Stockout Eliminator: the objectives and design of the eZICS technical solution in Zambia

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Agenda

- Project partners
- Context
- Brief history of eZICS
  - “enhanced Zambian Inventory Control System”
- Solution objectives
- Expected outcomes
- Technical design overview
- Conclusions

eZICS project partners

- Zambian Ministry of Health
- Medical Stores Ltd
- Crown Agents
- World Bank
- Prof. Gallien's Research Group
  - London Business School, MIT, UMichigan
- Pfizer
- IBM

Context

- Mobile telecoms growing dramatically in sub-Saharan Africa
  - Phones and other handheld devices the predominant user interface
- Previous projects have successfully showed this can be harnessed for healthcare supply chains, for example:
  - SMS for Life pilot, Tanzania, and subsequent rollouts
  - RapidSMS-based projects
  - cStock, Malawi
- Ongoing need for Ministries of Health to demonstrate good governance with Donor-funded drugs

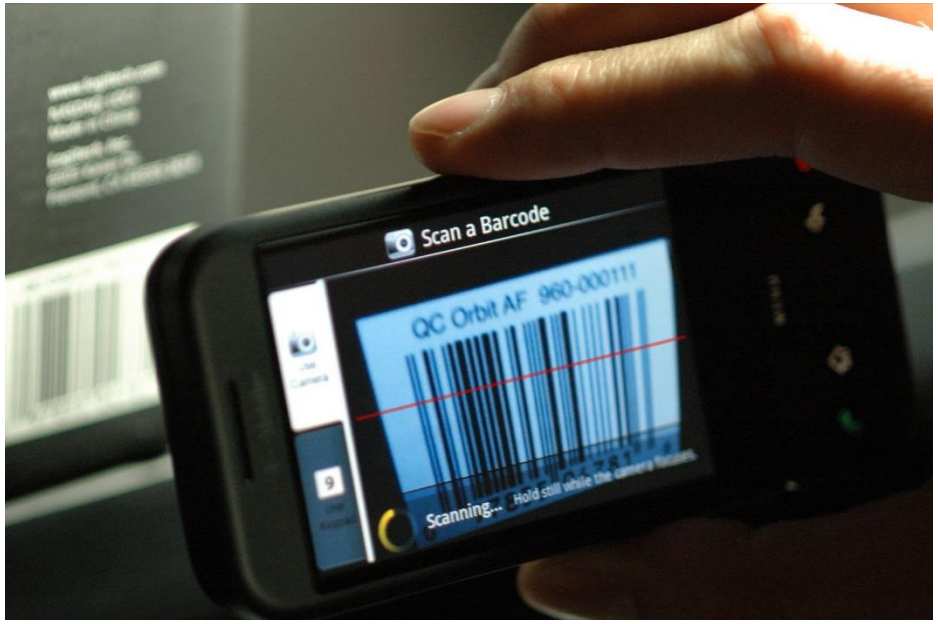
RapidSMS

Brief history

- Prof. Jeremie Gallien has covered the earlier history of the project
- In late 2010 I was asked to engage because of my SMS for Life experience in Tanzania
- The project team held a design workshop in Lusaka and agreed a way forward
- I arranged for IBM to contribute the technical solution
  - Mweene Monze is the technical genius behind it
- We anticipate starting the Zambian pilot soon

Solution objectives

- Improved:
  - Public health through enhanced access to medicines
  - Financial planning and governance through reduction in inventory costs, expired stock and accountability for health products
  - Drug procurement decisions from data-driven forecasts
- By:
  - Providing a means for health facility staff to report drug stock and usage information in real time
  - Using this information plus historical trends and other factors as input to new algorithms[1] which determine the stock reorder quantity for each drug month by month
- Therefore having all drugs always available at every health facility
  - As long as there is sufficient stock in the central stores
  - Otherwise share the stock equitably between health facilities requesting it



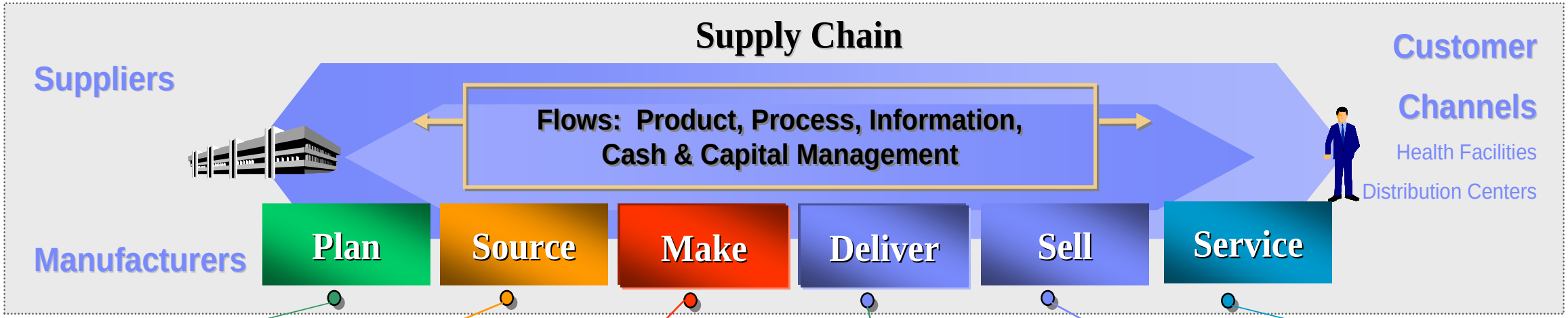
1. Algorithms developed by Prof. Gallien's research group and IBM

Expected outcomes

- Lower warehouse staff workload through automated order entry
  - Also reduced error rate since no manual data entry
- No need for health facility staff to calculate and place orders themselves
  - Also no need for MSL staff to check orders
  - But manual adjustments are permitted when required
- Historical patient demand data becomes visible
  - Opportunity to feed into procurement and budget planning processes
- Real-time visibility of stock availability and transportation data
  - Potential to contribute to logistics performance reporting

Supply chain operational and visibility model

The eZICS operational platform (IBM SCO/P) is built upon the industry standard Supply Chain Operations Reference (SCOR) model (See http://supply-chain.org), which baselines supply chain processes, metrics, resources and best practices.



Synchronizing supply and demand

- Integrating customer forecasts and demand to plan logistics requirements
- Participation in customer's Sales & Operations Planning process

Multi-source orders and fulfillment

- Ability to track purchase orders through their entire lifecycle
- Knowledge of total pipeline supplier inventory

Integration with manufacturer's systems

- Access to order commitments & delivery schedules
- Visibility into order production status

Monitoring shipment status

- Monitor shipment status throughout pipeline with proactive event notification
- Improved ability to identify short and over shipments

Multiple channels / touch points

- Single source dashboard to view overall performance
- Tracking from order to delivery
- Knowledge of total pipeline customer inventory

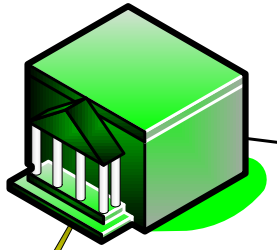
Post Sales Service

- Efficiently process returns
- Manage Spare Parts Inventories
- Visibility to entire reverse logistics processes

Conceptual overview

A simple information gathering, processing and analytics model provides end-to-end visibility of the pharmaceutical supply chain, from suppliers through distribution centres to end-users. The concept was developed collaboratively by the Gallien Research Group and IBM.

Supplier / Manufacturer



HQ

- Governance
- Procurement
- Planning
- Analytics

1

- Receipts
- Storage
- Packing
- Dispatch

2

National DC

Primary Distribution

3

Virtual Private Network (VPN) over WAN/LAN/Web/Mobile Network

- Receipts
- Issues
- Transfers
- Orders
- Audits
- Returns
- Supplementals

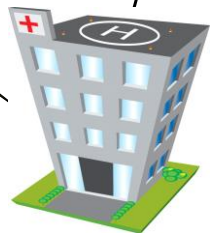
- Receipts
- Storage
- Packing
- Dispatch

4

Regional DC

5

Secondary Distribution



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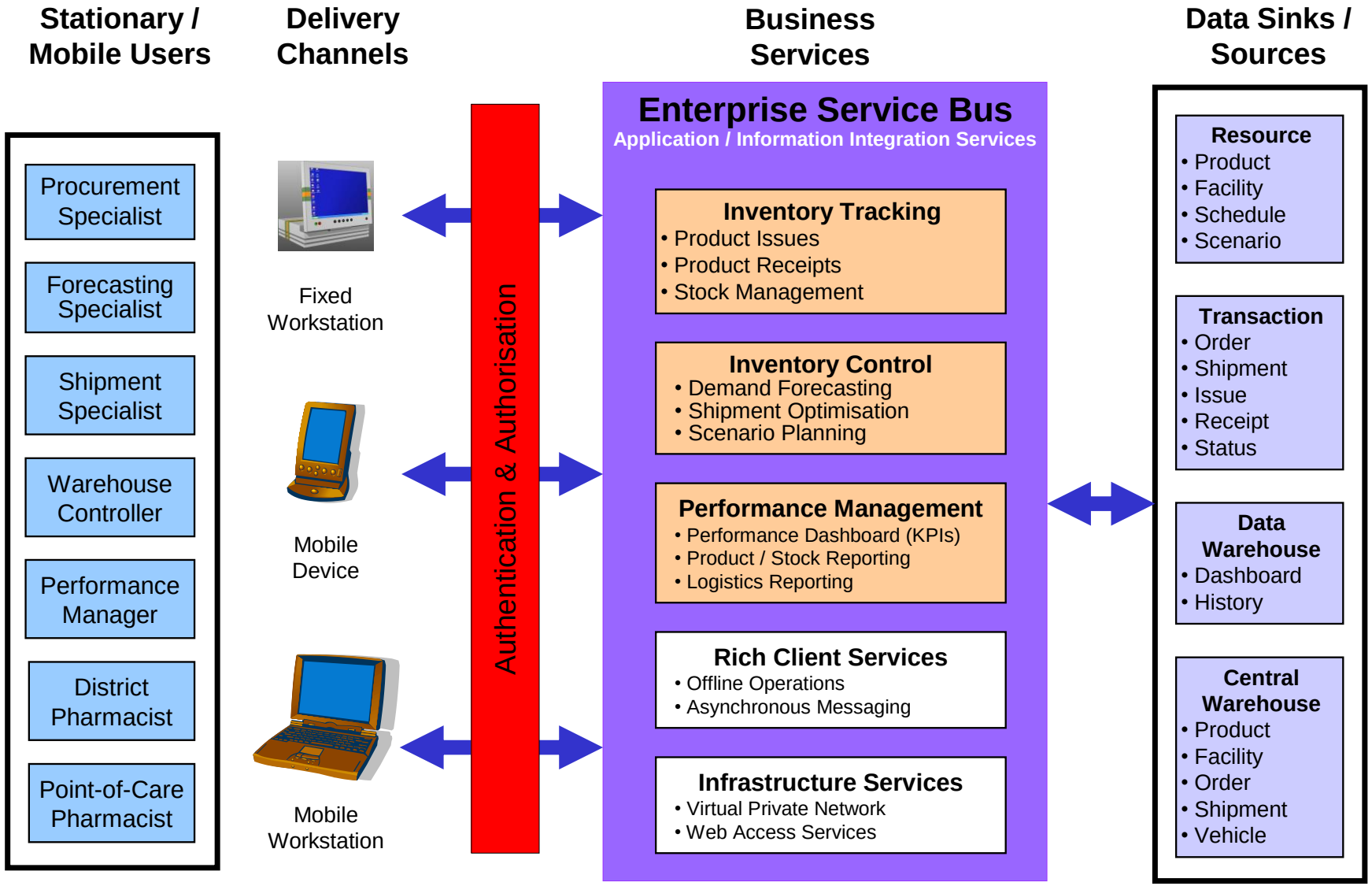
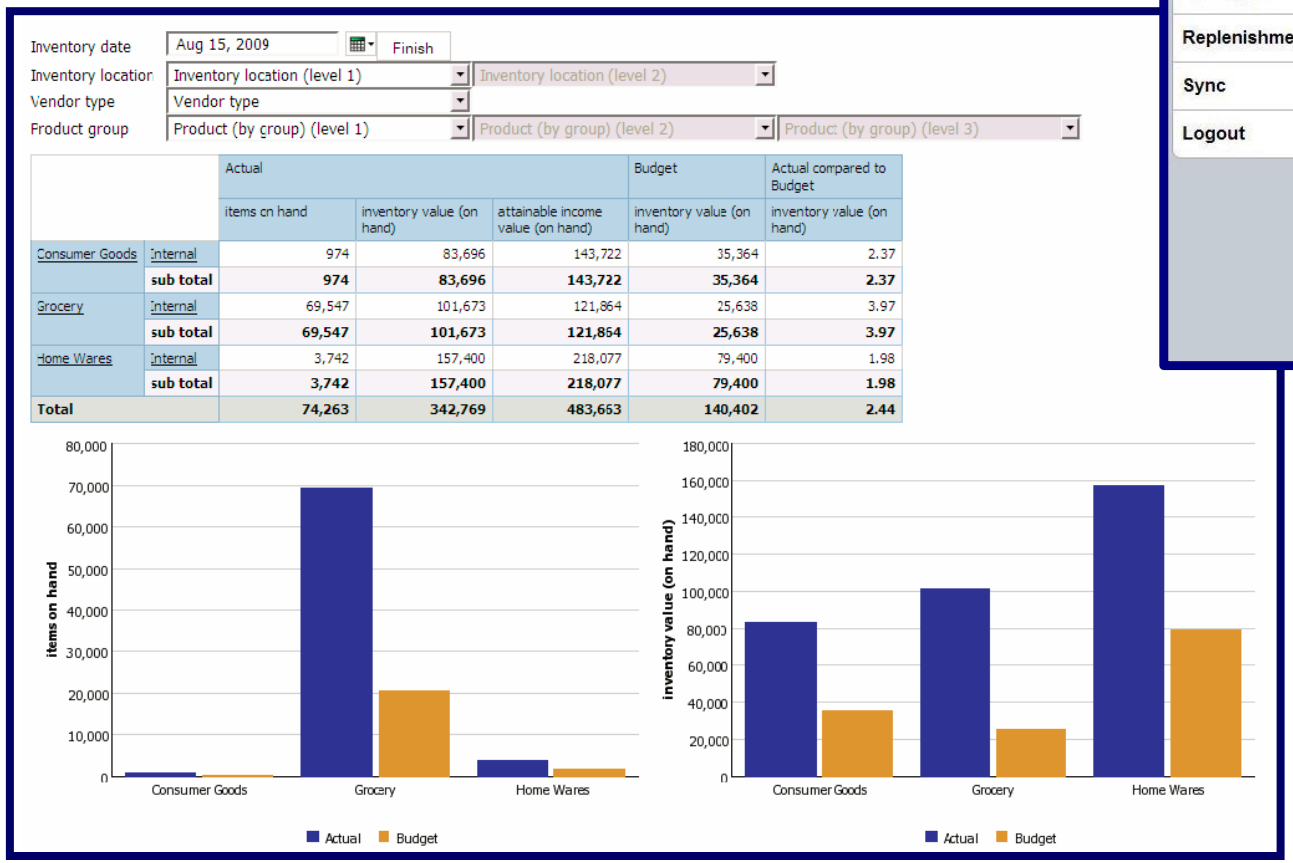
Regional / Local HF

Solution architecture

Implementation of the concept leverages a broad spectrum of world-leading IBM mobility, integration, analytics, forecasting and optimisation technologies to deliver a sophisticated and robust pharmaceutical supply chain operations planning platform.



What does it look like?



Inventory date: Aug 15, 2009 | Finish
Inventory location: Inventory location (level 1) | Inventory location (level 2)
Vendor type: Vendor type
Product group: Product (by group) (level 1) | Product (by group) (level 2) | Product (by group) (level 3)

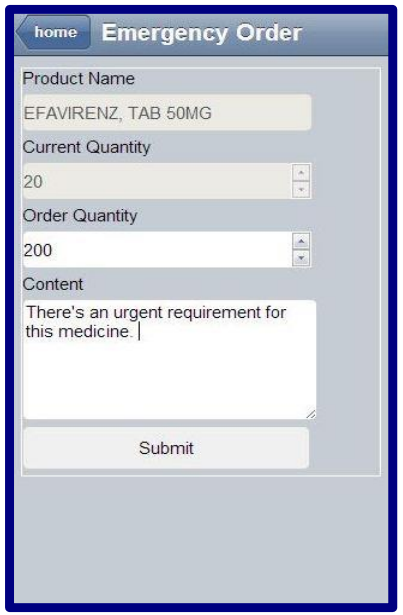
		Actual			Budget	Actual compared to Budget
		items on hand	inventory value (on hand)	attainable income value (on hand)	inventory value (on hand)	inventory value (on hand)
Consumer Goods	Internal	974	83,696	143,722	35,364	2.37
	sub total	**974**	**83,696**	**143,722**	**35,364**	**2.37**
Grocery	Internal	69,547	101,673	121,864	25,638	3.97
	sub total	**69,547**	**101,673**	**121,854**	**25,638**	**3.97**
Home Wares	Internal	3,742	157,400	218,077	79,400	1.98
	sub total	**3,742**	**157,400**	**218,077**	**79,400**	**1.98**
Total		**74,263**	**342,769**	**483,653**	**140,402**	**2.44**

Main Menu

- Receipts
- Issues
- Stock Management
- Messages
- Replenishment Orders
- Sync
- Logout

home — Physical Stock Count

roduct#Id	Product#Name	Stock Count
RV0002	ABACAVIR, TAB 300MG	0
RV0003	DIDANOSINE, TAB 100MG	20
RV0004	EFAVIRENZ, TAB 200MG	20
RV0004	EFAVIRENZ, TAB 200MG	20
RV0006	EFAVIRENZ, TAB 50MG	20
RV0007	EFAVIRENZ, TAB 600MG	0
RV0008	EFAVIRENZ, TAB 600MG	0
RV0009	LAMIVUDINE, SUSP 10MG/ML, 100ML BTL	0
RV0010	LAMIVUDINE, SUSP 10MG/ML, 240ML BTL	120
RV0011	LAMIVUDINE, TAB 150MG	0
RV0012	LAMIVUDINE / STAVUDINE / NEVIRAPINE, TAB 150/30/20	0
RV0013	LAMIVUDINE / STAVUDINE / NEVIRAPINE, TAB 150/40/20	0
RV0014	LAMIVUDINE / STAVUDINE / NEVIRAPINE, TAB 60/12/100	0
RV0015	LAMIVUDINE / STAVUDINE / NEVIRAPINE, TAB 30/6/50MG	0
RV0016	LAMIVUDINE / ZIDOVUDINE, TAB 150/300MG	0
RV0017	LOPINAVIR / RITONAVIR (KALETRA), CAP 200/50MG	0
RV0018	LOPINAVIR / RITONAVIR (KALETRA), CAP 200/50MG	0
HT0005	NYLON 7/0 RB	0
RV0019	LOPINAVIR / RITONAVIR (KALETRA), CAP 133.3/33.3MG	0
RV0020	LOPINAVIR / RITONAVIR (KALETRA), SUSP 80MG/ML & 20	0



home — Emergency Order

Product Name: EFAVIRENZ, TAB 50MG
Current Quantity: 20
Order Quantity: 200
Content: There's an urgent requirement for this medicine.
Submit

Solution brief (for more information)

Supply Chain Optimisation for Pharmaceuticals

IBM Smarter Healthcare Business Solution Brief

Minimise stock-outs and significantly improve your pharmaceutical supply chain through advanced optimisation analytics and comprehensive, real-time visibility of supply chain performance.

Business Challenge

Health Ministries across Africa and the developing world share the same challenge of getting the right drugs to the right people at the right time. Hard-working hospital and health facility staff do their best to place appropriate reorder requests, but we all know from experience that drugs will be out of stock at any health facility at any point in time. Hard evidence from various studies confirms this reality and the findings also suggest that stock-out elimination has probably become the number one goal across the pharmaceutical supply chains of the developing world [1], [2], [3], [4].

What do stock-outs mean to the Ministries and their served communities? For patients, it means accepting an alternative, or sacrificing income to purchase the drug, or otherwise undertaking a long trek to get service at another facility. For the community, this all-to-common scenario often sends the subliminal message that it is not worth going to the health facility any more because it doesn't stock the right drugs. The unfortunate outcome is that this could mean a longer illness – and in extreme cases, it could ultimately lead to death.

FIGURE 1 SUPPLY CHAIN VISIBILITY MODEL

Stock-outs can be attributed to multiple factors which negatively impact the operational effectiveness of our pharmaceutical supply chains. Consider the model in FIGURE 1 where products, processes and information move between supply sources, through production and throughout the pipeline to delivery and post-sales service. Minimising stock outs requires an understanding of questions that arise in each functional area, such as:

- *Planning*: What are the current stock levels and historical and future (projected) product demand at each distribution or health facility?
- *Sourcing*: How much of each product needs to be procured, and when, so that inventory stock-outs, expirations and holding costs are minimised ?
- *Delivery*: How can excessive transportation expenditure on expedited shipments and transfers be reduced across multi-tiered distribution networks with seasonally variable lead times ?

Conclusions

- The eZICS technical solution meets genuine validated requirements in innovative ways
- It improves the ordering process without requiring changes to warehouse management or distribution
- It is ready to pilot in Zambia
- It is available to customise and deploy elsewhere

Thank you!

Peter Ward

Mweene Monze

Backup slides

Distribution challenges

- Accessibility of essential drugs at the health facility level remains a bottleneck to health service delivery in Zambia, where health facilities face difficulties in accessing drugs in appropriate quantities because of inadequate drug distribution capabilities.
- The key distribution challenges include:
  - *Demand forecasting*: Reliance on simple monthly consumption averages as a predictors of future demand.
  - *Delivery lead time forecasting*: Failure to anticipate predictable changes in delivery lead-times, for example for health facilities that are cut-off by flooding during the rainy season.
  - *Allocation of scarce stock*: Adhoc and sometimes irrational allocation of stock across health facilities when inventory on hand is not sufficient to cover all requirements.
  - *Demographic variations*: Factors such as age, education, mortality rate, gender and employment distributions need to be considered since they impact the forecast and vary greatly across health facilities.
  - *Disease incidence*: The forecast is influenced by the frequency and severity of specific illnesses which vary during the year as seasons change.
  - *Procurement pipeline*: Due to disparate sources of funding, procurement cycles are largely unpredictable.
- The current manual drug distribution system determines demand forecasts and shipment schedules without adequately accounting for all these factors.
- A major consequence of these shortcomings is avoidable deaths due to downstream drug stock-out situations which can last over multiple months, as well as wastage due to over-supply of drugs to health facilities that do not need them in such quantities.

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eZICS goals

- The goal of the eZICS project is the development and pilot testing of a rational, sustainable, transparent and scalable supply chain management system that will improve access to essential drugs at the point of service delivery. Key objectives include:
  - *Sustainability and country-ownership*: the development, operation and maintenance of this system should involve the reliance on, and/or development of, local technical knowledge and expertise.
  - *Fairness and rationality*: shipments to health centers should be determined according to a scientific method which minimizes country-wide unmet drug needs of patients at all times and under all scenarios of inventory availability, storage capacity and all other relevant practical constraints while ensuring higher equity across different health facilities and regions.
  - *Transparency*: the system should support the collection and monitoring of all critical performance data such as unmet demand/service level and drug expiry on a continuous basis as part of regular operations, make that data available to selected key stakeholders, and also support accurate tracking of public assets.
  - *Knowledge sharing*: any knowledge generated as part of this initiative that is of potential value to other health systems and countries should be publicly disseminated.
- The current manual drug distribution system determines demand forecasts and shipment schedules without adequately accounting for all these factors.
- A major consequence of this shortcoming is avoidable deaths due to downstream drug stock-out situations which sometimes last over multiple months.

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Solution architecture

- The eZICS solution delivers IBM mobile, integration, analytics, forecasting and optimisation capabilities in a package that is designed to be rapidly deployed and cost-effectively supported in Zambia and other countries in Africa.
- The solution architecture consists of these core functional components:
  - *Demand Forecasting*: SPSS Statistics and SPSS Forecasting are used to generate sophisticated drug demand forecasts that take into account forecast complicating factors like lead time, seasonal and demographic variances.
  - *Shipment Optimisation*: This function exploits ILOG Optimisation Decision Manager Enterprise (ODME) which supports scenario comparison to enable informed trade-offs between alternative solutions and conflicting goals. ODME embeds sophisticated optimization engines that are used to create the optimised shipment schedules for the eZICS distribution scenarios.
  - *Mobility*: IBM Worklight serves as the host platform for the custom-built eZICS inventory management application, and its mobile device management functions are used to support over-the-air distribution of applications, data and configurations.
  - *Integration*: WebSphere Message Broker (ESB) and WebSphere MQ (connectivity) provide the application and data integration capabilities for all the system components, including the existing warehouse control system. WebSphere MQ Telemetry Transfer provides a reliable, efficient publish-subscribe messaging channel for the thousands of connected mobile devices.
  - *Data Warehouse*: The warehousing function leverages the InfoSphere Warehouse Pack for Supply Chain Insight whose components include a physical data model and sample data mart structures built on DB2 and InfoSphere Data Warehouse.
  - *Business Analytics*: Reporting and analytics also leverages sample Cognos BI reports that are packaged with InfoSphere Warehouse Pack for Supply Chain Insight.
- Custom data synchronisation have been developed to support offline operations at remote health facilities that are not connected to the mobile grid; these capabilities support local offline capture of inventory transactions, for subsequent synchronisation to the data centre at HQ via surrogate mobile devices.
- A custom Java component has also been developed to generate the lead time forecasts in a suitable format for the shipment optimisation algorithm.

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MSL - Zambia's central medical stores

- Created in 1976
- Semi-autonomous Parastatal
- Mandated to store and distribute medicines, medical supplies & health equipment
- Shareholders MoFNP & MoH
- MSL regulated by the PRA
- Upholds good warehousing and distribution practices

- 1998 – Outsourced as a management lease contract
- 2004 – Management contract awarded to Crown Agents
- Now effectively a PPP offering services to both public and private sectors

Challenges faced

- Political challenges – many stakeholders
- Culture shift – perceived loss of control, “District Approval”
- Piloting – necessity & difficulty of stock pots
- M&E – whole sub-project to ensure benefits/effects are measured
- Complexity beyond the basic functionality – substitutions, pack sizes, etc
- Roll-out challenges – mobile devices to 2000 locations
- Training
- Mobile devices - loss/damage/replacement
- Dealing with no signal – standard operating procedures

Lessons learned

- Clear business case
- Early stakeholder Buy-in at all levels
- Map all processes
- Spend time on exceptions (not just standard flows)
- Clearly define requirements
- Fully evaluate hardware, devices, OS options – Total Cost of Lifetime Ownership, familiarity, supportability locally
- Fully plan and budget for M&E, roll-out, and all other associated activities, not just development and implementation
- Cost the system for full roll-out in advance of commitment to pilot
- Include maintenance (software, hardware and mobile devices)
- Define standard operating procedures with new system