

# Promising Practices

# Warehousing and Inventory Management

Brief #3 in the *Promising Practices in Supply Chain Management Series*



## INSIDE

- Background ..... 3
- Introduce Infrastructure Improvements for Optimal Storage..... 5
- Improve Inventory Management and Security Using Barcoding or Radio Frequency Identification to Track Products ..... 8
- Parastatal, Semi-Autonomous Central Medical Stores ..... 10
- Outsourcing Warehouse Functions..... 12
- Conclusion ..... 14
- References ..... 15

This brief is part of the *Promising Practices in Supply Chain Management* series, developed by the Supply and Awareness Technical Reference Team (TRT) of the [UN Commission on Life-Saving Commodities for Women’s and Children’s Health](#) (the Commission or UNCoLSC). As part of the [Every Woman Every Child](#) movement and efforts to meet the health-related Millennium Development Goals by 2015 and beyond, the Commission is leading activities to reduce barriers that block access to essential health commodities. The Supply and Awareness TRT developed this set of briefs on promising practices in supply chain management to guide countries in identifying and addressing key bottlenecks in the supply and distribution of the Commission’s 13 life-saving commodities across the reproductive, maternal, neonatal, and child health continuum of care.

This series of briefs has been developed for use by in-country stakeholders. The briefs provide both *proven* and *promising* practices that may be used to address specific supply chain barriers faced by each country.

- *Proven practices* are defined as interventions with proven outcomes in improving health commodity supply chains in low- and middle-income countries tested using experimental or quasi-experimental evaluation designs. Examples of proven practices are identified by this symbol throughout these briefs. 
- *Promising practices* are defined as interventions showing progress toward improving health commodity supply chains in low- and middle-income countries.

To view all the briefs in the Promising Practices in Supply Chain Management Series, visit <http://siapsprogram.org/publication/promising-practices-in-supply-chain-management>

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### Abbreviations and Acronyms

ARV	antiretroviral	SCMS	Supply Chain Management System
CMS	Central Medical Store	SIAPS	Systems for Improved Access to Pharmaceuticals and Services
DDC	Domestic Distribution Centre	TRT	Technical Reference Team
Global Fund	Global Fund to Fight AIDS, Tuberculosis and Malaria	UNICEF	United Nations Children’s Fund
JSI	John Snow, Inc.	UPC	Universal Product Code
LMIC	low- and middle-income countries	USAID	US Agency for International Development
MSD	Medical Stores Department	WHO	World Health Organization
NDoH	National Department of Health	WiB	Warehouse-in-a-Box™
RFID	radio frequency identification		

## Background

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Defined broadly, pharmaceutical warehousing or warehouse management is “the physical movement of stock into, through, and out of a medical store warehouse.”<sup>1</sup> Warehousing is a key element of pharmaceutical supply chain management. It ensures the constant availability and flow of essential quality health commodities, in appropriate quantities, in a timely and cost-efficient manner, through the supply chain system. Key warehousing functions include receiving and storing stock, inventory management, and distribution management. This brief focuses primarily on warehousing, even though warehousing and distribution are highly interrelated, and the same entity is often responsible for both functions. Please see the [Promising Practices in Distribution](#) brief for more information on the distribution function.

While storing stock is a key function of warehousing, the need for large warehouses and large holdings of stock may reflect inefficiency in the supply chain. In an ideal supply chain, large warehouses storing large volumes of products are unnecessary because products enter and exit the warehouse quickly and efficiently on their way to the service delivery point. The task before all supply chain practitioners is to determine how much storage space is truly necessary if operations are as efficient as possible.

The warehousing domain of the supply chain faces problems created higher up the chain, such as poor quantification leading to incorrect stock procured, mistakes in orders, and insufficient financing. In addition, warehouses are challenged by insufficient human resources, poor physical infrastructure, and a lack of good systems to effectively track products throughout the system. These barriers lead to stock-outs, overstocking, and wastage of health resources. These are major problems in low-income country settings where resources for health are already limited.

A well-functioning warehouse has a strong governance structure, a smooth operations management system, sufficient and qualified human resources, and the ability to monitor performance. The following table presents examples of promising practices that have been used successfully to address the common barriers mentioned above:

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<sup>1</sup> Management Sciences for Health. *MDS-3: Managing Access to Medicines and Health Technologies*. Arlington, VA: Management Sciences for Health; 2012.

Barriers	Description	Promising Practice(s) that Address the Barriers
<b>Poor warehouse infrastructure, either in terms of the physical space or installations in the warehouse</b>	The storage space available for the volume of products that move through the warehouse is inadequate. The installations in the warehouse do not permit maximum use of the space available, and may even compromise the quality of the products.	Introduce infrastructure improvements for optimal storage
<b>Poor product traceability, stock leakage and security.</b>	Recording the flow of products in and out of the warehouse (receipt and dispatch) is often paper-based. This is time-consuming and introduces more risk for error. Without clear processes, a paper-based system may limit the visibility of data at other levels of the supply chain. Stock leakage and security issues, as well as low product traceability throughout the supply chain frequently lead to stock-outs.	Improve inventory management and security using barcoding or radio frequency identification to track products
<b>Lack of capacity in government to manage warehouse coupled with aging or inadequate infrastructure</b>	Bringing aging infrastructure and information systems to acceptable standards may require an investment the country is not willing or able to make. Outsourcing warehousing functions may be a more cost-effective way for the national health system to manage medicines and supplies.	<ul style="list-style-type: none"> <li>• Outsource warehouse functions</li> <li>• Parastatal, semi-autonomous central medical store</li> </ul>
<b>Poor performance of existing staff</b>	If staff engaged in warehouse operations are poorly trained, lack clearly defined roles and responsibilities, and are not held accountable for their actions, warehouse operations will be inefficient and ineffective.	Please see Performance Management and Supportive Supervision for Supply Chain Activities in the <a href="#">Promising Practices in Human Resources</a> brief

# Introduce Infrastructure Improvements for Optimal Storage

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## To address poor warehouse infrastructure

Appropriate warehousing infrastructure involves considerations of efficient layout, appropriate storage installations (e.g., pallets, shelving), good housekeeping, safety, quality control, and stock management.

Proper product layout is key for effective and efficient warehouse/inventory management. Warehouses should be organized into sections or zones according to the intended function they will have, or the characteristics of the products that will be kept in them. For example, if products require cold storage or special security measures, the zone should be equipped to meet these needs. Products should be kept off the floor on pallets or shelving that maximizes the use of space. Careful consideration should be given to how products are arranged and labelled in the zone to maximize space utilization. An appropriate location numbering system should be used to (1) make it easier to find a particular pallet; (2) maximize the use of space in the warehouse; (3) store faster-moving items closer to the location where orders are assembled and dispatched; and (4) facilitate the use of electronic warehouse management systems. Numbering every pallet location in the warehouse allows for the reorganization of the warehouse based on volume dispatched criteria. This will make inventory management, including stock-taking, much easier, and prevents double-handling when specific areas of the warehouse are full. It may also facilitate the development and implementation of a fully computerized warehouse management system.

Often, warehouses are poorly designed with inadequate storage space and conditions. Infrequent distribution of products may result in large amounts of stock being stored in warehouses with limited storage capacity, which may be further complicated by cold chain requirements for some temperature-sensitive commodities.

Good storage practices in the pharmaceutical warehouse are often overlooked. The warehouse should be kept clean and dry. Inventory should be stored according to the principles of “first expired, first out.” There should be regular inspection so that damaged or expired stock is disposed of safely. Disposal policies should be present and properly adhered to.

Related to these good storage practices, appropriate warehousing should consider the safety of both the products and the staff who work in the warehouse. There should be adequate lighting, temperature, and humidity control. The warehouse should have adequate, clearly visible, and functioning fire extinguishers with clear instructions for their use. There should be adequate and clearly labelled emergency exits. Warehouse employees should wear appropriate protective clothing, such as overalls, safety helmets, boots, and hi-visibility clothing, such as reflective jackets.

## When should infrastructure improvements for optimal storage be considered?

When considering improvements in infrastructure to increase storage capacity, the following should be taken into account:

- Available budget: how much funding is available to make improvements?
- Feasibility of optimizing existing space: can existing space (including vertical space) be used more efficiently?

- Product volume: is the increased volume a temporary situation or will the warehouse continue to experience an increased volume?
- Efficiency of the supply chain: are there other interventions, such as split delivery or direct delivery of products that may be undertaken to reduce the need for increased storage capacity?
- Effectively consider all available options: Consider building a new warehouse, extending the existing facility, centralizing or decentralizing stock holdings, or outsourcing to other parties or partners.

### ETHIOPIA

In 2012, the Supply Chain Management System (SCMS) program introduced racking systems in 10 warehouses throughout the country. Racking systems increase the storage capacity of an existing warehouse by allowing for optimal use of vertical space for storage, without compromising the quality of products. Racking may also allow for improved inventory management practices; products that are soon-to-expire may be placed in specified areas or sections of the racks.

As a result of the new racking, the storage capacity increased by up to 35% in some warehouses. Inventory management practices also improved since products could be more easily stored, located, and distributed systematically in clearly marked sections. In addition, the installation of racking was a cost-effective and efficient way to address storage limitations and improve inventory management and warehouse operations.

Racking has also been used in other countries. In Namibia, for example, installation of racking at central medical stores increased storage capacity from 664 m<sup>3</sup> to 1416 m<sup>3</sup>. In this case, the expansion of storage space helped the Central Medical Store (CMS) improve inventory control and distribution, including traceability of antiretroviral (ARV) medications.

#### To learn more:

- [Warehousing and Distribution](#)
- [Building Capacity: Racking Warehouse Improve Medicinal Supply & Access in Ethiopia](#)

## TANZANIA

In 2010, the Government of Tanzania and USAID entered into discussions on the state of the country's warehouses. There was increasing need to upgrade the infrastructure of the Medical Stores Department (MSD) to meet the needs of the country's expanding health program and the increased number of commodities moving through the system. Among the problems noted were limited space and, perhaps more importantly, the condition of the space available, which in many cases was either poorly constructed or badly maintained and managed.

USAID, through SCMS, proposed using Warehouse-in-a-Box™ (WiB). WiB, developed by Imperial Health Sciences (Imperial), is a kit that includes all the necessary infrastructure for a warehouse, including furniture and racking. It may be ordered and delivered to any location and rapidly assembled. In addition to physical infrastructure, WiB provides job descriptions, suggested standard operating procedures, and training materials for warehouse personnel. The installation of WiB includes in-country training for personnel and post-implementation audits to help build capacity in warehouse operations and management skills.

Three WiBs were initially installed in Tanzania. As part of the implementation, 55 MSD staff were trained in quality control, warehouse management, medicine recall, and disposal. Subsequently, through its Global Fund grants, Tanzania was able to obtain two additional WiBs and the further extension of the original three warehouses. As a result of WiB, pallet positions tripled from 12,400 in 2009 to 36,629 in 2013. This represents a 195% increase in storage capacity with only a 60% increase in surface area. Furthermore, MSD saves approximately \$1 million per year in rent through the use of the donated WiBs.

### To learn more:

- [In Tanzania: The US and Tanzanian Governments collaborate to deploy a world class warehousing facility to expand medical store's storage facilities](#)
- [Coping with the commodity tidal wave: A fast and affordable solution to expanding storage capacity](#)
- [Warehouse in a Box](#) (SCMS website)
- [Warehouse in a Box](#) (Imperial website)

# Improve Inventory Management and Security Using Barcoding or Radio Frequency Identification to Track Products

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To address problems with stock leakage, security, and low traceability

Today, the availability of timely, accurate, and inexpensive information is providing opportunities for improvements in quality and efficiency processes in warehousing. Warehouse transactions that may be linked electronically to warehouse management systems software in real time, using barcoding technology and scanners, for example, reduce the administrative burden and the lead time for access to accurate information for decision making.

Barcoding and radio frequency identification (RFID) are frequently used in commercial supply chains to track products. For decades, barcodes have been used as the main form of identification of products in retail supply chains. This technology helps track products from point-of-origin to their final destination. It also assists in recalling products or detecting counterfeit products. Barcodes are read with an optical reader. The bars represent a universal product code (UPC), which identifies the product manufacturer and type. Optical readers or scanners “see” the barcode. Only one barcode can be read at a time.

RFID uses radio waves to transmit data, as opposed to reading the data. An RFID reader transmits a signal via radio waves. RFID tags contain product identification information on a chip. They are inactive until the radio waves sent by the reader electromagnetically “charge” the tag. The RFID tag then responds to the reader by sending back its information. RFID does not require line of sight because the signal is transmitted via radio ways. Therefore, it can be read through boxes or other packaging or from products stacked on pallets. RFID can also read many tags simultaneously. For example, a reader could be placed in a warehouse entryway and exit and automatically read RFID tags on stock entering and leaving the building. Instead of a UPC, the RFID product identifier is an Electronic Product Code, which identifies the product more specifically than just product manufacturer and type.

## When should barcoding or RFID be considered?

When warehouses manage large volumes of diverse products, barcoding or RFID may streamline operations, reduce reporting error, and increase efficiencies.

A limitation for both systems is that the infrastructure necessary to read and use the data collected are not usually available in most resource-limited settings. In many low- and middle-income countries (LMIC), existing information systems are not equipped to handle and make optimal use of data generated from barcoding or RFID. In addition, while global standards for product identification exist, they have yet to be adopted by all manufacturers and the downstream supply chain network, including distributors and third party warehouses. Global standards will make it possible to manage all barcodes or identifiers by one standard so that national regulatory authorities do not have to develop their own standards or manage multiple standards on different products.

Despite these limitations, barcoding has been used successfully to improve warehouse operations in a number of countries. Some examples follow.

## PAKISTAN

Before the introduction of barcoding, Pakistan's Central Warehouse used a time-consuming paper system to track commodities, leading to delays in distribution, a large number of errors, and stock expiring. The USAID | DELIVER PROJECT worked with the Government of Pakistan to develop a warehouse management system that enabled warehouse transactions to be facilitated with barcode scanning. The project worked with the Central Warehouse to install the necessary hardware (e.g., computers, barcode scanners, and printers), software, and to provide staff training. The new system allowed for improved management of shipments, faster distribution of products to the sub-national level with easier tracking of dispatches, and improved control of leaks and theft. Because of the new system, the staff workload declined by approximately 30%, freeing them to complete other warehouse management functions. In addition, the time it takes to produce reports were reduced by 40% to 50% and reporting errors were substantially decreased.

### To learn more:

- [Pakistan Overview](#)
- [Barcoding: Modernizing Warehouses to Lighten the Workload](#)

## TANZANIA

A collaborative project with the participation of United Nations Children's Fund (UNICEF), World Health Organization (WHO), the GAVI Alliance), vaccine manufacturers, and PATH is exploring options for using barcodes on vaccine packaging to learn how this technology may potentially improve the management of vaccines in Tanzania and other developing countries.

The project is still in its early phases, after completing some feasibility testing in the field. The aim is that collaborating vaccine producers will add barcodes to the containers used to ship vaccines. Each barcode will also contain a serial code that identifies individual containers. An advance shipping notice will be sent so that on arrival, the barcodes may be scanned and parts of the arrival report automatically populated. Manufacturers will add barcodes to the secondary packaging as well, so that the vaccines may be tracked as they move down the supply chain. These barcodes will have the lot number and expiry date as well as the item number.

So far, Pfizer has implemented the application of GS1 barcodes on vaccine packaging for Tanzania, and at least four more manufacturers are expected to complete implementation in 2014. Further testing and integration of barcoding into Tanzania's central warehousing and logistics management information system are expected in late 2014.

### To learn more:

- [Tanzania leading the way with barcodes on vaccine packaging](#)
- [GS1 in Healthcare: Tanzania Project](#)

## Parastatal, Semi-Autonomous Central Medical Stores

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To address lack of capacity in government and inadequate infrastructure

Historically, many LMICs have relied on government-run Central Medical Stores (CMS) to procure, store, and distribute health commodities. Traditional CMS are divisions of the Ministry of Health, are financed fully by the government, and provide commodities to public health facilities free of charge. These institutions often struggle with shortages of qualified personnel, bureaucratic constraints, lack of transparency and, in some cases, corruption. As a result, many governments have started bestowing CMS with semi-autonomous status, allowing them more managerial and financial independence while still maintaining a mandate for service delivery to the public sector. The goal is to align CMS with private sector incentives that reward high performance and efficiency.

### When should parastatal, semi-autonomous CMS be considered?

One of the major benefits of parastatal, semi-autonomous CMS is an increase in managerial flexibility, including the ability to hire (and fire) professional logistics staff, respond more quickly to customer needs, and increased efficiency. However, when implemented without mechanisms to ensure the provision of equitable and affordable service delivery to the public health system, autonomy may have a negative impact on the supply chain. Granting parastatal, semi-autonomous status to a CMS should only happen in conjunction with thoughtful, coordinated, and well-executed reform to governance, funding arrangements, and regulations on decision rights, financial claims, accountability, and social obligations.

#### To learn more:

- [The World Medicines Situation Report 2011: Chapter on Storage & Supply Chain Management](#)

## CAMEROON

Cameroon's CMS was first granted semi-autonomous status by presidential decree in 1985 with the creation of ONAPHARM. ONAPHARM's budget came almost entirely from government funds and provided commodities for free until 1989. In 1990, ONAPHARM began operating more like a private, for-profit company, selling commodities to facilities, which then charged patients a fee in an attempt to recover the cost of the commodities, making medicines unaffordable to the country's poorest individuals and families. In addition, ONAPHARM started to purchase expensive brand-name medicines from preferred suppliers and sell them to facilities at marked-up prices rather than focus on procuring essential generic pharmaceuticals using a competitive tendering process.

To address these failures, a second phase of reforms took place between 1995 and 1998 to create an independent non-profit CMS known as CENAME. External technical advisors (including donors) helped draft regulations for the tendering process, the types of commodities that could be procured, and selling prices. Financial incentives for efficiency, such as the ability to retain surpluses, were built in. Donors also invested in infrastructure improvements, staff training, and initial procurements. An independent board was created that was given authority to manage human resources, finances, procurement, and logistics.

Cameroon has seen a number of improvements in operational performance and service quality since CENAME was introduced:

- Increased financial accountability: CENAME uses a commercial accounting system, which sheds light on costs that are often hard to see in public accounting systems, such as the cost of holding excess inventory. In addition, by regulation, CENAME is required to share financial audits with customers.
- Increased payment for service and reduction in debt: CENAME's average customer pays 50% of costs upfront and pays the rest within three months. Those who do not pay on time cannot make future purchases without settling debts. Public and religious facilities, however, are allowed to purchase on credit, when needed. Prior to the introduction of CENAME, ONAPHARM owed over a billion dollars to suppliers; by contrast, CENAME has very little debt.
- Improved distribution: CENAME's customers make new orders every three months. CENAME makes deliveries every three months while outsourcing some deliveries. CENAME's timeliness is generally considered acceptable by customers.
- Improved quality of service: Data from the pre-CENAME era were not available, however, customers interviewed reported that orders would take months to arrive. After CENAME, orders generally arrive between 1 and 28 days after order, with locations close to CENAME reporting the shortest delivery times.
- Improved commodity quality: CENAME performs quality assurance on every type of medicine, sampling 25% for testing in their quality control lab.
- Improved commodity access: After reform, CENAME increased the number of direct customers as well as increased their distribution network to include more rural areas. Stock-outs also decreased; a small study found that six out of eight of CENAME's sampled customers had less than a 5% stock-out rate, although the remaining two (both general hospitals) had stock-out rates between 20% and 40%.

### To learn more:

- [Applying Market Mechanisms to Central Medical Stores: Experiences from Burkina Faso, Cameroon, Senegal](#)

## Outsourcing Warehouse Functions

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To address limited government capacity to manage warehouses and inadequate warehousing infrastructure

Outsourced warehousing entails engaging a third-party provider to manage the warehousing domain of the supply chain, including maintaining the physical infrastructure of warehouses and performing other essential warehousing functions, such as inventory management, picking and packing, and tracking orders. Often warehousing and distribution are outsourced to the same provider, as is the case example from South Africa below and the Nigeria example in the [Promising Practices in Distribution](#) brief.

Outsourcing warehousing functions to a third party does not eliminate the role of the government but rather shifts the government's role to one of contract management and monitoring the performance of the provider. The government should have capacity to actively manage the relationship with the provider, conduct oversight, hold the provider responsible for meeting key performance indicators and contractual obligations, and ensure timely payments to the provider. [High levels of trust and transparency between the government and the provider are needed in order for outsourcing to work.](#)

### When should outsourcing warehouse functions be considered?

Outsourcing may be an option for governments lacking the physical and technological infrastructure to store stock, track commodities, and maintain cold chain requirements, and/or for governments lacking the expertise, personnel, or capacity to effectively manage warehouses. In addition, governments facing increases in the volume or type of commodities moving through their public health supply chain may use outsourced warehousing as a short-term or long-term solution to expand capacity without increased investment in infrastructure or personnel. In many cases, third party providers have more capacity to provide upfront investments in infrastructure and are willing to do so in return for multi-year contracts that help guarantee return on their investment.

#### To learn more:

- [Emerging Trends in Supply Chain Management: Outsourcing Public Health Logistics in Developing Countries](#)

## SOUTH AFRICA

South Africa's National Department of Health (NDoH) operates the largest ARV treatment program in the world, with more than two million patients on treatment at more than 3,000 public health facilities across the country. In the past, ARV warehousing and distribution were decentralized and managed by provincial depots in each of the nine provinces. The provincial depots would deliver commodities to district stores and facilities in their catchment areas. In 2010, in response to challenges with expired stock, delivery delays, and stock-outs at health facilities, the NDoH applied for and received a grant from the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund) to pilot an outsourcing model through a public-private-partnership.

In this model, ARVs are procured by the NDoH through the Global Fund and are then managed by a private service provider (Imperial) from a central stockholding point called the Domestic Distribution Centre (DDC). From there, commodities are distributed directly to health facilities, with replenishment to provincial depots as needed. IHS was selected to serve as the DDC for a period of two years, starting in 2012, through a competitive tender process. Twenty-six first- and second-line ARVs are now stored at its warehouse in Centurion and are distributed throughout the nine provinces.

In this public-private partnership, the NDoH remains the primary liaison with the facilities receiving stock and all orders are sent through a Central Procurement Unit, which monitors expiries and stock levels. Imperial is responsible for the warehousing and distribution of ARVs and related health commodities. Their duties include:

- Inventory and stock management
- Order and batch order processing
- Batching and repacking
- Tracking and tracing
- Cold chain storage
- Delivery and distribution of commodities to provincial depots and to selected treatment facilities for regular and emergency deliveries

As part of the agreement, Imperial ensures that normal orders are dispatched from the warehouse within three working days and emergency orders are dispatched within 24 hours. In return, NDoH agrees to release payments within 30 days of being invoiced.

To date, the DDC has distributed more than 4.1 million units of ARVs to treatment centers throughout the country, worth more than \$13 million dollars. The DDC is the only consistent source of ARVs for some of health facilities and strives to prevent stock-outs. For example, in July 2013, the DDC went into overtime to pick, pack, and deliver more than 400,000 packs of ARVs within 48 hours to prevent stock-outs at some of the country's largest hospitals.

The success of this public-private partnership is due to a number of factors, including the availability of external funding, the political will of the NDoH to successfully implement the partnership, and the fact that Imperial already had a presence and warehousing infrastructure in South Africa that could be leveraged for the project.

## Conclusion

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The appropriate management of warehousing functions and inventory is a complicated process that includes physical, procedural, financial as well as human resource considerations. As stated earlier in this brief, many resources that describe accepted good practices in warehousing and inventory management already exist. Some examples are:

- [MDS-3: Managing Access to Medicines and Health Technologies. Management Sciences for Health](#)
- [Guidelines for Warehousing Health Commodities](#)

There is inherently much overlap between warehousing and inventory management and distribution. Please see the [Promising Practices in Distribution](#) brief for additional examples of how distribution of products may be improved.

Finally, the importance of adequately trained and motivated staff for optimal warehouse operations cannot be underestimated. Please also see the [Promising Practices for Human Resources](#) brief.

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