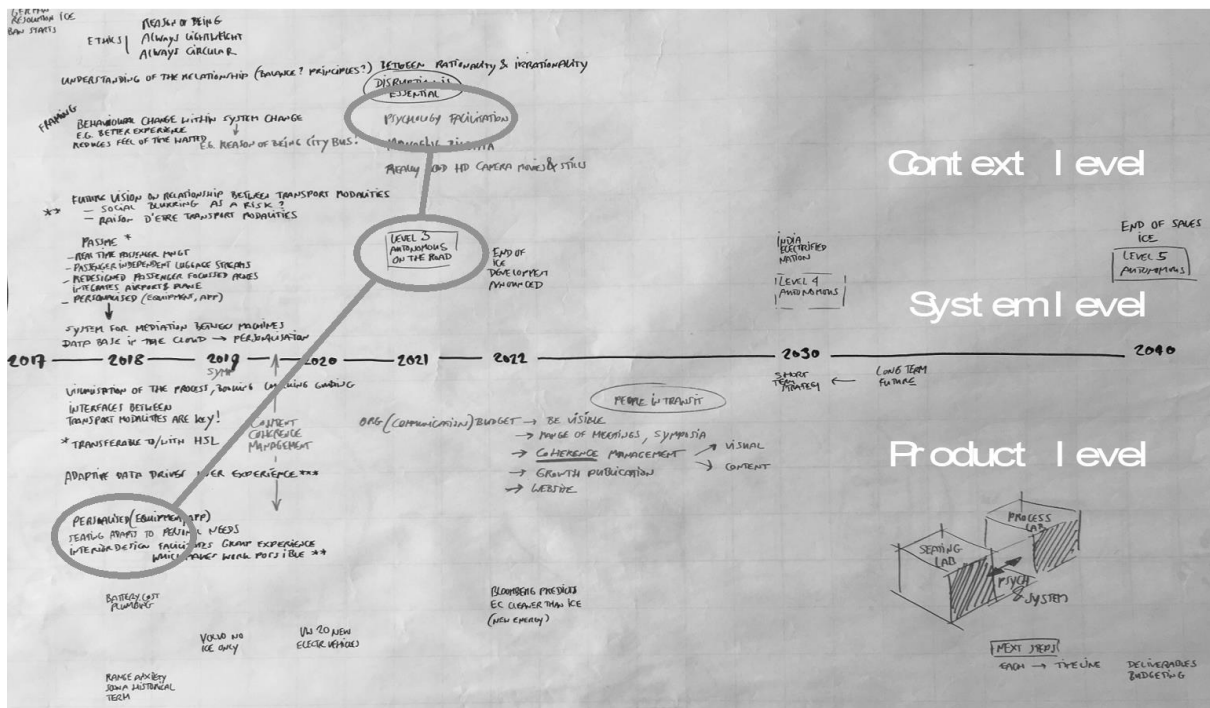


Figure 2. Research mapped out over time and positioned in complexity

Figure 2 is a snapshot of an ongoing A1 visual, which is drawn in negotiations with various stakeholders over time. Scaling down obscures details but it is shown for its entirety only. In this snapshot an example of potential cross fertilisation between three projects is depicted. Research on context level is concerned with user acceptance of autonomous vehicles around 2021, which connects to various system development projects on the interaction with non-autonomous vehicles, which then connects to HMI design research at product level. Interconnections and their potential for research and funding co-operations become instantly visible.

#### 4 STRATEGY IMPLEMENTATIONS

The visual thinking in the previous paragraphs drives the development of the virtual laboratory i.e. a digital user-driven platform which actively elicits communication between all parties, aimed at cross fertilisation. Over time this mechanism must become self-maintaining and evoke voluntary and active cross fertilisation between all stakeholders.

While the development of visualising cross-fertilisation in two dimensions (time and levels), as described in the previous paragraph, creates first awareness of opportunities and potential value of cross-fertilisation amongst researchers, a limitation of the visual is that organisational stakeholders, like owners and manufacturers of transport modalities, are not specifically visible. Those industrial and governmental stakeholders were only visible in the strategy visual.

End users i.e. travellers were not visible at all despite their central role in our mission's *seamless travel*. From their perspective, mobility means connecting departure location and destination, and even activities at their destination, if we consider experience and behavioural change as important as efficiency. This is new design perspective in mobility design throughout transport modalities, is possible because of the holistic approach.

A common and most appropriate means to visualise end user's activities and experience is a customer journey [8]. Therefore, a customer journey was the visualisation starting point for a visual, which allows all stakeholders to visually position their research and connect to related stakeholders. Seamless travel is the core timeline, incorporating all touch points in the system, including activities at the destination. Stakeholders are connected to their respective touch points directly or beyond, depending on their position in their respective value chains. Figure 3 shows the generic customer journey while in figure 4 some touch points have been filled in and stakeholders in the value chain for one touch point have been identified.

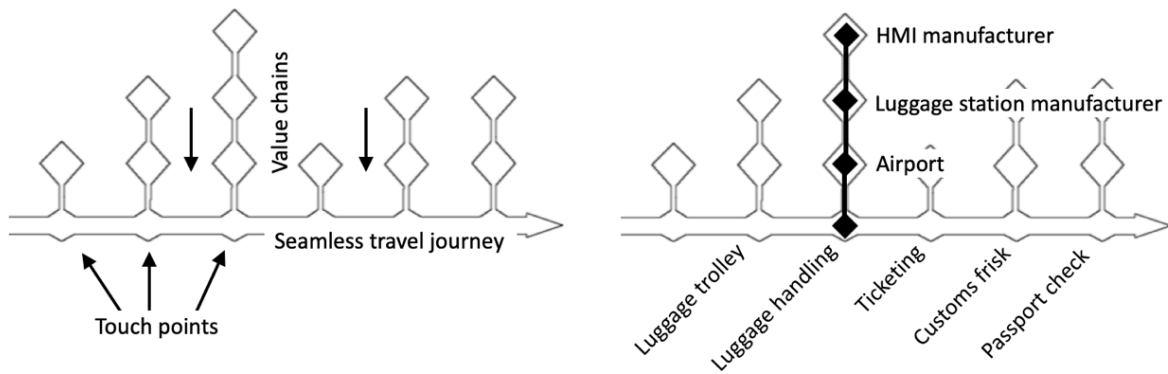


Figure 3. Generic mobility customer journey and Figure 4. touch point with value chain

The purpose of a conventional Value Chain though, is to visualise business flow in which Value refers to financial profit. It is not designed to share knowledge [9] i.e. evoke cross fertilisation. Cross fertilisation is evoked by connecting the three aforementioned and interconnected levels as derived from our holistic approach; context, system and product. These levels form the third dimension of the model. Although visual thinking is integral to design practice, its recognised application into other domains is relatively new. There is still little to none in-depth literature [10, 11] on visual thinking, often limited to an explanation of depicted images with little depth as to why specific views or colours were chosen. Third dimensions are sometimes added for aesthetic reason, but no insight was found on how to apply a third data dimension [11]. Figure 5 shows the customer journey with the third dimension added. Stakeholders in the value chain may now be identified at their respective level. In figure 6, which is another view, an example how identified potential for cross fertilisation may be displayed across context, system and product level.

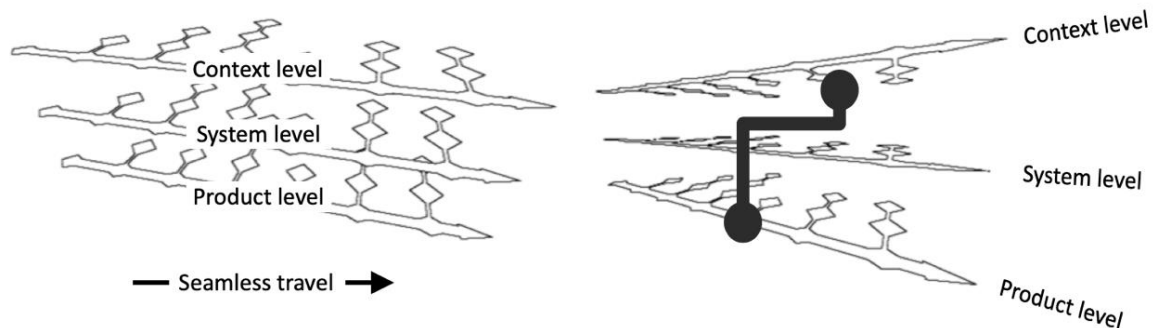


Figure 5. Customer journey at three levels and Figure 6, identified cross fertilisation

#### 4.1 From static to dynamic

Up to the current status of the process static visuals, either hand-drawn or computer-generated, were used to share with stakeholders and fill in specific research topics and their embedding in the overall complexity on an experimental scale. For the virtual laboratory to develop itself across the complex network of all stakeholders and become self-maintaining, a digital platform is being developed.

This platform must initially facilitate a number of filling actions and meet several conditions. After a user ‘fills in’ the system, positioning and framing their research or project, the system must recognise potential connections to other research and projects in the system. The platform must also actively set-up communication with and between users to maintain information extraction on e.g. upcoming experimentation. By actively sharing resources, experimentation and data the scientific process also becomes more efficient. Knowledge must only be generated once and becomes available earlier, including supporting services like finance and valorisation.

In the development of the digital platform, the virtual laboratory, the underlying three-dimensional database and required Artificial Intelligence algorithms are relatively easy to develop. For the design of the user interface though, we aim to go beyond existing digital customer journeys, which are 2-dimensional [12], and develop a 3-dimensional user-interface. Starting from the CAD model in figure 4, it would allow users to actually rotate the structure (customer journey in three dimensions) and visualise their own position as well potential cross fertilisation. It would raise the look and feel of a dynamic organism, which is very much how the virtual laboratory is intended.

## 5 CONCLUSIONS AND FURTHER RESEARCH

The design application of these visuals may be positioned as *visual thinking* as they have facilitated negotiations in a design process, serving as a *management models* i.e. models in which stakeholders recognise their own position or domain and may adapt the model to their own needs, as you would do in a SWOT or Porter's Five Forces.

In this research by design process, the use of visual thinking as a means to frame complexity, create awareness and consensus, has proven valuable. There is no identifiable difference therein between stakeholders in management, stakeholders with a design or engineering background or with a 'non-visual' background such as psychologists.

While the consider none of the elements in this strategy design process new in their own right, we do suggest novelty in how they are integrated and applied, in this specific domain. Preliminary results in Strategy Implementation indicate that the transition from 2D static visuals into 3D dynamic visuals are the main challenge, and therefore subject to further research.

Further research addresses the actual development of the digital platform with a focus on HMI design, as an interactive visual, recognisable to stakeholders who have been involved in the strategy process. A preliminary assessment suggests that the current visual, which suggest three customer journeys (at three levels) instead of one, is confusing. Alternative representations may be investigated.

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