

## Featured Articles

# Smart Cash Stream Solution for More Efficient and Tightly-controlled Cash Management

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*OVERVIEW: The use of automated cash handling machines is spreading rapidly in China, with the number of such machines continuing to rise, having already reached more than 200,000, similar to the total number in Japan. On the other hand, this rise in the number of machines has led to ongoing increases in the cost to banks of their operation, causing a major problem for bank management. Hitachi has been supplying cash recycling ATMs that enable efficient operation by re-using deposited banknotes in China and the rest of the world. In the future, Hitachi also plans to supply solutions that provide further operational efficiencies beyond what can be achieved using cash recycling ATMs alone. As a first step, it has launched the smart cash stream solution, which improves both the efficiency and rigor of cash management at cash handling centers.*

## INTRODUCTION

HITACHI first began selling cash recycling ATMs that can re-use deposited banknotes in China in 2000, with a cumulative total of more than 100,000 such machines having entered service by 2014. Meanwhile the total number of automated teller machines (ATMs) of all types in China continues to increase, having already surpassed 200,000 machines.

To improve customer service by ensuring that ATMs operate reliably, Chinese banks are placing an emphasis on equipment availability. Through fault monitoring, maintenance, and preventive maintenance of ATMs, they strive to provide reliable customer service by minimizing the amount of time ATMs are unavailable due to such problems as equipment faults or running out of banknotes. This desire to make efficient use of money and minimize the amount of time ATMs are unavailable due to running out or being full of banknotes is part of the background to why it is cash recycling ATMs rather than other types of ATMs, such as cash dispensers or cash deposit machines, that are so prevalent in China.

Activities performed by the cash handling centers that fill, collect, and replenish banknotes in ATMs include managing cash-on-hand, formulating plans for supplying banknotes to ATMs, and performing the actual supply and collection work. It is anticipated that their workload will expand considerably in the future as the number of ATMs increases.

Hitachi, which has a large share of the market for cash recycling ATMs in China, has responded to this situation by developing the smart cash stream solution, which relieves the workload of cash handling centers as the number of ATMs rises, combining greater efficiency with tighter control of cash. This article describes a solution to the problems faced by cash handling centers, and the technologies that underpin this solution.

## CURRENT CHALLENGES FACING CASH HANDLING CENTERS

### Current State of Cash Handling Centers

While large banks operate their own cash handling centers, this is not possible for small- to medium-sized banks who instead outsource this work to the central bank or a large bank. Additionally, the cash handling centers themselves come in a range of sizes, both small and large. In the case of large banks, while some cash handling centers may handle as many as 1,000 ATMs, others may handle less than 100.

Fig. 1 shows an overview of the operations of a cash handling center. This shows how, along with the delivery of cash cassettes loaded with a number of banknotes determined separately for each ATM, the center also counts and sorts the banknotes from collected cash cassettes and uses those that are reusable to fill the next lot of cassettes.

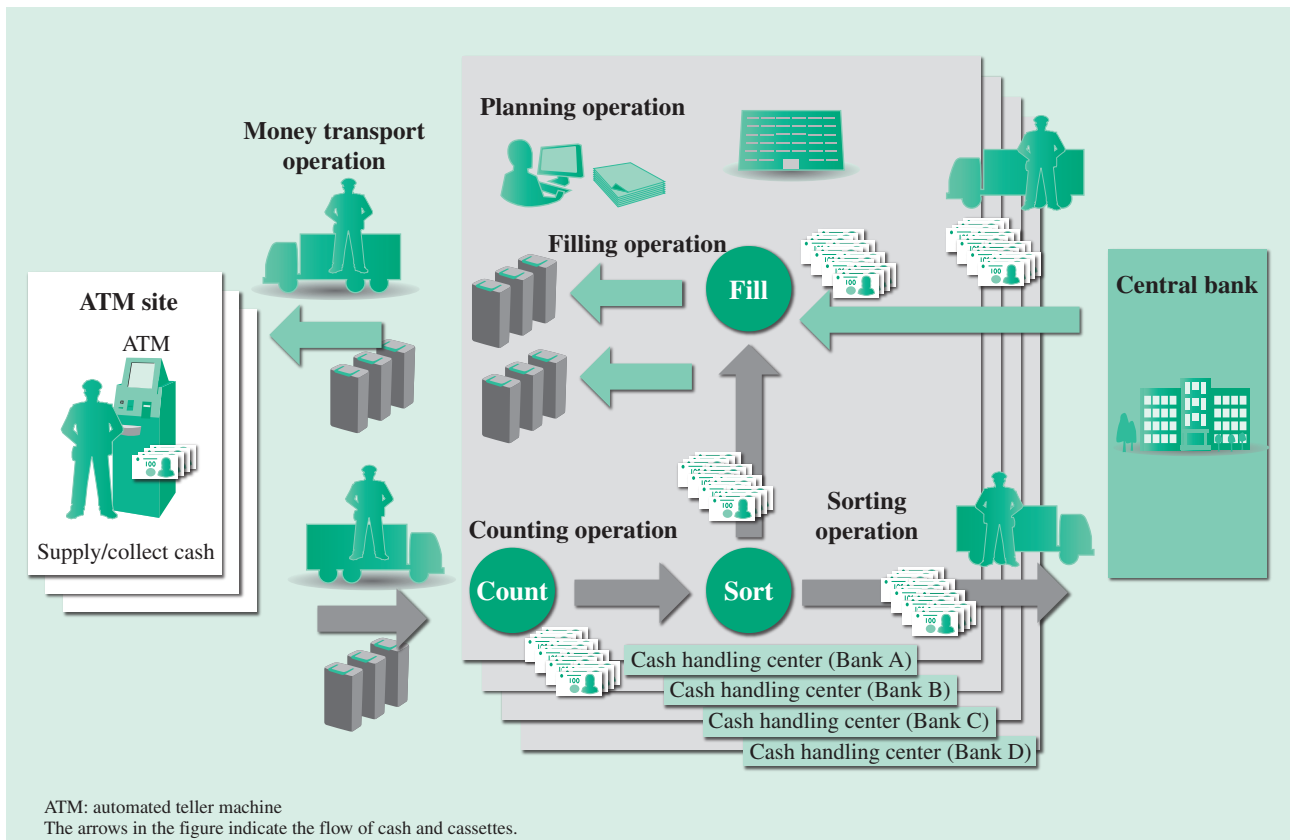


Fig. 1—Overview of Cash Handling Center Operations.

The figure shows the sequence of steps whereby money is received from the central bank and supplied to ATMs, and collected cash is returned to the central bank, as well as the role of the cash handling center in this process.

The plan prepared for banknote filling stipulates how many banknotes to supply to each ATM, determining the number of banknotes to load into cash cassettes and the route that the security van is to take to visit each ATM location. Filling consists of counting out the number of banknotes specified by the plan for each ATM and inserting them into cash cassettes. Transporting the banknotes consists of visiting ATMs to load the cash cassettes prepared in (delivered from) the cash handling center and collect the ones slipped into the ATM.

The first step in the counting process is to count the banknotes from the collected cash cassettes. This is followed by a reconciliation step in which the totals are compared against the ATM balances recorded in the accounting host computer to confirm that they match. Finally, there is the sorting step, which includes separating the collected banknotes into those that can be used again to fill ATMs on the following day and those that are to be returned to the central bank as damaged notes. The final sorting of the banknotes includes making sure they are all oriented the same way and collecting them into bundles of 100. Cash

handling centers repeat these tasks several times a day, with each task needing to be performed accurately despite the time constraints.

### Obstacles to Achieving More Efficient Cash Management

The following lists six obstacles to making the cash handling center tasks described above more efficient.

- (1) Forecasting demand for cash is one of the difficulties of ATM operation, meaning it is necessary to predetermine the number of banknotes to supply when filling an ATM, or else to supply significantly more than what will be needed.
- (2) The more ATMs there are, the longer it takes to produce a filling plan.
- (3) While it is desirable to visit only the bare minimum of locations when filling ATMs and collecting cash, the difficulty is that, for security reasons, the route needs to be different each day.
- (4) The more ATMs there are, the greater the number of security vans and the higher the transportation costs.
- (5) Higher banknote handling volumes result in higher labor costs for sorting.

(6) Efficiency is low because each bank in a region operates its own cash handling center and performs its own filling and collection.

**Obstacles to Maintaining Tighter Control of Cash Management**

The following lists four obstacles to achieving tighter control over cash management.

(7) Inability to monitor the supply and collection of cash cassettes in ATMs and how staff go about their work.

(8) No records to trace what happens when cash cassettes or banknotes go missing.

(9) Investigating claims relating to ATM banknote deposits and withdrawals is time consuming.

(10) When reconciliation finds a mismatch between the counted number of banknotes and the balance recorded in the host computer, investigating the cause is time consuming.

Because cash handling centers face these obstacles to achieving more efficient and tightly controlled cash management, they place a large burden on the banks that operate them.

**SOLUTIONS FOR OVERCOMING OBSTACLES**

Not all of the above problems faced by cash handling centers can be overcome by installing cash recycling ATMs. Accordingly, Hitachi decided to augment the benefits of cash recycling ATMs and develop ATM functions and cash handling center solution tools that could overcome the above problems. Table 1 lists the obstacles and corresponding solutions.

**Making More Efficient Use of Money**

Cash recycling ATMs work by reusing deposited banknotes for withdrawals, thereby using cash more efficiently by reducing the frequency with which banknotes need to be supplied and collected from the ATM.

Further improvements in cash efficiency can be made using a cash demand forecasting tool. This tool forecasts how many banknotes need to be supplied to an ATM on the following day based on past ATM transactions. Many banks in China still do this manually based on past experience.

Forecasting how much money cash recycling ATMs will require is generally very difficult. The number of banknotes in a cash recycling ATM varies not only due to the relative proportions of deposits and withdrawals, but also due to the different timings of peaks in

TABLE 1. Obstacles and Corresponding Solutions  
This table lists the problems faced by cash handling centers and their solutions.

	Category	Obstacle	Solution
(1)	Efficiency	It is difficult to forecast how many banknotes to supply.	Recycle function
(2)		Planning the cash filling operation takes time.	Automatic reconciliation
(3)		It is difficult to change cash delivery routes.	Cash demand forecasting
(4)		Increased costs and number of vans	Delivery plan
(5)		Increased sorting volumes	Filling and collecting banknotes
(6)		Each bank has its own cash handling centers.	Cassette management
(7)	Control	It is difficult to monitor cassette filling and collection and work progress.	Cassette management
(8)		Cassettes and banknotes, etc. cannot be tracked.	Serial number management
(9)		Investigating claims takes time.	
(10)		Investigating out-of-balance reconciliation takes time.	

deposits and withdrawals. It is this that makes demand forecasting more difficult than it is for cash dispensers (where the number of banknotes steadily reduces) or cash deposit machines (where the number of banknotes steadily increases), with the added complication that the number of transactions per day is significantly higher in China than it is for typical ATMs in Japan.

The cash demand forecasting tool that has resolved this problem makes it possible to operate ATMs with the minimum amount of cash needed to ensure they never run out. This not only reduces the interest from the central bank associated with ATM servicing, it also helps minimize workloads, as described in the next section, by reducing the number of banknotes that need to be counted.

**Minimizing Workloads**

Cash recycling ATMs supplied by Hitachi have an automatic reconciliation function. Here, “reconciliation” means the task of comparing the number of banknotes in the ATM against the ATM transaction data recorded in the accounting host computer to confirm that the numbers match. In the past, this required that the cash cassette be removed from the ATM and taken to a cash handling center. In contrast, the automatic reconciliation function verifies the number of banknotes in an ATM by feeding out the banknotes from its cassette and having the machine count them itself.

Because reconciliation can be performed without needing to collect banknotes from the ATM, this minimizes the workload associated with collecting cash cassettes and counting banknotes at the cash handling center.

Hitachi also provides effective tools that reduce workloads for routine tasks performed at cash handling centers. Planning the filling of ATMs has in the past been performed manually on the day when cash cassettes are to be delivered to ATMs by determining for each ATM whether or not filling and collection are required and, if required, how many banknotes to supply. When the cash demand forecasting tool is used, this is performed automatically at the click of a button, taking only a few seconds and producing a schedule sheet. It can also produce plans that are more detailed and use fewer banknotes than those determined based on a planner's experience.

The delivery planning tool, meanwhile, can reduce the number of security vans needed by determining the appropriate number to use to perform cash filling and collection for a different set of ATMs each day.

The banknote filling and collection tool is used to fill cassettes with the number of banknotes specified in the filling plan (which is different for each ATM). It reads the radio-frequency identification (RFID) tag attached to each cash cassette to identify which ATM it is to be supplied to, and in which order it is to be loaded, and a sorter (a device that automatically counts and sorts banknotes) is used to automatically issue the required number of banknotes. As a result, all the worker needs to do is take the banknotes issued by the sorter and load them into the cassette.

### Tighter Control

Keeping track of cash cassettes is one of the requirements for tighter control, and Hitachi supplies a cassette management tool for this purpose. Workers are able to scan the RFID tag attached to each cassette in the workplace. By tracking the ID information read from the RFID tags, the cassette management tool keeps track of where each cassette is currently located through each step, including taking the cassette from the depository, loading it into a security van, and loading it into an ATM. This enables continuous monitoring of the location and status of all cassettes.

The same tracking can also be performed for banknotes. Each banknote has a printed serial number for identification. This serial number is read and recorded each time a banknote is counted in the sorter or deposited or dispensed in a cash recycling ATM.

Hitachi supplies a serial number management tool that manages and tracks these recorded serial numbers and is useful for investigations such as customer inquiries about banknotes or when totals cannot be balanced in reconciliation.

### Information Linking

Each of the above tools can be used on its own. However, further efficiency improvements can be made by linking information together, using the output of one tool as the input to another (see Fig. 2).

The system is based around a central management server to which management terminals, counters, and other devices are connected, controlled, and interlinked. Currently, no such system is available that provides integrated management across all cash handling center activities. So, deploying this system in a cash handling center would enable it to operate with greater operational efficiency and tighter control.

Through efficiency measures like this, it is possible to increase the volume of work that a cash handling center can process. In this way, even more efficient operation could be achieved by consolidating at a regional level the cash handling centers currently operated separately by each bank to save them from duplicating the same tasks and delivering cash along similar routes.

## TECHNOLOGIES UNDERPINNING THE SOLUTIONS

### Cash Demand Forecasting Technique

Because cash recycling ATMs reuse deposited banknotes, the number of banknotes in an ATM's cash cassettes will fluctuate up and down throughout

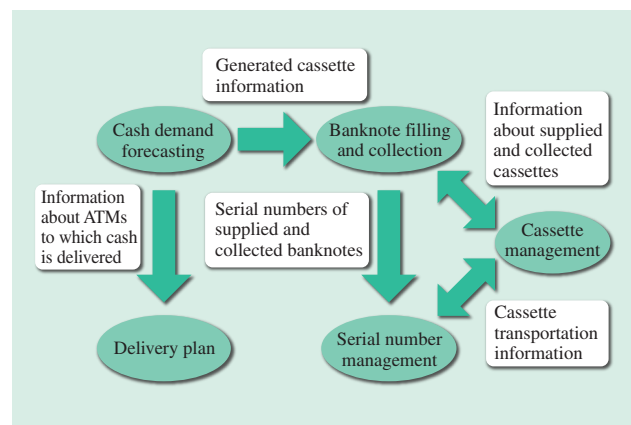


Fig. 2—Tool Outputs and Overview of Integration.

The linking of information is achieved by using the output of one tool as the input to another.

the day. This behavior is significantly different to the case when the number of banknotes in a cassette only decreases (as in a cash dispenser) or only increases (as in a cash deposit machine), making cash demand forecasting more difficult.

While cash demand forecasting for cash recycling ATMs is used widely in Japan, reusing the same techniques without modification is not viable in China where the volumes of deposits and withdrawals from cash recycling ATMs are much larger and more dynamic. Furthermore, while it is possible to apply learning techniques to records of past ATM deposit and withdrawal transactions and use this as the basis for forecasting future demand for money, operational constraints mean it is not always possible to obtain a sufficient quantity of past data from financial institutions.

It is common with forecasting techniques that, whereas forecast accuracy is enhanced by using a more complex forecast model, a lack of learning data leads to poorer accuracy. Accordingly, Hitachi chose to adopt a hybrid approach whereby it produced a number of forecast models of varying complexity which are combined in the way that provides the best possible forecast accuracy given the quantity of transaction records available for learning at any given time. If combining forecast models fails to provide sufficient accuracy, practical cash demand forecasting techniques are implemented that modify operating practices to augment the accuracy. Because of this flexibility, the demand forecasting technique developed by Hitachi can also be used to forecast cash demand at a bank’s branches and at its major customers (see Fig. 3).

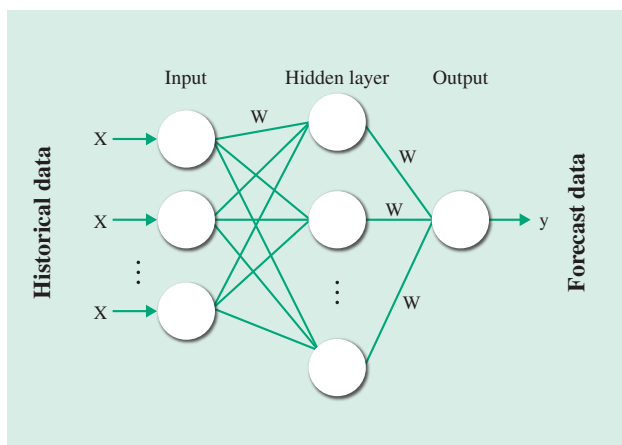


Fig. 3—Example Forecast Model (Neural Network). The model uses a neural network to forecast upcoming demand for money from records of past requirements.

### Delivery Route Optimization Technique

Even once the amounts of cash to load into the cash cassettes for each ATM have been determined based on the cash demand forecasts, the cost of delivery for cash handling centers can vary widely because the number of ATMs to visit also varies depending on the cash demand forecasts, with the number of security vans required to deliver the cassettes being significantly different depending on the sequence in which these ATMs are visited. In response, Hitachi has developed a new technique for optimizing delivery routes. Taking account of how much time is to be spent at each ATM, the technique searches for the route that can visit the greatest number of ATMs within the maximum permitted time between departing the cash handling center and returning. The technique can also optimize the routes when the ATM visits are performed by a number of security vans. The newly developed technique can also be used to optimize routes for visiting bank branches and major customers as well as ATMs (see Fig. 4).

### PLANNED FUTURE SOLUTIONS

Since it first started selling cash recycling ATMs in China in 2000, Hitachi has supplied more than 100,000 machines to date.

Cash recycling ATMs are not yet widely used in the rural and inland areas of China, where cash dispensers account for more than half of all ATMs. Along with replacing these with more efficient cash recycling ATMs, the demand for replacing old cash recycling ATMs that have been in service for eight years or more means that the cash recycling ATM



Fig. 4—Example of Delivery Route Optimization. The technique automatically searches for the optimal (quickest) route for visiting each site.

business can be expected to continue to grow in the future.

With the increasing number of cash recycling ATMs, Hitachi is focusing system development on improving operational efficiency and tightening control at cash handling centers. Other activities relating to the operation of cash recycling ATMs include equipment monitoring and maintenance.

In the future, Hitachi aims to achieve even greater efficiencies by expanding the scope of its solutions to incorporate monitoring, maintenance, and other tasks at central management servers. Examples include use of the electronic journals that record transactions at ATMs to progressively improve the accuracy of cash demand forecasting, or the collection of information such as monitoring data and cash recycling ATM equipment logs to perform preventive maintenance. These efficiency-enhancing solutions will lead to future businesses that can provide ATM operation services.

## CONCLUSIONS

This article has given an overview of solutions for improving the efficiency of cash handling center operation and tightening control of cash management in China, and described the technologies that underpin these solutions.

By improving the operation of cash handling centers and reducing the workload associated with operating ATMs, these technologies and solutions enable banks to focus more on their core financial activities. Hitachi believes it can provide solutions that contribute to bank management.

## REFERENCE

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