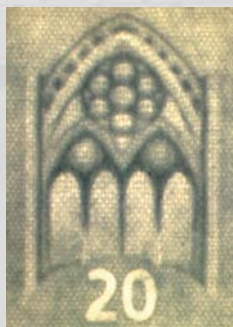


BILLETARIA

YEAR I

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Editorial

■ **J. Darío Negueruela** *Banco de España*

We would like to express our gratitude to the numerous colleagues and friends at central banks around the world who have congratulated, encouraged and supported us in this new initiative to enable professionals in the field of coins and banknotes to communicate and get together. Our thanks go to everyone, and we remain committed to making further efforts to improve the review, with the aid and collaboration of all.

- **BILLETARIA** remains faithful to the basic ideas we set out in the first issue:
- It is a review for central banks by central banks; although, of course, public banknote printing works are also invited to participate.
- It is open and markedly international in nature, and is not exclusive to the participant countries.
- It takes a dual approach, combining opinion and information articles. Clearly, the responsibility for the texts published lies with their authors and not with the Banco de España.
- The idea of including a personal interview with a leading figure in the banknote world, whose experience and position are benchmarks for all professionals, has been maintained, whenever possible.
- The review tries to strike a delicate balance between the necessary rigour and quality of the articles published and their brevity and accessibility, so as to make the review easy to read. More detailed research work is reserved for special and thematic issues.
- Collaborations with the main private companies relating to the world of banknotes will be included, allowing them to contribute their know-how and information regarding technologies of interest to central banks. No commercial or promotional articles will be published.



The Banco de España does not pay contributors or allow subsidies or sponsorship. The editorial independence of a central bank review such as this is a critical feature.

- The original aim was for the countries of Latin America to be the review's main audience, although this has now been broadened considerably. Nevertheless, the Latin American emphasis will remain a constant feature of the review.

BILLETARIA will always offer the International Cash Management Course, a significant initiative launched four years ago as a joint effort by the Banco de España, the Banco de México and the Banco Central de la República Argentina, a forum for spreading of knowledge. The expansion of the number of central banks included in the initiative, and the high academic and professional level of the Course, are making it a benchmark worldwide for the technical training of cash managers. We believe that this is an initiative worth supporting.

In terms of its format and publication, this second issue of **BILLETARIA** incorporates some significant changes in response to the comments and suggestions made by our readers: the size has been reduced, it is now both in Spanish and in English, and the characteristics of the review have been changed to improve the appearance and quality of the images.

The content of this second issue places the emphasis on two basic characteristics: quality and diversity. Contributions from central banks in Europe, Asia and America give a broad view of different interests, concerns and points of view. The interesting work presented by the Reserve Bank of India on their strategy for cash management, and the Banca d'Italia Printing Works on intaglio printing, are published here alongside contributions by the Banco de Portugal on coin issues, and Giesecke und Devrient on smart banknote processing applications. The Banco Central do Brasil and the Real Casa de la Moneda-Fábrica Nacional de Moneda y Timbre in Spain join the central banks of Colombia and Uruguay to complete a diverse and enriching range of topics, views and opinions. We would like to take this opportunity to reiterate our invitation to all our friends and colleagues to take part in **BILLETARIA**, whose doors are always open to all professionals in the cash sector. At the same time, the Cash and Issue Department of the Banco de España, following the path taken by the Russian publication "News bulletin. Banknotes of the World", has prepared a brief catalogue of the main banknote security features, which we hope will be of value to our readers. And of course, our warmest thanks go to our friend and mentor, Wolfgang Söffner, for generously giving his time to share with us his authority and wisdom in relation to the activity to which we devote so much of our time.

José Barone, whose support and collaboration were decisive in the launching of both the International Cash Management Course and **BILLETARIA**, is giving up his cash-related work to take on new responsibilities at the Banco Central de la República Argentina (BCRA). We wish him the best of success. He has been replaced in the Editorial Committee by Guillermo Zuccolo the new Treasury Deputy Manager at the BCRA.

Collaborators

Wolfgang Söffner

J. Darío Negueruela

Prabir Biswas

Joao S. de Figueiredo

Helder Rosalino

Bernardo Calvo

Alfredo Allo

Vincenzo Ciaramella

Francisco Lacuesta

Alfred Schmidt

Claudio Hils

Fernando León

Chief Cashier of the Deutsche Bundesbank.

Director of the Cash and Issue Department. Banco de España.

Executive Director. Reserve Bank of India.

Chief of the Treasury Department. Banco Central do Brasil.

Deputy Director of the Issue and Treasury Department. Banco de Portugal.

Director of the Treasury Department. Banco de la República. Colombia.

Chief of the Treasury Department. Banco Central del Uruguay.

Deputy Chief of the Printing Works. Banca D'Italia

Head of the Production Service. Real Casa de la Moneda-Fábrica Nacional de Moneda y Timbre. España.

Chief of the Banknote Processing Systems Department. Giesecke und Devrient.

Photographer and communications designer. Mitglied der Deutschen Fotografischen Akademie.

Head of the International Currency Unit. Banco de España.

Interview with Wolfgang Söffner,

chief cashier of the Deutsche Bundesbank

■ J. Darío Negueruela *Banco de España*



I met Wolfgang Söffner in 2003, in Frankfurt, when, right after his designation to carry out the responsibilities in the field of cash of the Deutsche Bundesbank, he started his participation in the Banknote Committee in the Eurosystem. Since, he has played an extraordinary role in the Eurosystem's banking community, taking the moral leadership amongst his colleagues, boosting initiatives and helping to create a climate of positive cooperation within the project of the euro. His experience in other professional fields, as well as in complex international relationships, has been remarkably useful in a moment in time in which it was necessary to re-define strategies and implement new policies in cash management, both in the domestic and cross-border spheres. Furthermore, he has demonstrated the skill and ability to handle very difficult situations. It is an hon-

our for me to hold this interview with Wolfgang, with whom I am linked both through friendship and in a professional capacity.

Q. The current collaborative environment between central banks and, in particular, between Cash Departments, is it just a trend or maybe a permanent change in the relationship models?

A. Increased cooperation is essential. Those who, like us, have benefited from increased international communication and cooperation do not want to turn back the clock. Central banks' tasks and problems require more and more coordination and this is not only the case in Europe.

Q. Concerning the Eurosystem: What are the main changes the Bundesbank's Cash Department has gone through in the

Mr. Wolfgang Söffner was born on 8 May 1943 in Berlin. In 1970, after two years' military service, he graduated in business management from the University of Münster. He joined the Bundesbank in 1971 and held various managerial posts in information processing at the Bundesbank's Central Office and represented the institution in the Group of Computer Experts at the Bank for International Settlements (BIS) from 1983 to 1990. From 1993 to 2003 he was the Head of Organisation, Information Technology, Payments and Control at the Land Central Bank in Hesse and from 1995 to 2002 he was the Bundesbank representative on Clearstream AG's (Deutsche Börse Group) Customer Advisory Board. For more than twenty years between 1981 and 2002 he played an important role as a special technical central bank consultant in various countries. Since 2003 he has been Head of the Deutsche Bundesbank's Cash Department, responsible for all policy issues in the field of cash payments such as banknote development and issuance, cash management and counterfeit money matters, as well as banknote processing and its automation. Among other tasks, Mr. Söffner is also entrusted with the duties of Bundesbank representative on the Banknote Committee of the European System of Central Banks. From 2004-2006 he was Chairman of the European Banknote (Printers) Conference.



last 6 years, from the Deutsche Mark to the euro?

A. The introduction of the euro not only meant a change of currency but also a change in the framework under which the Bundesbank carries out its public mandate. As part of a structural reform, the Bundesbank sought to discharge its tasks more cost-effectively and to streamline and centralise its management structure to ensure that it is ready for Europe. Since then, the Bundesbank has had five business areas at the centre of its strategic orien-

tation, with a particular emphasis on an efficient infrastructure and cash supply.

Q. How has your internal management model been affected by the shift from an autonomous policy designed for a country of 80 million inhabitants to a common policy oriented to an area of 300 million European citizens?

A. Of course the changeover from a national monetary policy to a European monetary policy has significantly changed the Bundes-

bank as a whole, as well as the cash handling activities. The era of a national federal structure ended for the Bundesbank with the introduction of the euro. In March 2002 the Land Central Banks lost their independence and became Regional Offices of the Bundesbank (in the previous structure of the Bundesbank, the independent Land Central Banks conducted the domestic business for specific regions in Germany and the Directorate in Frankfurt coordinated these activities and was responsible for foreign con-

tacts). Since then an Executive Board, based at the Central Office in Frankfurt, has been the sole executive body. This leaner organisational structure leaves the Bundesbank well equipped to effectively bring its competence to the European System of Central Banks and to accomplish its wide variety of national tasks.

Q. Has the Bundesbank designed a strategic action plan regarding the central bank's role in German / European society? Has it defined basic princi-

ples – or limits – regarding its banknote and coin management?

A. At national level, it is very important for a central bank to be perceived by the public as a capable institution which performs its professional duties convincingly. The consistent implementation of the structural reform, in particular, further improved the Bundesbank's public identity as an efficient, transparent and open institution. Furthermore, crucial policy decisions were made, for exam-

ple in the area of cash payments, in reaction to the declining demand for central bank services in non-urban areas. By means of closures, the branch network, which used to consist of more than 200 branches, will have been reduced and focused to 47 locations by the end of 2007. As part of the change in the range of services offered by cash payments, the Bundesbank is particularly concentrating on quality assurance in banknote processing and has scaled back its activities in the area of coins.



Wolfgang Söffner's guidelines to deal with the quality of banknotes in circulation

We should pay attention to the quality of banknotes. It helps to maintain and support public acceptance of the euro as legal tender. The unrestricted use of banknotes in cash dispensers and vending machines should be ensured. Only if the banknotes in circulation are in good condition can we assure that humans can reliably detect counterfeits with their senses.

In order to achieve these aims, numerous quality control regulations have

already been passed at European level. In this context, an important instrument has been established, the "minimum standards", which tell the individual central banks at what level of wear and tear or soiling the banknotes should be withdrawn from circulation.

In addition, central banks have to be concerned about how private professional cash handlers, particularly credit institutions and cash-in-transit companies, can contribute to achieving these aims. Alongside the obligation to detain

counterfeits immediately and pass them onto the competent authorities, the new European Banknote Recycling Framework is vital as it obliges professional cash handlers, who process the banknotes themselves, to check the banknotes at a standard similar to that of the central banks. This aim is primarily achieved by testing the sorting accuracy of the banknote processing systems used by private cash handlers both before they are operated for the first time and also during their ongoing operation.

Central banks themselves make the most important contribution to good banknote quality. The sorting performance of their banknote processing systems is

monitored intensively and continuously. This ensures the issuance of good quality banknotes. Furthermore, it is important that credit institutions are required to report irregularities found in the banknotes as quickly as possible. In turn the central banks should analyse such reports very carefully and, if need be, to remedy the situation as quickly as possible.

An appropriate central bank involvement in banknote processing is the way to achieve and maintain the high quality of banknotes in circulation. The involvement in each country will be different, according for example, to the form and structure of the cash cycle.

Q. Does the Bundesbank think that a central bank should offer cash services to the citizens or should it focus its activity exclusively on the professional cash handlers instead?

A. Traditionally, central banks are the “banks’ bank”. However, in recent years we have all been able to observe that credit institutions have retreated more and more from the cash cycle, while other market participants (particularly cash-in-transit companies and the wholesale and retail trade) have gained in significance. The Bundesbank responded to this change by introducing multi-denomination deposits and has thus contributed to shortening the cash cycle and, in so doing, speeded up the entire process. In other words, we have thus actually increased overall efficiency and not only shifted costs. Only a limited volume of cash services for citizens is necessary if the tasks are not taken on by banks.

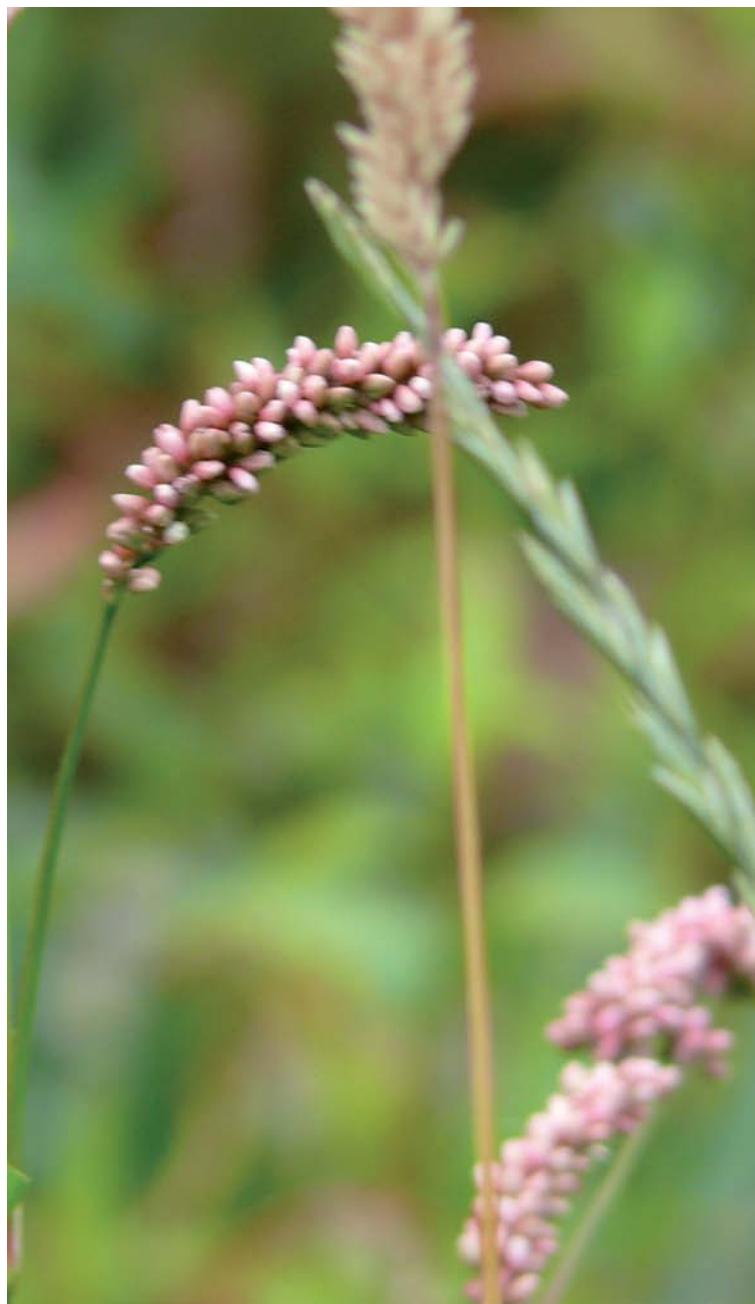
Q. Should the term “professional cash handlers” only be applied to credit institutions or should it also relate to real economy agents who need to manage important amounts of cash (eg superstores, the vending machines sector, gambling sector, etc.)?

A. Merely in terms of cash alone, the aforementioned groups may also be regarded as professional cash handlers, as the volumes of their lodgements often exceed those of smaller savings banks or people’s banks. Therefore, it makes little sense to subdivide wholesalers according to sectors. However, as a central bank, we still have to take other aspects into account, such as statutory regulations on money laundering and prudential supervision. This legal framework must particularly be taken into account when including the retail sector, vending machines sector or gambling sector in the group of professional cash handlers.

Q. What is the Bundesbank’s “one-step policy”? How have you implemented it? What are its advantages?

A. Our “one-step policy” is based on multi-denomination lodgement, which should reduce the time it takes cash to get from wholesale and retail trade to us. Multi-denomination lodgement has rendered obsolete the “two-step process” (which involved

pared” cash. In other words, the banknote bundles do not have to be aligned, separated according to denomination, counted or valued. The associated reductions in costs and gains in efficiency actually occur twice over. Firstly as only around half of the prepara-



preliminary processing in a cash centre, where the banknotes were processed in accordance with the Bundesbank’s terms and conditions for lodgements). The changeover to the multi-denomination processing, which started at our branches at the beginning of 2006, should be completed by the end of 2008. Then all branches of the Bundesbank will be able to receive lodgements of “unpre-

tion stages market participants used to have to complete are now required. Secondly the Bundesbank’s costs are also reduced through smaller reject rates and larger reconciliation units.

Q. In your opinion, what are the key aspects that are encountered in the modern management of a Cash Department? Is there an ideal model of organi-

sation and functioning for a Cash Department?

A. One key aspect is carrying out our statutory mandate in a framework of optimised costs. At the same time, we need to not only optimise our internal operations in line with the state of the art but also ensure the overall economic efficiency of the cash processes. In my opinion, confidence in the currency forms the cornerstone of our work. We must nurture and preserve this confidence by ensuring that the banknotes are always in good condition, that their authenticity can be verified quickly and contingency plans for crises are also in place. Concerning the central bank’s organisation, I think we all agree that there is no ideal one-scheme-fits-all model, as the differences between the national frameworks and particularities are too great.

Q. To what extent is the central bank branch meant to be: a contact point with society, a banknote storage and custody allocation, a distribution and collecting point or a banknote sorting centre?

A. Our branches unite more or less all of these aspects. Cash processing is just as important as direct contact with banks and cash-in-transit companies, while lodgements and withdrawals at Bundesbank branches form the basis of the Bundesbank’s role as an agent of quality assurance in the cash cycle.

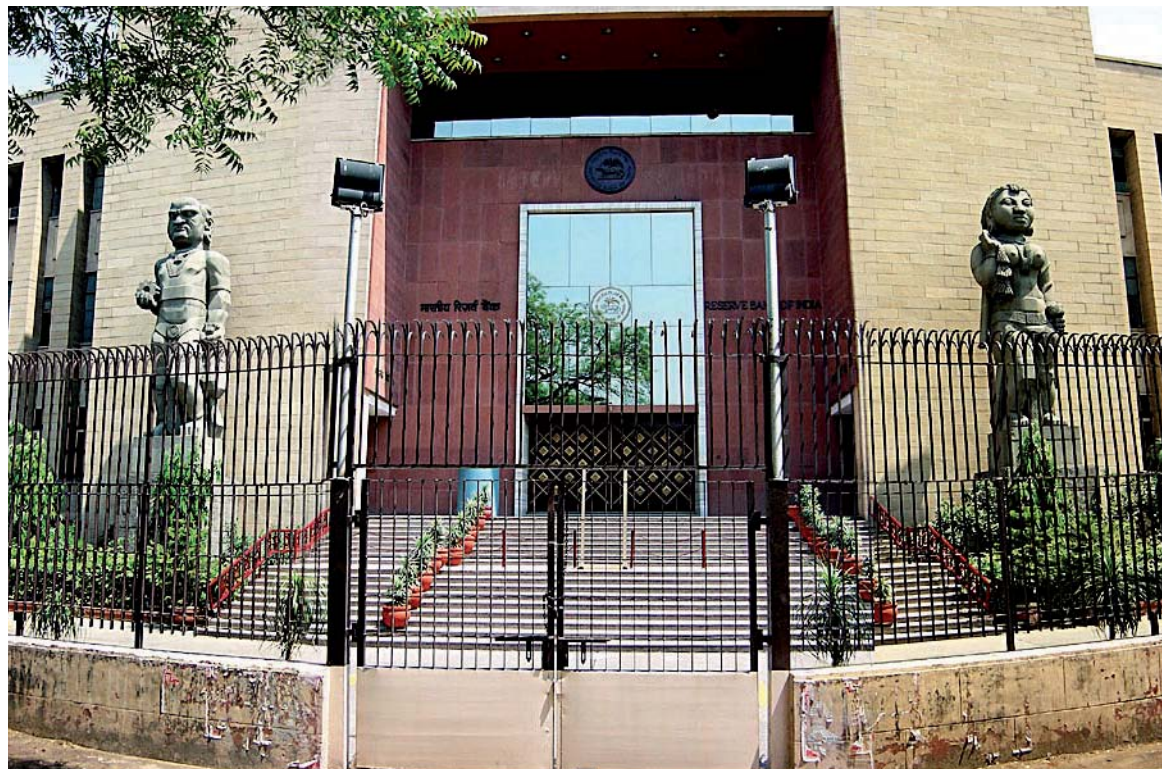
Q. Does cash management face any considerable challenges in the forthcoming decade?

A. Perhaps the efforts to push ahead with coordination between central banks in the euro area and assimilate our business policies inter se, but also with third parties, could be seen as a big challenge. At this point, I personally would like to describe the creation of the Eurosystem as the greatest achievement of the European central banks. Whatever follows on from this will build on this important first step.

Strategic plan for cash management

■ Prabir Biswas *Reserve Bank of India*

Management of currency has been one of the oldest core functions of a central bank and the value of currency¹ in circulation has been a major constituent of money supply. As such the value of currency in circulation is related to the overall figures of money supply. In most countries the ratio of value of currency in circulation to overall figure of money supply bears a constant ratio² unless warranted by developments like high rates of inflation³ or deflation, large fluctuations in liquidity, and / or volatility in interest rates and exchange rates⁴. At the same time central banks have to also ensure the integrity of the currency in circulation and availability of good quality currency (banknotes as well as coins) in adequate numbers in all parts of the country. While discharging its responsibility, central banks have to depend on the network of bank branches for operations like distribution, storage and retrieval, and on the banknote printing presses and the mints for timely supply of fresh banknotes and coins. And finally central banks have to ensure that costs associated with printing to final disposal of soiled banknotes and coins are commensurate with the benefits. And since currency is the most visible face of a central bank to the members of the public, any issue or lapse or adverse development causes harm to the image or reputation of the central bank. Such



issues or lapses or adverse developments include poor designs of the banknotes, counterfeit banknotes, security lapses resulting in robbery, circulation of soiled banknotes, denominations of banknotes and coins not meeting the public requirement for transactions, drying up of automated teller machines, poor choice of technology in printing⁵, etc.

Strategic planning for currency management thus consists of (a) forecasting demand for value of

currency in circulation, (b) decisions on denominations of banknotes to be circulated, (c) designing of banknotes including selection of substrate, security features, and types of printing, (d) designing and management of the supply chain for distribution, storage and retrieval of banknotes, (e) maintenance of integrity of the banknotes⁶, (f) security in operations, (g) customer service, (h) cost effectiveness, (i) policies related to outsourcing, and (j) contingency planning and disaster management.

Forecasting demand for banknotes depends on projected growth in money supply and projected growth of other modes (other than cash) of payment and settlement⁷, public preference for denominations, circulation life of each denomination of banknotes, printing capacity, cost, changes in designs and security features, and threats of counterfeiting. In general public preference for other modes for payments and settlements depends on their cost and easy accessibility on one hand and the safety of using such



modes on the other hand. So far as denominations are concerned, public mostly prefer lower denominations, which have comparatively lower circulation life resulting in printing of large quantities annually to replace the existing banknotes in circulation⁸. Central banks have to review regularly the costs of banknotes vis-à-vis their circulation lives, and decide on their coinisation in a phased manner⁹. Central banks can also think of coating of banknotes to increase their circulation lives (like £5 banknotes issued by Bank of England) or using environment friendly durable substrates (like Bank of Thailand).

printing by reducing the volume of banknotes in circulation, while meeting the higher demand for value of banknotes in circulation. For illustration, expenditure on printing was brought down by 15.6 per cent from 2003-04 to 2004-05 in India by reducing the number of banknotes in circulation while meeting the demand for higher value. The value of banknotes in circulation increased by 12.2 per cent from 2003-04 to 2004-05, while the volume reduced by 4 per cent over the same period¹¹.

Designing of banknotes, selection of security features, etc.,

for banknotes in lower denominations. Further, according to the Interpol, intaglio printing offers the best possible way to prevent counterfeiting¹², as desktop printers cannot make intaglio printing. If a decision is taken to use intaglio printing, then due planning is necessary since intaglio printing takes longer time than offset printing.

Management of the supply chain is most vital in managing currency circulation, and this aspect is most neglected all over the world. First, in almost all the commercial banks, and even in most central banks, posting in the currency

in reducing cost and in improving effectiveness. This in turn needs a comprehensive policy relating to all the operations and risks associated with them. There must be prescribed procedures and accounting methodologies for operations ranging from (a) simple handling of cash, (b) verification, processing and sorting of banknotes, (c) disposal of non-issuable banknotes, (d) treatment of counterfeit banknotes, (e) resource management, (f) remittance, (g) records and management information system, (h) security, (i) audit and inspection, (j) citizens' charters, codes, and standards, (k) redressal of griev-



Changes in security features and designs also necessitate large quantities for replacement. For illustration, if large quantities of counterfeit banknotes in a particular denomination are noticed, it may be advisable to recall all the banknotes of that design and denomination and replacing the same with the new ones¹⁰.

Decisions on denominations of banknotes are vital on two counts, first, such decisions must meet the public demand, and second, by judiciously choosing the denominations, a central bank can bring down the cost of

have three major implications. First, the banknotes must be attractively designed and should not be cramped by security features. Second, the banknotes should not become easy targets for counterfeiters. Third, the cost of printing a banknote cannot be disproportionate to its utility. In many banknotes, designs are anything but aesthetic because of too many security features. Security features are necessary to prevent counterfeiting, but since all the denominations are not targeted by the counterfeiters, there may not be any need to select too costly security features

department or cash department is considered as a punishment posting for routine work. Second, commercial banks consider handling of cash as a costly affair, and more often than not outsource these activities resulting in increasing risk due to outsourcing¹³, increasing cost, and poorer service to the customers (as evidenced by long queues in front of cash counters). In my opinion, the handling of cash should be viewed as part of supply chain management, and management of currency supply chain is as important as managing computerised numerical control systems

ances, (l) right to information, (m) contingent planning, and (n) disaster recovery management. My experience of years has taught me that even when these are in place, banks do not pay attention in ensuring their implementation. This apathy or complacency results in lack of innovations (both technological and strategical) in processes to meet the challenge of increasing volume and complexities (particularly counterfeit banknotes) in currency management. Any innovation needs knowledge, and it is more so in respect of process innovation. Without knowledge within an or-

organisation or a firm, it is not possible to design and create new processes that will work. Sadly, most of the managers in banknote issuing authorities shun such innovations and rather prefer to continue with the existing methods. At best they tend to adopt product innovations even at the cost of increasing expenditure without commensurate increasing benefits. In most cases, physical objects and products are more appreciated than ideas that will lead to changes that will bring benefits. This tendency is strange as all the banknote issuing au-

causes for an unsuccessful supply chain are (i) focus on efficiency rather than on effectiveness, (ii) globalisation of supply chains, (iii) focussed sources and centralised distribution, (iv) increasing tendency to outsource, (v) reduction of the supplier base, and (vi) absence of supply chain resilience.

Physical security has always been and will be a major concern in handling currency. My personal conclusion after all these years is that there is no such thing as "total security", and we should



thorities enjoy total monopoly and hence should take the challenge of developing new processes. The successful management of currency notes or banknotes in future will depend not merely on public demand for banknotes, but on the ability of the banknote issuing authorities to be open to new ideas while capturing the benefits of the new technology. "Innovation is like virtue; it is important, we would like to have more of it, but few know how to get it and even fewer know how to keep it." Banknote issuing authorities should realise that innovations are comparable to supply of fresh water to a river, without which a river dries up very soon. In my view the most common

rather plan for strengthening security for those operations where the probability and the impact of security risk are high. Such planning calls for having security personnel who can look at security issues through a business prism, and not look at business issues through a security prism.

Customer service has been one of the major concerns of all central banks, as quite often commercial banks and other institutions may not share the same level of concern for the customers as central banks do. Such customer service in currency management means ensuring circulation of good quality banknotes of all the denominations, facilities to

exchange soiled banknotes, and facilities to exchange coins into banknotes and banknotes into coins. In India the central bank, Reserve Bank of India, takes all the decisions regarding policies and operations of the 'supply chain' in consultation with the banks, law enforcing agencies, state governments, etc. There are 18 full fledged regional offices and 2 sub-offices of the Reserve Bank across the country, which are responsible and accountable for managing the inventory, distribution and servicing of currency under their jurisdiction. There are about 4500 currency chests (receptacles for both banknotes and coins)¹⁴ and about 3500 small coin depots (receptacles for small

denomination coins) with the commercial banks (a few with other financial institutions including co-operative banks) through which the Reserve Bank has to ensure compliance with the statutory requirements of ensuring adequate supply of good banknotes and coins¹⁵. In the preamble to the RBI Act, it has been stated, "Whereas it is expedient to constitute a Reserve Bank of India to regulate the issue of banknotes, keep reserves, with a view to securing monetary stability in India and generally to operate the currency and credit system of the country to its advantage Act." To improve the customer service the Reserve Bank during the years, 2002 to



2004, made major changes in the policies and procedures like progressive automation of the verification, processing and sorting of banknotes, simultaneous shredding and briquetting of soiled banknotes, build-up of denomination-wise and chestwise data and information, etc. However, perception about what constitutes customer service differs from one age-group to another, from rural to urban areas, etc., and it is a continuous process for a central bank and commercial banks to make their operations effective to not only meet the customers' needs but also to reduce the risks¹⁶ associated with currency management. Personally I am of the view that the best way to improve customer service¹⁷ is to keep members of public aware of their rights and responsibilities.

Finally, in today's world disasters¹⁸ (man-made as also natural) occur with much faster frequency and with much higher impacts, and unless contingency plans are in place and there are clear policies and procedures for disaster management, currency management will progressively become more complex and may lead to loss of image or reputation¹⁹. In India many places suffer from floods every year. Because of submergence of buildings for days in some places, banknotes stored in currency chests and other bank branches become heavily soiled and unfit even for handling besides being health hazards. And of late terrorism has added another dimension in the sense that counterfeit banknotes are used for funding the activity.

Strategic Plan for currency management means linking each of the activity with the overall operations in the banking system and integrating currency risk management with the overall risk management structure. While doing so, we need to realise that banking activity all over the world has gradually changed from 'liability driven banking' to 'asset driven banking'. Making a choice about innovative ideas rather than dreaming them up is one of the toughest decisions facing banks

in general and in currency management in particular. My own experience has taught that success in innovation depends on people and events up and down the value chain, and accomplishments tend to depend largely on managing expectations.

The other important segment of strategic planning for currency management is to put in place an appropriate risk management policy and procedures. Such risk management approach can be based on either qualitative or quantitative risk measurement approach, if not both. The qualitative approach through structured formats help in identifying the operational risks, and the quantitative approach helps in identifying the key risk indicators.

The challenges of currency management are enormous and test a person or a team of persons regarding one's or team's ability to be innovative and manage changes while meeting the expectations of the public without increasing risk to the banking system.

Footnotes

1. Currency is commonly known as banknotes denoting the liability of the issuer, mainly central banks. Banknotes are papers issued by banks promising to pay the bearer on demand a specific sum of money. Banknotes differ from promissory notes in that they may be reissued after payment.
2. This relation normally shows a constant ratio if nominal data is adjusted for inflation and other factors and figures are taken at constant prices.
3. Latin American inflation and capital flight in the Eighties and the Nineties resulted in a sharp increase in demand for cash, particularly, high denomination banknotes. Such situation often leads to regulatory actions like demonetisation (Gesselli, Silvio, "The Natural Economic Order" published in 1929). In India, banknotes of Rs.1000, Rs.5000 and Rs.10000 denominations were demonetised in the Eighties.
4. A central bank normally affects fluctuations of output in the economy in the short and medium term by choosing between tight money and an easy money policy. In India share of currency in broad money has come down from nearly 40 per cent to marginally more than 15 per cent in the recent years. However, 'broad money' grew at 21.6 per cent (year-on-year on July 06, 2007) as against 19.0 per cent (y-on-y on July 07, 2006). And value of notes in circulation increased from Rs. 4424 billion (July 21, 2006) to Rs.5101 billion (July 13, 2007).
5. In some countries change of substrate used for printing made the inks and printing disappear in quick time from the banknotes printed on the new substrate. Crumpling of banknotes during handling also results in such printed banknotes turning into plain substrate.
6. Even in ancient times counterfeiting was a hanging offence. In Dante's Inferno forgers were placed in one of the lowest circles of the hell. In recent times, the Bank for International Settlements has constituted a dedicated group to combat counterfeiting.
7. All over the world, there has been significant growth in other modes of payment and settlements, particularly, cheques, cards and electronic banking, and collectively these other modes can help in reducing the value as well as the volume of banknotes in circulation by about 2 to 5 per cent per annum. And strategically a central bank can formulate and pursue policies that will encourage growth of other modes so as to bring down the demand for banknotes.
8. For example, in India it was observed in the early Nineties that put together denominations in Rupee 1, Rupees 2, and Rupees 5, constituted about 57 per cent of the volume of notes in circulation, and contributed about 7 per cent of the value of notes in circulation. It was, therefore, decided to discontinue their printing and these denominations were coined in a progressive manner.
9. In many countries decision to stop printing of banknotes in lower denominations was not preceded by adequate supply of coins in these denominations resulting in shortage of these denominations resulting in hue and cry from the members of public. And as it happens in times of shortages, members of public start hoarding these denominations resulting in further aggravation.
10. Threat of counterfeit banknotes is far higher today than in the past due to availability of low-cost desktop publishing systems. It has been reported that at present 40 per cent of the seized counterfeit banknotes are digitally printed as against only 1 per cent a decade back.
11. The author was then in-charge of currency management.
12. Interpol Conference, 2002.
13. As noted by the Bank for International Settlements.
14. The banknotes in the currency chests belong to the central bank (RBI) in India. Maintenance of the currency chests by the RBI helps in avoiding extensive and frequent physical movement, as these currency chests store stocks of banknotes and coins, they facilitate distribution, exchange, and remittance of banknotes. As and when a commercial bank deposits or withdraws cash from the currency chest, the bank reports the matter to the Reserve Bank of India, and in turn its account with the RBI is either credited or debited. One of the key factors to reduce costs in operations as well as to reduce risks in India during the years, 2003 to 2005, was streamlining the operations of these currency chests and improving their effectiveness as also reporting system (MIS). The RBI also commissioned in 2004 a project for computerised and integrated reporting of currency chest operations.
15. The Reserve Bank derives its powers for management of currency from the provisions of the Reserve Bank of India Act, 1934, and in terms of Section 22 of the said Act, Reserve Bank is the sole authority for issuance of currency in India. In addition there are other legislations like (a) Indian Coinage Act, 1906, dealing with minting and issuance of coins, (b) Small Coins (Offences) Act, 1971, prohibiting melting of small denomination coins, (c) Currency Ordinance of 1940 dealing with the printing and issuance of Rupee One notes (Printing of Rupee One notes has been discontinued since about ten years back), (d) Legal Tender (Inscribed Notes) Act, 1964, intended to prevent use of notes for conveying political slogans and messages, (e) Chapters XII and XVIII of the Indian Penal Code, 1860, read with the Code of Criminal Procedure, 1898, relating to offences in respect of currency and coinage, and (f) Foreign Exchange Management Act, 1999, relating to export and import of coins and banknotes from and into India.
16. Operational risk is the risk of direct or indirect loss resulting from inadequate or failed internal processes and systems or from external processes. In currency management, such operational risks may arise on account of (a) lack of security, (b) outsourcing, (c) lack of specialised processing operations, (d) lack of technical upgradation, (e) too much of reliance on technology, (f) complexity of the operations, and (g) lack of strategy. The probability of occurrence of operational risks and the impact can be reduced, if not eliminated, by improving internal control environment and mechanisms, developing risk management policies and procedures, and employing risk transfer techniques.
17. Biswas, Prabir K., 'Banks and Customers : Yesterday, Today and Tomorrow' – House Journal of Views Exchange, Volume 9, Number 7, January, 2007, and Biswas, Prabir K., 'Know your customer or know your bank?' – Vinimaya, Volume XXVIII, Number 1, April – June, 2007, National Institute of Bank Management, Pune, India.
18. Disaster is 'anything ruinous or distressing that befalls', or 'a sudden or great misfortune, or a mishap, or a calamity'. The great Indian economist-cum-statesman-cum-strategist, Chanakya (3rd Century B.C.), wrote (Kautilya's Arthashastra, Chapter 8.1.2) "A calamity of a constituent, of a divine or human origin, springs from ill luck, or wrong policy".
19. For illustration if banks hold too much of cash, it reduces their profitability. On the other hand if they do not have cash to meet public demand, it may induce a run on the bank (worse on the banking system) as people consider non-availability of cash (either across the counter or through the ATM) as sign for failure.

Risks and security for the custody of cash

■ João S. Figueiredo

Banco Central do Brasil

Currency in circulation amounts presently to approximately R\$ 80 billion, 3.2% of GDP, accounting for 12 billion coins and 3.5 billion banknotes. The federal republic is composed of twenty six states and a federal district with 5,561 municipalities and more than 188 million inhabitants. An efficient currency system is therefore essential for the economic development of the country.



Banco Central do Brasil – Rio de Janeiro (at the beginning of the 20th century).

Maintaining central bank valuables in custody accounts with third parties, with a view to guaranteeing withdrawal and deposit transactions by commercial banks, has been an alternative adopted by different central banks across the world. In general, the custodian shall operate on behalf of the central bank, in line with regulations establishing operational routines and obligations intended to ensure the quality and reliability of the services.

The custody account can hold either banknotes, coins or both, and is intended to meet its own and/or other institutions' requirements. Its configuration depends on the purposes, ranging from improving the supply of small amounts up to a model fully complying with all cash requirements, including the custody, processing and sorting of unfit banknotes.

The advantage of the custody account for the system also consists

in the possibility that the financial resources deposited with bank reserve accounts of financial institutions are immediately available, usually at lower costs, depending on the self-custody option or on the proximity of the custodian in regions where the highest possible number of institutions is located. When adopting some of these modalities, central banks incur two types of risk:

- Operational risk, resulting from the fact that the custodian may cease to provide a satisfactory service, failing to supply banknotes and coins meeting the quantities and quality standards required by central banks; and
- Risk of loss, possibly depending on the undue utilisation, loss or theft of the valuables, or even bankruptcy of the custodian.

Both risks have a common additional feature: the risk of damaging the reputation of the central bank,

given that, to the eyes of society, the liability continues to lie with the granting central bank. Some measures may be adopted by central banks with a view to minimising such risks: regulation, safety and supervision.

Regulation includes laying down rules and defining penalties, including financial penalties, as well as creating instruments and means of control to ensure compliance with the established procedures. Formal rules signal to the market the central banks' expectations in terms of services to be provided, and permit new participants to join, in a context of low information asymmetry.

The stage of regulating the custody account service may involve the participation of the user institution. Some of the positive aspects of this interaction would be:

- Discussions with the users, promoting mutual understanding

and permitting future rules to be in immediate direct contact with the reality of the organisations. This may be reflected in terms of bringing down implementation and operational costs; and

- Participation which in general improves the cooperation level and widens the understanding of the benefits to be provided to society.

The safety of the valuables in custody should be ensured by a number of material and institutional conditions minimising the risk of loss. Among material conditions, the following should be highlighted:

- 1) physical safety of the premises, the requirements of which should be determined in such a manner that the custody account would be held in premises that are appropriate to the safe-keeping of and transactions with valuables;

The implementation of the concepts above analysed has been developed further since the adoption of the present model for the management of the currency in circulation, which includes the custody of valuables in a financial institution under contract.

The regulations governing this model are laid down in the Resolution of the National Monetary Council N. 3322 of 2005, regulated by Central Bank Circular N. 3298, which lays down the Regulation governing the custody of cash; Circular-Letter N. 3214, which defines operational procedures of the currency circulation system, within the scope of the Brazilian payment system; and Press Release N. 13828, which discloses the Regulation of the Technical Council on the custody of cash, all of which are available on the Banco Central do Brasil's website, at www.bcb.gov.br



Operations with cash.

- 2) definition of ceilings to the safekeeping of and transactions with valuables. If possible, valuables should be widely distributed across different locations, and the respective balances should be allocated to a higher number of branches. Closer proximity with the users is thus obtained and valuables are less concentrated in few locations. The ceilings are associated with operational needs of moving valuables;
- 3) collateralisation with the monetary authority. A percentile may be used on the total valuables in custody, the equivalent of which in public securities would be available for the coverage of losses;
- 4) setting up of a reserve fund, the value of which may be a percentage of or even total valuables in custody, with a view to covering losses;
- 5) taking out an insurance;

The institutional conditions, in turn, are related to the economic-financial health of the custodians, which are usually financial institu-

tions, but may also be cash-in-transit companies.

The selection of financial institutions may be advantageous for the safekeeping of and transactions with valuables on behalf of the central bank. These institutions are the primary users of the services, given that in modern economies the issuance model is adopted through the intermediation of commercial banks. Banks would therefore be interested in and prone to require and carry out such services – due to operational reasons and for possible cost cut. Another aspect is related to the fact that commercial banks are supervised by the central bank, and shall comply with prudential limits in order to carry out their banking transactions, with a view to maintaining the stability of the financial system. The banking supervision area may monitor the performance of banks and of the system as a whole, thereby mitigating the bankruptcy risk of the custodian.

The selection of cash-in-transit companies chiefly depends on the degree of technical and institutional maturity of that segment. These conditions are reflected on

the level of reliability regarding the safety of the valuables and the quality of the services.

Finally, reference should be made to the supervision of the custodian by the issuance and treasury areas. The main objective of supervision is to ensure ongoing monitoring from the point of view of compliance with the regulations, the quality of the services provided, and the existence of the valuables in custody. The frequency may be established according to a methodology that resorts to a risk matrix to evaluate and weight all activity risks. Compliance with the procedures may be accomplished according to well-known supervisory methods.

As regards the fulfilment of custodian users' requirements, regular consultation contributes to the management of the system and evaluates objectively whether society is taking advantage of all benefits of the model adopted. The purpose of the whole issuance and treasury activity is to provide currency in circulation under good and safe conditions, with the necessary quality standards and adequate quantity to meet the requirements of the public.

Coin cycle management in Portugal

■ Helder Rosalino *Banco de Portugal*

Managing the coin system

In Portugal, the management of the coin system is a shared responsibility of the State, which has exclusive competence for the issuance, of Imprensa Nacional Casa da Moeda (Portuguese Mint), responsible for the production, and of Banco de Portugal, which puts the coins into circulation.

In addition, Polícia Judiciária (Portuguese Criminal Police) is ultimately responsible for checking the authenticity of coins through Laboratório de Polícia Científica (Forensic Laboratory) and as National Counterfeit Analysis Centre. Banco de Portugal also participates in close cooperation with the Police, and, to that end, created a laboratory for the analysis of counterfeit coins.

Furthermore, Portuguese credit institutions and cash-in-transit companies also participate in managing the coin cycle. The latter are generally responsible for the physical distribution of coins on behalf of the credit institutions to the banking sector and other economic operators.

With the introduction of the euro in 2002, it was necessary to harmonise strategies and functional cooperation among the parties involved in managing the coin system in order to better distribute currency to the economy, ensure its regular circulation and monitor matters relating to the

participation of Portugal within the Community bodies responsible for this area.

Thus, Banco de Portugal, in partnership with the Portuguese Mint and the State, decided to create a contact group to monitor coin-related issues. This group aims to monitor and discuss matters related to the issuance, minting, putting into circulation, distribution and marketing of normal use, commemorative and collector coins.

The intervention of Banco de Portugal in the logistics

Up to the introduction of the euro in 2002 the intervention of Banco de Portugal in this field was limited to an annual request for coins to the Portuguese Mint and to putting normal use or collector coins into circulation. In fact, on the assumption of a self-regulated market, no deposits of coins were accepted at the counters of Banco de Portugal.

The circulation of a single currency in an enlarged area originated migratory phenomena (currency inflows and outflows) across the whole Eurosystem led to imbalances in the national currency markets. Aware of these imbalances and acting as the institution responsible for regulating the circulation of coins, from 2004 onwards Banco de Portugal allowed deposits of excess currency by credit institutions at its

counters, free of charge, aiming at ensuring an efficient and regular circulation of coins within the national territory.

In 2004, a coin reception centre was specifically created in one of the branches of Banco de Portugal, supported by a coin counting and packaging system in order to allow not only the reception, but also the handling and subsequent withdrawal of volumes of coins counted and packaged according to the standards adopted in Portugal.

Deposits made at that centre were processed under the direct coordination of Serviço Central de Tesouraria (Central Treasury Service) of the Carregado complex. These must be scheduled in advance with the credit institutions, due to the fact that: a) the ratio of coins held by Banco de Portugal to total coins in circulation must be monitored to verify that they are not above a 10% to ensure that they are not a credit facility provided to the public sector (according to the Council Regulation (EC) No 3603/93 of 13 December 1993), and b) the branch's work and storage capacity must be managed, by coordinating the withdrawal and deposit flows.

In operational terms, deposit requests by credit institutions are managed by Serviço Central de Tesouraria through an analysis of the stocks in coins held by Banco de Portugal together with the

Aiming to facilitate the settlement of coin circulation and, at the same time, to guarantee strict compliance with the Community rule prohibiting government financing, Banco de Portugal signed an agreement with the State, which provided the Central Bank with a permanent debit authorisation, according to the following rules: "Whenever requests from credit institutions for deposits of coins may lead the value of stocks in coins held by Banco de Portugal to exceed the 10% limit established in Article 6 of Council Regulation (EC) N. 3603/93 of 13 December 1993, the excess amount will be settled by debiting the account of Direcção Geral do Tesouro (Directorate General of the Treasury) with Banco de Portugal, with prior notice". This was an unprecedented measure at national level and allowed Banco de Portugal to act in a completely flexible and autonomous manner in the management of the issuance and settlement of coins in circulation in Portugal, even if not being the institution responsible for currency issuance.

1. With the introduction of the euro, the Member States became responsible for the issuance of coins, whereas the ECB is competent to approve the volume of the said issuance, in accordance with Article 106 (2) of the EC Treaty.

2. Holdings by the European Central Bank or by National Central Banks of metal coins issued by the public sector and entered to the credit institutions of the latter shall not be considered a credit facility under Article 104 of the Treaty, provided they do not exceed 10% of the coins in circulation.

coins to be handled in order not to compromise the 10 % ratio or to cause constraints in currency handling centres.

At the moment, coin activities are conducted in two handling centres, one located in a regional delegation and the other in the Carregado complex, both equipped with the SCAN COIN 4000 sorting system. The coins not fulfilling the authenticity and quality require-

ment in training its specialists in order to cover all fields of relevant know-how concerning coins, aware of the higher competence of this central bank in the subject. The counterfeit analysis laboratory was furnished with precision equipment (scales, vernier callipers, conductivity and magnetic moment measuring equipment) and optical equipment (magnifying glasses, stereoscopic magnifying glasses, microscopes),

regulated by the Commission Recommendation 2005/504/EC of 27 May 2005)

In Portugal, the verification of authenticity and sorting of euro coins conducted outside Banco de Portugal is regulated by a Decree-Law published on 10 May 2007. All professional cash handlers, namely credit institutions and cash-in-transit companies, are required to hold counterfeit coins or

institutions and cash-in-transit companies) by checking, collecting and handling relevant data.

- Management of the National Counterfeit Centre, which facilitates the use of the Counterfeit Monitoring System by different national authorised users.
- Disclosure of know-how and information on genuine and counterfeit coins to third parties by



Coin conductivity measuring equipment.



Coin sorting system.

ments will be sent to the counterfeit analysis laboratory, where they are analysed and classified, and counterfeits are registered in the Counterfeit Monitoring System. As a strategic basis underlying the coin-sorting project, and considering the counterfeit levels in the European area, it was deemed appropriate to centre the sorting activity, at an earlier stage, on high denomination coins (2 and 1 euro coins and 50 cent coins).

With the aim of fulfilling its new tasks concerning coins, Banco de Portugal obtained new technical expertise, namely by technically and scientifically strengthening this field and acquiring laboratory analysis equipment. In addition, Banco de Portugal requested the cooperation of Deutsche Bundes-

which are considered essential in the analysis and classification of counterfeit coins.

The Centro Nacional de Contrafações (National Counterfeit Centre) of Banco de Portugal is also in charge of a project for ongoing training focused both on banknotes and coins and aimed at all professional cash handlers.

Authenticity and fitness checking

The authentication of euro coins and handling of euro coins unfit for circulation follow common rules and procedures in the euro area Member States seeking to guarantee an adequate level of intervention in coin recycling (as

coins suspected of being counterfeit which they may encounter during their professional activity.

The following new tasks in the field of coins has been conferred on the Banco de Portugal by the aforementioned Decree-Law:

- Development of activities for handling coins deposited in its own centres and subsequent verification of their authenticity and quality.
- Analysis, classification and registration in the Counterfeit Monitoring System of counterfeits detected during the coin authentication process.
- Monitoring of the recycling process by third parties (credit

defining adequate communication and training policies.

In the near future, Banco de Portugal will present a model contract to entities recycling euro coins. The contract will regulate, in operational terms, the relationship between the Bank and the said entities, in compliance with the new legal framework. In parallel, Banco de Portugal will create a model aimed at supervising and monitoring their activity in the field of coin recycling.

Colombian banknotes

■ **Bernardo Calvo** *Banco de la República*

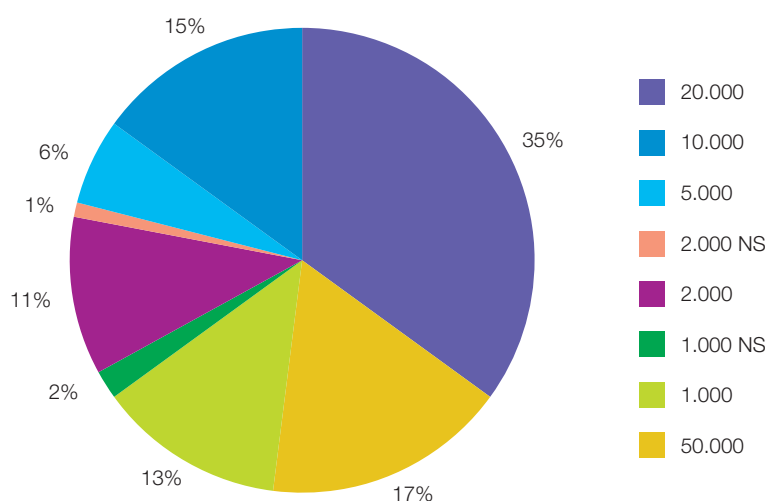
The Political Constitution of Colombia of 1991 (Article 371) determined that the Banco de la República should exercise the functions of a central bank, including that of issuing the legal currency of Colombia. The Banco de la República is empowered by the State to issue, exclusively and without delegation, the legal currency in the form of banknotes and coins (Law 31 of 29 December 1992).

The Banco de la República performs the industrial activity of producing banknotes and coins, for which purpose it has a banknote printing works, to produce the banknotes requested by the Treasury Department. Since 2002 the currency has consisted of six peso banknote denominations, with the same dimensions (70mm x 140 mm). However, on the occasion of the entry into operation of the Bank's new production facilities at its Cash Management Centre, the production of a new series of banknotes was initiated, commencing with the 1,000 and 2,000 peso denominations, which are 65 x 130 mm in size.

At the end of 2006 the value of the six denominations of banknotes in circulation amounted to 23,910 billion pesos and the number of banknotes in circulation was 1,352.7 million. The breakdown by denomination is shown in the adjoining chart. It should be noted that in 2006, with respect to the previous year, there was a 15.9% increase in the number of banknotes in circulation and a 24.8% increase in their nominal value. The growth in the banknotes in circulation may be explained by the strength of the Colombian economy and by the reduction in inflation during the year. In the period 1986-2006, the banknotes destroyed amounted to 83.6% of the whole volume of banknotes issued.

The 50,000 peso banknote is considered the most representative banknote of the country. It is the highest denomination note and the only one with a vertical design, unlike the other denominations which have horizontal designs.

Structure of the banknotes in circulation



Data: End-2006. NS is new series of banknotes

Features of the 50,000 peso banknote

Design and printing substrate

With the 50,000 peso banknote, the Banco de la República pays homage to the Colombian writer Jorge Isaacs (1837 – 1895), author of the novel *La María*, which has left its mark on many generations of Hispanic readers since it was first published. By the end of the 19th century there had already been 50 editions and in 1967, its centenary year, it was said to be the most-read novel in Latin America. Immortalised by the novel, Isaacs was much more than a writer: he was also a politician, journalist, diplomat and President of the State of Antioquia.

On the front is the figure of the writer printed in intaglio. On the upper part is the figure of María set against a Cauca Valley landscape, crossed by the Cauca river, and to the left of centre the signatures of the Bank's General Manager and Deputy General Manager and the date of issue. The 8-digit series number is printed vertically in green ink on the upper part of the note and in red ink on the lower part. On the upper area of the banknote appears the word "COLOMBIA" in two colours schemes and, on the lower part, "BANCO DE LA REPÚBLICA" can be read.

On the back of the note is a depiction of the El Paraíso country house, the scene of the novel; in the foreground stands a shaman tree, characteristic of the area, and in the background the mountains that frame the Cauca Valley. A fragment of the novel, describing an evening in the region, is superimposed. On the upper left-hand side is printed the number 50 and the words "MIL PESOS" in coffee and violet tones, underneath which is the writer's figure, taken from a personal photo.

Statistical data (2006)	Pesos	Euros
Total value of banknotes in circulation (millions)	23,910,016	7,993.9
Average value of banknotes in circulation	17,675.6	5.9
Number of banknotes in circulation (millions)	1,352.7	
Banknotes in circulation per capita	66.5	
Value of banknotes in circulation as a proportion of GDP	7.9%	

Printing techniques

Intaglio: This printing technique which offers a tactile relief is used for the portrait on the front, the main motif on the back, the letters and numbers of the face value of the banknote and for the optically variable ink of the number 50 on the front.

Offset: Is used for the security backgrounds on the front and back printed in rainbow. Also, a see-through register is incorporated into the backgrounds, the complete image of which can be seen when the note is held up to the light.

Letterpress: Is used in the vertical numbers on the front, one of which is red and the other green.

Security features for the public

- **Watermarks:** When the note is held up to the light, a multitone watermark can be seen with the image of the writer Jorge Isaacs and an electrotype watermark with the text "50MIL".
- **Security threads:** there are two horizontal threads, one opaque and embedded in the paper and the other a window-type metallic which has five segments on the front side and the text "50 MIL PESOS COLOMBIA" visible in a yellow tone under ultraviolet light.
- **Colour-shifting ink (OVI):** The inks used for the figure "50" on the front enable the surface to change colour when observed at an angle of 45°, changing from gold to green. This element deters reproduction of the banknote using colour photocopiers.
- **Tactile printing - Intaglio:** Areas of the note printed in strong tones, perceptible to the touch, which make up sharp images composed of fine lines and well defined outlines. At the top-left on the front of the note is the word "COLOMBIA" in two tones and on the back, the letters "BRC" which make up the complete design of the tree.


- **See-through register:** There are geometric figures on both sides of the note in the form of a book. When seen against the light from either side, the white areas of these figures become coloured, their outlines exactly coinciding.
- **Microprinting:** With a magnifying glass the texts "BANCO DE LA REPÚBLICA COLOMBIA", "50 MIL PESOS" and "50 MIL BRC" can be read repeatedly on the front.
- **Ultraviolet (UV) properties:** Under UV light the texts "50MIL" and "50 MIL PESOS COLOMBIA" can be seen on the front in a green tone. Also, the banknote serial numbers are fluorescent under UV light.

Information about the substrate, dimensions and colours


Substrate	Paper 100% of cotton fibres
Substrate weight	90 g/m ²
Dimensions	70x140mm
Dominant colours	Violet and green on the front and violet and blue on the back.

THE 50,000 PESO BANKNOTE


1 and 2. Watermarks




12. OVI ink




20. See-through register



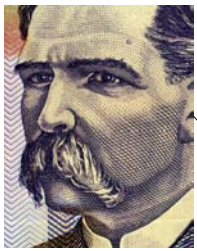
17. UV properties



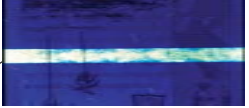
4. Window thread




6. Intaglio printing



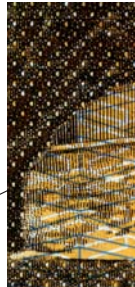
3. Embredded thread




16. Microprinting



16. Microprinting





Note: The number which appears beside each of the security elements in the 50,000 pesos banknote refers to the numeration which that certain feature has in the section "Banknote security features" which can be found in the Miscellaneous section of this magazine. A more detailed description of each security feature can be found there.

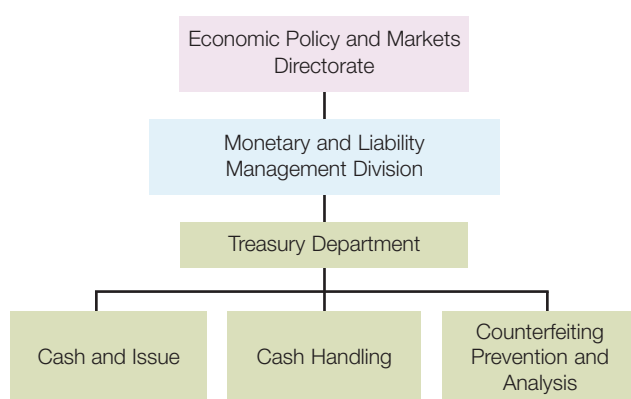
The Treasury Department of the Banco Central del Uruguay

■ **Alfredo Allo** *Banco Central del Uruguay*

The Economic Policy and Markets Directorate of the Banco Central del Uruguay is responsible for the Monetary and Liability Management Division, to which the Treasury Department reports. This Department is responsible for cash management, in the broad sense.

The Bank's cash activities are carried out at its head office in Montevideo and at remote vaults where banknotes belonging to the Banco Central del Uruguay are deposited. The Bank has no branch network operating throughout the country. Banknotes to be issued are obtained through tenders, since the Central Bank lacks an owned printing works and mint to manufacture banknotes and coins.

The Treasury Department has twenty-five staff, around 5% of the total staff of the Bank. It is made up of 3 Units: Cash and Issue, Cash Handling and Counterfeiting Prevention and Analysis.



The Cash and Issue Unit has the largest variety of tasks and the largest number of staff (12 in all). Its basic functions include the issuance, distribution, custody and management of the country's banknotes and coins, and the withdrawal and destruction of poor quality banknotes. In addition, the Unit also performs the following activities:

- The Treasury Department maintains a permanent sample of national currency and a foreign collection (obtained through exchanges with central banks and other issuing bodies) at the Numismatic Museum. Aware of the importance of the Internet as a means of disseminating information, the Cash Unit is also responsible for keeping up to date the "Virtual Museum", which can be accessed from the Bank's web-site.
- The Treasury Department is also responsible for planning and coordinating the minting of numismatic and commemorative coins. It also has a specialised library whose function is to conserve and disseminate the numismatic collection and to give advice to collectors and the public in general.
- The electronic Clearing House, reporting to the Treasury Department, manages and supervises the use of cheques by the financial system.

- There is an Advisory Committee for banknote and coin matters responsible for designing and updating the cash security features, on the basis of the technological innovations on the international market. In addition, the Committee is involved in the preparation of the terms and conditions of tenders for the purchase of banknotes and coins.
- Reception of shipments of US dollar-denominated banknotes from the Federal Reserve of the United States. Likewise, the Banco Central del Uruguay sends to the Federal Reserve shipments of US dollar damaged and low-denomination banknotes received from credit institutions and the public.
- Cash analysis and supervision: a Committee set up for the purpose carries out studies of banknotes and coins, broken down by denomination. In particular, issues of great importance for decision taking are analysed, such as the lifetime of banknotes, destruction rates, buffer stocks, threshold alerts for new banknote orders, etc. The Committee also prepares a monthly management report with the Department's main statistics, and a quarterly summary that is distributed to Directors and Board.
- Auditing of remote vaults: with the prior authorisation of the Banco Central del Uruguay, financial institutions may deposit banknotes in remote vaults. The management of these vaults is the responsibility of the financial institutions. The Cash Unit is responsible for inspecting banknote deposits belonging to the Banco Central del Uruguay located at remote vaults. Their task is essentially to verify compliance with the rules on remote vaults issued by the Banco Central del Uruguay.
- Custody of valuable items, objects and documents: the Cash and Issue Unit provides a safekeeping service for valuable items, objects and documents to the Bank's various divisions and departments and to those financial institutions that request it. The Managers of Provisional Savings Funds (pension fund management entities) deposit with this Department, as they are required to do by law, the certificates representing their investments.
- Public debt related services: the payment of interest to the public and the redemption of the physical public-debt certificates issued.

The Cash Handling Unit, with 8 members of staff, counts and sorts the banknotes received from the financial system and from the public. Banknote processing is carried out using a BPS 1040 sorting machine, equipped with an on-line destruction system and a Kusters briquetting system. Reports are made daily on the quantity of banknotes processed and destruction percentages, to help avoid deviations from the rates approved by the Department Head.

Poor quality high-denomination banknotes are all processed, while low and medium-denomination ones are counted by sampling with conventional counting machines, in accordance with percentages established by the Internal Audit Division.

The Counterfeiting Prevention and Analysis Office, with 4 members of staff, has a database of the counterfeit banknotes retained by the whole financial sector, with information broken down by currency. The institutions introduce the data on these banknotes into the database and send the counterfeits, together with the form generated by the computer system, to the Counterfeiting Prevention and Analysis Office. The database Administrator, upon receiving the banknotes, first checks their quantity and value, and then sends the whole consignment of banknotes of doubtful authenticity to the National Technical Police

Directorate so that the latter can prepare the relevant expert's report. When this task has been finished, the database information is completed, which may be consulted by financial institutions. As regards US dollar-denominated banknotes, in the event of doubt regarding their authenticity, they are sent to the US Federal Reserve for consultation.

This Unit also organises seminars on banknote security features for cashiers from all branches of economic activity, with the aim of reducing the circulation of counterfeits by making information available to users. With the same objective, descriptive leaflets are designed for distribution among financial institutions and retailers, which disseminate the security features of banknotes and information for their care. The Unit has also made a telephone line and e-mail address available to the public for queries regarding banknotes and coins.

In addition, there is a Fraud Committee to combat the counterfeiting of cash, cheques, cards, passports and bonds, made up of representatives of the Central Bank, Interpol, Economic Offences, Technical Police, Treasurers and private bank Security Heads. As a result of these measures counterfeiting levels recorded are low and it is not a problem for the Uruguayan authorities.

Plans for the future

The Treasury Department is currently in the process of obtaining quality certification for its management processes, in accordance with the requirements of ISO standard 9001-2000. For this purpose, officials have completed training courses and it is planned that this certification be obtained during 2008.

Statistical data ¹	2004	2005	2006
Banknotes in circulation			
Amount	13.819.745	16.833.963	21.445.430
Volume	77.862	82.294	86.161
Banknote withdrawals from the Central Bank			
Amount	39.191.945	44.098.967	49.707.913
Volume	77.216	77.956	82.164
Banknotes paid in to the Central Bank			
Amount	37.382.542	40.694.150	46.826.860
Volume	71.952	73.297	81.762
Banknotes processed by the Central Bank			
Amount	30.373.530	36.553.956	38.772.786
Volume	40.041	49.208	51.382
Destruction rate²	63%	34%	59%

1. Amounts expressed in Uruguayan pesos and volume in thousands of banknotes.

2. Volume of banknotes destroyed / volume of banknotes processed.

The Numismatic Museum

The Banco Central del Uruguay has a Numismatic Museum located at the Bank, which was set up to enable visitors to find out about Uruguay's numismatic history. Opened in 1997, it houses examples of Uruguayan banknotes issued since 1826 and of coins minted since 1840. These exhibits are supplemented by the banknotes and coins of 150 countries, old public debt certificates, money boxes and materials used for printing and minting notes and coins. The museum was awarded the Morosoli Prize in 2006 for its contribution to culture and dissemination of the country's numismatic history.

The Museum receives a great variety of visitors, with different interests and professional profiles, including tourists, collectors and schoolchildren. In addition, the Bank's website hosts a virtual museum which is continuously updated, disseminating information on and pictures of the security features of banknotes in circulation and photographs of coins issued since 1840 and of banknotes put into circulation since 1896.

Each year, to coincide with National Heritage Day, the Museum organises thematic exhibitions on currency. The 2007 exhibition is on the flora and fauna on banknotes and coins.



Premises of the Banco Central del Uruguay in Montevideo.

Intaglio printing

■ Vincenzo Ciaramella
Banca d'Italia Printing Works

Intaglio printing is acknowledged today to be one of the most effective banknote security features, having two characteristics that are practically inimitable: the high printing definition and the tactile effect produced by ink in relief. The first characteristic makes the printed lines extremely sharp, even though very thin and close each other, with no smudges or ink smears, while the tactile effect is produced by the combined effect of the embossing of the paper against the plate engraving and the large quantity of ink transferred during the printing to the paper. Given that these effects cannot be achieved with other printing techniques and also that intaglio equipment is very expensive and not widely available, being restricted to accredited printers, this technique makes counterfeiting much more difficult and is therefore very secure.

At the beginning of the 20th century the intaglio technique began to be used as an element to ensure the authenticity of banknotes. The printing was done by primitive machines capable of printing only one banknote at a time at a very low speed (see the Johnston machine in the picture). The transition to more advanced techniques allowing higher printing volumes took place around 1930 when the ability to duplicate the original engraving through mechanical and/or galvanic processes made it possible to obtain plates with more than one original. After the end of the second world war, a high speed multicolour intaglio press was developed by Gualtiero Giori, founder of the homonymous company: it was the beginning of a new age in which intaglio printing was increasingly used as a banknote security feature. In subsequent years, the fast progression of technical innovations and improvements – both in the printing process and ink formulation – helped make intaglio printing even

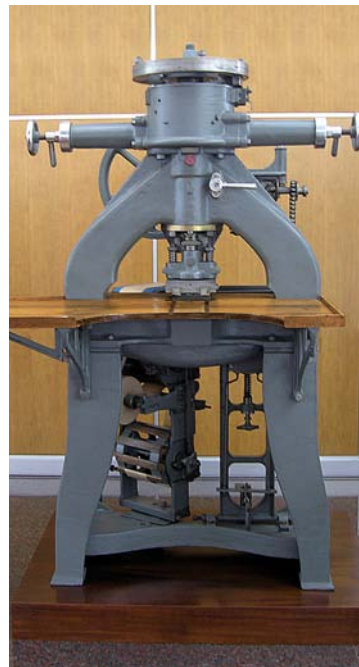
Background

The first examples of intaglio reproductions appeared in Europe during the 15th century in the field of goldsmiths' art, the subject being hand-engraved on a copper or zinc plate by means of a hard metal point (burin).

In order to make the engraving easier, the plate was sometimes protected with a layer of wax on which the drawing was made by removing the wax and exposing the metal.

The plate was then plunged in an acid bath, which etched the exposed areas only, since the wax, but not the metal, was resistant to the acid. On other occasions a mixed engraving technique was also used, i.e. burin engraving plus chemical etching. In order to make the printing possible, the engraved cavities of the plate were filled with a dense ink, taking care to remove any excess from the flat areas; the inked plate was then fixed on a press plane and the paper sheet pressed against the plate, so that the ink contained in the engraving adhered to it.

Apart from the reproduction of works of art engraved directly by the author, the intaglio technique was also used as a vehicle for the diffusion of paintings or sculptures that were "copied" by the engraver on a plate and then reproduced many times.



British-made "Johnston" intaglio press (1919), able to print one banknote at time at a rate of 550 cycles per hour. The printing takes place plane against plane; the plate dry-wiping is done with paper; the sheets are fed and removed manually. (Banca d'Italia; Banknote Museum)

more secure and effective. In this regard it is worth mentioning the following achievements:

- The progressive increase of the print size up to the current "super size" used today by the vast majority of banknote printers;
- The progressive fine tuning of the pre-press activities to facilitate the complex plate-making processes while ensuring, at the same time, complete fidelity to the original;
- The abandonment, thanks to the formulation of new inks, of trichloroethylene for plate wiping, a highly toxic substance that has been replaced by a water based solution;
- The production of quick-drying inks, which avoid the transfer of ink between piled sheets.

Recent developments

As a consequence of the widespread use of intaglio as a secure

printing technique, it has been realized that the large quantity of ink transferred to the paper can be used as a vehicle for other security features. Certain pigments make the inks optically variable or give them properties invisible to the naked eye, such as magnetism or infrared light reflection. Even intaglio printing without ink (blind embossing) – alone or in combination with other features – can produce special tactile/visual effects, increasing the overall security level of a banknote.

Computerised laser engraving

While the pre-press and printing processes have evolved and been improved until the present high levels of quality and productive efficiency have been achieved, the engraving process did not undergo any major change from the 15th century until a few years ago. Only very recently have computers been used in this field. First, graphic software was adapted to simulate the burin engraved lines and photo-etching processes were developed to transfer them to the plate. Nevertheless such a system is not able to control the engraving depth, so that it has been necessary to adapt the original engraving, often even by means of burin or chemical etching, in order to give the right depth to the various areas of the engraving.

Today this drawback has been overcome by computer aided laser engraving, the latest technological development in this field. These systems are able to ensure three-dimensional micrometric control and to engrave multiple versions of an original, without having to replicate the first original to achieve multiple printed forms. Some printers have already adopted the new system and the results obtained, so far only on an experimental basis, are quite remarkable. The advantages of the new technique are the following:

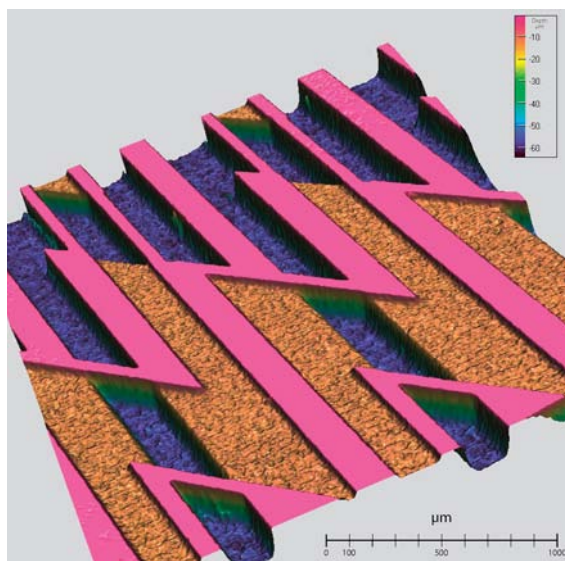
- The possibility of performing very fine (up to 10 microns) or very deep (up to 100 microns) engravings. The latter are easy

to print thanks to the geometric shape of the engraving used which facilitates detachment of the ink (see photograph). The relief effect and the line sharpness, the most important intaglio properties, are thus enhanced; furthermore the micrometric depth control allows the achievement of special effects (multilayered engravings) that are not feasible with traditional techniques. The particular profile of the ink relief, created by the geometric shape of the engraving, can create parallax and lenticular diffraction effects in combination with especially brilliant inks;

- The possibility of intaglio printing up to the banknote edge, an option prevented by the traditional pre-press process connected with the preparation of the multiple originals, which requires an unprinted band of some 4 mm from the edge of the banknote. This advantage has particular benefits for visually impaired people, as it enables tactile elements to be printed on banknote borders, the area most touched by the fingers;

- The significantly reduced time for setting up the single and the multiple original, compared to the traditional process. This technique is less labour-intensive and allows rapid correction of possible defects arising in the proof-prints until an optimal plate is achieved. The procedure for adjusting the plate dimensions, to compensate for paper stretching during the printing, can also be carried out more promptly and efficiently.

In short, intaglio printing develops in line with technological progress, and it can therefore be expected to maintain its primacy among banknote security features for many years to come. From the current perspective, it appears that future developments in this field will involve the printing of more sophisticated graphic elements thanks to computerised laser engraving technology, the introduction of advanced special effect inks



Magnified detail of a computer aided laser engraving. The picture shows two engravings with different depth; the engravings are made rough in order to facilitate ink detachment.

The engraving

The engraving depth and its geometrical shape are parameters of paramount importance to obtain the best results from the intaglio technique, especially in terms of tactile relief. The deeper the engraving the larger the height of the ink layer, which produces the relief effect. However it is not certain that during the printing all the ink in deep engravings will be transferred to the paper. This is because too tight or too sharp engraving can obstruct the transfer, but certain tricks in the geometry of the engraving can facilitate ink detachment. The ability of the engraver to balance carefully the engraving ingredients (width, depth, shape) is a decisive factor for achieving successful printing results.



Work station to control intaglio plate engraving by laser.

and the development of more efficient printing machines.

Single or double intaglio

Concerning the debate on the application of intaglio printing to one or both sides of the banknote, a double side intaglio printed banknote is undoubtedly more protected against counterfeiting. In addition, the graphic richness provided by intaglio printing on the reverse side gives the banknote as a whole a more agreeable appear-

ance. Some laboratory tests have also shown an improvement in banknote resistance to wear and tear. Nevertheless certain considerations should be borne in mind:

- The relief effect of the first intaglio carried out on the reverse side, is reduced by the second intaglio step carried out on the obverse side.
- In the event of application of a holographic foil, this is affected by the second intaglio printing. The holographic foil loses brightness because of the moleskin pressure of the intaglio printing.
- These factors, together with the increase in production costs occasioned by a second intaglio printing, mean that a decision on

this matter can be taken only after a comprehensive cost/benefit analysis has been conducted.

- It should also be taken into account that the new laser engraving techniques can enhance the banknote security against counterfeiting offered by intaglio printing on one side, without the drawbacks of double side intaglio printing.

The finishing stage of the banknote production process

■ **Francisco Lacuesta**

Real Casa de la Moneda-Fábrica Nacional de Moneda y Timbre. España.

This article presents the work done by the Real Casa de la Moneda-Fábrica Nacional de Moneda y Timbre de España (RCM-FNMT), the Spanish National Mint and Printing Works, to automate the finishing stage of the banknote production process. Once the banknote sheets have been printed by the RCM-FNMT (a process outside the scope of this article), an automated, integrated system is used to avoid human handling in the tasks involved in finishing the banknotes for delivery.

Change in new finishing systems

In recent years the technological advances incorporated in printing machines and in the new systems developed for cutting, sorting and

packaging operations have represented a qualitative leap in banknote production. The manual handling tasks have been virtually eliminated. Nowadays, each banknote is the result of a complex industrial system in which the automation of tasks is pivotal within the production process. The most complicated stage to automate of all those involved in banknote production was that of finishing, which includes the cutting of sheets into banknotes, the quality control of the final product and its packaging.

The incorporation of banknote sorting machines into finishing processes marks a major milestone. The introduction of these advanced machines for the quali-

tative and quantitative control of banknote obviate the need for a consecutive sequence in the serial numbering of the banknotes. Until recently, each banknote packet contained 100 consecutively numbered units. When a banknote was found to be defective during the production process, it was replaced by another with the same number or by one from a special replacement series prepared for the purpose. These operations meant the cutting machines often had to be stopped to carry out physical replacement. Also, a numerous team of people performing rigorous control of substitute banknotes and of those replaced was needed.

In the production of euro banknotes, the fact that their technical specifications do not require consecutive banknote numbering in the packets and the reliability of the sorting machines make it possible to form groups of 100 banknotes which, although not numbered consecutively, are strictly

identified. The information on the content of each packet is included in a computer file along with other data on the quality of each banknote. These data enable central banks to have reliable, secure information on the banknotes received from printing works for putting into circulation.

In this way, the cutting operation has been transformed into a continuous activity not interrupted by stoppages to replace defective banknotes. Any banknote that now has a defect is destroyed on-line at the very time it is detected by the sorting machine and replaced by that banknote immediately following it in the production sequence that meets quality standards. The process generates full and detailed information which offers total assurance of the operation.

Experience of the RCM-FNMT

On the basis of the above, after the first issue of euro banknotes,



Banknote packaging line. RCM-FNMT

Cash activities and Technology

The finishing stage of the banknote production process



Banknote sorting machine. RCM-FNMT



Automatic palletisation with robot. RCM-FNMT

the RCM-FNMT undertook a project to gather together the various machines and processes involved in banknote cutting, sorting and packaging. The challenge was not only to automate co-ordinatedly a series of operations carried out by different machines, but also to incorporate those operations all into a single production line. The objective of the project pivoted on the optimisation of two key factors:

■ **Security:** this is a vital factor in the production process, particularly in the areas or operations in which completely finished banknotes are handled. Here, wherever possible, all human contact with the banknotes should be prevented and all manual operations that cannot be avoided should be registered automatically.

■ **Productivity:** another aim of automating the finishing process is to reduce the human resources needed for it. If the operators assigned to a production line did not have to handle the product, they would be free to carry out the essential operations of loading and replacing the input materials and, basically, of supervising and controlling the various factors and processes involved in a production line.

During months of intense work alongside the personnel of an associated private firm, the RCM-FNMT technical staff designed and implemented the project to

combine the finishing processes in a single production line. In 2004 they started to install the first equipments, which now, in 2007, are fully operational in four finishing lines and functioning to the full satisfaction of the Mint. Each new finishing line consists of the following:

- Sheet feed
- Automatic cutting machine
- Intermediate storage
- BPS 2000 sorting machine
- Packaging and labelling of thousand-unit bundles
- Dynamic scales for weighing thousand-unit bundles
- Control and reading of thousand-unit bundles
- Boxing/sealing machine
- Dynamic scales for weighing boxes
- Box labelling
- Transport to the palletisation area

Each of the four finishing lines currently making up the Cutting, Sorting and Packaging Unit gives onto the palletisation area, which contains the following equipment:

- Box transport control
- Palletisation robot
- Pallet shrink-wrapping system
- Pallet strapping system
- Pallet labelling system

The completed process

At present, the RCM-FNMT can guarantee with pride that, from the time the printing phase finishes and the reams of 100 sheets start

to be fed into the cutting machine, there is no manual intervention whatsoever in producing the packets, neither in quality and quantity control, nor in banding, packaging and subsequent packing in special cardboard boxes of 10,000 banknotes, nor in palletisation to form finished pallets ready for transport.

Control of both active and passive security in each production line is supervised by a computer program designed by the RCM-FNMT. The program was developed taking into account, inter alia, the supervision of each of the elements making up the production lines and as a priority, security-related details of the product itself and of operating procedures. In this way, all the production line functions are co-ordinated and supervised via the computer connection with the programmable automatons of the machines. The final result has been completely satisfactory, amply exceeding the most optimistic predictions.

The configuration described above is computer-managed via a SCADA system, the computers being connected to a local area server operating under Windows Server 2003. The local area server has another server associated with it in parallel to endow the system with the highest possible level of security insofar as data processing is concerned. The information is included in Oracle databases in the banknote production traceability management system

known as CP3, which was designed and implemented in-house.

Future projects

The RCM-FNMT continues to work on improvements to banknote production quality control and supervision systems. It is currently conducting the studies required to enable it to unify the processes of real-time monitoring and control of printing machine production, with a view to achieving automatic control of the whole production process, integrating machines of different stages, quality controls, raw material management, etc.

Apart from controlling each banknote sheet as it passes through each of the machines, other aims are to automatically generate the production-in-process reports between one process and the next, manage all the information on an integrated basis and transfer rapidly that required at each point by the operators who use it. This will enable the efficiency of procedures to be improved and the traceability data to be collected as and where it is produced.

Smart solutions for banknote processing

■ Alfred Schmidt *Giesecke und Devrient*

Cash volumes are growing world-wide, often with growth rates beyond GDP and inflation. In addition, the speed of banknote circulation is increasing and central banks have to cope with higher return frequencies of banknotes, i.e. they are deposited more often at the central bank. Although debit cards, credit cards and electronic purses are strong competitors, cash will remain the most important means of payment. It is available under most conditions, it does not need electronics and data networks, and it supports hand-shake transactions with immediate value transition. Cash does not fail in case of natural catastrophes or terror attacks. For large segments of the population, cash is the only available means of payment: the unbanked, youth, illiterate or the visually impaired. However, there is a challenge, and a lot of potentials, for cost reduction in the cash cycle to be competitive and to provide an economic and efficient basis for value transactions.

Giesecke und Devrient (G&D) offers flexible and modular solutions for automated cash processing with seamless material and data flow. Next generation banknote processing systems will offer further opportunities for smart and more efficient processes. This is basically driven by higher degrees of automation, such as packing systems, and enhanced functionality, such as the capability to process multi-denomination and/or to eliminate sequential runs by integrated processes. Improved detector technology will use higher resolutions and provide higher performance and accuracy of evaluations. Scalable systems, based on standardized building blocks, will meet the diverse requirements of large and small cash centers. Management Information Systems (MIS) will provide information for strategic decisions to monitor and control the banknote circulation and quality. The technical evolution will allow central banks to adjust their roles for enabling synergies in the cash processing and alleviate cooperation with the commercial cash handlers.

General aspects for banknote processing by Central Banks

In 1970 G&D started the development of both machine readable authentication features and corresponding detectors. Additionally, full automation requires machines specifically designed to single, transport and stack banknotes. This became the driving force for the ISS 300, the reference of first generation banknote processing systems. In 1986, an on-line shredder was added as an option. The ISS 300 proved to be a reliable workhorse with more than 2,200 units sold between 1976 and 2000. Today, there are still more than 1,200 units in operation. For central bank applications, this machine became the first world reference for reliability and accounting accuracy. The experience, and also the reputation and quality, of this machine established the fundamental basis for G&D to develop high and medium speed BPS systems. Since 1996, the BPS 1000 took over the role of the most successful medium speed banknote processing system. On-going developments will transform new technologies into the next generation of banknote processing systems and meet future requirements for the optimization of the cash cycle.

As seen from today's perspective, the most relevant challenges for the next generation banknote processing systems can be categorized by the following four criteria:

- Applications: A modular and flexible construction kit for variable system configurations, such as the number of stackers and detector



ISS 300, 1st generation banknote processing, a reliable workhorse for central bank applications

functions, enables tailored solutions and protects the customer investments by options for future upgrades and enhancements. Automated reporting to the cash management system ensures smooth data flow for accounting and monitoring purposes. Overall intrinsic system security, based on highest accounting accuracy with minimum risk of data corruption and data manipulation, is an indispensable prerequisite for on-line destruction, particularly in case of hardware or software failures or exceptions.

- BPS performance: For reduced operating costs, the BPS must ensure a high productivity and availability. Singling speed and nominal throughput are part of this equation, but optimized machine interfaces and automated support functions generally have a significant impact on the overall efficiency of the entire process. For example, on-line reconciliation of rejects with optional rerun may be more efficient than off-line reconciliation, opening the risk of undetected counterfeits and requiring additional supervision. In addition, frequent jams with poor banknote or deposit quality and/or insufficient reliability of the system may corrupt any theoretical figure.
- Detector performance: Reliable and secure detection of authenticity features is fundamental for central bank applications. However, the adaptation must also care for low reject rates in case of damaged or worn banknotes. For economic reasons, different decision parameters may be used for high and low denomination values. Top fitness quality requires the detection of all defects with sufficient resolution. In addition, soiling and other degradations, such as graffiti, must be quantified in scaled measurements. For stable and repeatable results the detectors must compensate for inevitable offsets or drifts. This is better achieved by embedded self-test and calibration features than by processing of questionable test decks subjected to aging and wear. The plausibility of fitness results matching with human perception is still a major challenge as the human eyes and

brains are mostly superior to technical solutions, though less objective.

- Ease of use: The functionality of modern banknote processing systems gets more and more complex. Nevertheless, less specialized staff must be capable to operate the systems with minimum training efforts. This requires that the user menus are self-explaining to the most possible extent, reducing the risk of human errors. Ergonomics must be optimized, e.g. to avoid operator fatigue due to prepping the banknotes or loading the singler.

One size doesn't fit all

From a historical level, the central banks have developed their rules and policies in different ways, depending on the existing structure of the banking industry and other country specific characteristics, such as geographical conditions (distances and population density in metropolitan or rural areas, risk of robbery, etc.) and political constraints. In 2002, G&D proposed the four generic models of controlled, involved, delegated (held-to-order) and privatized styles considering the main (but differing) objectives of control, management, cost and efficiency of cash. Meanwhile, privatization is no longer seen as an independent dimension as it only addresses the legal ownership of an operation without any additional relevance. The diagram presented below therefore suggests a "commercialized" position which can be combined with the three basic styles (delegated – involved – controlled). Depending on the return frequency and the level of process integration, each central bank can be assigned to a certain position within this map.

The return frequency has a major impact on processing volumes and banknote quality in circulation. For example, with a delegated style the volumes are lower but at higher unfit rates. Depending on regional conditions, the central bank may have a distributed branch network or a centralized operation. In any case, the daily volume of a cash center is the most determining factor for the optimum combination of processes and equipment. A large cash center, with a million or more banknotes per day, some BPS 1000 systems with NotaPack packing

systems enable the most efficient operation (see next picture). The automated shrink-wrapping of bundles with 500 or 1000 banknotes provides highest security at lowest personnel interactions with minimum surveillance. One NotaPack can be combined with up to four BPS 1000. The system is dedicated for banknote packing and has a smaller footprint and lower energy consumption than off-the-shelf products.

For smaller cash centers, the BPS 500 (see next page) provides a similar functionality, except automatic packing, with a compact footprint. Its detectors and applications are compliant with BPS 1000 technology to achieve consistent sorting results and security levels in a branch network of different sizes. The modular concept of the BPS 500 allows many optional configurations, among them facing, automatic banding and air-supported singling. The power consumption is very low so a single-phase power supply is sufficient even with on-line shredding.

For very large cash centers, G&D offers the high-speed systems BPS



BPS 1040SB with NotaPack shrink-wrapping system – smart automation in banknote processing

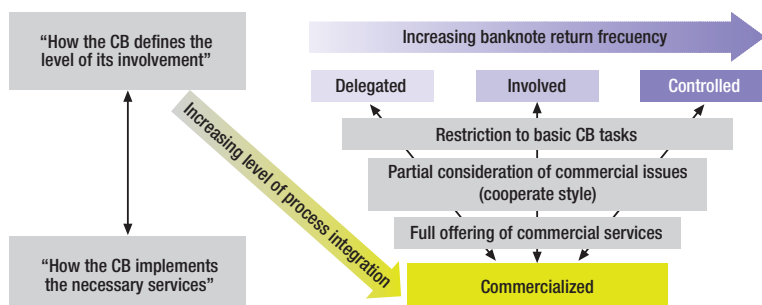
2000 and BPS 3000. The BPS 3000 supports automatic debanding for verification of straps with off-line reconciliation. The BPS 2000 supports continuous feeding for verification of bundles or larger deposits and runs at highest speed with up to 140,000 banknotes per hour. Due to the additional automation on the input side, these systems achieve the highest performance with minimum staff requirements.

Future trends and challenges

Cash has been criticized as being "too expensive", causing the central banks to rethink their traditional roles in the cash handling business. This challenge is reinforced by the increasing volumes and hence the limitations of capacity and other resources. The future challenge is how an appropriate banknote quality with low counterfeit rates at minimum costs for a society or an economy can be achieved. The central bank can support this by offering services or modify the regulations, with the following starting points for optimizations:

- Deposit verification: A standard procedure is to process and verify mono-denomination straps. In case of a discrepancy the difference can be tracked back to the strap identifying the depositor and responsible cashier. But strap verification (i.e. per 100 banknotes)

Central bank styles concerning the cash cycle





BPS 514S with shredder, facer and bander modules – minimum footprint for smaller cash centers

slows down the productivity due to reconciliation constraints. As an alternative, larger units, such as bundles or multi-strap deposits, can be verified with higher throughput. However, the possibility to track a difference to a single strap is lost and some administration overhead is required for deposit identification (e.g. by machine readable barcode labels). Thus deposit verification with mono-denomination has some restrictions.

- Multi-orientation processing: Previously facing or orientating banknotes was required for manual handling to count the values, check for authenticity or sort by fitness. With processing machines, even low-cost desktop counters, this is no longer necessary. In addition, in most cases ATMs will work more reliably with mixed orientations to avoid skewed banknote stacks due to asymmetrical intaglio printing

or foil applications. Therefore acceptance of banknotes in any orientation will reduce the number of processing steps in cash handling.

- Multi-denomination processing: The occurrence of mixed denominations is standard in daily cash handling. For example, the deposits of a bank cashier or a vending machine are larger volume, but multi-denomination type. In commercial cash handling significant costs are caused for sorting and strapping by denomination and handling the remaining banknotes with incomplete straps. This may raise the question for a central bank whether it is more economical to process one larger multi-denomination deposit or to verify several mono-denomination straps which have to be separated into batches per each denomination.
- Process integration: Productivity can be increased if several steps can be combined into one processing run. Picture shows a maximum integration based on a BPS 1000. Multi-denomination deposits are received in the cash center and put into processing trays, separated by header cards for each deposit. The BPS 1000 then processes the banknotes at its maximum speed without interruptions, and performs the steps of deposit verification, denomination sorting, fitness sorting and on-line destruction of unfit banknotes in the same run. A NotaPack packing system seals the fit banknotes into tamper-proof bundles.
- Fitness for automation: Besides the sensitivity for processing costs, maintaining a good quality of banknotes in circulation is the most important objective of cash processing activities. This is mainly because poor banknote quality deteriorates counterfeit detection, both on street level with acceptance of counterfeits and on machine level with higher reject rates. Of course, high-level authenticity features is a solid basis for reduced reject rates in central banks. But the lower level machine readable features should also be checked as fitness criteria to leverage high acceptance rates in all applications, such as processing in cash centers or paying at vending machines or cash-in machines. Recently also the retail business is investigating cash au-

Integrated process – cutting costs by combining the steps of banknote processing



tomation for cost reduction. Therefore the quality guideline of “fitness for automation” will become more and more important in addition to the evaluation of defects and soiling as unfit reasons.

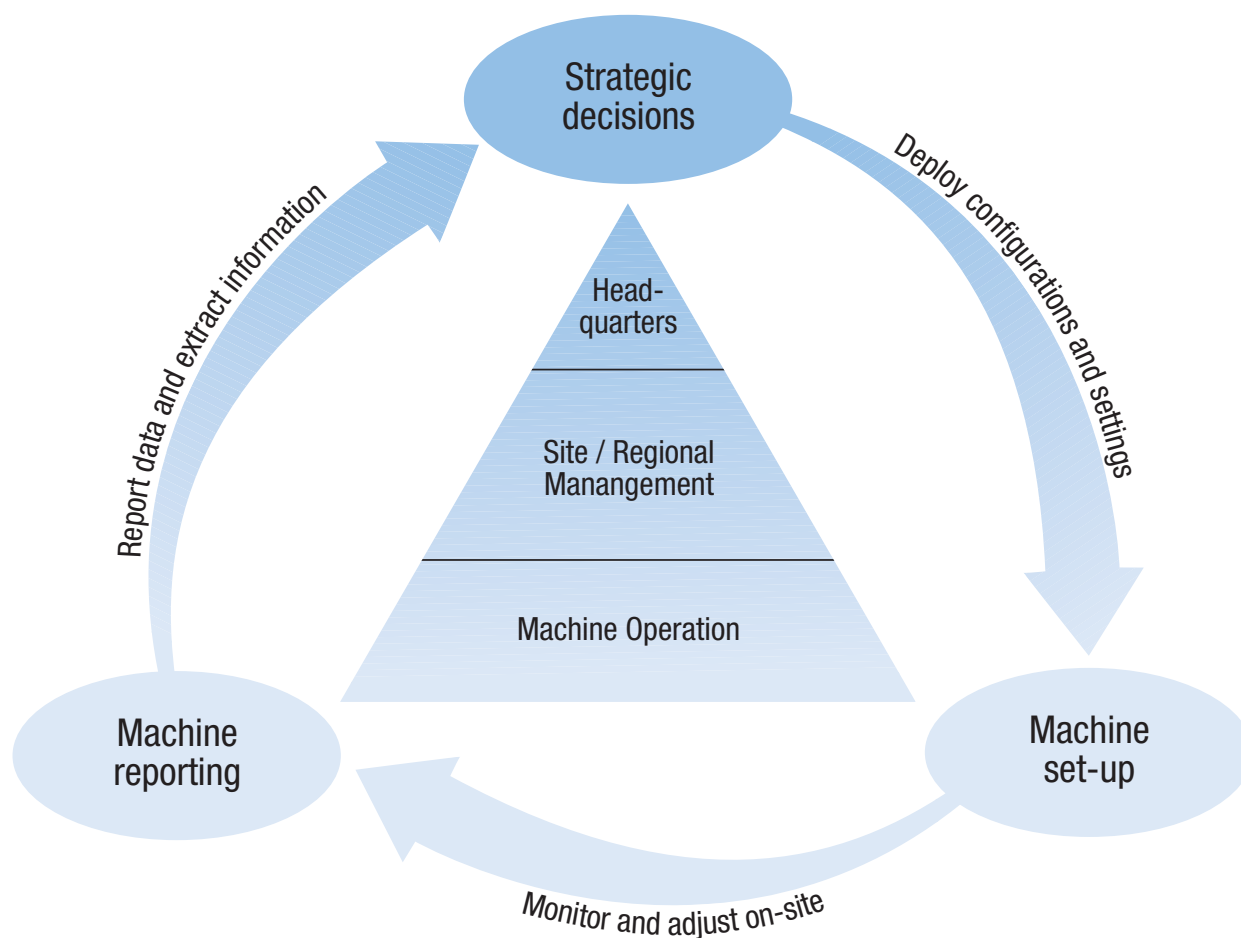
- Management Information System (MIS): The central bank needs tools for the continuous monitoring of the cash cycle and the cash centers. Figure shows how machine reporting supports strategic decisions by providing information on banknote quality, machine performance etc. The MIS of G&D is designed to collect and accumulate this statistical information in a data warehouse for all processing systems in a country. Modified control parameters, such as new sorting thresholds, can be evaluated and deployed to the banknote processing systems. With this machine set-up the loop for controlling the banknote quality will be closed and develop according to the strategic decisions of the central bank. The MIS may also be used to monitor the activities of commercial players, e.g. the implementation and fulfillment of recycling frameworks. This, in turn, will work only if the processing systems are adjusted by the same repeatable detector standards and not based on volatile individual settings.

Conclusions

The central bank will continue to play the dominant role in the cash cycle with a major responsibility for its structure and efficiency. It determines the general standards for the quality of banknotes in circulation. By taking commercial requirements into account the central bank has an opportunity to optimize the interfaces for commercial depositors and thereby reduce the total costs of cash handling in an economy.

Next generation banknote processing systems will offer further opportunities for smart and more efficient processes. This is basically driven by higher degrees of automation, such as packing systems, and enhanced functionality, such as the capability to process multi-denomination and/or to eliminate sequential runs by integrated processes. Dedicated IT systems will provide management information on cash center performance and the quality of banknotes in circulation. As a result, the central bank is able to control the integrity and efficiency of the cash cycle. In addition, this will increase banknote quality and support public trust in the currency, both required as a reliable basis for the success of the entire economy.

Closed loop for banknote quality – monitoring the banknote quality in circulation



IV International Course on Cash Management (CIGE)

■ **Bernardo Calvo Reguero** *Banco de la República*
 J. Darío Negueruela *Banco de España*

The IV CIGE took place from 10th-14th September 2007 in Bogotá, D.C. (Colombia) with the attendance of 52 students from 18 countries. The Course was opened by the General Manager of the Banco de la República, Mr. José Darío Uribe, and closed by the Industrial Deputy Manager of the Banco de la República, Mr. Néstor Plazas, and the Director of the Cash and Issue Department of the Banco de España, Mr. J. Darío Negueruela. As in previous editions, the Course was imparted in Spanish and Portuguese, and a Diploma was awarded to the students present, who worked in sessions from 8:00am until 17:30pm. The Banco de la República, the National Central Bank of Colombia, hosted the Course and was responsible for organisational, logistical and operational aspects which, once again, were of a very high standard and conducive to an atmosphere of collaboration and team spirit. This contributed decisively to the success of the meeting. The Director of the Treasury Department of the Banco de la República, Mr. Bernardo Calvo, and his team of collaborators were responsible for the exemplary organisational arrangements, which saw the faultless streamlin-

ing of academic, professional and personal topics. The technical management of the Course was run by the Banco de España.

The academic methodology of the Course followed that of the previous year, dedicating the first three days to developing the basic academic content, conveyed from a triple perspective:

- Theoretical lessons given by experts from different countries.
- Working tables where discussion topics were debated, facilitating the exchange of knowledge, experiences and technological innovations in areas related to cash handling by the different central banks.
- Visits to working centres, facilities, labs, etc., where technical application of the operational model used by the host Central Bank was discussed.

Those imparting the lectures at the IV CIGE were senior officials from the Central Banks of Argentina, Brazil, Colombia, Spain, Mexico and Portugal, and the three working panels addressed "Models for forecasting monetary species", "Information Systems

for cash management" and "Models for analysing the quality of banknotes in circulation". In all sessions the students enjoyed an extensive and lively debate in which the early contributions were concluded and enriched by comments and discussions that provided an opportunity to consider organisational, structural and technological improvements, at the same time as proving instructive for the central bank employees attending the Course. In addition, the participants were able to visit the new modern facil-

ities where the banknote printing works has been set up. It boasts a new set of high-technology machinery which has enabled the banknote production capacity of the Banco de la República to be increased. A new paper storage system is also being set in place, along with the new facilities of the Treasury Department of the Bank, which has a modern system to move security items thanks to a fully robotised vault with 2,976 storage points and no fewer than 4 automatically guided vehicles (robots). Visitors were able to observe and discuss aspects related to the processes carried out on these premises with the help

of advanced machinery and the highest security standards. The students were also able to compare the machinery, equipped with the latest technology, with that in their own countries. The Banco de la República asked several speakers to lecture on the following topics: a talk about "The current challenges in cash management", another one on "The management of the coin" and a further one on "The fight against counterfeiting". On top of this there was a work table about "the



models for the custody of cash outside the vaults of a Central Bank". At the closing ceremony, the Director of the Course officially announced that the next Course would be in Lisbon, organised under the auspices of the Central Bank of Portugal. The details of this V Course would be distributed in a few months. Any information about the CIGE courses can be obtained through the following e-mail address: cige@bde.es

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International events

Fourteenth Conference of the BPS International Users Group of BPS

Delegates of central banks and official printing works from around the world, who use BPS banknote sorting machines manufactured by Giesecke and Devrient (G&D), attended a conference in Madrid from 18th to 21st June 2007. This fourteenth Conference was held under the auspices of the Banco de España, and the Director of the Cash and Issue Department, J. Darío Negueruela, acted as Chairman. Eighty-seven delegates attended, from 26 countries (European Union, United States, Canada, Australia, China, Hong Kong, Indonesia, Korea, Russia, South Africa, Sudan, Singapore and Venezuela). Currency processing automation and the quality of banknotes in circulation were the main subjects addressed, in 12 presentations and 2 panel discussions. Separate meetings were held for the delegates of central banks and the delegates of printing



works, to give these two groups the opportunity to discuss matters of interest to each of them in greater depth. The delegates also visited the facilities of the Cash and Issue Department at the Banco de España's Alcalá 522 building. Along with the delegates and accompanying persons, the closing dinner was attended by the Banco de España Director General, Mr. Alonso Ruiz-Ojeda, and the Second Vice President of the Spanish Congress of Deputies, Mr. Vilajoana, as well as by Mr. Ottenberger, the Chairman, and Mr. Schlebusch, member of the Board of G&D.



Regional symposium on Polymer Banknotes in Mexico

The Regional Symposium on Polymer Banknotes' was held in Mexico in June 2007. Organised jointly by Banco de México and the company Securrency Pty, Ltd., it was attended by more than 100 banknote experts representing 21 central banks, independent printing works and suppliers of printing machines and inks. This symposium was a forum to exchange information and experiences regarding the use of polymer technology in the production of banknotes. There was also time to discuss the printing and sorting of banknotes manufactured from this substrate.

The majority of representatives were Latin American central banks staff. Nevertheless, there were also delegates from the US Federal Reserve and Bureau of Engraving and Printing, the Bank of Canada, the Banco de España, the Bank of England, the Central Bank of Vietnam, the Bank of Zambia and the Central Bank of Nigeria attending the symposium. Dr. José Sidaoui Dib, Deputy Governor of the Banco de México, opened the forum and welcomed the delegates. His speech dealt with the success of the Mexican experience in the use of polymer substrates in the production of banknotes and called for open and honest discussion by all those present of their advantages and disadvantages.



First Meeting of the Issue and Treasury Departments of the Central Banks of the Community of the Countries of Portuguese Language.

The heads of the Issue and Treasury Departments of the National Central Banks of Angola, Brazil,

Guinea-Bissau, Mozambique, Portugal and São Tomé and Príncipe attended the 1st Meeting of the Issue and Treasury Departments of the Central Banks of the Community of the Countries of Portuguese Language held in Lisbon from 19 to 22 June 2007. This Meeting was hosted by the Banco de Por-

tugal and chaired by Mr. Vitor Rodrigues Pessoa, member of the Board of Directors of the Banco de Portugal. The speakers included Mr. António Gustavo do Vale, member of the Board of Directors of the Banco Central do Brasil, Ms. Esselina Macome, member of the Board of Directors of the Banco de Moçambique, Mr. Manuel Castelhana, Head of the Treasury and Issue Department of the Banco de Portugal and, as a special guest, Mr. Darío Negueruela from the Banco de España, who gave an overview of the issue and treasury functions in the Eurosystem context.

The main objectives of the Meeting were the establishment and strengthening of contacts between the Issue and Treasury Depart-

ments of the participating central banks and the exchange of experiences and knowledge regarding the different organisational structures and contexts. In spite of the different contexts, organisational and functioning models and scales/dimensions of the participating countries, it was possible to conclude that the mission and functions of the departments are, essentially, the same, that they face identical problems and challenges in putting the necessary legal tender into circulation in their national economies and guaranteeing its quality and authenticity. Given the beneficial experience of this Meeting, it was recommended that in future it should be held on a regular basis, once every two years.

VIII Meeting of Central Banking Legal Advisors (CEMLA)

The VIII Meeting of Central Bank Legal Advisors took place in Madrid on 27th-29th June 2007. The meeting is organised every two years by the Centre for Latin American Monetary Studies (CEMLA) and promotes the exchange of experiences among central bank legal experts and others associated with CEMLA.

The Meeting gathered together representatives from many Central Banks and International Financial Organisations (European Central Bank, International Mone-

tary Fund, Central American Monetary Council, Bank for International Settlements). On this occasion, the meeting focused on the study of various legal aspects relating to the issuance of banknotes and, in particular, there were reports and debates addressing the following topics:

- Legal arrangements governing seigniorage
- The role of a Central Bank in combating counterfeiting
- Legal framework for banknote distribution



International Seminar on the European Banknote Recycling Framework

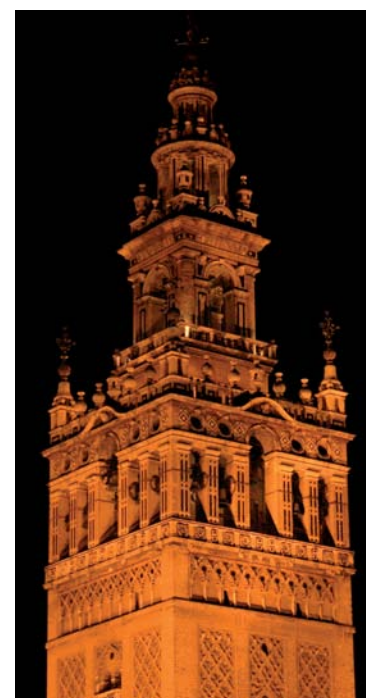
An International Seminar on the European Banknote Recycling Framework was held on 1st and 2nd October 2007 in Seville (Spain). The Seminar was organised by the Cash and Issue Department of the Banco de España and attended by the cashiers from practically every Central Bank of the Eurosystem and the European Central Bank.

Mr. Javier Alonso, the Director General of Operations, Markets and Payment Systems at the Banco de España, participated in the opening session. During the Seminar the participants were given the opportunity to describe their individual experiences regarding their own countries' position regarding the implementation of the European Banknote Recycling Framework. The presentations revealed the differing importance and scope of the common project for the different countries, depending on their respective starting points. And they further highlighted the different organisational and operational systems in place in respect of the cash cycle.

These differences also took the form of different strategies adopted by the central banks in facing the same problem, and the various approaches chosen to deal with it. Some countries were seen to adopt a legal approach (laws and decrees), while others opted for lesser ranked regulations. There were also cases of countries in which bilateral agreements were entered into between the central banks and the credit institutions or their banking associations.

On the second day, a comparative table of the different situations in the participants' countries was circulated. An interesting debate arose, leading to the identification of common and significant points of interest around which future work would be carried out.

The Seminar highlighted the benefits of these theme-based international meetings in which a small number of people discuss the different aspects of a common problem in depth, exchanging experiences and identifying potential problems.



Central banking news

Argentina: New materials for minting coins

In 2007, the Banco Central de la República Argentina (BCRA) began to put into circulation 5 and 10-cent coins made from steel blanks coated with electrodeposited tin. These new coins will circulate in parallel with those previously issued, which were minted in aluminium bronze (both denominations) and in cupro-nickel (the 5-cent coin only). As to their appearance, the new coins have the same design, diameter and thickness, but their edges are smooth rather than reeded. The smooth edge has been chosen because coins with reeded edges are more prone to wear and tear, the top layer of the coin tending to thin at the edges of the grooves.

The change in materials is warranted by the increase in the price of the metals traditionally used for minting, which is very high relative to the face value of these coins.



Opacifying polymer plant in Mexico



The Central Bank of Mexico announced on 3rd July 2007 that it has agreed to a joint venture with Securrency PTY to build a plant producing opacified polymer substrate. That same day there was a modest ceremony in the State of Querétaro, Mexico, to mark the start of the works. Among those attending were the Chairman of Securrency PTY LTD, Mr. Graeme Thompson, and the Director General of Issuance of the Central Bank of Mexico, Dr. Manuel Galán Medina, along with several employees from both institutions.

The new Company will be located in the “Querétaro Industrial Park” and is expected to commence operating in the first quarter of 2009. The investment will total approximately 12 million dollars, with the Banco de Mexico accounting for 20% and Securrency the remaining 80%. The plant’s target production capacity will be 100,000 reams per year.

Modification of Paraguay’s family of coins

In late July 2007, the Banco Central del Paraguay issued a new family of coins consisting of four denominations: 50, 100, 500 and 1,000 guaraníes. The new coins have the same colour tones, but may be distinguished by their different sizes, which increase with face value. This design will facilitate coin counting and sorting tasks.

The new coins are minted using the electroplating technique, which increases the durability of the coin and reduces the environmental impact of the production process.

The obverse sides of the coins depict notable Paraguayan buildings, while on the reverse sides appear the effigies of soldiers who have played an important role in Paraguayan history.



Banco de México issues a new polymer 20-peso banknote

On 20 August 2007 the Central Bank of Mexico issued a new polymer 20-peso banknote as part of its programme commenced in November 2006, when the new 50-peso banknote was released, printed also on polymer. The new 20-peso banknote is 66mm high and 120mm wide, making it 7mm shorter than the recently issued 50-peso banknote. This 20-peso note is the second of the new series to be issued.



As the previous 20-peso banknote in paper, the dominant colour of the new one is blue, and its main motif on the front is the effigy of Don Benito Juárez García. On the back is an engraving of the archaeological area of Monte Albán, Oaxaca.

The main security features are a complex transparent secure window (WinTHRU), a dove in the top left-hand corner printed with a special ink that changes colour when the banknote is tilted at different angles (G-switch), a watermark (shadow image) with the picture of Don Benito Juárez, a microtext of decreasing height and a perfect see-through register with a map of the Republic of Mexico.

The security features of the new 20-peso banknote can be viewed on the Banco de México's website www.banxico.org.mx.



New design of the \$5 banknote

The United States government continues to stay ahead of the counterfeiters and to be proactive and protect the integrity of the \$ currency introducing new currency with enhanced designs and security features. A new design of the \$5 banknote was unveiled in September 2007. The new \$5 banknote will enter in circulation in early 2008.

As with the redesigned \$10, \$20 and \$50 banknotes that preceded it, the new \$5 banknote features contain an American symbol of freedom printed on the back side of the note and the Great Seal of the United States printed on the front side. President Lincoln's portrait, printed in intaglio, is enhanced and the oval border



around it is removed. The large easy to read number "5" on the back side has been enlarged and it is printed in high contrast purple ink. Another noticeable design difference in the new \$5 banknote is the addition of light purple colour in the centre of the banknote, which blends into grey near the edges. The watermarks and security thread are the key security features of the public to check the authenticity of the banknote. There are two watermarks on the redesigned \$5 banknote: a larger number "5" watermark located to the right of the portrait, replacing the watermark portrait of President

Lincoln, and a column of three smaller "5"s located to the left of the portrait. The substrate of the banknote is paper and contains red and blue fibres. More information on the new design of \$5 can be found in the web site, www.moneyfactory.gov/newmoney

Publications devoted to cash

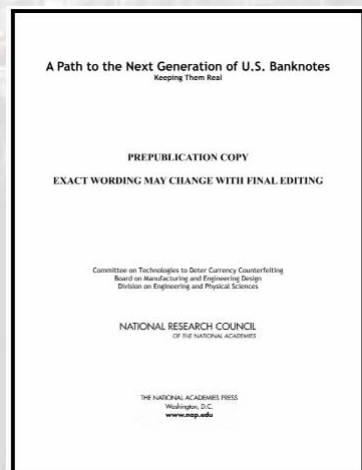
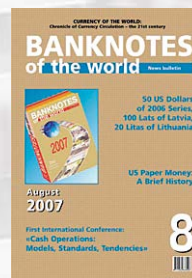


How the euro became our money. A short history of the euro banknotes and coins

Publication issued by the European Central Bank which briefly describes the design, production, storage, distribution and issuance of euro banknotes and coins. It also addresses the communication campaign for the launching of the euro. The book is published in English and is 92 pages long. The English version can be found at www.ecb.int and the Spanish version at www.bde.es

Banknotes of the world – News bulletin

Monthly bulletin (32 pages) which presents the changes and news relating to every banknote issued in 250 different countries. The magazine is published by the Russian company Interkrim-press. Additional information can be found at www.icpress.ru



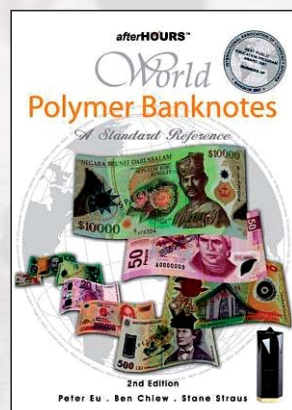
A path to the next generation of U.S. banknotes

This study was carried out by the US Academy of Sciences and is used as a guide to identify new security features for 21st century banknotes. The study was commissioned by the US Treasury Department through the printing works "Bureau of Engraving and Printing" (BEP). This 240-page publication is only available in electronic format at www.nap.edu/catalog/11874.html



World Polymer Banknotes

Second version of this publication, released in 2007. It contains detailed information about every polymer banknote issued worldwide. It is over 200 pages long and can be found at www.eurekametro.com



Banknote security features

■ **Fernando León** *Banco de España*

BILLETARIA presents a new section: 'Banknote security features'. It consists of a brief catalogue with the main security features currently available and used in banknotes worldwide. The document, produced by the Cash and Issue Department of the Banco de España, presents an image with an attached text which briefly describes the referred feature. We have tried to offer a broad and complete vision of these security elements along with a simple and understandable detail of each of them. In order to keep it simple, we have only picked those elements which are easily recognisable by the people and retailers either with the naked eye or by using simple devices.

The set of elements described is a group of possible security features that might be included in any banknote. In no way will we suggest or recommend any particular element. Each Central Bank must decide for its own issued banknotes which elements will suit them the best taking into account a broad variety of aspects such as the design, the quality, the resilience against counterfeiting, the costs, the preferences of the people, etc. Furthermore, it must be highlighted that, in order to decide which design should be applied, a key factor is the adequate selection of the security features. They must, at the same time, offer an efficient protection against counterfeiting at a reasonable cost.

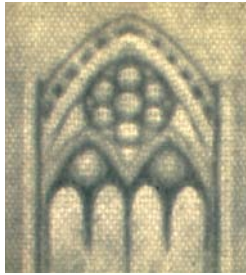
The elements have been grouped by their common functional properties for their detection by the public and retailers. The different groups contain diverse tactile and visual properties which allow an easy identification of the banknotes. Among each different group we present several technical possibilities to produce the security elements. Therefore, there are different types of watermarks, security threads, structures of special lines, printing with a relief effect, colour shifting inks, holographic structures, etc. We have also included those elements, ultraviolet (UV) and infrared (IR) properties, which need special devices to be checked.

The pictures presented are from both real banknotes and samples and have been captured using the means owned by the Banco de España National Analysis Centre. We must always consider this list as

an evolving group of elements as we are constantly adding the latest technological innovations produced by the printing and security industries. Obviously, as some new elements are incorporated, others will be discarded when they are no longer relevant for the industry of banknotes.



WATERMARKS



1. Multitone watermark

Image incorporated into the paper which is visible when the banknote is held against the light. It is created during the paper making process by varying the thickness of the paper. The resulting variations in opacity give rise to an image with bright and dark areas.



2. Electrotype watermark

It is a filigree visible when held against the light. It is created during the paper making process using a filament which takes the form of numbers or different types of characters.

SECURITY THREADS



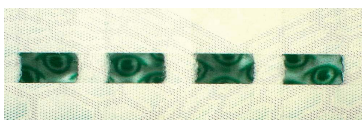
3. Embedded security thread

A thin band of plastic inserted into the paper. It is usually made of 1-2 mm wide and 30-40 microns of thickness. It often bears microtext and fluorescence. It can also contain electric and magnetic properties readable by banknote processing machines.



4. Window thread with colour shifting

This band is made of a thread wider than the abovementioned, 3-4 mm, that weaves in and out of the paper. The uncovered sections are visible and contain an optically variable ink that changes colour when the banknote is tilted.



5. Thread with floating images

A window thread inserted into the paper using a standard window embedding technique. The floating image effect is produced by embedding microlenses into the thread. When the thread is tilted, the microlenses move producing floating images.

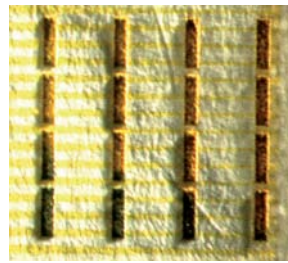
INTAGLIO FEATURES

Tactile



6. Intaglio printing

The printing with relief is detectable by the sense of touch. It is a printing technique in which the ink is transferred directly from the plate to the substrate under high pressure and temperature conditions. The printing produces a relief effect due to the thick layer of ink deposited and the embossing of the substrate. The main motif of a banknote is usually printed in intaglio.



7. Tactile marks for the visually impaired

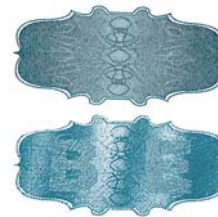
These tactile marks are detectable by touch. They are printed in intaglio and are usually located near the borders of a banknote to facilitate its recognition by the visually impaired.

Visual



8. Colour gradation in intaglio

Gradual superimposition of colours printed in intaglio that very difficult to reproduce by copiers.



9. Latent image

A hidden image that becomes visible when the banknote is viewed at a certain angle. It is made by intaglio printing using a particular structure of lines.



10. Blind embossing

An embossed colourless image that becomes visible when the banknote is viewed from an oblique angle. It is created by deforming the substrate by the high pressure of the intaglio printing without ink.

OPTICALLY VARIABLE FEATURES



11. Iridescent ink

A brilliant ink that changes colour when the banknote is tilted. The ink can be applied in a stripe and displaying an image.



12. OVI ink

Printing with optically variable ink (OVI), implies it will change colour when the banknote is tilted. Its effect is increased when the whole surface is covered by a layer of this ink applied in silkscreen printing.



13. SPARK ink

A particular type of OVI ink which changes colour, containing magnetic particles which can be oriented in such way as to produce a dynamic colour effect when the banknote is tilted. The effect is increased when the whole surface is covered by a layer of this ink applied in silkscreen printing.



14. Optically variable devices (OVDs)

Images produced onto holographic elements which change form and colour when the banknote is tilted. These are anti-copying devices based on the light diffraction principle, such as kinegrams. OVDs can be stamped onto the substrate in the form of a patch or stripe.



15. Moiré variable colour

Feature that uses the latent image principle. It produces a rainbow effect which appears when the banknote is tilted. It is performed by means of an offset printing combined with an intaglio printing.

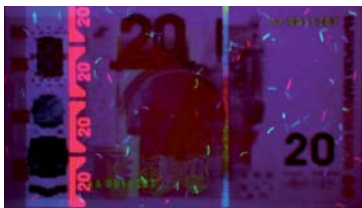
VISIBLE BY MEANS OF A MAGNIFYING GLASS



16. Microprinting

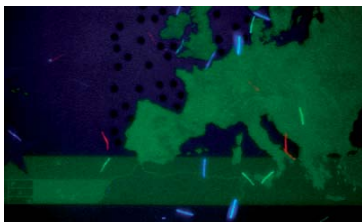
Printing of small characters that are not visible to the naked eye but can be seen through a magnifying glass. When printed onto a banknote, it usually combines characters in positive and negative.

ULTRAVIOLET AND INFRARED PROPERTIES



17. Ultraviolet properties (UV)

These properties are incorporated into the fluorescent pigments of the printing inks which are not visible in daylight but are visible under UV light. Ultraviolet properties in banknote printing turn out really notorious as the substrate used is non-fluorescent under UV light.



18. Fluorescent fibres

Fibres made of synthetic material and differently coloured embedded into the paper that are not visible in daylight but are visible under UV light. Their length is usually 3-6mm. There are certain fluorescent fibres in which each fibre has several colours. The fibres are incorporated onto the banknote in a random way while elaborating the paper mass.



19. IR properties (IR)

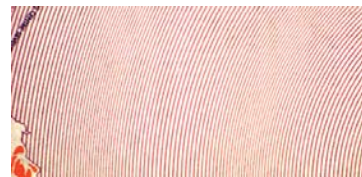
These are incorporated into the pigments of the inks. These are inks with different infrared performance due to different absorptions in that spectrum. The IR characteristics are usually applied combining transparent inks with inks opaque to IR.

OTHER FEATURES



20. See-through register

Some elements of an image are printed in offset on the front side of the banknote and the remaining elements of the image are printed on the back. The whole image with perfect coincidence is visible when the banknote is held against the light. This feature is also known as 'perfect register' as it is printed simultaneously on front and back sides in register.



21. Structure of fine lines (moiré effect)

Set of fine and narrowly printed lines which produce an optical confusion, named moiré effect, when reproduced by copiers.



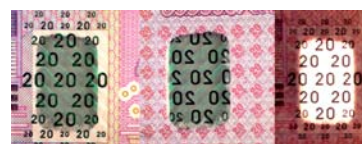
22. Rainbow printing

Offset printing that creates in the banknote an area with different colours that are gradually mixed together to create a rainbow effect.



23. Numbering

The serial number on each banknote, which enables it to be identified. It is usually printed in letterpress, naked eye readable and may also be machine readable if mechanically readable characters are used. The ink usually incorporates magnetic properties.



24. Transparent window

Transparent area on a banknote on which optical effects are incorporated by applying various elements, such as a blind-embossed image or an optical device. It is used in polymer banknotes and is beginning to be used in paper banknotes too. In these, the window is placed on a holographic band.



25. Microperforations

An image made up of a large number of microholes in the paper, which becomes visible when viewed against the light. The microholes are drilled by means of laser.



Carte Universelle Hydrographique. Jean Guérard, 1634.

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Secretariat

Cash and Issue Department
Alcalá, 522
28027 Madrid
Tel.: +34 91 338 6310
Fax: +34 91 338 6887

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For subscriptions and contacts:
billetaria@bde.es

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