Use-centred design of banknotes: getting started

by Hans de Heij

A new threat to banknotes is becoming increasingly prevalent: the usage threat. The public are turning to digital payment instruments to pay for transactions as they provide a swift and timely service. In order to combat this, central bankers must consider the user in their approach to design. The use-centred design policy is a common approach employed which divides the user functions into user interface functions (UIFs) and user experience functions (UXFs). Central banks tend to focus on the UXFs, like the main image, and less on the UIFs, the most relevant user functions for daily payments: value recognition, handling and authenticity self-checks.

In designing a banknote, central banks follow the adage of “one size fits all”. However, since banknotes are not a consumer product but a utility product, central banks cannot opt for a trendy banknote design or a senior model with a bigger letter type. A use-centred design policy starts with a look at the end-users: the public and the retailers, before turning to the main end-user of a banknote, the public, along with a definition of two key terms, the “use” and the “experience” of a product. The model for use-centred design of banknotes is then presented, and a framework supporting its management. The chapter concludes by presenting ten practical steps that central bankers can take to develop use-centred design of banknotes.

The user is missing

Central banks are able to decide on banknote denomination and appearance. In practice, it is the printer or the cashier that tends to dominate the design process. A quote by Henry Ford represents the printers’ view: “Any customer can have a car painted any colour that he wants so long as it is black”. A cashier takes a more paternalistic view of “father knows best”. In both of these views, the user is missing (see Figure 4.1). Therefore central banks may adopt a users’ view, a similar customer approach expressed by Apple’s
late co-founder, Steve Jobs. Jobs turned the Ford idea on its head by saying: “User experience is the only thing that matters”. The term for such an approach is “user-centred design” (with an “r”), which was first introduced by Don Norman, who also worked for Apple. A user-centered design policy is characterised by an early and continual focus on the people using the product. A user-centred design policy has been laid down in an ISO standard on human-centred design process, defining usability as the extent to which a product can be used by specified users to achieve specified goals (ISO, 2010). Effectiveness, efficiency and user satisfaction are the main criteria.

As banknotes are not a consumer product but a utility one, it is more appropriate to focus on the use or usage. The step from user to use was made by Flach and Dominguez, who introduced the term use-centred design (without an “r”).

**Difference between user and stakeholder**

People expect to use banknotes without any difficulties. The automatic processing of banknotes by automated teller machines (ATMs) and payment terminals has increased since the 1990s. Therefore, central banks developed “outreach programmes” to communicate and engage with key stakeholders, especially to banknote equipment manufacturers (BEMs). However, as underlined in Figure 4.3, a stakeholder policy is not similar to a design policy. In simple terms, stakeholders provide the infrastructure for the usage of the banknotes, while the focus of a design policy is on the use of the banknote by the public and retailers. Central banks should shift their technology-driven design policy to a use-centred one, a policy led by user behaviour (see Figure 4.4).

![Figure 4.1 User is missing in banknote design process](image)

Source: author.

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Use and experience

When it comes to model building for banknote design, academic thinking is still in its infancy. Model building may start with the distinction between use and experience. Application of the variables “use” and “experience” leads to four basic models to approach a new banknote design (see Table 4.1). As any new banknote design will be replacing an existing one, the innovations involved in a new banknote should be compared to its predecessor. If not much has changed, in use or experience, the design is an upgrade (model 1). An example of this model is the second series of euro banknotes, which had a refreshed design (see Figure 4.5).

**Figure 4.3  Banknote design policy and stakeholders’ policy**

<table>
<thead>
<tr>
<th>Main users</th>
<th>Main stakeholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public - retailers -</td>
<td>- Banknote producers (e.g. printers)</td>
</tr>
<tr>
<td>Users of banknotes</td>
<td>- Banknote distributors (e.g. commercial banks)</td>
</tr>
<tr>
<td>Design policy</td>
<td>- Banknote Equipment Manufacturers (BEMs)</td>
</tr>
<tr>
<td>Stakeholders of banknotes</td>
<td>- Cash In Transit companies (CITs)</td>
</tr>
<tr>
<td>Stakeholders’ policy</td>
<td></td>
</tr>
</tbody>
</table>

Source: author.

**Figure 4.4  Imaginary scale of banknote design policies**

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Technology-driven                   Use-centred

Led by technology                  Led by user behaviour

= Position of modern banknote design
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Source: author.

The replacement of paper-based banknotes with synthetic substrates is an example where the emphasis is on a novel use (model 2), as their graphic designs are usually kept similar (Figure 4.5). Since the first Australian polymer banknote was issued in 1988, over 25 central banks have followed, including New Zealand (in 1999), Canada (in 2011) and the UK (in 2016). The third model (model 3) represents new banknote designs that show a different graphic design and emphasise the user experience. The new series of Swedish banknotes is an example here, as they replaced their historic portraits with images that had more public appeal, such as film stars (Figure 4.5). An example of new banknote designs emphasising both the use and the experience (model 4) is the Norwegian banknote series “The Sea” (Figure 4.5). This series introduces images from different categories, including an animal (fish) and a building (lighthouse), which supports instant value
recognition, the main user function. Furthermore, the Norwegians underlined their banknote identity, the main experience function. The introduction of the euro banknotes in 2002 to the citizens of 12 countries also saw a large design change, emphasising both the use and the experience of this new currency. Compared to the existing banknote model, a new banknote design may have different settings to emphasise the use and/or experience aspects.

Table 4.1  Four basic models for new banknote design

<table>
<thead>
<tr>
<th>Base model of use and experience of banknote design</th>
<th>User functions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Use</td>
</tr>
<tr>
<td>1. Refresh existing model</td>
<td>o</td>
</tr>
<tr>
<td>2. Emphasise use</td>
<td>●</td>
</tr>
<tr>
<td>3. Emphasise experience</td>
<td>o</td>
</tr>
<tr>
<td>4. Emphasise use and experience</td>
<td>●</td>
</tr>
</tbody>
</table>

○ = Maintained design policy  
● = Result of new design policy  
Source: author.

Figure 4.5  Examples of basic models of banknote design

1. Refreshing existing model — Euro (2013)

2. Emphasis new use: from paper to synthetic — Canada (2011)


4. Emphasis on new use and new experience — Norway (2017)

Source: authors.
Model for use-centred design of banknotes

The model for use-centred design of banknotes, builds further on the introduced terminology of use and experience, dividing the user functions of a banknote into UIFs and UXFs, as shown in Table 4.2. As the model is also applicable to other payment instruments such as a debit card, the model is labelled Upid-Model, for User Payment Instrument Design. The ranking of the UIFs is based on public input and reports, as well as the “usability score”, which was used for euro banknotes. The result was 6.4, on a scale from 1 to 10, which was an acceptable but not very high score.

In terms of the order of the UXFs, the public is interested in their own banknotes and not that much in others, which is the reason “experiencing identity” is put first (UXF 1). Very quickly, people make a judgement on their aesthetics, finding a new banknote either beautiful or ugly (UXF 2). Subsequently, people want to trust their banknotes (ie, “retain confidence”, UXF 3), and may “connect with the main image” (UXF 4). The next two experience functions are positioned at the foot of the scoring – “expecting sustainability” (UXF 5) and “linking to information technology” (UXF 6), such as with a smart phone. As with the usability score, which provides an end-score for the UIFs, the experience score offers an end-score for the UXFs. In analysing new banknote designs, central banks tend to focus on the UXFs and not on the UIFs.

The left-hand side of Table 4.3 depicts the targets a central bank may set. On the right are the realised values for the €50 (2002), measured in the Netherlands. Measurements are not available for the targets set between brackets. In general, a banknote should score more than seven on a specific user function on a scale of one to 10.

**Table 4.2 Model for use-centred design of banknotes (Upid-Model)**

<table>
<thead>
<tr>
<th>User interface functions UIFs</th>
<th>User experience functions UXFs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Recognising value</td>
<td>1. Reorganising identity</td>
</tr>
<tr>
<td>2. Handling</td>
<td>2. Judging aesthetics</td>
</tr>
<tr>
<td>3. Checking authenticity</td>
<td>3. Retaining confidence</td>
</tr>
<tr>
<td>4. Receiving a communication message</td>
<td>4. Connecting with main image</td>
</tr>
<tr>
<td>-</td>
<td>5. Expecting sustainability</td>
</tr>
<tr>
<td>-</td>
<td>6. Linking to information technology</td>
</tr>
</tbody>
</table>

Source: author.
From user functions to design requirements

All user functions must be defined in terms of design requirements. To get the design requirements right is the hardest part of any design process. Design requirements are set either in the first phase of a design project or the fuzzy front end of design. Indeed, for many central banks the start of a new banknote design process is an unstructured period.

Figure 4.6 shows how user functions are transformed into design requirements in three stages: from user functions via functional requirements, to user requirements, and subsequently to design requirements. The figure also provides an example of the user function “value recognition”, where the functional requirement is 50. To have a readable numeral 50 is the next step, and user requirements will have to be formulated. To list these, knowledge has to be gained on user needs, which is commonly obtained via literature or by performing dedicated studies. In the case of the numeral 50, typographic parameters have to be set, such as the height of the numeral and the contrast with its background. Finally, all collected information has to be analysed, leading to an instruction to the banknote designer in the form of design requirements.

Figure 4.6 From user functions to design requirements, including an example of the user function “recognising value”

To summarise, user functions should first be identified, followed by functional requirements. The functional requirements then have to be transferred into user requirements based on preferences of the different user groups. Subsequently, the user requirements have to be translated in design requirements.
Table 4.3  Assessment scheme for banknote design, applied on euro 50 (model 2002)

<table>
<thead>
<tr>
<th>Model for Use-centred Design of Payment Instruments (Upid-Model)</th>
<th>Target</th>
<th>Realised (Euro 50, NL)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Year</td>
</tr>
<tr>
<td>UIF:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Recognising value</td>
<td>&gt; 98 %</td>
<td>2015</td>
</tr>
<tr>
<td>2 Handling</td>
<td>&gt; 90 % clean</td>
<td>2015</td>
</tr>
<tr>
<td>3 Checking authenticity</td>
<td>Av. knowledge of features &gt; 3</td>
<td>2017</td>
</tr>
<tr>
<td>4 Receiving com. message</td>
<td>(&gt; 7)</td>
<td>-</td>
</tr>
<tr>
<td>1-4 Usability score</td>
<td>&gt; 7</td>
<td>2013</td>
</tr>
<tr>
<td>UXF:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Experiencing identity</td>
<td>(&gt; 7)</td>
<td>-</td>
</tr>
<tr>
<td>2 Judging aesthetics</td>
<td>&gt; 70 % beautiful</td>
<td>2017</td>
</tr>
<tr>
<td>3 Keeping confidence</td>
<td>For complete series &gt; 7</td>
<td>2017</td>
</tr>
<tr>
<td>4 Reacting on main image</td>
<td>(&gt; 7)</td>
<td>-</td>
</tr>
<tr>
<td>5 Requiring sustainability</td>
<td>(&gt; 7)</td>
<td>-</td>
</tr>
<tr>
<td>6 Linking to IT</td>
<td>(&gt; 7)</td>
<td>-</td>
</tr>
<tr>
<td>1-6 Experience score</td>
<td>(&gt; 7)</td>
<td>-</td>
</tr>
</tbody>
</table>

* Combined score for recognising and handling euro banknotes (European Commission, 2015).
Source: author.
Two examples of assessment

To assess the role of the model for use-centered design, two examples are given below – one for UIF and one for UXF, respectively, on an authenticity self-check (UIF 3) and on judging aesthetics (UXF 2).

The first example is a unique set of longitudinal data on the average knowledge of correctly recalled public authenticity features. Figure 4.7 shows that this knowledge almost doubled, from 1 in 1983 to 1.9 in 2015. The introduction of the euro in 2002 provided the average knowledge with a boost from 1.7 in 1999 at the end of the guilder era to 2.3 in 2002 at the start of the euro. Since then, the average moved between 1.9 and 2.3 features, which is above the average for the former guilder banknotes. Over the years, the average shows a deviation of about +/-1 per feature. For example, in 2013 the average of all features mentioned is 2.6 (including incorrect answers) and people belonging to the highest social class mentioned, on average, 3.6 features, while people of the lowest social class recalled, on average, 1.8 feature.

The second example is also a unique set of longitudinal data, but this time on judging aesthetics. People tend to find banknotes either beautiful or ugly. The appreciation of a banknote over its complete product lifecycle was felt for the first time for the NLG100/Snipe presented in Figure 4.8. Over the

Figure 4.7 Checking authenticity

Average public’s knowledge of authenticity features in The Netherlands (1983–2015)

- All answers, including partly incorrect and incorrect
- Correct answers

Source: author.

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years, the public's appreciation for this banknote model was steady, scoring around 80% "beautiful". In 2013, a similar graph was completed for the €5/Classic (2002–13), which is also shown in Figure 4.8. The Dutch rated this model as "ugly", scoring on average below 50%. The measurement method used does discriminate between two different banknote designs. One more relevant finding is that, over time, the appreciation curves for both banknote models are constant.

Implementation of use-centered design of banknotes

This section ends with a few words on the implementation of a use-centred design policy for banknotes. Two situations can be distinguished. First, there is the gathering of information about the user to identify design requirements (see Figure 4.6). This will not cause any problems. The second situation aims for actually involving the end-user in the realisation of the design. Central banks may not feel comfortable with this because of confidentiality arguments. However, this road has already been embarked upon. The results of banknote design contests have been made public before the issue of the first design (for example, in Denmark and Switzerland in 2005). Central banks are also informing the BEMs increasingly early (for example, in Canada in 2010 and the European Central Bank (ECB) in 2014). Moreover, some users have been informed in advance, such as the blind (for example, in The Netherlands in 1984), and other central banks have asked the public to participate on the subjects for their designs (for example, in Canada in 1998 and the UK in 2005).
More recently, the US and the UK have also invited people to participate in the selection of a female to be portrayed on a forthcoming banknote, and the Bank of Canada has had a project to decide on an identity description for future Canadian banknotes based on public input.\textsuperscript{10}

**Ten tips for use-centred design of banknotes**

The reasons for a shift from a technology-driven banknote design policy towards a use-centred one is detailed in the following ten tips for use-centred banknote design.

1. Overcome reluctance regarding the replacement of existing banknotes: People have a wait-and-see attitude towards new banknote designs. They have the view that new banknotes are foremost issued to prevent counterfeiters from mimicking banknotes.

2. Design user-friendly banknotes: User-friendly banknotes are the result of a use-centred banknote design policy. Technology should serve the banknote design and not dominate matters.

3. Choose a new design rather than an upgrade: A new design should receive attention and not be confused with the previous one. A completely new banknote design should therefore overwrite memory of older versions.

4. Provide an appealing identity: A new banknote design can be used immediately and will be in place for the next few years. During times of economic uncertainty, traditional symbolism can come under pressure, so taking an identity approach can be seen as steering, and even experienced as paternalism. Opting for forward-looking (future-oriented) symbolism is a better approach.

5. Offer one main theme: People use banknotes for payment purposes and not for their communication messages. To reduce memory load, a series of banknote should cover a single main theme, and each denomination should tell one story. According to linguistic determinism, people can only remember something when they can give a name to it.

6. Focus on value recognition: What people need most from a banknote is instant value recognition. Colour is the main design parameter, and should be immediately recognised when the banknote is used. On seeing just a small part of it, people should be able to recognise the banknote's value by its colour first. A characteristic main image and large numerals are two more parameters that contribute to the denominating process. The banknote's dimensions play a lesser role.

7. Optimise the colour scheme: Make sure that the colours of any new banknote fit with the overall colour scheme of the series. Changes to
a banknote’s colour should first be checked by the colour blind and the poorly sighted.

8. Optimise handling: Ensure banknotes fit properly into a wallet, and then assign the front to the public and the reverse to usage by retailers and banknote automation. The interaction between humans and banknote automators – receiving and paying – is on the increase (see Figure 4.9). Banknotes should have a single note height, serving banknote automators and the automated processing of banknotes.

9. Underline confidence: People want to be able to trust banknotes. Banknotes from ATMs are known to be genuine, while checking banknotes with automatic devices by retailers is on the rise. Design features should support confidence in the same way that as aesthetically pleasing banknotes.

10. Offer an authenticity self-check: People should be able to carry out an authenticity self-check. Three public features are sufficient for this. Features should be based on both feel and visual examination. To reduce short-term memory loads, there should be less usage of tilt features and colour-changing features. Any such feature should be recognised within three seconds.

Conclusion

Central banks could give more attention to the underpinning of their banknote designs. A user-centred design policy is an innovation that should be explored by any central bank, one that aims for user-friendly banknotes, covering all
user interface and user experience functions. The key to such a policy is
the involvement of the general public and retailers; their feedback should be
used in several steps of the design process. On that basis, it is the central
bank's responsibility to represent the user and formulate user requirements
and subsequently design requirements.

Notes

3. De Heij, H. “A Model for Use-Centered Design of Payment Instruments Applied to Banknotes: Uipid-
4. Rhea, D. “Bringing Clarity to the ‘Fuzzy Front End’: A Predictable Process of Innovation.” In Design
5. Firth, A. V., and S. E. Church. “Building Better Banknotes: The Role of Scientific Research at the
    principles-bank-note-design).