TOOLBOX

A concept car in the airport

Why a concept car design approach also inspires baggage handling software design

This article describes a recent project where the concept car design approach, as used in the car industry, is applied to the airport's baggage control software to instigate such a big leap. In the car industry it is common to envision innovative ideas in a concept car. This approach brings unique benefits and proofs to be attractive to customers as well as to designers, engineers and management. It visualizes ideas in an attractive, tangible way, such that the value of the ideas can be validated with different customers and users before much effort is put in making it work.

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Imagine you are traveling from a busy airport to a lovely holiday destination for which you have just checked in your bag. Behind the scenes different organisations, people, processes and advanced, automated systems are trying to ensure that your bag gets onto your flight, on time. Those of us who have been waiting at the reclaim carrousel and did not meet their expected bag, know the feeling of (temporarily) losing their bag. Airports and airlines understand that their air travel business is largely about the passenger experience and therefore about their emotion. Nonetheless, baggage handling is a complex process.

To succesfully meet your bag at the reclaim carrousel of your holiday destination requires a smooth baggage handling operation of all parties involved. Tasks and responsibilities are split over airport personnel as well as over airlines, security-, baggage handling- and maintenance companies (see Figure 1).

The complexity of these processes relates to several aspects the baggage control room needs to deal with, one being the baggage flow (number of bags/hour). A single terminal at a busy European airport processes, for example, approximately 12.000 bags an hour.
In these baggage handling processes many human factor challenges can be found. One of the most important is matching the user's experience and expectations with the technical challenges behind the 'screen'. How can a complex system be fine-tuned to the individual? The

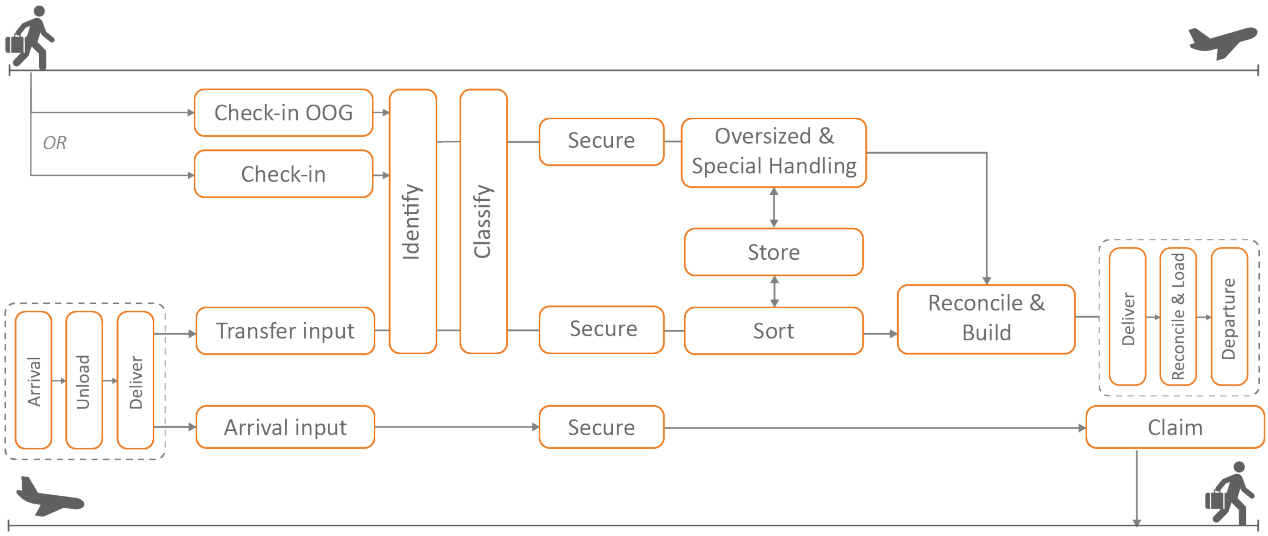


Figure 1. Overview of the different baggage processes.

automotive industry has decades of experience in tackling these issues by developing concept cars to make big leaps in designing increasingly complex systems with individual preferences and user experiences. It is designed to show future, potentially ground-breaking concepts of which the car manufacturer likes to know what is appealing to the public and what is not. They are one-off cars build for the purpose of testing the potential customer's response to new ideas and thus decrease the risk of the commercial car's development (Crea, 2015), which is costly and time-consuming. Developing a concept car allows the manufacturer to understand which ideas should be followed up now and which can be left out for the next version of a car. A concept car can feel weird to some users, because it takes time to understand a concept that is responding to the future instead of to the current needs. So, if a specific aspect is currently disliked, does it need to be thrown away or might it be desired (in a slightly different form) in a later version of the car?

This article focuses on the car industry's concept car approach that is being used to bring the user experience of the baggage handling software to the next level. However, before we look at how this approach can be applied, we first briefly discuss the more traditional approach used in the domain of baggage handling.

Evolutions in more than ten years of baggage design and operation

In 2003 an HTA (see text box) was created for the operations and maintenance of a large baggage system (Lenior, 2006). In the detailed design phase, discussions upon what the user interface exactly should look like were taking quite some time and effort. At the time the solid HTA approach sped up making the right user interface design choices. It brought more clarity in the roles and responsibilities of the different organisations involved and identified the exact split in the user interfaces.

HTA - Hierarchical Task Analysis (Kirwan and Ainsworth, 1992)

HTA is a structured approach to describe the users' tasks. Start with the main goal that needs to be achieved and split it up into tasks to achieve that goal. Then break down each task into subtasks, until sufficient understanding of the user's actions is found. For each (sub) task aspects like the sequence, duration, frequency and the user role can be described. An analysis that results in a base for the user interface designs and provides clarity upon roles and responsibilities.

Since the baggage system in the airport terminal mentioned above went live, the organisation of baggage monitoring and control has changed and requires updates to its process. The multi-terminal airport has consolidated all baggage control rooms into a single, airport-wide room (see Figure 2). Though different terminals at this stage still use different software applications, this centralisation allows for more efficient sharing of knowledge, operators and baggage system capacities.

Furthermore, technology and its integration in society has changed substantially in ten years' time. Artificial intelligence for example has taken a leap, also in private use. Having intuitive smartphones and tablets with apps that support the user by 'spontaneously' providing suggestions (e.g., 'it will take you 20 minutes to travel to work if you leave now') has resulted in higher expectations by users from technology and a more individualized and smoother user experience.

Figure 2. A baggage control room with a variety of software- and communication systems.

With this new context in mind, it was time to re-envisage the baggage software tools. Besides doing gradual software upgrades, based upon changes in legislation or user requests, this led to an explorative project with a completely fresh view on what is desired to optimally support the baggage operation.

Project concept car

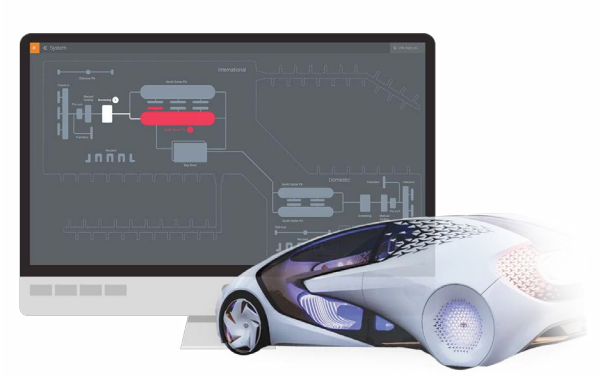
In 2017 our *concept car* project started. This project aimed on bringing the user experience of the baggage control software to the next level. The assignment was to design an innovative, easy-to-use and attractive user interface that fully focuses on the main goal to be achieved; getting each bag on the right flight, at the right time.

This project was executed in close cooperation with a strategic design agency, that makes attractive and useful products and uses design as a power to change and improve (www.fabrique.nl, 2018). After having the whole team on the same page with regards to the baggage handling contexts, a creative session was held to set the first idea directions for the concept car. An important aspect that needed quite some discussion, was the decision upon the appropriate timeframe. This timeframe needed to balance fitting the world as it is, because it should be possible to start development now, as well as being innovative and fitting the near future. Even though certain parts of the concept car are expected to be launched sooner, a timeframe of four years out, as also used in the car industry to launch a new car (Meijia Sarmiento, 2018) appeared to be quite appropriate.

Subsequently, a so-called *pressure cooker*, which resembles a *design sprint* (Knapp, Zeratsky and Kowitz, 2016) started; an agile approach to build a prototype with a small team in just five days. This prototype, the concept car, consisted of an attractive, interactive set of user interface designs and was first tested internally. Feedback was gathered via presentations and discussions with colleagues in baggage design, sales

Intelligence in baggage control systems

User interfaces in the baggage control room are amongst others a planning system to allocate baggage processes and flights to specific system resources, a SCADA system to monitor the status of the baggage equipment with an integrated CCTV system to show camera footage of specific baggage areas and a real-time Operational Dashboard to have insight in the performance of the baggage processes. This dashboard provides insight in situations that create 'traffic jams' in the system. For example, when there is a backpack strap that gets stuck and blocks the flow or when there's an abnormal peak in the number of late bags arriving with delayed flights, the smart baggage system will indicate that and re-route bags.



and engineering. After another iteration, the concept car was taken to control room operators and their management at three airports to receive feedback. Interviews were held, and observations made whilst users were asked to perform certain tasks with the prototypes. Management was involved as the solution impacts the way work is organised. To set the right expectations, the name concept car was first briefly explained, internally as well as with customers. Responses on this approach for new concept development and user's involvement were positive, even though choices on certain concepts were challenged. For example, this future concept car looked at the users' experience of map and navigation technology with seamless zooming and decision support that invited users to easily share their comments and ideas. After all, a concept car in a car show also evokes all sorts of reactions.

The reactions on the prototype of the software steered decisions upon which aspects needed to be developed more and which aspects of the prototype are not desired in the foreseen future. After the users' decisions were considered, the development project phasing could be defined and the technical feasibility study for only the desired features could be finalized, all resulting in a better indication of the required development budget.

At this moment of writing, the software development of the next generation of baggage control software has started. An agile project that uses Scrum (see box) and several user centred/design thinking methods. In this quickly changing world, with more and more technology integrated into our lives, it is essential to keep on validating the solution and being able to adapt to the new learnings. Lessons on how to best scrum, with a team of user experience- and visual designers, front-end and back-end developers in the technical baggage environment are crucial, but out of the scope of this article.

Concluding thoughts

The use of technologies in different markets and in the home environment (e.g. smart speakers, use of smartphones to control household equipment) has substantially grown the last years. This heavily influences the expectations of the user in a work environment. It

therefore becomes more important to understand the needs and desires of the future professional user and the goals he or she needs to achieve.

These new technologies are also for engineers great to use in their products. It is however still important to exactly understand the user's goals. So, how difficult is it to stick to a user-centred design approach in this fast changing, increasing technology driven, world? Especially when the exact users of the system and their responsibilities are becoming less fixed. A challenge for the human factors professional as well as for various kinds of designers to keep on putting the user first. Engineers however do like it when attractive, challenging solutions are created with new technologies.

In this article two methods have been touched upon which differ in approach as well as in appliance. The method of HTA is a more verbal approach that looks at the main and sub goals to be achieved. It was time-consuming to create but helped in detailing the user interface designs. Nowadays having more easy-to-use software available that could speed up HTA work, I would like to see what HTA still can bring in this quickly changing world.

The second method, that of the concept car approach via a design sprint, is more high level; in a short period of time it visualizes how innovative ideas could work in a tangible user interaction design. This makes it possible to quickly evoke reactions and get feedback from users if or how they would use it.

Concept car in the airport

So, why do concept cars inspire the airport's baggage world?

The approach has shown that it works to create an attractive visualisation of the future baggage control software and enabled prospect users to more easily provide their feedback. Bringing in the emotion of a concept car made it easier for direct colleagues as well as for future users and management. to comment on the design of the software.

Properly balancing the people, business and technology aspects will result in a safe and enjoyable operator experience. When the concept car has turned into a driving car, i.e. when the software will be fully developed and operational at different airports the coming years, we're eager to learn whether the design for the baggage control operators in the end translates into a more pleasant passenger experience. No waiting at a reclaim carrousel for a bag that never shows up.

Summary

Airports and airlines understand that their passenger's experience is one of the most important aspects in the air travel business; for a large part of travelling is emotion. How baggage is processed is part of that passenger experience. Baggage handling at the larger airports is quite a complex process in which many organizations need to collaborate. The challenge for baggage system designers is to not only design a system that meets the performance and capacity requirements for the logistical challenges, but to also ensure that the system is optimally used. An optimal design for the baggage control room operator minimizes errors and delays, such that each bag reaches the correct destination on time. For each airport there are differences in the challenges they face to achieve this, for example because of differences in size, space, organisation, passenger- and baggage flows. This implies that, besides enhancements required by changes in legislation or technology, baggage control software is often enhanced based upon user requests for a specific situation. The result is that there are continuous step-by-step improvements, but it misses out on the big leap forward.

Scrum to develop software products

Scrum (www.scrumguides.org, 2018) is an iterative framework to develop software products in a flexible way. It accepts that complex problems cannot be fully defined up front, that things change and that unpredictable challenges will always be there, for which a fully planned approach is not suitable. In short sprints (1-4 weeks) with a small, multidisciplinary team (3-9 people) working products will be delivered and shown to the stakeholders, such that it quickly becomes clear whether the project is on the right track.

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