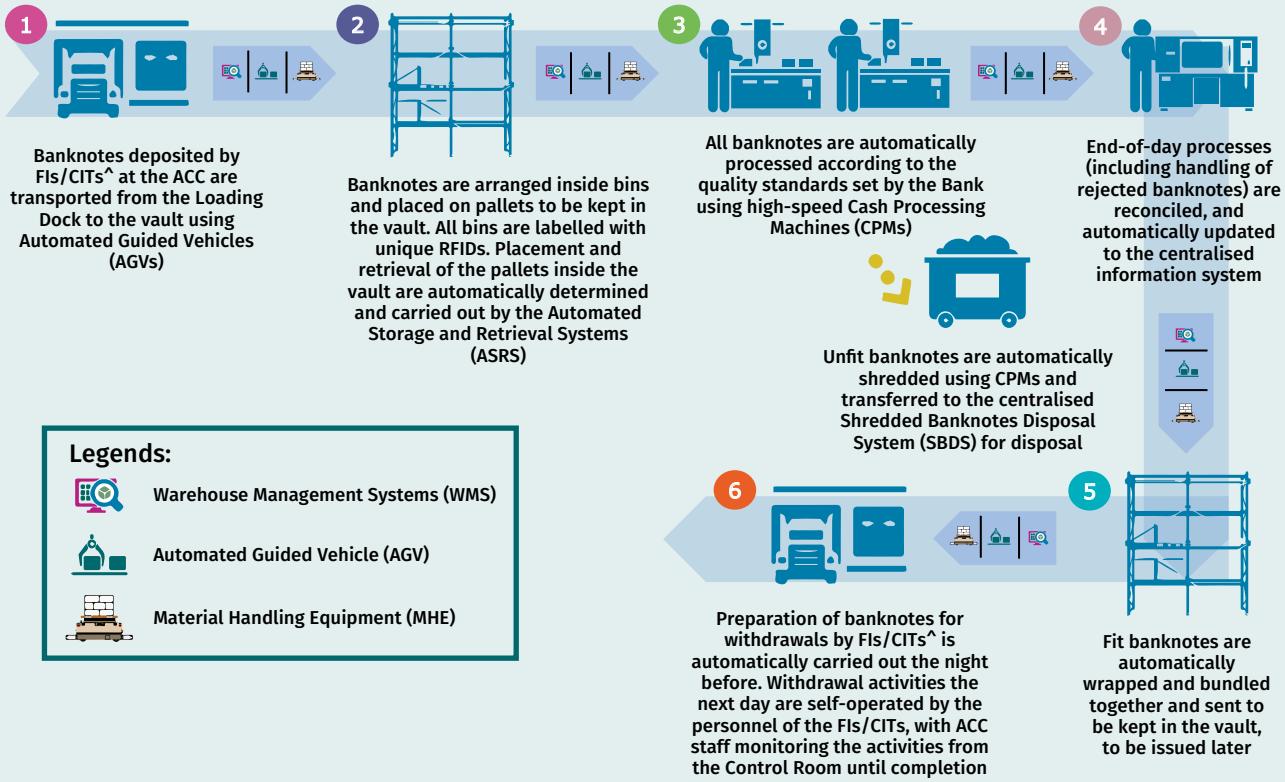
## ACC – An Automated and Integrated Cash Management Facility

About three billion pieces of banknotes return to the Bank every year via deposits from financial institutions (FIs). Every single banknote is inspected and sorted according to the pre-set fitness level. Banknotes that are worn out, limp or soiled will be removed from the system, thus ensuring only high quality banknotes go back into circulation. The Automated Cash Centre (ACC), which was built in 2016, serves as the facility with the capability to efficiently process large volumes of banknotes at high speed. The new facility enables the Bank to reduce total manpower strength by 53%, increase processing capacity per machine by 33%, increase throughput[1] handling per hour by 3.5 times and shorten the time taken to handle banknote deposits (from 205 to 45 minutes) and withdrawals (from 125 to 40 minutes) by FIs.

### Automated Cash Centre (ACC)

The ACC is a fully automated, secure and integrated cash management facility (Diagram 1). It is equipped with state-of-the-art machines, systems and equipment, such as Automated Guided Vehicles (AGV),[2] Automated Storage and Retrieval Systems (ASRS),[3] autonomous robots[4] and high-speed banknote processing machines.

Diagram 1: End-to-End Cash Activities at the ACC




Note: ^ FIs/CITs - Financial Institutions/Cash-in-Transit companies.

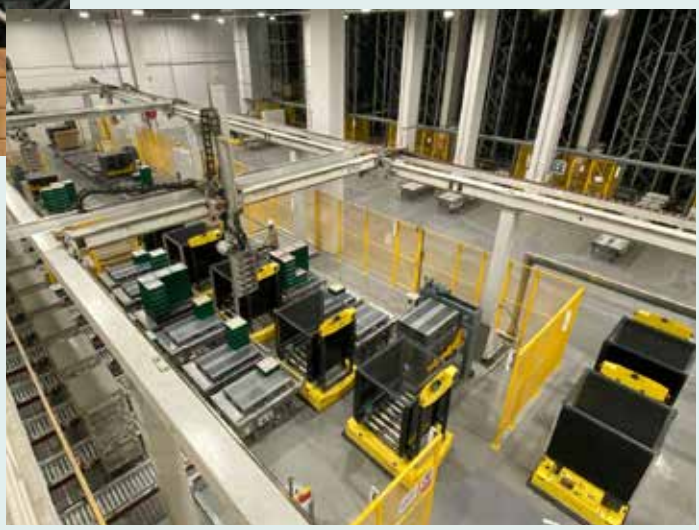
Source: Bank Negara Malaysia

[1] Throughput is inward and outward movements of banknotes through the cash centre.
[2] AGVs are load carriers that travel along the floor of the ACC without an onboard operator/driver.
[3] ASRS are computer- and robot-aided systems that automatically place and retrieve items from the predefined locations within the facility.
[4] Autonomous robots are intelligent machines that are capable of performing predefined tasks, without explicit human intervention.

*Movement of pallets of banknotes into and from the rack inside the vault managed by automated cranes.*

*Each banknote processing machine is capable of processing up to 2,000 pieces of banknotes per minute.*

*Automated Storage and Retrieval Systems (ASRS) autonomously handle banknotes inside the vault, turning it into a completely human-free zone.*

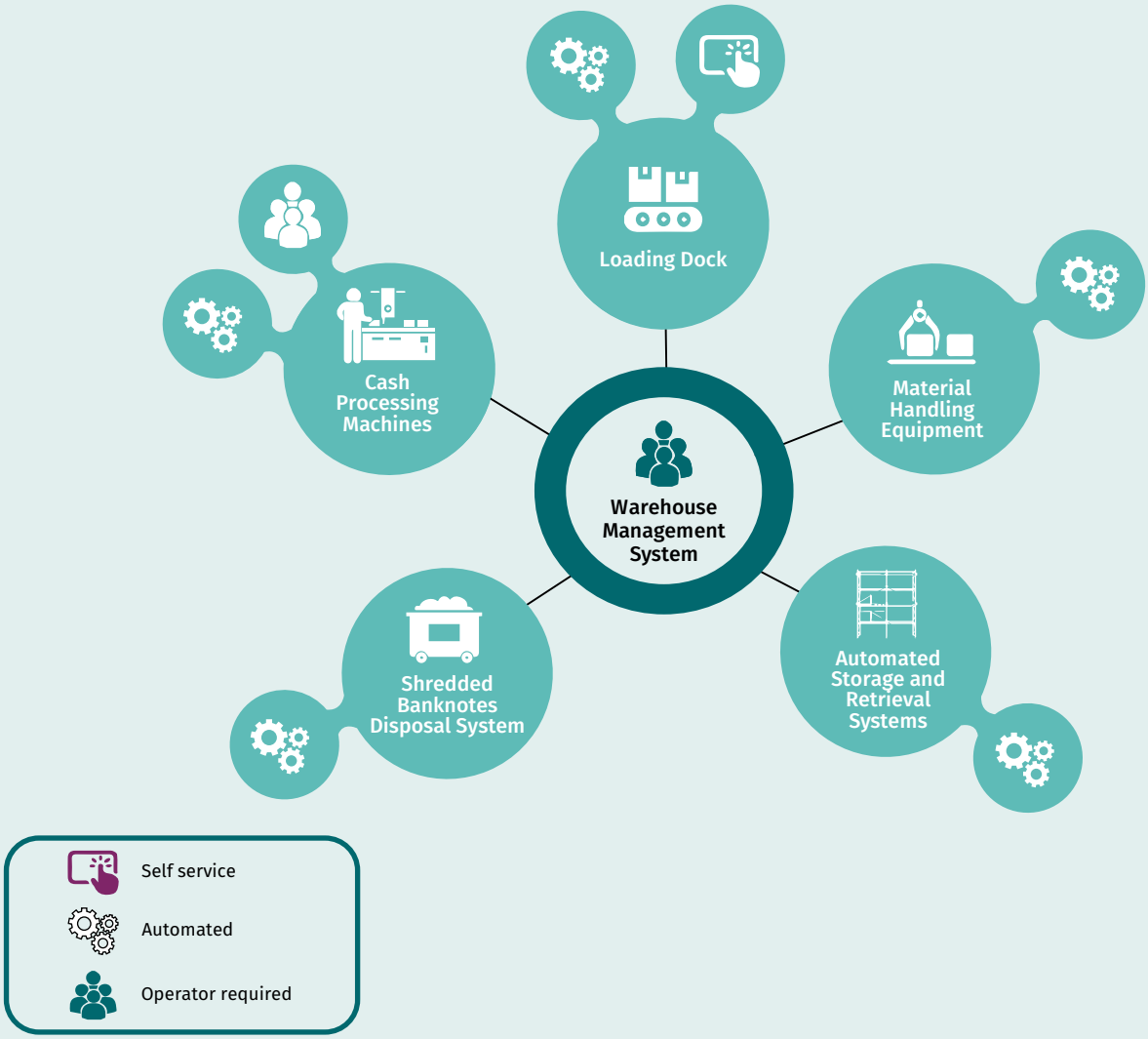


*Minimal human intervention enabling the facility to operate around the clock.*

## IT/OT Convergence[5]

The Warehouse Management System (WMS)[6] is the ACC's core system (Diagram 2). It controls the processing of banknotes in the ACC. The system determines, tracks and records in real-time every movement of banknotes, logging their timing and denominations. No single banknote is left unaccounted or unrecorded. Based on the first-in-first-out (FIFO) principle, WMS also automates the flow of bins of banknotes for storage in or retrieval from the vault for receiving or issuance respectively.

**Diagram 2: WMS Central to the Automated Cash Operations at the ACC**




Source: Bank Negara Malaysia

The efficiency of our currency operations has improved significantly, thanks to the enhanced connectivity between the IT systems and automation machines. The convergence of Information Technology (IT) and Operational Technology (OT) enables autonomous robots to replace humans for many tasks in the production chain, enabling non-stop operations. Numerous sensors along the production chain generate volumes of

[5] IT/OT convergence refers to the integration of information technology (IT) systems with operational technology (OT) systems, establishing two-way communications with one another.

[6] A warehouse management system is a software application that controls the AGVs, conveyor, retrieval and placement of inventory, as well as manage the day-to-day operations of a warehouse facility, which in this case is the ACC.

data. These allow for real-time data analysis and production of immediate data visualisation and alerts. This transforms the ACC into a smart cash management facility with Industry 4.0 elements (Diagram 3).

### Diagram 3: Embedded Industry 4.0 Elements Into the ACC Operations

**Industry 4.0: Smart Cash Management Facility**

| | |
|---|---|
| **Systems Integration** | Facilitates agile operating environment, allowing increased system connectivity and production of real time data |
| **Autonomous Robots** | Replaces human workers for many tasks in the production chain, with added ability to monitor and transmit data |
| **Internet of Things** | Facilitates the connectivity between the IT systems and the OT machines, allowing for transmission of data via sensors |
| **Simulation** | Facilitates testing of new enhancements as well as periodic disaster recovery testing to ensure preparedness<br>Simulation activities occur offline with better audit trail |
| **Big Data Analytics** | The collection and evaluation of voluminous data from the operation helps real-time decision making<br>Dashboards facilitate timely decision making and planning |
| **Cyber security** | Necessary to protect the OT systems from the potential threat of cyber attacks |

Source: Bank Negara Malaysia

The advent and convergence of IT and OT enable currency operations to run at high speed with the highest level of precision and control within a secure environment. Currency operations can run around the clock, undertaking voluminous processing of banknotes and preparation of currency withdrawals by FIs at night without human intervention. Our on-site AGVs, cranes and conveyors can 'talk' to each other, work autonomously and synchronise the logistics. This includes the retrieval and palletising the bins of banknotes based on the pre-set instructions for withdrawals the next day.

IT/OT convergence also enables us to scale our currency processing operations to meet withdrawal demands at short notice. This flexibility also allows us to achieve the desired output level with minimal downtime. For instance, throughout the pandemic, our critical functions of banknote deposits and withdrawals by FIs remained uninterrupted. Our ACC engineers were able to resolve operational or technical issues remotely within a short period. IT/OT convergence has also enabled us to unlock and harness the value of OT data from multiple disparate systems into actionable insights. This end-to-end visibility via a dashboard of all activities inside the premise ensures any problems along the processing chain are promptly detected and rectified.

In addition, IT/OT convergence in currency processing operations has also enhanced our ability to optimise currency stock. With the ACC having a higher capacity for processing banknotes, we are able to reduce the backlog of banknotes to be processed, thus resulting in higher banknote turnover. This increases our ability to meet demand for circulation using fit banknotes instead of new ones.

## IT/OT Challenges

While the IT/OT convergence drives productivity and efficiency to new heights in our currency operations, it is not without challenges.

First, is the risk of obsolescence. While the mechanical components of the ACC seldom change over the years, its IT components are subject to obsolescence every few years. This requires timely and regular upgrades or replacements. To address this issue, we have completed a comprehensive technological refresh review. Following this, we will implement the recommendations progressively in the next few years.

Second, is the risk of external threats. With interconnectivity with the wider IT systems of the Bank, OT systems of the ACC are exposed to potential threats of cyber attacks. Any gaps in cybersecurity have to be identified and adequately addressed to keep IT and OT systems from being compromised. To this end, we have made extensive investments in IT hardening and cyber resilience to improve our IT/OT security designs and controls alignment with, amongst others, the Guidelines for Secure Industrial Control System, issued by CyberSecurity Malaysia, and other internationally recognised standards, such as IEC62443 Security of Industrial Automation and Control Systems (IACS) and the National Institute of Standards and Technology (NIST) cybersecurity framework.

Third, is the need for a workforce with skills in emerging areas. The combined IT/OT field requires niche expertise. Specialists have to be developed internally given the lack of IT/OT experts locally. Therefore, training and learning are crucial to keep pace with existing and emerging technologies. During the year, we have engaged IT/OT industry experts, developed a customised technical curriculum that fit the nature of our operations and upskilled our staff to obtain technical certifications from the Malaysia Board of Technologists.

## ACC as Smart Cash Management Facility

Despite the challenges, IT/OT convergence proves critical in transforming the ACC into a smart cash management facility. Multiple components of the ACC operate autonomously but in sync to process a huge volume of banknotes in a short period of time. With capacity that is highly scalable, we can continue to depend on the ACC to generate significant quantity of fit banknotes for recirculation for many years in the future.