The Upid-Model

A model for use-centered design of payment instruments applied to banknotes
by Hans de Heij and reviewed by Douwe Brongers

This article reflects in short the main chapters of Hans de Heij’s dissertation, for which he developed a model for the use-centered design of payment instruments. This model describes the interface between a human being and a payment instrument, such as a banknote denomination or a debit card, and its aim is fourfold: to provide a description of the reality of a payment from a users’ perspective; to be the smallest testable model to design the human interface of a payment instrument; to deliver a terminology supporting the design of payment instruments; and finally, to put the user first when designing a payment instrument.

Model building on use-centered design of payment instruments

Banknote design is a niche area of product design. Banknotes have existed for over 350 years and have always been designed without an academic model. Ever since the 1970s, when the number of security features started to increase as a result of the emergence of automatic banknote inspection, a technology-driven design policy has been favoured over a use-centered one, where the banknote user is put first. This is illustrated by a definition of banknote design by the Reserve Bank of New Zealand: “Banknote design requires very specific technical knowledge in a range of areas, including aesthetics, printing techniques, security features and banknote equipment requirements”.

Literature

Literature does not provide a model for banknote design. Banknotes are part of the graphic design domain. Although Frascara’s ‘User-Centered Graphic Design: Mass Communication And Social Change’ does connect graphic design and user-centered design, the design methods presented are not applicable to banknote design. The well-known publication ‘The Design of Everyday Things’ delivers inspiration, but does not deliver a model either.

The first publication on user-centered design related to banknotes is ‘Embedded Reading Device for Blind People: a Use-Centered Design’, in which the development of a reading device for blind people is described, which can also detect a banknote’s denomination. This study highlights how human aspects should be managed within an engineering space. The subtitle of ‘Design as a process’, a recent publication on design, is ‘Why designing a chair is the same thing as designing a website’. Although job titles of designers may be different, their design processes overlap. The article in question supports the idea that banknote designers can be compared to website designers, as ‘chair’ can be replaced by ‘banknote’.

Upid-Model

The proposed ‘Model for Use-centered Design of Payment Instruments’, in short the Upid-Model (see Box 1), connects banknote design with two existing knowledge domains, respectively the economic function...
of money and design methodology. The adopted design methodology builds further on interaction design and use-centered design.

**Model for Use-centered Design of Payment Instruments**

‘Upid’ stands for User Payment Instrument Design. The Upid-Model connects two fields of knowledge within the domain of design methodology, respectively ‘use-centered design’ and ‘interaction design’. Use-centered design is derived from ‘user-centered design’ - with an ‘r’ in ‘user’ - a knowledge domain developed within the last 25 years. Interaction design is younger, known for about 20 years.

**Interaction design**

Interaction design distinguishes between the use and the experience of a product, and is divided into ‘user interface design’ and ‘user experience design’. Similarly, the Upid-Model divides the user functions of a banknote into User Interface Functions (UIFs) and User Experience Functions (UXFs).

**Use-centered design**

Use-centered design is a specific form of design. As a banknote is a product, its design is limited to the design of material products. The product to be designed can be approached in different ways, expressed by the ‘design policy’, which may range from specific problem solving to a holistic approach, respectively from a new banknote design to an alternative means of payment. A use-centered design policy puts the end user first, which has been the starting point for the Upid-model.

**Banknote users**

The first question regarding a use-centered design of banknotes is: Who are the users of banknotes? This question is usually answered by a classification of security features used to check banknotes on authenticity:

- level 1, for the general public
- level 2, for the retailers
- level 3, for the central banks

However, checking banknotes on authenticity is not the reason why people use banknotes. A common usage situation is ‘value recognition’. Looking for the value, people are in ‘denomination mode’, one of the user function modes, and a novel term combining the user and the user function. Another user function mode is the ‘handling mode’, which describes the situation that a banknote is stored in someone’s wallet. When a user receives a dirty or damaged banknote, they may leave the denomination mode and opt for the ‘confidence mode’ as they will make up their mind whether they can trust the deviant note. When distrust persists, they may switch to ‘authentication mode’ and may perform an ‘authenticity self-check’.

**Economic functions of money**

There are three economic functions of money:

1. unit of account
2. means of payment
3. store of value

These economic functions are converted into the user functions of a banknote, which form the basis of the Upid-Model for the design of user-friendly banknotes. The distinction between use and experience is key: user functions are divided into User Interface Functions (UIFs) and User Experience Functions (UXFs). Ten user functions are identified within the model: four UIFs and six UXFs (see Table 1).

**User Interface Functions**

Within the Upid-Model four UIFs are identified. Of these four, the most decisive user function is ‘recognising value’ (UIF 1), the others are: ‘handling’ (UIF 2), ‘checking authenticity’ (UIF 3) and ‘receiving a communication message’ (UIF 4). The main conclusion is that modern banknotes show shortcomings on all four UIFs.

When a central bank has little knowledge of user functions, it will not be able to formulate user requirements (see Figure 1). Subsequently, design requirements will remain unidentified, which may result in suboptimal banknote designs. This seems especially true for the
**The Upid-model**

**User Experience Functions**

Within the Upid-Model, six UXFs are identified. The most decisive user function is ‘experiencing identity’ (UXF 1). The others are: ‘judging aesthetics’ (UXF 2), ‘keeping confidence’ (UXF 3), ‘reacting on the main image’ (UXF 4), ‘requiring sustainability’ (UXF 5) and ‘linking to information technology’ (UXF 6).

UXFs are not strictly necessary to make a payment. From a historical point of view, most UXFs have been added after the introduction of the UIFs. One observation is that modern banknotes tend to focus on UXFs, while for a daily payment the UIFs are more relevant. Obvious design variables are identified for the UIFs, while the design variables of UXFs seem to be more multifaceted. Concluding, the number of banknote UXFs is increasing, with new UXFs such as requiring sustainability (UXF 5) and linking to information technology (UXF 6).

When a newly designed banknote is issued, people are interested in the UXFs. The unveiling of a new banknote is therefore an ideal moment to get the public’s attention. However, after a while people get used to the new design and they rely on the UIFs. Ideally, the UXFs should contribute towards an optimal functioning of the UIFs.

**Users’ perception**

As the user is put first in the Upid-Model, it is essential to have knowledge on how they perceive certain banknotes. However, there is no dedicated theory on cognitive processing of banknotes, and although there are several methods supporting insights into human reactions on a banknote design, they all seem to be at their infancy.

Two models have been developed to increase understanding of user behaviour with banknotes:

- the ‘4M Model for the Perception of Banknotes’, which focuses on people’s attention for banknotes;
- the Model for the New/Upgrade Ratio of Banknote Design, which uses two parameters to create a concept for a new banknote: innovative technology and change of graphic design.

These models show that banknote designs should not deviate too far from what people may perceive as a banknote; a rule of thumb is that the maximum design change can be 80%. However, in general people are not looking forward to a new banknote design; any

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**From user function to design**

<table>
<thead>
<tr>
<th>User functions</th>
<th>Functional requirements</th>
<th>User requirements</th>
<th>Design requirements</th>
<th>Role of the central bank</th>
<th>Role of designer</th>
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<tbody>
<tr>
<td></td>
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<td>2) Main image</td>
<td>2) A bird</td>
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<td></td>
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<td>3) Numeral</td>
<td>3) Size &gt; 22 mm</td>
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<tr>
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<td>4) Size</td>
<td>4) 146 mm x 72 mm</td>
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**Figure 1:**
Schematic representation of the derivation of user functions to design requirements, including an example of the user function ‘recognising value’. This is the role of the central bank. The designer can start once the Programme of Requirements is ready, identifying user functions and functional requirements. The functional requirements are translated into user requirements, based on preferences of the different user groups, and subsequently the user requirements are translated into design requirements.

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**Douwe Brongers** (1945) worked for the Dutch Postbank and ING for nearly 40 years. He was policy advisor in the field of fraud prevention and development of new means and procedures against fraud. After his retirement Douwe first became editor of the Journal and later editor-in-chief. During his retirement he has written several articles and books, related to fraud and also related to other areas of interest.

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Application of the Upid-Model to the design of banknotes

A common stage within a banknote design process is the preparation of a technical layout. This is a drawing providing the optimal locations for machine readable features, taking into account circulation effects such as folding lines and tears. Banknote designers may also prepare a functional layout: a mixture of machine readable features and main design elements serving user functions, such as the main image and large numeral. A further development of a technical and functional layout is the creation of a usage layout, to be prepared for each user function of the Upid-Model.

Method for Creating a Usage Layout for Banknote Design

To transfer design requirements into a usage layout, the Method for Creating a Usage Layout for Banknote Design has been developed. This method aims to create separate, optimal designs for each UIF and UXF. Dedicated specialists may be consulted to develop an optimal usage layout for each user function. Subsequently, the banknote designer combines the developed usage layouts to arrive at a usage layout for respectively all UIFs and all UXFs. From there, a blueprint is created that is the basis for sketch designs for each of the denominations.

The Upid-Model has the potential to deliver use-centered banknote designs, based on user requirements. This novel approach provides an advanced perspective on the banknotes designed.

Application of the Upid-Model to the design of digital payment instruments

The digitalisation of payment techniques has reduced the use of banknotes, a development which started with the arrival of mainframe computers in the 1960s. These days, cash is losing market share, and although it is not expected that coins and banknotes will disappear completely within the coming decade, people do opt for digital payment instruments as they fulfill their user needs better. As the user of a payment instrument can be seen as a constant – the user of a banknote is considered to be the same person as the public attention for banknotes is hindered by a wait-and-see attitude.

An overview is provided of the knowledge gained on the perception of banknotes, suggesting that:

- The main images within a series of banknotes should be selected from different image categories, as the main image contributes to the recognition of the banknote’s value (UIF 1).
- No evidence has been found that people will perceive disturbances in a portrait better than similar types of disturbances in images of other categories.
- Designers usually concentrate first on the front of the notes, and then the reverse. They have little eye for their designs when viewed in transmission.
- Tactile structures positioned on the banknote’s back will improve the instant recognition of genuine banknotes (UIF 3).
- According to linguistic determinism, people may only remember design elements of a banknote when they have a name. This is relevant for the series theme, the theme of individual banknotes and the public authenticity features.
- Instead of look-through and tilt features, feel and look-at features should be developed, as they match the user experience requirement of a delicate authenticity check.
- People experience problems with the perception of tilt-features (images, colours).
- Monitoring eye movements during the design process is useful as they provide design feedback, so that changes of the design can still be made.

Measurements reported according to the Upid-Model

The proposed Upid-Model delivers an appropriate framework to report measurements reflecting the users’ perspective. This conclusion can be drawn from the measurements done on the user functions of banknotes covering the period 1981-2017, for both the Dutch guilder and the euro designs. Measurements were reported for four different types of banknote designs, two variants of the Dutch guilder and two types of euro design.

When a target score is specified for each user function, a new banknote design can be compared to the model it will replace. A banknote model can also be compared to any other banknote design or to a benchmark. In case of a benchmark, the score should, for example, be at least 7 on a scale from 1 to 10. Translated to the aesthetic qualities of a banknote, this implies that at least 70 % of the population should judge a banknote as beautiful.
Design

The Upid-model

To answer this question, the Upid-Model was applied to two digital payment instruments: a debit card payment at a point of sale and an internet payment with a wallet app on a smart phone. This did not unveil other user functions than those relevant to banknotes. However, one topic could not be addressed: the user need for reliability. When a digital transaction is interrupted, and consequently fails, payer and receiver become uncertain and irritations may occur. Unlike a cash transaction, a digital payment may fail in one or more of the following circumstances:

• a power failure, either of the electrical grid (debit card payment), or because of a dead battery (mobile payment);
• loss of internet connection, which prevents connecting to the payment service provider, usually a bank.
• an insufficient amount of money in a person’s bank account.

Most of the given design advice on how banknotes can be made more user-friendly is also applicable to digital payment instruments. This is largely explained by the observation that the design of digital means of payments is characterised by a technology-driven design approach. Apparently, the end users first have to complain before the designs of UIFs or UXFs are adapted. The author’s advice to both banknote and other payment instrument designers is to deliver a use-centered design.

Conclusions

Four research questions were posed in the dissertation and all four received a positive answer.

1 The dissertation proves that it is possible to develop a Model for Use-centered Design of Payment Instruments, which can be applied to banknote design, as all user situations concerning banknotes could be addressed. The proposed Upid-Model proves to be an appropriate description of reality, and provides an insight into the interrelationships between the different user functions.

2 The Upid-Model delivers an appropriate framework to report measurements reflecting the users’ perspective.

3 The Upid-Model proves to be a useful guide to create a use-centered banknote design, delivering a novel concept.

4 The Upid-Model can also be applied to digital payment instruments (debit card and wallet app).

References


6 Oosterlaken, E. (2017). Design as a process. Why designing a chair is the same thing as designing a website. Turn the Page. Study Association I.D. Delft Technical University. Faculty Industrial Design Engineering, 18(60), pp. 33-35.

Figure 2: The banknotes depicted here are innovative concepts for a imaginary currency: MAX (Money of Area X). Although they look different, the notes are immediately recognisable as banknotes.