The design methodology of Dutch banknotes

Hans A.M. de Heij
De Nederlandsche Bank NV, Amsterdam, The Netherlands

Proceedings of SPIE Vol. 3973
San Jose, California USA
27 - 28 January 2000

Presented at
IS&T/SPIE's 12th International Symposium
Electronic Imaging 2000
Conference 3973
Optical Security and Counterfeit Deterrence Techniques III
San Jose, California USA
27 January 2000
The design methodology of Dutch banknotes

Hans A.M. de Heij*
De Nederlandsche Bank NV, Amsterdam, The Netherlands

ABSTRACT

Since the introduction of a design methodology for Dutch banknotes, the quality of Dutch paper currency has improved in more than one way. The methodology in question provides for

- a design policy, which helps fix clear objectives,
- design management, to ensure a smooth co-operation between the graphic designer, printer, papermaker and central bank,
- a Programme of Requirements (POR), a banknote development guideline for all parties involved.

This systematic approach enables an objective selection of design proposals, including security features. Furthermore, the project manager obtains regular feedback from the public by conducting market surveys. Each new design of a Netherlands Guilder (NLG) banknote issued by the Nederlandsche Bank over the past 50 years has been an improvement on its predecessor in terms of value recognition, security and durability.

Keywords: banknotes, design policy, design management, value recognition, security features, durability.

1. INTRODUCTION

The advent of euro banknotes in 2002 heralds an end to the circulation of the cherished Netherlands Guilder (NLG) banknotes. Dutch banknotes are unlike any other paper currency, because of their striking designs and unique communicative aspects. If you were to exhibit specimens of all of the world’s banknote, the Dutch guilder notes would be among the easiest to spot.

Figure 1
The NLG 250 banknote, also referred to as the lighthouse, was designed by R.D.E. Oxenaar and issued in 1986. Much liked for its appearance by 97% of the public in 1999, it is the most popular Dutch banknote design.

*) Correspondence: Email: h.a.m.de.heij@dnb.nl
Dutch banknotes owe their popularity to a number of factors. For one, their design precludes confusion over the value of the notes. Furthermore, the average counterfeit rate is as low as approximately 7.5 per million of banknotes in circulation.

Another success factor is the public’s appreciation of Dutch banknotes for their aesthetic merits. More than 75% of the Dutch public think over the years - NLG notes are beautiful. For the NLG 250 banknote (Figure 1), the appreciation percentage even exceeds 90%! Featuring at many design exhibitions, Dutch banknotes often meet with positive response from art connoisseurs.

Finally, a well-controlled circulation of the NLG notes, including continuous replacement of tattered banknotes and a relatively long life, are other contributors to the success of the Dutch banknotes.

From a managerial point of view, the design process used for the production of Dutch banknotes leaves little to be desired, offering the following advantages:

a) less than 2 years from the date when the proposal for a new banknote is approved to the first day of issue,
b) low development costs: around EUR 1 million (for external costs, i.e. for the designer, paper mill and printer).

What makes Dutch banknotes so different? What does de Nederlandsche Bank (the Bank) do differently from other central banks to be able to achieve this result? This paper – a design testament of the NLG banknotes – will answer these questions, focussing on the following 6 aspects:

1. Pre-conditions
2. Design policy
3. Design management
4. Value recognition
5. Security features
6. Durability

2. PRE - CONDITIONS

One of the pre-conditions for the success of the Dutch banknote design has been Dutch legislation guaranteeing the Nederlandsche Bank’s independence (see Figure 2). While today all the National Central Banks (NCBs) of the European System of Central Banks (ESCB) are independent of their Ministries of Finance, this has not always been the case. However, apart from World War II (1940-45) and the first years after that, the central

![Diagram of design and external influences](Figure 2)

The design of a banknote is influenced by several external factors and by various design factors. The decision to develop a new design is usually prompted by the arrival of new reproduction techniques, like photography around 1860 or colour copiers in the 1980's. The spirit of the time, too, may inspire new banknote designs.
bank of the Netherlands has enjoyed this independence since its establishment in 1814. The Central Bank Act of 1948 gave the Governing Board of the Bank again full authority over Dutch banknotes, underscoring this institution’s independence. This authority implies that no parliamentary or ministerial approval is required for the creation of a new banknote and that the Bank is free to fix the denominations and designs of the notes.

But why would the Board of the Bank endorse proposals for new, innovative banknote designs, when it is supposed to play it safe? The answer lies in the many small steps made over the years towards a fully-fledged design methodology. The graduality of this process helped foster a *good feeling* among Board members about design. By the time a new banknote design was a regular Board Meeting agenda item (in the 1980’s and 90’s), this had become not much less than a *fun* item! Encouraged by the plaudits received for previous designs of the notes, the Board always felt challenged to take a design one step further every time a new banknote was to be produced.

One of the first design successes came in the 1930’s, i.e. with the NLG 50/Minerva by graphic designer Jacob Jongert 1. Further progress was made between 1948 and 1968 with work by designer Eppo Doeve (5 new models). In the following thirty years (1968 - 1997), the quality of Dutch banknote designs would rise to great heights, due to several actors, like the *time spirit* (see Figure 2). Besides meeting high standards, Dutch Public Design was very popular in that period (stamps, public telephones, public transport and road signs). Dutch Public Design was *in*. A similar time spirit prevailed in Switzerland, Denmark and the UK, for that matter.

Another important pre-condition is the *commercial* relationship that has existed between the Bank and the firm printing the Dutch banknotes, Joh. Enschedé, since 1814, the year when the Bank was founded. In this relationship the Bank is the party that commissions the printer to produce banknotes. In the course of time, however, the Bank grew accustomed to commissioning banknote designs as well. This is why, since 1890, the Bank has also acted as a direct principal of the paper mill (VHP), instead of leaving this task to the printer. And since 1880, the Bank has procured banknote paper from VHP, the only Dutch banknote paper supplier since 1945. In the early 1920’s, the Bank hired its first engineer, entrusting him with the management of the technical aspects of banknote production.

After the arrival of banknote sorting machines in 1968, the Bank turned into an expert client of both the paper mill and the printer, recruiting printing specialists on its workforce. In 1981, the Bank added an industrial designer to its staff, who has since been in charge of the development of new banknotes. Since 1860, graphic designing has been a trade conducted on a free lance basis. Since 1924, the Bank - and not the printer - has acted as a principal of graphic designers.

Another positive experience for the Board of the Bank was the public response it received through opinion polls. The Bank learned to listen to the people. Its first opinion poll was held in 1965 and served to gauge the public’s view of a new low denomination, i.e. NLG 5. The same was done in 1981 for the Bank to find out what value a new high denomination between NLG 100 and NLG 1000 should represent in the eyes of the public. Also on the basis of the public preferences emerging from that survey, NLG 250 was chosen. This survey was also the first occasion on which the Bank inquired after the appreciation of the latest NLG 100 note, popularly referred to as the Snipe, after the bird on the note’s face. The introduction of an animal species marked a watershed in the long-established tradition of portraying mainly historical figures on NLG notes.

The *learning curve* is another actor in the Bank’s banknote design policy. After a series design of 4 banknotes by R.D.E. Oxenaar (NLG 10, 25, 100 and 1000; in 1968-72), it became standard policy to issue new banknotes per denomination instead of by complete series, be it consistent with the style of previously issued banknotes. In 1987, the Bank organised a preliminary design contest for a new series of NLG notes. From then on, every new banknote was to feature more details and include new innovations, with the NLG 10/Kingfisher – ‘my best note’ (designer Jaap Drupsteen) – marking the end of a long and valuable tradition (Figure 3).
3. DESIGN POLICY

One of the basic requirements for any product design to be successful is having a design policy. The Dutch central bank has formulated this design policy as follows.

A banknote is a product for daily life. It changes hands many times a day, and is carried close to or even on bodies! Therefore, a note should first of all have an easily recognisable denomination and an attractive, contemporary look. In short, it should be designed for the public to like it. Therefore, it should neither be historical or educational, nor feature elements designed to please tourists, such as tulips, wooden shoes or windmills.

Considering NLG banknotes a means to express the contemporary Dutch culture, the Bank attracts well-known, top graphical designers from the market. In line with this policy, rather than searching existing literature for a poem suitable for the micro lettering section, the Bank commissions one from a contemporary poet. For the two latest NLG banknote designs, the Bank asked for brief texts befitting the notes’ themes.

Many central banks’ first concern is that their banknotes are designed to deter counterfeiters. The Nederlandsche Bank, however, gives priority to precluding confusion about its banknotes’ denominations (see 3.1) over protection against counterfeiting (see 3.2), a maximum life (see 3.3) and an appearance reflecting Dutch culture (see 3.4), in the order given.

Subsequently, the Bank looks at banknotes through the eyes of marketing people. Who are its customers, for whom are the banknotes produced? The following user groups can be distinguished:
- the general public, *the man in the street*,
- cashiers (e.g. supermarkets, gas stations),
- the central bank’s sorting machines (detectors),
- banknote issue and acceptor machines (ATMs - *Automated Teller Machines* - and vending machines),
- copiers and scanners etcetera (*the counterfeiters*).

Furthermore, the Bank only issues banknotes whose value, security, text or any other feature it can account for.

The Bank’s banknote policy is set out in detail in the following sub-paragraphs.
3.1. Value recognition at a glance

The public should be able to determine the value of a banknote at a single glance. The design should extend to the use of colours, the picture, numerals and other design elements. While not secure for obvious reasons, *Monopoly notes* fulfil this requirement, mainly because of their colours and easily distinguishable numerals! Opposite examples of such easy value recognition are US-Dollar banknotes, whose colours, portraits and numeral sizes until recently used to be all alike, irrespective of their denomination. They are the product of a design policy that proceeds from the assumption that an individual wishing to check the face value of the note is compelled to have such a close look, that a counterfeit note would stand little chance of escaping a user's notice. In 1996, the policy was changed in favour of value recognition: the portrait area of the USD 100 was enlarged, just as one of its numerals.

Paragraph 5 sets forth the value recognition theory.

3.2. Easy recognition of counterfeits

3.2.1. Limited number of security features

First of all, set a limit to the total number of security features. As the complexity resulting from an excess of

<table>
<thead>
<tr>
<th>User group</th>
<th>Total</th>
<th>Security feature</th>
<th>Production technique</th>
<th>Main security principle</th>
</tr>
</thead>
<tbody>
<tr>
<td>General public</td>
<td>4</td>
<td>1 watermark</td>
<td>1 paper</td>
<td>1 optical density</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 see-through register</td>
<td>2 simultaneous offset</td>
<td>2 geometry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 micro-text (0,3 mm)</td>
<td>3 offset</td>
<td>3 resolution</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 tactility</td>
<td>4 intaglio</td>
<td>4 geometry (relief)</td>
</tr>
<tr>
<td>Cashier</td>
<td>3</td>
<td>5 fluorescent fibres</td>
<td>5 paper</td>
<td>5 colour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 non-fluorescent paper</td>
<td>6 paper</td>
<td>6 colour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7 micro-text (0,2 mm)</td>
<td>7 wet offset</td>
<td>7 resolution</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8 size of banknote, cut at right angles</td>
<td>8 cutting</td>
<td>8 geometry</td>
</tr>
<tr>
<td>Central bank</td>
<td>3</td>
<td>9 bar watermark (AQUIS)</td>
<td>9 paper</td>
<td>9 optical density</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 intaglio pattern (ISARD)</td>
<td>10 intaglio</td>
<td>10 geometry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11 banknote number</td>
<td>11 letter press</td>
<td>11 geometry</td>
</tr>
<tr>
<td>Banknote issue and acceptor</td>
<td>1</td>
<td>8 size of banknote</td>
<td>8 cutting</td>
<td>8 geometry</td>
</tr>
<tr>
<td>and acceptor automates*</td>
<td></td>
<td>- thickness of note</td>
<td>- paper + print</td>
<td>- geometry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- colour measurements</td>
<td>- paper + print</td>
<td>- colour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- opacity measurement</td>
<td>- paper + print</td>
<td>- opacity</td>
</tr>
<tr>
<td>Copiers and scanners</td>
<td>9</td>
<td>12 iridescent planchettes</td>
<td>12 paper</td>
<td>12 optical density</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13 foil seal, overprinted</td>
<td>13 hot stamp press and dry offset</td>
<td>13 optical density</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14 iridescent ink</td>
<td>14 silk screen</td>
<td>14 optical density</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15 metallic ink</td>
<td>15 dry offset</td>
<td>15 optical density</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16 transparent inks</td>
<td>16 intaglio</td>
<td>16 optical density</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17 screen traps</td>
<td>17 offset</td>
<td>17 geometry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18 colour outside euroscale</td>
<td>18 dry offset</td>
<td>18 colour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19 rain-bow printing</td>
<td>19 dry offset</td>
<td>19 optical density</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 -</td>
<td>20 -</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Table 1*
Overview of security features in NLG 10/Kingfisher.

*) as far as known*
security features decreases a banknote’s security, the maximum number of security features on Dutch banknotes has been set at 20 (see Table 1). In short, if a new feature is added, another one has to go. Prevent inflation of security features!

3.2.2. User-specific security features

Target one user group per security feature. For optimum targeting, make sure a security feature is listed only once in the security features overview (see Table 1).

3.2.3. Clear visibility

Use features that are discernible in a genuine note, while appearing only partly or not at all in a counterfeit. Avoid texts like VOID or other features that pop up on a reproduced banknote. Every feature’s colour, dimensions and resolution should be designed to ensure easy recognition.

3.2.4. Self-defending

Sooner spend more money on the security of the banknotes than on tracing counterfeits! In this respect, NLG banknotes are self-defending, i.e. it does not take an expert to prove they are genuine. As a consequence, their production costs are higher, though. Features developed for detectors in colour copiers, scanning devices or graphic software should preferable not be used in banknote design.

3.2.5. Use linked technologies

Security features should not be isolated - island features - but be linked with one of the other technologies by partly overlapping other features. For example, make sure that about 10% of the watermark surface is overlapped by offset/intaglio, and that about 15% of the surface of the foil is overprinted with dry offset.

3.2.6. Policy on public security features

a) The public should - at any time - be able to check a note for security without needing another note for reference, or tools.

Typically, security features for the general public can be checked without the aid of a tool or instrument. Neither is it necessary to compare one banknote with another. Features for the general public should be prominent for easy recognition and understanding, as well as permitting a description over the telephone.

b) Instead of making a habit of checking each note for genuineness, the public will only do so after being alerted, e.g., by a press release from the central bank. If there are more than e.g. 15 counterfeits per million notes in circulation, the central bank may consider releasing a statement to that effect.

c) A public feature should be resistant to all sorts of destructive treatments. For that reason, a foil cannot be a public security feature, since it may be affected by the use of detergents. Notes need not be fire-resistant, though.

d) The security features and their communicative functions should be applied consistently throughout a banknote series. In other words, the banknotes in one series should all have identical and identically arranged features to make it easy for the public to familiarise itself with denomination-specific features and feature configurations.

Given that surveys show that the public is able to recall about 1.7 security features (measured in 1999), it does not make much sense to have more than 4 public security features in one banknote.
e) Select the public features from the different production techniques:
1 paper technique → watermark (in NLG notes since 1814; mould-made watermark since 1924),
2 simultaneous offset printing → see-through register (since 1927),
3 intaglio → tactile feel (since 1814),
4 wet offset → micro text (since 1860).

Do not alter or leave out features to which the public has grown accustomed! Bear in mind that it takes a long
time for the public to get used to new ones. A fine example of a traditional feature is the watermark. Used for
the first time in a western banknote in Sweden in 1665, now, well over 300 years later, it is still the most
popular security feature for banknotes.
Over the past 70 years the Bank has not introduced one new public security feature! Instead, it enhanced
understanding of its public banknote features by optimising the design and through publications.

f) The public security features should be very easy to find and evenly distributed over the note: 2 on the face, 2
on the reverse; one on the left-hand side, one on the right-hand side (see Figure 4).

![Figure 4](image_url)
The four areas to which the use of security features should be confined. Do not place security features on
folding lines or on folded corners (dog-ears).

g) For a security check to be reliable, at least 3 out of the 4 public security features must be checked.

h) Surveys have shown that the more the public likes a banknote model, the more it knows about it. In other
words: a high appreciation promotes security.

i) Satisfy people’s fondness of other living beings like other humans, animals or plants, by making this is a
regular feature in each banknote. This element is absent in the coming euro series.

j) Make the public security features realistic, ensuring that they fit in with the theme. As a result, the public will
be able to recall them more easily, just by looking at the note!

k) Print a security feature title as close as possible to the picture concerned, as it has proved that this helps users
memorise the picture!

l) Do not use the same image or subject for different features. This policy runs counter to traditionally designed
currency, in which a portrait watermark resembles its engraved counterpart in the printed design. In banknotes
based on this concept, portraits also serve as a security feature, because people would notice small differences
in the portrait of a counterfeit note. Never having found any evidence supporting this theory, the Bank does not
favour this concept. A watermark image and intaglio picture that look alike, will not excite the public’s interest.
And with a view to security, two different, juxtaposed representations of one image may be confusing, since the
counterfeit note will feature the same two more or less similar images, too.
3.2.7. Information to the public

In the past, many central banks, including the Nederlandsche Bank, were reluctant to disclose data about banknotes to anyone, lest counterfeiters used these to optimise reproductions. As a result of this policy, all sorts of myths and notions were circulating and the Dutch public had difficulty naming the right security features (based on a survey held in 1983).

The Bank issued its first information brochure on security features in 1979, within the scope of its product demystification policy (see Figure 5). In 1986, the Bank brought out its first professional, large-edition, full-colour (instead of the traditional, secure black-and-white) leaflet on the occasion of the introduction of the NLG250/Lighthouse banknote. This leaflet contained all the data both the public and cashiers needed to know about the new banknote.

Since 1990, every NLG note has borne a text drawing attention to the 4 public security features! This text has come in the place of the penalty code. In other words, Dutch banknotes are designed to have a preventive effect on the general public rather than acting as a deterrent for counterfeiters! That is why the issue of the NLG 100/Little Owl in 1992 was the first note to be accompanied by promotion tools, like posters and video tapes. The above-mentioned actions helped increase public awareness of the security features used from 1.03 features in 1983 to 1.7 in 1999! In the same period, the percentage of people incapable of naming one single feature fell from 20 to 11%. Finally, the percentage of (partly) wrong security features named dropped from 0.81 in 1983 to 0.26 in 1999!

3.2.8. Select 3 to 5 cashier features

In general, cashiers check a banknote at their workplace, using tools and instruments, like a UV lamp, a magnifying glass, a ruler or a filter (see Table 1). Awareness of fibres turning fluorescent under a UV lamp - and therefore probably the use this feature - has grown over the years from 2 % in 1983 to 19 % in 1999!

3.2.9. Select 2 to 3 central bank features

Choose one paper feature and one print feature and adjust these for the sorting machines. The intaglio pattern ISARD has since 1968 (Intaglio Scanning and Recognition Device) and the bar watermark ‘AQUIS’ since 1986 featured on NLG banknotes. Being couvert in the note, neither are easily visible to the naked eye. The ISARDs on the latest models are printed in transparent intaglio ink.

In the case of de Nederlandsche Bank, the OCR-B banknote number is a third machine-readable feature. Since 1968, the OCR-B cameras on the sorting machines have scanned all the numbers of the notes in circulation. For the latest series, the Bank developed a printed barcode number, which is better suited to machine scanning: the new, single barcode number has a higher reading reliability than the previous two OCR-B numbers!
3.2.10. No overlap of machine-readable features

Avoid interference due to overlapping machine-readable features, e.g. banknote numbers overlapping the barcode watermark.

3.2.11. Banknote issue and banknote acceptor automates

As indicated in Table 1, no special features have been introduced for ATMs or banknote acceptor machines (vending machines). The manufacturers of these machines, with whom the Bank cooperates, prefer not to see any changes introduced in banknote production. The Bank is aware that it cannot change inks, opacities or thicknesses without letting them know. Some banknote acceptors use, e.g., soft magnetic pigments, which do not occur in NLG notes.

The producers of these banknote issue and acceptor machines are very much in favour of a standardised height for banknotes. With regard to other cash handling logistics and sorting machines of central banks a standardised height also saves costs. Since 1965, NLG notes have come in a uniform height of 76 mm. Today, this would be a bit too high. More and more central banks offer standardised heights tending towards 65 mm, the height of the US-Dollar since 1929.

3.2.12. Anti-copy and anti-scan features

The last generation of NLG notes was rendered anti-copy and anti-scan by means of a gloss realised by several techniques: foil and silk screen printing, iridescent planchettes and metallic inks. This gloss is an additional security feature, a trigger feature, as its absence from a note should induce the public to check the note for the standard public features like the see-through register or the watermark.

The anti-copy & anti-scan effect is obtained by the reflection (or optical density) of the note. The light used by copying machines to illuminate the original is reflected at an angle to the light-sensitive elements. This leaves a big black mark in the place of the foil of a colour-copy note, disturbing the mirroring effect. To protect the foil against counterfeiting, the foil is overprinted with a dark dry offset ink, which appears as a black mark on a colour copy or DTP (Desk Top Publishing) print of the note.

The silk screen in the NLG notes is optimised for gloss and not for the iridescence effected with an OVI (Optically Variable Ink). The area covered in the NLG 100/Little Owl and NLG 1000/Lap Wing is about 80 % and is overprinted with offset and intaglio!

3.2.13. Features for producers: register marks

One special banknote user category are the banknote producers, i.e. the graphic designer, the papermaker, the printer and the central bank. For this category especially, NLG notes are provided with clear register marks. These marks, for which offset – intaglio, and offset – letterpress production techniques are used, are printed on a NLG banknote to facilitate quality control by the printer and the Bank. For the same purpose, the reverse sides of NLG notes have cutting marks. In addition, the reverse of each NLG banknote bears a stacker mark to facilitate the sorting of banknotes that have been taken out of circulation. This mark tells the sorting machine operator, who always keeps his eyes on one side of the stack of banknotes forming at the end of the sorting machine, when banknotes have been fed the wrong way.

As a special feature for the designer and printer, NLG banknotes state the names of these specialists. The design policy for producer-oriented features is to integrate these into the design so as to make them as inconspicuous as possible for the public eye.

3.3. Optimize the note for durability

Durability serves two purposes:
1) fitness for public use (clean notes, no dog-ears, no holes and tears etcetera),
2) a long life, fitting in with the bank’s search for cost effectiveness in banknote production.
3.3.1. The notes should be easy to handle

As the banknotes should fit into a standard wallet and the slot of a banknote acceptor machine, as well as being processable by ATMs, vending machines and counting machines, they may not be lower than 65 mm and higher than 70 mm.

3.3.2. Suitability for intensive use

To be fit for intensive use, the notes should:
- be clean,
- be foldable, over and over again,
- have a good wet strength,
- have a high colourfastness,
- be resistant to water and other liquid solutions,
- be between 65 - 70 mm high.

3.3.3. Indelible public and cashier features

Public and cashier features should be indelible, also after washing.

3.4. Design philosophy: business card of the Netherlands

Considering that they are among a visitor’s first impressions of a country, banknotes may be regarded as business cards. Considering this, what should a banknote show?

3.4.1. Expression of Dutch culture

Banknotes are an important mirror of Dutch culture. Therefore, the notes should be of a contemporary design as well as reflect the period between the present and fifteen years onward. On the other hand, the note’s design should be neither too progressive nor too trendy.

3.4.2. Stately, valuable, dynamic and cheerful

An NLG note should feature a Dutch, or at least not an un-Dutch, character. The design should be stately, valuable and dynamic as well as exuding some measure of cheerfulness.

3.4.3. Only historical figures

The design should not show contemporary individuals that are still alive.

3.4.4. Paper money appearance

Besides requiring state-of-the-art banknote printing technology for its production, a banknote design must look like money.

4. DESIGN MANAGEMENT

Once the design policy has been formulated, the design management of the NLG banknotes must be arranged. This is the daily work of the project team in charge of the development of the new note. The Bank’s design management may be summed up by the following guidelines:

4.1. Give your all for the product banknote

The banknote proper should always come first, before the production, the design procedure, the co-operation with others (consensus!), the political influence, etcetera. Always ask yourself: What is best for the banknote as a product?
4.2 Work with a small design team

Select 4 specialists:
1) the project manager – an engineer on the Bank’s staff, acting as an expert client,
2) a free-lance graphic designer (working independently of the printer),
3) a representative of the printer’s (Joh. Enschedé),
4) a representative of the paper mill’s (VHP).

This project manager is responsible for quality, time planning and the budget. The project manager is also in charge of the information flow and the project organisation.

4.3. Take small steps

A banknote design process should be arranged with a view to minimising the risk of a failure. Therefore, it is better to arrive at a new design via many small steps than via one or two large moves. Remember that while on paper a project may look successful, the implementation of the technical innovations is often less so. Never change a winning banknote (too much)!

4.4. Introduce only tested elements

If you want to add novel elements to the design, make sure that these have been thoroughly tested, preferably in the context of design studies prior to the final design. Always execute these design studies by way of a (pre)note that resembles the final design as much as possible. All designs should be presented on scale 1:1.

It is also possible to have a development run parallel to the design process. If a new feature is ready in time it will be introduced into the note. If it is not, a fallback design will be available. This strategy was observed, for example, with the implementation of a special ink against colour-copiers: a bismuth ink on the reverse of the NLG 1000/Lap Wing. Bismuth ink is a high-gloss, semi-transparent white silk screen ink. If this feature had not been ready in time, it would have had to be left out. But as you may know, it was ready in time, which is why it can be found on the note!

For the new NLG10/Kingfisher, a pre-study anti-soiling design was made on the basis of the actual note size.

If the above procedure is observed, the lead-time for a new NLG note is less than 2 years: from the moment the Governing Board gave the go-ahead, until the first day of issue!

4.5. For a new series, organise a design contest

Design contest participants need not design all the denominations of new series, because, first, this would take too much time and, second, the result would not necessarily cast more light on the quality of the design. Instead, request every contestant to enter a small series of 3 notes: one low, one mid-range and one high denomination.

Draw up a Programme of Requirements Series Design and a standard contract. Organise a closed design contest, inviting, for example, 6 designers: 2 young (30-40 years), 2 middle-aged (40-50 years) and two older (50-60 years). The total time this takes is 6 months. Observing the said criteria, the Bank organised a design contest in 1987.

4.6. Selection of a graphic designer

Select a graphic designer from among free-lance designers instead of real artists. Bear in mind that graphic and television set design, as well as advertising and industrial design are key words here. Always choose a top-of-the-range senior designer. Do not choose a representative of a short-lived art wave. The new note should remain interesting to look at for at least 10 years!

Conclude a contract for one note.
4.7. **Programme of Requirements**

A *Programme of Requirements (POR)* or a *List of Requirements (LOR)* is needed for each of the following four banknote development stages:

1) POR Sketch Design,
2) POR Printing Proof,
3) POR Zero Production Run
4) POR Mass Production and Issue.

Draw up a POR, observing the utmost precision. Regard POR as the actual product translated into words and drawings! PORs list exhaustively what clients want to have incorporated into a design. Formulate a requirement in the POR as a problem, not as a solution.

Prior to designing, discuss a POR with the paper mill, the printer and the designer.

4.8. **Design individual banknotes within the scope of a concept for a series**

After the design for a new series has been approved, the project team starts developing the first denomination. As said above, this takes almost two years. After the first banknote of the new series has been issued, the team proceeds to the next denomination, and so on and so forth, until the series is complete. The entire process takes from 10 to 12 years.

There are serious advantages to this approach. It guarantees a constant work flow for the paper mill origination department, the printer as well as for the designer, who thus is also afforded ample opportunity to hone his skills (the second note is usually much better than the first). Also, it enables the central bank to respond quickly and adequately to new counterfeiting techniques by introducing new features, such as the foil on the NLG100/Little Owl.

The only disadvantage of this approach may be that, once complete, a new series will be in circulation for three years or so, before the first note of the next banknote generation is introduced. The Dutch public, though, has never protested against this policy, apparently finding the idea of new designs appearing at relatively short intervals exciting.

4.9. **Avoid revised designs**

A redesign may confuse the public, for besides the old note, there will be a new – slightly changed – one and (usually) the counterfeit note. Since a new note can be produced in 2 years or less, there is no need for a redesign procedure, as this would save a mere couple of months only. With a new design, new features can be properly integrated and something looking a *cut-and-paste job* is avoided.

4.10. **Define the different user groups of a banknote**

The POR paragraphs should be based on different banknote users. The general public, the cashiers, the central bank’s sorting machine, the ATMs, the copiers and scanners, etcetera.

Ask yourself for each value, security or other feature why it is there, and for whom? The signatures are obviously only designed for one or two persons: the Governor and Chief Cashier! Should we leave them out then?

4.11. **Leave the choice of a subject to the designer**

You should write a *design philosophy* (see 3.4), but leave the choice of a theme to the designer, for the designer is the expert who will be able to turn any dull subject into a very interesting design! Asking the general public for a banknote theme is risky, as most people will not be able to envisage something - and certainly not an innovative design - when a subject is mentioned. They will fall back on something they already know.

In 1981, in its first survey of this kind ever, the Nederlandsche Bank polled the public’s appreciation of the then brand-new NLG 100 note, or Snipe, the first note in decades without a portrait. It was crucial for the outcome that the Bank did *so after* the new banknote was issued. The public’s response was positive. If the Bank had asked - prior to the design - whether the public would like to see a bird on the new note, the response
might have been negative. But having had the time to study and use the result, the people were quite positive (83 % beautiful in 1981).

4.12. Do not introduce committees for interim evaluation

During the design process, neither experts should be consulted nor public surveys held. After all, it is the project team that is responsible for the choice of the design and the technical realisation of the successive proofs. A style consultant may be called in all right, but only at the start and after completion. It will then be up to the Board to approve the design or not.

4.13. Leave the introduction of changes to the designer

The graphic designer should be granted full and sole authority over the design, and be the only one allowed to alter it. The central bank may change the POR, if they want, but should refrain from doing the actual designing. In reality, the designer of the NLG notes was allowed three opportunities to modify the design during the origination process. However, the graphic designer will not be able to do the job without guidance from the project manager and other experts. Guidance is needed especially in the field of security features, but also in other banknote development areas.

4.14. Keep the designer involved throughout the process

When the sketch or draft design is approved, keep the graphic designer involved in the process of origination, proof printing and even at the start of the mass production phase, so that the banknote may be changed or further optimised during the origination phase. The graphic designer should be available for the final decisions.

Graphic designer Oxenaar used to make sketches of designs in pencil and show these at every meeting with the printer, wishing the originators and printer to reproduce these drawings as accurately as possible. Graphic designer Jaap Drupsteen preferred a different working method. He was more interested in the interaction between the craftsmen of origination and his first design. The final result of his designs was in many ways unpredictable, but made much use of all the ideas and skills of all the people involved.

4.15. Present only the best design

Present only one design, the best, to the Governing Board. If shown all sorts of alternatives and variants, the Board will probably ask for the face of this design, combined with the reverse of that proposal. If the design is not accepted, ask the designer to come up with a new one. In the worst situation: find yourself another designer. Experience has shown that the Bank’s Board may approve the offered designs without hesitation. The designer is always invited to the Board meeting in question.

5. THEORY OF VALUE RECOGNITION

Monopoly money! This is what is often condescendingly said about a colourful note. But it may well be regarded as positive criticism if we look at it from the point of view of value recognition. Designer Oxenaar always considered it a compliment when his banknotes were referred to as Monopoly money (Figure 6). And it has proved true! People recognise a denomination in the first place by its colour. The 10-guilder note has been a blue note since it was first introduced in 1904. People's instant reaction to a blue note - old or new - will be that it must be a 10-guilder note!

A simple test demonstrates the importance of colours: select the portrait area of two well-known banknotes. Switch the colours. Asked to specify denominations, people will tend to respond first to the colour of the portrait rather than to the portrait proper!
Figure 6
Monopoly money: (a) orange, approx. 1935; (b) orange, approx. 1965; (c) euro monopoly, green, 1999. The colour of the 100-euro banknote is emphasised by its green margin.

With the introduction of the euro notes the colours of the denominations will change. There is a chance that during the changeover from NLG to EUR notes the Dutch public will be confused by the fact that the blue euro note represents a value of EUR 20!

After colour, the main image is the most important discriminator. If no colour is discernible, as may be the case in a dark taxi, a 50-guilder note is recognised by its image, i.e. a plant, a sunflower.

The colour scheme of the Dutch banknotes has developed over the years. As the public had grown accustomed to the main colours, the colour scheme of the existing notes was continued: blue = 10, red = 25 etcetera. With the arrival of two new denominations, i.e. the NLG 50 note in 1982 and the NLG 250 note in 1986, additional main colours had to be chosen. Designer Oxenaar proposed yellow and purple; the first for the lower, cheaper NLG 50 note, and the latter for the more dignified NLG 250 note!

5.1. Selection of main colours

One of the most important design parameters for optimal value recognition by the public is the main, dominant colour of the note. This is the one colour that the public will recognise if the note is held at a distance of 2 or 3 meters.

The Dutch banknote colour scheme comes close to the optimal colour scheme for a banknote series. This scheme is based on the secondary colour circle, first described by Isaac Newton, but worked out further for designers by Johannes Itten, who was a teacher attached to the famous Bauhaus (Figure 7).

The primary colours blue, red and yellow – which names graphic designers prefer to cyan, magenta and yellow – should be reserved for the most common notes. These are the colours to which the human eye is the most sensitive. Secondary colours should be reserved for the higher denominations; purple for the most dignified note, the highest denomination. If there are seven denominations, a neutral grey may be added. Use the grey for the note that may be replaced by a coin, to ensure that the memorised colour stays intact. This colour scheme has been laid down for the euro. It was proposed by the Nederlandsche Bank and accepted on condition that the colours initially intended for the EUR 50 and 200 notes be changed, because a yellow note would not be easy to print. The Bank does not underline this statement.

Finally, the banknote paper hue used for a denomination should bring out the main colour of the note.

A professional graphic designer does not object to being told to proceed from one specified dominant colour, like blue, since such a colour comes in a variety of shades anyway. All other colours the designer may use at his discretion, as long as the general appearance of the note is blue.
5.2. Selection of main motive

After the colours have been selected, subjects must be found. But first of all, definitions are required, to avoid confusion. Take, for example, the 17th century painter Frans Hals, whose portrait features on the NLG 10 note issued in 1970. After 25 years of using this note (!), the Dutch public was asked to tell who was on this note. Only 14 % managed to come up with the right answer; more than half (53 %) did not know, and 9 % was wrong. The remaining 24 % gave answers that were only partly right: historical person (16 %) or painter (= motif, 7 %) or a man (1 %).

Table 2
Different recognition and perception levels of the main picture on a banknote.

<table>
<thead>
<tr>
<th>Perception level</th>
<th>NLG 10/Frans Hals</th>
<th>NLG 250/Lighthouse</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Main theme</td>
<td>Great historical Dutch figures</td>
<td>Coast of the Netherlands</td>
</tr>
<tr>
<td>2 Theme</td>
<td>Science and art</td>
<td>Protection against the sea</td>
</tr>
<tr>
<td>3 Main subject</td>
<td>Painting</td>
<td>Things you can find along the coast line</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(lighthouses, rabbits, dunes, oyster catchers)</td>
</tr>
<tr>
<td>4 Subject</td>
<td>Frans Hals</td>
<td>Lighthouse</td>
</tr>
<tr>
<td>5 Design</td>
<td>Blue portrait with a few thick lines and a head</td>
<td>Purple lighthouse in 2D, emitting abstract light</td>
</tr>
<tr>
<td>6 Main image</td>
<td>Portrait of a man</td>
<td>Lighthouse</td>
</tr>
</tbody>
</table>

From the above table it appears that recognition of a subject starts at level 6 in Table 2, i.e. the main image. Consequently, the design of a series should proceed from this level. Often, a discussion of the theme remains confined to a perception level that is too high.
An excellent example is provided by the NLG 250/Lighthouse (see Table 2). This note’s main theme is the Dutch coast (level 1); the protection against the sea (level 2); elements typical of the coastline, like a lighthouse, a rabbit and dunes (level 3), and a lighthouse emitting light (level 4). The design is purple and the lighthouse is drawn in 2D instead of 3D (no perspective). The lighthouse emits an abstract spectrum (level 5). The first thing to strike the user’s eye is the lighthouse (level 6).

In view of the effects described above, Darwin’s theory would make a suitable theme for a new banknote series (see Table 3).

<table>
<thead>
<tr>
<th>Colour</th>
<th>Main image</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – High</td>
<td>Purple</td>
</tr>
<tr>
<td>2</td>
<td>Orange</td>
</tr>
<tr>
<td>3</td>
<td>Green</td>
</tr>
<tr>
<td>4</td>
<td>Yellow</td>
</tr>
<tr>
<td>5</td>
<td>Red</td>
</tr>
<tr>
<td>6</td>
<td>Blue</td>
</tr>
<tr>
<td>7 – Low</td>
<td>Grey</td>
</tr>
</tbody>
</table>

Table 3
A concept for a banknote series, for each banknote of which a specific colour is reserved as well as a specific main image.

Further, the theme of the note should be easy to memorise. To this effect, the public must be offered a name of no more than two syllables, which it may use to refer to the banknote. This contributed to the success of the NLG 100 banknote issued in 1981, which featured a picture of a snipe (a type of long-beaked bird). Before long, the term ‘Snip’ (Dutch for snipe) became synonymous with the NLG 100 banknote.

Although in Euroland 14 out of the 15 countries have portraits on their banknotes, the euro banknotes will not feature any. Instead, the themes on the seven euro notes will each represent a different European age and architectural style. The edifices or building elements portrayed have been altered to avoid complete similarity with existing buildings and, thus, to avoid a national bias. In other words, the euro notes are based on the same design concept as the NLG 250/Lighthouse: an existing building somewhat modified for the purpose! Unlike NLG notes, euro notes feature more than one theme. The main theme on the reverse of a euro note is constituted by pictures of bridges in the same Age and Style as on the face of it. The third design theme selected for euro notes is Europe, graphically represented by its flag, ring of stars and map. Further, the words EURO and EYP? recur over and over again on either side of a Euro banknote.

5.3. Design of denomination numerals

After colour and image, denomination numerals are the third design element that is to enhance recognisability of the face value of a banknote. These numerals should have a minimum height of 15 mm and be in the dominant main colour. People will get confused about the colour of the note if the colour of the numerals differs from the note’s main colour.

The large numerals should contrast sharply with a quiet, homogeneous background and be in sans serif lettering.

5.4. Other design features furthering value recognition

Finally, value recognition will be furthered by the use of features bearing a relation to the value, such as the
10-unit grid for the 10-guilder note, a 25-unit grid for the 25-guilder note, etcetera in the last NLG series. The said grid pattern extends to all of the note’s edges, enabling anyone to tell a note’s denomination from a mere corner of a note sticking out of their wallet!

Other examples of such a design feature are the features on the GBP notes issued in the 1990's. The bright squares, triangles or circles on the different denominations serve to facilitate value recognition by the visually impaired.

5.5. Abstract - realistic main image

The new Dutch banknote designs by Jaap Drupsteen are often called abstract. But this is only partly true. While no longer featuring one main realistic image like a portrait or flower or even an abstract main picture, for that matter, all the banknotes’ security features are figurative. The watermark is a bird supporting the main colour of the note and lending its name to the note. The see-through register is a poppy flower, an egg, a mouse or a small fish. The micro lettering is a poem, especially written for the note. Together, these public security features are there to support the note’s main theme: its colour.

When, in 1987, the design policy of the Bank was explained to the six candidate designers for the new NLG banknote series, Jaap Drupsteen conceived the idea of using the face value of the note as a leading theme instead of the, usual, special subject. Mr. Drupsteen decided to depart from the tradition set by his predecessor Oxenaar, which he thought almost impossible to improve on. The omission of the subject marked the beginning of a new design direction.

5.6. Visually impaired

People with a visual handicap are a special category of banknote users. How can they tell a banknote’s value?

In Western countries the visually impaired constitute about 2 % of the population:
1) partially sighted, low vision (about 1.8 %),
2) blind (about 0.2 %),
3) colour blind (about 0.002 %), partially colour-blind (8 % of males and 0.5 % of females).

For the partially sighted the NLG notes have: 3
a) one main bright colour,
b) large numerals (minimal 15 mm).

The blind can rely on:
c) the size of the note: each note in a series is 6 mm longer than the next one lower in value,
d) each note has a special tactile pattern indicating its value.

In 1968, the Bank was the first to introduce specially designed blind marks (circles, squares and triangles). In 1990, however, it was the first to abandon this policy, after research had shown that blind marks had two disadvantages:
1) only a very few blind people used them,
2) the general public regarded it as a security feature (more than 35 %!). In other words, blind marks attracted too much attention from people with eyesight!

Before long, the old blind marks had more or less turned into a public relations feature for the organisations of the blind, instead of serving as a tactile recognition feature!

Since the new 1990-series featured colour and value as a theme, it seemed logical to give the grid on the NLG 25/Robin a tactile mark for this purpose: five L shapes were printed on the note’s left-hand and right-hand margins. The other notes in the series each had a different tactile pattern in transparent intaglio ink: a fish bone on the NLG 10 note, dots on the NLG 100 note and wavy lines on the NLG 1000 note. These tactile patterns serve a double purpose. They are both a public security feature and a tactile value indicator for the blind! With these two functions combined, it is no longer necessary to have special blind marks on banknotes. The visually impaired welcomed this approach!
6. SELECTION OF SECURITY FEATURES

Having resolved the face value recognition problem, the project team entrusted with the development of a new banknote can focus on the security features of the NLG notes. In accordance with the policy set forth under 3.2, the Bank’s policy for the selection of new security features can be summarised by the following guidelines:

6.6.1. Select physical/chemical effects

A graphic product like a banknote can be defined in terms of six physical and chemical effects (see Figure 8). To be considered for use on a new banknote, a security feature must for its production involve physical or chemical values that are higher or lower than the extreme values feasible with existing systems. For example, a micro printed element on a banknote should have a resolution higher than the resolution of a standard copy machine. Or the iridescent planchettes that are made of a material (polyester and acrylic) that is not available in most reproduction systems.

![Diagram showing Original banknote, Reproduction system, and Reproduced banknote]

1) resolution 4) optical density
2) colour a 5) material b
3) geometry 6) mass

a = including UV, IR and other spectral features
b = including magnetism, conductivity

Figure 8
The reproduction system is regarded as a black box that reproduces six physical and chemical effects found in a genuine banknote in a counterfeit note.

6.2. When is a new security feature superior to an existing one?

6.2.1. The more extreme, the better

A new security feature is better when its specification values exceed those of an existing, comparable security feature.

6.2.2. High design freedom

Can the feature be designed and introduced in the banknote without a surplus of restrictions? Does it take much room? Does it interfere with other features, or with the reverse?

6.2.3. Costs

Obviously, the less expensive of two features is more attractive than an expensive one.

6.2.4. Several production techniques per user-specific feature

Each user group specific feature should require various production techniques (paper, foil, offset, intaglio etc.). In other words: do not use, e.g., paper only for the cashier-oriented feature.
6.2.5. Several effects per user-specific feature

Every security feature should combine several physical/chemical effects instead of being the result of, e.g., colour or resolution alone.

6.2.6. Intrinsic features are preferred to extrinsic ones

An intrinsic security feature is a feature that can only be produced inside a security paper mill or printing works. Examples of external or extrinsic features are threads, foils and special luminescent features. Being semi-finished products to be processed further by the security paper mill or printer, they are less suitable for use as features. Especially for machine-readable features, intrinsic security features, like a bar watermark in the paper (AQUIS) and a special intaglio line relief (ISARD), are preferable.

In addition to the general procedure, specific criteria are observed for the public, cashiers and sorting machine features:

6.2.7. Public

One public security feature is better than another public security feature if:
- the feature can be more easily recognised,
- the feature is easier to check (yes-no decision, hardly any interpretation needed),
- the feature bears a clear relation to other image or text elements in the note (so it will be better remembered).

6.2.8. Cashiers

One cashier security feature is better than another cashier security feature if:
- the checking equipment is more accessible in terms of use and costs,
- the reliability of the check of the security feature is higher.

6.2.9. Central bank

One sorting machine feature is better than another sorting machine feature if:
- its security feature checking is more reliable,
- it permits a more inconspicuous incorporation of the security feature into the design.

6.3. No security thread in NLG notes

Dutch notes do not have security threads. The Bank is often asked: why not?
If it had opted for a security thread in the 1980's, the Bank would have done so for the sake of the public. It decided against this feature, since it saw no need for a third machine-readable feature or for another cashier feature.

From among the security threads offered, the Stardust Thread – as it is referred to by the public - was considered the most interesting security feature. When the note is held up to the light, the stardust thread is clearly the darkest element in the note – pointing to a low optical density – whereas seen from above it is shinier than any other part of the note, which is indicative of a high optical density. So, basically, having extremes on either side of the optical density scale, the Stardust Thread meets the criteria for a security feature,

However, a major disadvantage of the Stardust Thread, and all security threads for that matter, is that it offers relatively little design freedom. A thread should not be placed in a watermark area, run through sorting machine features or the middle folding line, or be too close to the edges of the note. In the NLG banknotes, there was practically no room for a security thread, including the wander zone, in addition to the other features. Also, the edges of the note around the thread tended to tear, decreasing the life of a note.
The above disadvantages do not hold for foils, which offer much greater freedom of design (place on note, shape, surface structure), and, importantly, are much more easily perceived by the public than the tiny rectangles of the Stardust Thread.

Another serious disadvantage of a security thread is the public's habit of checking the note by attempting to tear it apart along the thread. Changing the paper fibres' direction from long-grain notes (paper fibres parallel to the long edge) to short-grain notes (paper fibres parallel to the short edge) would yield another disadvantage. Although in a circulation trial held in 1987 no difference was found between banknotes with cotton fibres in different directions, it is still felt that long-grain notes provide better resistance to the main centre fold.

After these analyses, the Bank opted for a foil on the NLG 100/Little Owl (issued in 1992). The Bank followed the Austrian example of the ATS 5,000 banknote issued in 1989, i.e. the first paper-based note to bear a foil.

7. DURABILITY

Based on an analysis of unfit NLG notes in accordance with the BFIS (Banknote Fitness Inspection System) – the fitness detector on the Bank’s Toshiba banknote sorting machines – the following unfitness rates were found for NLG 10 and 25 banknotes:

1) soiling; about 70 %,
2) folded corners (dog-ears); about 25%,
3) mechanical defects like holes and tears, adhesive tape, writing etcetera; about 5 %.

In general, a note will first soil and then, after reaching a certain soiling level, it will begin to show mechanical defects. Usually, NLG notes do not get the chance to develop this kind of imperfections, as by that time they will have been taken out of circulation for having too high a soiling level! With this in mind, the first interest is a good protection against soiling. A single film of varnish protects the notes mainly against soiling. During a circulation trial of NLG 25 notes conducted in the 1980’s, several varnishes were tested. This resulted in replacement of the first varnish – used since 1957 – by another, more effective one: the Dirt and Abrasion Resistant, or DAR, varnish. This product turned out to extend a banknote’s life to 3 times that of a non-coated note, making for a banknote production decrease by about 70%.

Therefore, every Dutch banknote produced since 1987 comes with a DAR varnish coating. Circulation trials of the kind referred to above also relied on the banknote number. Since 1968, all the numbers of the banknotes in circulation have been scanned by the Bank’s sorting machines; first by means of OCR-B readers, later by means of barcode readers (since 1990). With the aid of this Number Reading System – an active database of banknote numbers – specific series of banknotes were monitored while in circulation.

The last note, the NLG 10/King Fisher, has a double DAR varnish. So far, a circulation trial conducted in 1998-99 showed no differences between single- and double-varnished notes. For this denomination it was found that the life coated notes almost doubles compared to non-coated notes. A double life seems more realistic than the earlier found triple life of DAR-varnished banknotes. The two circulation trials each made use of a different sorting machine, including a different fitness detector. Also, the circulation behaviour of low denominations during the second trial differed from that prevailing during the first trial, as the return frequency of these denominations had decreased in a decade due to commercial banks changing their cash management methods.

Furthermore, the differences between the trials also extended to the measurement methods. The 1987 trial kept track of each individual note, whereas the 1998 trial was also based on a statistical sampling method.

In 1996, new alternative varnishes like waterborne (‘WDAR’) and UV-cured varieties were tested in circulation trials using NLG 50 notes. It turned out that WDAR notes had a shorter life than non-coated notes. At this early stage it would seem that notes coated with a UV-cured varnish do not make for a statistically significant increase in life compared to DAR-varnished notes.
With a view to protecting the denomination in the note-coin zone, i.e. NLG 10, other solutions were studied, like anti soil design patterns. On the basis of the outcome, the Bank concluded that a banknote’s watermark area should be as small as possible, since the white area is easily soiled, as well as inviting people to write on it. Off running print was introduced, abandoning the white margins. Furthermore, by way of a trial, the Bank had also a black NLG 10 printed.

Other measurements against soiling and wear and tear were studied, but not implemented:
- grey paper colour instead of white,
- thicker paper (higher weight),
- addition of plastic fibres (5%),
- size of the note (note height from 76 mm  p 65 mm).

ACKNOWLEDGEMENTS

People are essential to any progress in development and design; people to exchange ideas with, to get feedback from. I found such a sparring partner in my colleague Dr. Peter Koeze. Without his help and inspiration the design of Dutch banknotes would not have been what it is now.

REFERENCES

2. P. Koeze, Mechanical sorting, data processing and security against counterfeiting, De Nederlandsche Bank NV, Banknote Printers' Conference, Helsinki 1982
3. H.A.M. de Heij, Denomination recognition of Netherlands banknotes by the visually impaired