USE - CENTRED DESIGN OF BANKNOTES
Balancing the Use and the Experience

Article by Hans de Heij, De Nederlandsche Bank NV

This article reflects the presentation with the same title, presented at the 4th International Banknote Designers Conference on 12 September 2016 in Paris.

1. INTRODUCTION

Banknotes have existed for over 350 years and have gone through several banknote design periods (De Heij, 2012). Present designs are copies of the 1980s; One might argue that in many ways, banknote design has come to a standstill (Figure 1). Innovative approaches are not developed and central banks tend to follow each other on setup and graphical layout. Central banks also tend to follow each other on feature selection. A greenish ‘rolling bar’ with the brand name ‘Spark’ appeared for the first time on a Chinese banknote in 2008 and is today present on many contemporary banknotes. Another example is the small stripes at the short edges of banknotes, which first appeared on Pakistan currency in 2007 (De Heij, 2009). These stripes provide tactility to the notes and are offered as a denomination feature to the blind. Both features, ‘rolling bar’ and small stripes, are also present on the Europa Series of the euro (Figure 1d). Central banks seem to be caught in their search for authenticity features, durability topics and stakeholder discussions. Not much attention is given to the underpinning of their designs, illustrated by the fact that banknote design policies are a rarely covered topic (De Heij, 2016a). Therefore, a model to review and complete a central bank’s design policy will be welcomed. The road proposed is an academic one, which starts with the end users, the public and the retailers (Figure 2). To date, these two user groups are not part of the banknote design process. In the best case both groups are seen as stakeholders. However, new banknotes are developed for the users and not for the stakeholders and this is a crucial insight (Figure 3). The users may use the banknotes to pay each other and the stakeholders provide the infrastructure for the usage of the banknotes.

Although new technologies have been introduced, the graphical setup of modern banknote designs has not evolved since the 1980s. Knocking on the door of central banks and their banknote designers is a use-centred design policy. A novel approach is found in academic model building on banknote design, which starts with use and experience.

Modern designs are variants of the 1980s

![Figure 1](image1.png)

Similar setup of the graphic design of two banknotes.


![Figure 2](image2.png)

The end users are not represented in a banknote design activity.

- a) Usually three parties are involved in a banknote design project: 1) Central bank, 2) Contractor, commonly the printer, and 3) Banknote designer.
- b) The banknote users are missing.

![Figure 3](image3.png)

The relation between a design policy and a stakeholders’ policy. The small arrow represents the underdeveloped user feedback to the stakeholders.

Figure 1.

Figure 2.

Figure 3.
This publication continuous with the following five topics. First the banknote design process is analysed, which does not involve the banknote users (Topic 2). Subsequently the Coaster Model is introduced (Topic 3), followed by an example of a novel banknote concept developed along the lines of an use-centered approach (Topic 4). The conclusions are presented in the last part (Topic 5).

2. ANALYSIS: USER IS MISSING

In the past central banks received a monopolistic position from their legislator. Within this monopoly central banks are free to decide on the banknote’s denomination and on its design, although in several cases, endorsement is required from the Ministry of Finance or Treasury. In daily practice it is the cashiers or the printer dominating the design process depending on who is in charge at the central bank (De Heij, 2007). The printers’ view often reminds one of Henry Ford’s quote: “Any customer can have a car painted any colour that he wants so long as it is black”. An exponent of a cashier’s view is a paternalistic approach of ‘father knows best’. In both views the user is missing. By stating that “User experience is the only thing that matters” the customer approach of Apple’s late co-founder Steve Jobs made an 180-degree turn compared to Ford. User-centred design - with an ‘r’ - was introduced by Don Norman (1988), who also worked for Apple. A user-centred design policy is characterised by an early and continual focus on people using the product. A banknote is not a consumer product but an utility product and therefore, it is more appropriate to focus on the use or usage. The step from user to use is made by Flach and Dominguez (1995), introducing the term use-centred design, without an ‘r’. Today user-centred design is a common approach for consumer products, reflected in the establishment of an ISO-standard on a human-centred design (ISO, 2010).

It is about time for central banks to shift their banknote design policy from a technology-driven design policy to use-centred one (Figure 4).

Banknote design policies

<table>
<thead>
<tr>
<th>Technology-driven</th>
<th>Use-centred</th>
</tr>
</thead>
<tbody>
<tr>
<td>Led by technology</td>
<td>Led by user behaviour</td>
</tr>
</tbody>
</table>

Figure 4.

Imaginary scale of banknote design policies with on the extreme left a technology-driven banknote design policy and on the extreme right a use-centred banknote design policy. Modern banknote designs operate on the left side of this spectrum, focusing on production techniques and logistics. The focus of use-centred banknote designs is on user behaviour.

Design terminology borrowed from Information Technology

Inspiration for model building of use-centred banknote design is found in the images on computer screens. Like a banknote, computer screens are a form of graphic design or 2D-design, while industrial design represents 3D-designs. In the 1970s the development of the Information Technology (IT) brought the first terms which provided insight in this new design domain of images on computer screens. The term user interface is coined by Tom Stewart in 1975 (Stewart, 2008) and the term user experience by Don Norman in 1988 (Norman, 1988). Today these two design domains have become mature and are respectively referred to as User Interface Design (UID) and User Experience Design (UXD).

An example of User Interface Design is provided in Figure 5a, a working interface but to many first users a puzzle. Opposed to such type of designs is the example of an User Experience Design provided in Figure 5b, a screen design which will be immediately understood by the user of this gasoline station. For both type of designers one may find job advertisements, respectively ‘Asked: world-class UI Designer’ and ‘Searched: UX Designer’. The overarching field is usually referred to as Human-centred Design as in the ISO-standard or the more often used User Interaction Design, which is used in Figure 5.

User Interaction Design

User Interface Design

User Experience Design

Figure 5.

User Interaction Design (UID) is divided in User Interface Design (UID) and User Experience Design (UXD).

a) Example of User Interface Design. Everything works, but it is not easy to comprehend.

b) Example of User Experience Design. It is immediately clear which button should be pushed to confirm an order of 50 gallons of gasoline.

Concluding, knocking on the door of banknote design is a use-centred design approach. A banknote design can be compared with the design of a computer screen.

3. THE COASTER MODEL

The analysis made above is used as input for the development of a Model for Use-Centred Design of Banknotes or in short the Coaster Model (De Heij, 2015a; 2016a; 2016b). The fundament of this model is the distinction between use and experience, which is explained by two examples, one from architecture and one from art (Figure 6). The usage of a building will be given more weight than its experience, at least in general. In the case of a painting it will be the reverse, the experience will be key, as the use of a painting is bluntly ‘something for on the wall’. Application of these two variables leads to four basic models for approaching a new banknote design (Figure 7). As a new banknote design will replace an existing one, the novelties of a new banknote should be compared to its predecessor.
If not much has changed - neither in use, nor in experience - the design is an upgrade (Model 1). An example are the second series of euro banknotes, a refreshed design. The replacement of paper based banknotes by synthetic substrates is an example of an emphasis on a novel use of banknotes, as their graphic designs are usually kept similar (Model 2). Since the first Australian polymer banknote was issued in 1988, over 35 central banks followed, including Canada (2011) and the United Kingdom (in 2016). The third model represents new banknote designs which show a different graphic design and emphasise the user experience, for example by replacing portraits by other main images (Model 3). Although the Dutch already started with the replacement of portraits in 1981, the replacement of portraits has become a real trend since the introduction of the euro banknotes in 2002, with its main images taken from architecture. The new Norwegian banknote series "The Sea" is a fine recent example. Nowadays examples of banknote designs emphasising both the use and the experience are not identified (Model 4). An example 'avant la lettre' is the replacement of the Dutch NLG 10/Frans Hals (1970) by the NLG 10/Kingfisher (1997). Also the introduction of the euro banknotes in 2002 was the citizens of eleven countries a large design change, emphasising both use and experience.

**Figure 6.**
Architects and Artists speak about "Use and Experience".


<table>
<thead>
<tr>
<th>Basic Models 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>•</td>
</tr>
<tr>
<td>4. Emphasise use and experience</td>
<td>•</td>
</tr>
</tbody>
</table>

O = Maintained design policy
• = Result of new design policy

**Figure 7.**
Four basic models to approach new banknote design.

Compared to the existing banknote model a new banknote design may have different settings to emphasise the use and/or experience aspects.

**UIFs and UXFs**
Model building on banknote design continues with dividing the user functions of a banknote into *User Interface Functions* (UIFs) and *User Experience Functions* (UXFs) as shown in Figure 8. The ranking of the UIFs and UXFs is important, as it will provide guidance to fill in the banknote design. After all, there is an increasing number of features to be incorporated, while the banknote's sizes are decreasing. Such priorities in the user functions are set by the central bank. In the model presented in this article the ranking of the UIFs could be done quantitatively, based on public input (De Heij, 2015b). The order of the UXFs is the result of the following qualitative argumentation. People are first of all interested in their own banknotes and not that much in foreign notes, the reason to start with 'recognising identity' (UXF 1). Second, within an instant, people have their judgement ready on the aesthetics, they find a banknote either beautiful or ugly (UXF 2). Subsequently people want to 'retain confidence' (UXF 3) and they may 'connect with the main image' (UXF 4). The two upcoming experience functions received a position at the bottom, 'expect sustainability' (UXF 5) and a 'link to information technology' (UXF 6), for example with a smart phone. It is the role of the central bank to study the user functions and to translate them into design requirements (De Heij, 2015a). It is the role of the banknote designer to realise all design requirements into a graphic design. The Coaster Model may not only serve to underpin a new banknote design, it may also be used to assess banknote designs. For example, the *usability score of banknotes* can be calculated, the average score on the four UIFs (De Heij, 2015b). For euro banknotes this score came out on 6.4 on a scale from 1 to 10, an acceptable, but not a very high score. This measurement appears to be representative of the status of banknote designs. Central banks and their designers seem to focus too much on the UXFs and tend to forget about the UIFs. This is a wrong approach, as the interest for a new banknote design will vanish quickly, while for each cash payment, people have to undergo the suboptimal designed UIFs.

**Figure 8.**
The Coaster Model for Banknotes divides the banknote's user functions into User Interface Functions and User Experience Functions.

**4. EXAMPLE OF USE-CENTRED BANKNOTE DESIGN**

The next step is to apply the Coaster Model to a new banknote design and the burning question is whether the developed model will deliver a novel type of design?

The advocated order of the application of the Coaster Model is the following. First, for each UIF an optimal design concept is de-
developed (Figure 9a). These concepts are the result of dedicated design activities. For example, in case of readable numerals (UIF 1), a vision specialist may become part of this activity, as was the case for the development of the large numerals on the banknotes of the “Canadian Journey”, first issued in 2001 (Spencer and Dupuis, 2007). One more example is consulting a mass communication expert to prepare an appealing communication message (UIF 4), done for the underpinning of DNB’s design proposal for the second series of euro banknotes in 2006 (De Heij, 2007).

Once the partial designs are ready, the banknote designer has to merge these optimal design solutions into a generic template for banknote design. An example of such a blue-print is presented in Figure 9b, in case a new banknote series of the imaginary currency of ‘Money of the Area X’, bearing the currency code MAX. The design of the generic template is not a cut-and-paste job, but the start of a new creative design process, as will be explained further on.

**Method of the Generic Template for Banknote Design**

Design concepts for different user functions

<table>
<thead>
<tr>
<th>Value recognition (UIF 1)</th>
<th>Handling (UIF 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Value recognition" /></td>
<td><img src="image2" alt="Handling" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Authenticity check (UIF 3)</th>
<th>Communication (UIF 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="Authenticity check" /></td>
<td><img src="image4" alt="Communication" /></td>
</tr>
</tbody>
</table>

**Public side**

Generic template

**Open 2D gravure**

Value panel  Banknote number  Confidence panel

**Figure 9.**

From design concepts for different user functions to a generic template for the public side of a series design.

a) Schematic representation of four design concepts for respectively UIF 1, 2, 3 and 4.

b) Generic template for the front of a use-centred banknote design for the fictional currency unit max.

**Design philosophy of the UIFs**

To arrive at a generic template is a creative process. Banknote designers will develop their own personal argumentation or design philosophy. To illustrate this process, the design philosophy of the creation of the generic template prepared for the max banknotes is provided. According to the Coaster Model the most important User Interface Function of a banknote is value recognition (UIF 1). Therefore, the future designs should first of all express this most relevant function of a banknote. In case, first a value panel is developed. Subsequently this value panel is prominently positioned in the centre. In the heart of this panel - and thus in the heart of banknote - there is the currency indication template, representing the ISO-code of the currency (MAX) and the full name of the currency. After all, trust in banknotes is mainly trust in the currency. Two large numerals, one in positive and one in negative, are added and a vivid colour completes the design of the value panel. The main image is positioned on the left, contributing further to the determination of the banknote’s value. As most people are right-handed, the main image is not covered in this position when they take the note from their wallet. The main images are taken from different image categories, as this improves value recognition (De Heij, 2009). The design of the main image received a characteristic and recognisable outline, an argument for a 2D-image impression rather than a 3D-type of pictures, supporting an optimal perception. Furthermore, these main images received an open structure, combining thick, maximum gravure lines with the thinnest possible lines, supporting UIF 3. Because the most sensitive finger is usually on the reverse of the banknote, tactile areas are positioned on the back, serving two functions. First, these areas are optimised to serve as a trigger feature to all persons and, second, these tactile areas assist value recognition by the blind. As colour is the main banknote property to recognise its value, the general colour perception should not be affected by a second or third colour.

The next User Interface Function to be designed is the handling function (UIF 2). Analysis show that the public is mainly interested in the front of the banknotes and appreciates a horizontal format, as such a format is most suitable to their wallets. ATMs also offer the withdrawn banknotes in a horizontal or landscape format. Opposed to these two user situations, a vertical or portrait position is required when people insert a banknote into an payment automate, just as many retailers store their banknotes in a vertically in their cash drawers. These analyses of the handling of banknotes provided the basis for the concept of a public front (horizontal orientation) and a retail reverse (vertical orientation). All public features (UIF 3) are positioned on the front. Located in the quadrants, they are symbols of their guardian role of the banknote’s value. All authenticity features are similar in size. In case, three active public features are proposed and one sleeping feature. Their design is mainly figurative, public features should be recognisable images with a name. Like the main image, their design is also based on a 2D-image impression. Retailers will use the reverse for a (retail) authentication check.

Name giving within banknote design is important; according to the school of linguistic determinism people may only recall something when they can put a name to it. Therefore a banknote design
should include a communication plan (UIF 4). Figure 10 presents
such a plan for the series of max banknotes. The proposed theme
of the series is ‘Life’, a theme based on feelings instead of (pa-
ternalistic) factual information. The main images are searched in
different categories, to support optimal value recognition. All
authenticity features received a name. Two of the three public fea-
tures are figurative and one is kept non-figurative. The first
figurative feature represents a group, making reference to the
collective use of banknotes, for example a duck with little duck-
lings. The second feature refers to the individual use of bank-
notes, for example a girl with a ponytail. A third, non-figurative
feature, provides design freedom to any type of feature, like a fea-
ture for smartphone applications. The non-figurative feature can
be based on graphic illusions or on other appealing designs and
may also be used for any type of machine readable feature.

<table>
<thead>
<tr>
<th>Communication Plan New Series</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name of series: Life</strong></td>
</tr>
<tr>
<td><strong>Max denomination</strong></td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>1000</td>
</tr>
</tbody>
</table>

Figure 10.
Communication plan for a new series of max banknotes. Feature names are indicated by 1, 2 and 3.

**Design philosophy of the UXFs**
The identity of the series (UXF 1) is based on an identity description
which aimed for forward looking symbolism. From a study done
on the identity of euro banknotes it is known that the currency in-
dication ‘euro’ contributes most to their identity (De Heij, 2012).
In line, the central value indication MAX will support the identity
perception of max banknotes. The design of the public authenticity
features is based on the following thought. Individual citizens
have their own personal identity and together they have a group
identity. Therefore one feature shows a single variant, while
another represents the group variant, as indicated in the commu-
nication plan (Figure 10).

The aesthetics of the series (UXF 2) should be provided by a
number one graphic designer. The designs offered are just a first
concept.

Confidence in banknotes (UXF 3) is first of all confidence in the
currency. Similar to the currency indication template, a confidence
panel is proposed, which emphasises the confidence features of
a banknote. The confidence panel lists the specifications of the
issuing authority and is situated close to the short edge on the
right, where most people will take the banknote, so that people
will be literally in touch with the confidence elements of a bank-
note. Banknote numbers will also contribute to confidence and
therefore are situated on the front.

Connecting with the main image (UXF 4) is a disputable user func-
tion. The function of a main image is first of all a contribution to
instant value recognition (UIF 1). Still the proposed images will
invite people to bond with the design.

Banknotes are a utility product and modern citizens expect that
their banknotes are ‘green’, sustainable (UXF 5). The banknote de-
signer has not much instruments to realise green designs. One of
the options is ‘anti-soil design’, by minimising the unprinted areas.

To link the banknote to information technology (UXF 6), the series
received a QR-code, representing the denomination and the
model. By scanning this label code with a smart phone, people
may receive dedicated information on this type of banknote. In-
formation related to the public authenticity features, but also
actual information may be provided on circulating counterfeits of
this denomination.

**Retail side**
The previous example elaborated on the design philosophy of
the public side, the front of the note. A similar approach can be
applied to the retail side, the reverse (Figure 12). Like on the
public side, two large numerals dominate the layout. (UXF 1). Be-
cause of the different handling of the retail side (UIF 2) these nu-
merals received a different position as on the front. One numeral
is located at the top and one on the bottom. While inserting a
banknote in the slot of an automated device accepting banknotes,
people will notice the feeding arrow. As the upper large value
numerals disappear into the machine, the large numeral at the
bottom will remain visible to right-handed people up to the very
end of the insertion. Handling the retail side, people will touch
the currency indication, a link to experiencing confidence (UXF
3). When facing the reverse in their wallet, people may read the
smaller values on the long sides of the generic template (UXF 1).
Authenticity features for retailers are either based on devices
which need human interpretation or on automatic devices. The
design of the human assist features received a realistic design,
matching with the theme of the banknote (UXF 3). The checkout
scanners of the retailer may read the metameric code. A barcode
on the reverse represents the same banknote number as on the
front and makes more reliable number reading possible as in
the case of OCR-B numbering.
5. CONCLUSIONS

Academic model building for banknote design is at its infancy. The way to go is a use-centred design approach and a Model for Use-centred Design of Banknotes, named the Coaster Model makes a start. This Model divides the banknote’s User Functions into User Interface Function (UIFs) and User Experience Functions (UXFs). The Coaster Model is applicable for both the underpinning of new banknote designs and for assessing existing banknote designs.

The ranking of the UIFs and UXFs within the Coaster Model is done by the central bank. Setting such priorities will assist the banknote designer in organising the design. Subsequently, the central bank lists the design requirements for each user function. Based on these design requirements the designers may develop an optimal design concept for each UIF. Dedicated specialists may be consulted in such supporting design studies. In a third stage the banknote designer proposes design concepts for the individual denominations of the new series. Finally, these concepts are worked out in detail in the origination phase.

One may question the advocated approach of the Coaster Model, by arguing that an optimal design concept for a single user function will be similar all over the world and as a result all currencies will receive similar designs. However, similar design concepts for a user function do not have to lead to identical banknote designs. First, central banks may set different priorities within the Coaster Model. Second, central banks and their banknote designers are free in theme and subtheme selection and in the selection of authenticity features. Furthermore, banknote designers will have their own design philosophy to fill in the graphical layout and the application of colours.
The assessment of existing banknote designs is the second application of the Coaster Model. Banknote designs may be assessed for each user function, like for example ‘judging aesthetics’. (UXF 2) or ‘retaining confidence’. The scores for different user functions can be combined to one score, like an usability score representing all UIFs. Using the Coaster Model as a fundament for an assessment shows that:

1) The usability score of banknotes is low; UIFs are residual design items.
2) Banknote designers are too much focused on UXFs.
3) After introduction UXFs are no longer key.

References
