Supply Chain Analysis for Nepal

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Executive Summary

Background

Since 1994, with the support of USAID|DELIVER Project, the Government of Nepal's (GoN) Ministry of Health (MoH) has implemented the use of a logistics management information system (LMIS). Additionally, Nepal rolled out a web-based electronic LMIS (eLMIS) in 2008.

While coverage and use of the tools is available down to the District level, challenges still remain in reaching the facilities at the health post and primary health care centers. This gap / transition from paper to electronic creates high degrees of uncertainty in the supply chain with downstream issues in wastage, transparency – and ultimately, negatively affecting the efforts to provide health services for the people of Nepal.

The eLMIS was cutting edge in its infancy, but time has moved on, and this represents both a challenge and opportunity to upgrade and optimize in order to take advantage of advances in technology. Additionally, there is increased interest in how to better leverage data analytics and transparency so that decision makers are empowered and equipped to make sound forecasting decisions.

The approach for the analysis is to move through four phases:

1. Gather Data
2. Assess Current State
3. Establish Desired Future and Gap Analysis
4. Develop Action Plan

The focus of the effort is in on what will make the next generation of tools and processes for Nepal successful and sustainable. This report covers through Phase 3.

Key Findings

Several pain points in the supply chain emerged from the gather and analysis phases. Of these, the following four are the most pressing:

1. Level of skill and knowledge of logistics and supply chain functions at the District level creates a functional breakdown in the overall supply chain.
2. The time lag from data collection to analysis leads to increased inaccuracy in forecasts, and the inability to understand demand / stock levels in-country.
3. Highly manual processes create an error-prone and difficult system for the current staffing levels to maintain.
4. Lack of visibility into the procurement process creates uncertainty and lack of alignment.

It is important to note that no technology will help the supply chain of Nepal while procurement remains stalled. The lack of commodities being procured has created a series of unintended consequences, not the least of which is that it is pushing the system to devolution (shift from centralized procurement to decentralized) without the necessary controls in place. Many individuals have been finding ways to procure locally from other sources but these are not available in sufficient quantities to cover the need. It also has the impact of individuals keeping multiple tracking mechanisms depending on the source of the commodity. This confusion will only make it more difficult for **Logistics Management Division** (**LMD)** to effectively understand and quantify demand well enough to provide the necessary supplies in the future.

In logistics, there is a debate on methodology for "Push" vs. "Pull." A Push-based system requires sufficient understanding of future demand in order to purchase large volumes of commodities on schedule and move them into position as needed. A Pull-based system requires high degrees of operation trust and responsiveness to requests. Currently, Nepal has neither the sufficient data to understand demand to place orders with confidence and, with the limited commodities in place and a sense that none are coming, storekeepers are trying to protect what stock they have.

These factors have combined to collapse the functioning of the Pull based supply chain and decision making processes have shifted to Risk Based decision making in efforts to buffer against strategic uncertainty with an effective lack of operational trust between parties.

Opportunity

We believe that by simplifying the experience for the District storekeepers, automating the electronic data capture of the supply chain transactions in the distribution network to create near real-time visibility into demand, and creating transparency into the procurement tender process, that Nepal will experience a fundamental improvement in health outcomes throughout the country.

Of the products evaluated, the top four for consideration are shown below. These products represent the best for the combination of capabilities and that have a clear path towards sustainability. Each product has strengths and weaknesses that will need to be considered as a set of tradeoffs for final selection and any one of them will be fully capable of improving the management of the supply chain.

These are in fundamentally two different categories: **Speed & Ease** & **Integrated Features.**

Top 4 Products

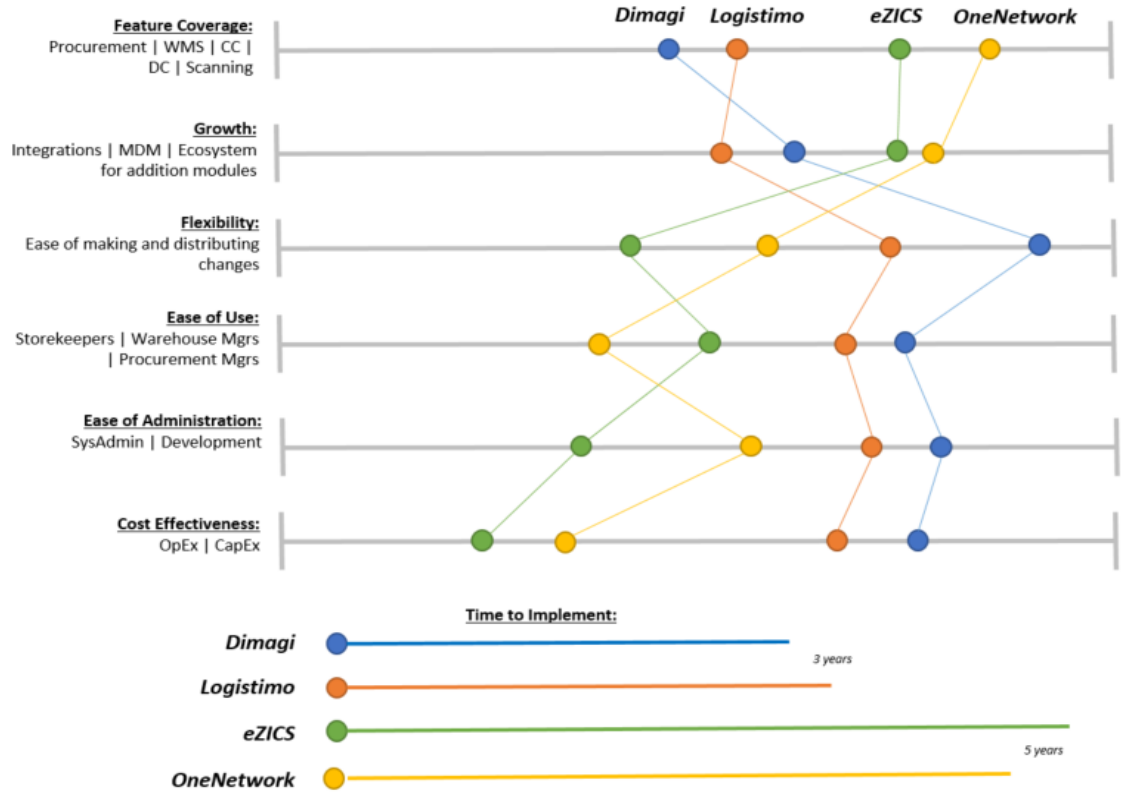


Figure 1 – Top 4 Products

Speed & Ease - Dimagi and Logistimo:

Simple to use, simple to maintain, fast to implement, fast to change, but lacking in an integrated environment with procurement functions, and lighter on warehouse management.

Integrated Features – eZICS and OneNetwork:

Full featured, commercial grade systems able to manage integrated workflows between procurement and warehouse logistics. Much more expensive in both CapEx and OpEx costs. Additional risk in working with the Vedic and Fiscal Calendars in use for Nepal which will require more development time when considering ERP functionality.

Top 4 Tradeoffs

SPEED & EASE		INTEGRATED FEATURES	
DIMAGI	LOGISTIMO	eZICS	ONENETWORK
The optimal scenario for Dimagi is one where the Ministry of Health wishes to capitalize on having a **common mobile data capture** platform enabling each program to leverage and maximize on common integrations. The core focus is creating visibility in the **distribution chain**. Of all the systems, this one is the easiest to maintain providing the **lowest OpEx** cost. It also is already being leveraged successfully in multiple instances in Nepal and would be fastest product to deploy. The key tradeoff is that the procurement / tender processes must be handled **separately**.	The optimal scenario for Logistimo is one where LMD wished to make the system available to the **widest range** of users and mobile platforms. The core focus is on the **distribution chain** with more extensive abilities for warehouse management, distribution routing, and reporting than Dimagi. This has a slightly higher OpEx cost than Dimagi while still being very flexible and easily maintainable. The key tradeoff is that the procurement / tender processes must be handled **separately**.	The optimal scenario for eZICS is one where LMD wished to have an integrated and **fully managed lifecycle with a simplified** end-user experience. The core focus moves beyond the distribution chain and **connects the procurement cycle directly** with the distribution chain. It adds more sophisticated rules management for shipping and ordering. The key tradeoff is the capital costs and the complexity of the backend that will require **professional assistance outside of the GoN** to keep operational. To achieve the integrated environment, the Vedic / Fiscal Calendar used by GoN will need to be tackled and this is **not to be underestimated**.	The optimal scenario for OneNetwork is one where LMD wished to have an integrated and **fully managed lifecycle** with a simplified **backend** / administrative experience. The core focus on the integrated experience connects the distribution chain with the procurement cycle directly. With the **SaaS** offering, the systems administration is also simplified. The key tradeoff is that the licensing model is potentially risky and the **product is designed for good bandwidth** conditions that could prove to be fundamentally unattainable for Nepal over the course of the next five years. To achieve the integrated environment, the Vedic / Fiscal Calendar used by GoN will need to be tackled and this is **not to be underestimated.**

Baseline and Assessment of Current State

A series of workshops and interviews were conducted to gather a sense of the current condition of the supply chain. We followed the flow of product from the point of consideration at the External Development Partner (EDP) level, through the central warehouses, to the buffer and safety stock of the regionals, down to the District and out to the health posts. These interviews were structured to pull forward the current condition of stock and the processes used to assess, report, and request commodities.

Figure 2 – LMD Slogan

When logistics are working well it is an invisible service. We never know about the number of people, processes, and effort that went into getting the right product in the right place at the right time. We only hear about logistics when they aren't working. Nepal was once considered a success story in the supply chain context. However, no supply chain can absorb the series of blows that Nepal has experienced over the last four years and remain at the same level of effectiveness. Perhaps most critical is the erosion of skills and knowledge necessary due to the rapid staff rotation at the District level, which makes it very challenging to keep the system functional. The constant flow of new storekeepers rotating into this critical position with a minimal background in public health and/or logistics has slowly worn away this once effective supply chain.

Each tier of the supply chain is performing limited, and often repetitive, data analytics and data entry. In the locations that have the eLMIS application deployed, the typical workflow is to record the data in the system, print it out, and route it to the next tier where it will go through manual data analytics and finally be re-entered at the central tier.

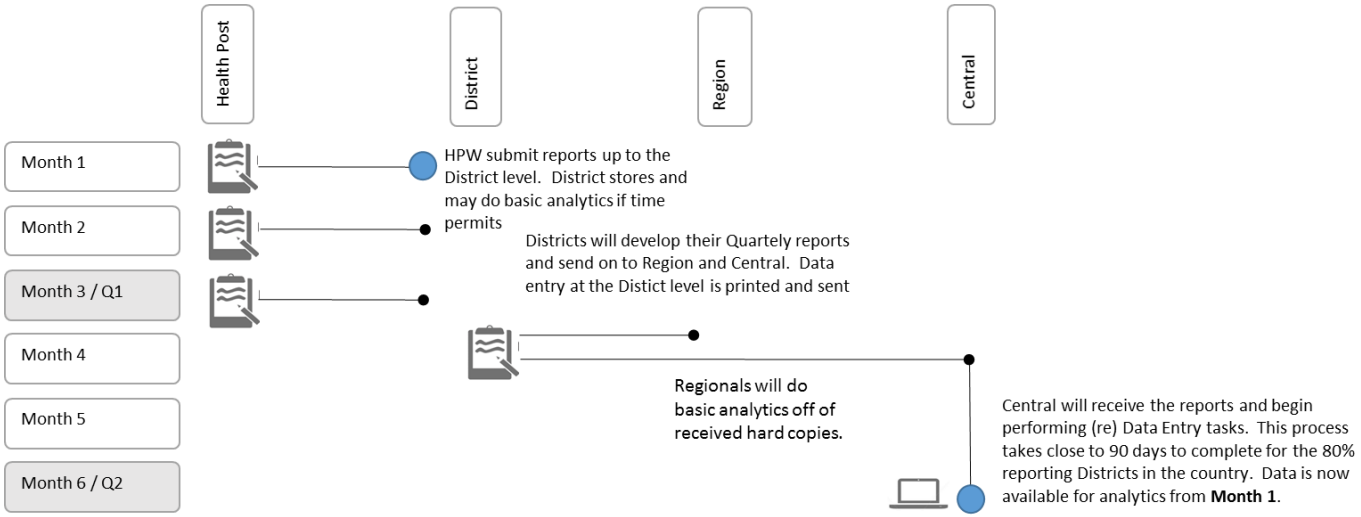


Figure 3 – Time Lag on Data Collection to Analysis

This current process places a heavy burden on staff for the time spent repeating tasks and is failing to effectively leverage the opportunity that technology can provide.

Ultimately, the time delay in analytics means that the ability to detect, respond, and deliver before a problem becomes a stock-outage is extremely challenging for LMD to achieve. This fundamentally limits the health outcomes that can be achieved by the programs.

Supply "Cycle" Pain Points

One way of looking at the supply chain is through the lens of a feedback loop. This graphic highlights how a delay or small error compounds each time through the cycle to create larger and larger variations over time as subsequent decisions are based on late or inaccurate data.

Currently, the single greatest challenge in the supply chain is the time gap in data collection and the level of inaccuracy of the data itself. Each tier of the supply chain is operating with a different cadence for data collection and analysis. Effectively, each tier's perspective on the amount of stock and condition of demand is irreconcilable with the other tiers.

The data collected is focused on reporting the current stock status. The order->issue->receive cycle is stored solely in paper form, and not in electronic format, due to the level of effort for data entry; therefore, no electronic tracking and analysis of the distribution network was possible. This lack of analysis also makes it near impossible to track wastage/loss, optimize routes for better cost management, or balance stock at selected buffer points to prevent stock-outs with existing supplies.

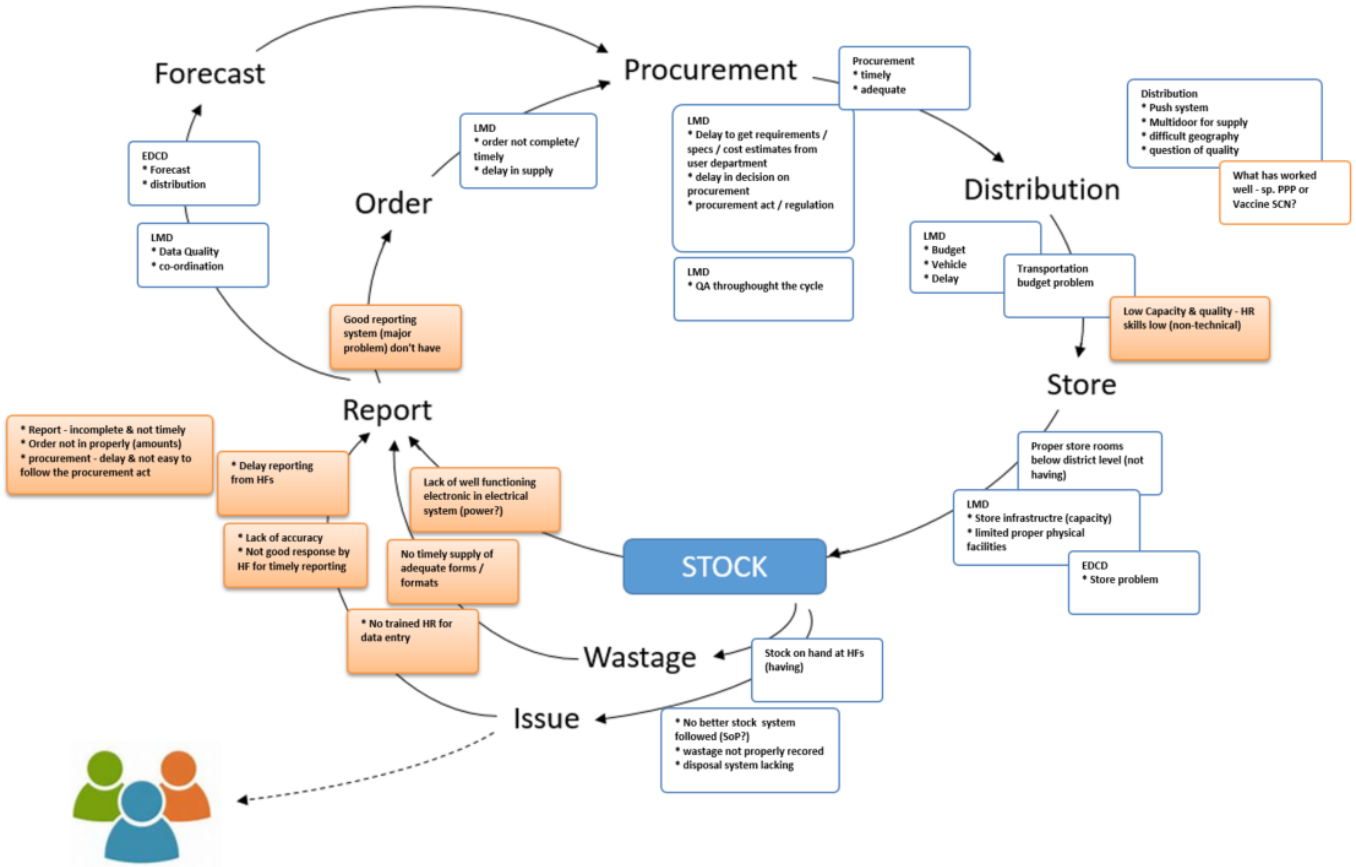


Figure 4 – Supply Cycle Pain Points

In general, the level of technology usage and care is relatively low. Integrations between systems are most typically manual, and the ability to support cross-division reporting (i.e., matching number of patient visits to stock level) is not possible in the current environment. Further, core equipment such as servers frequently sit in offices on desktops, exposed to dust and heat. It is unknown what level of administration is happening with this equipment (i.e., backups, security, patches, protection from dust, and power surges).

Distribution Tiers

Nepal's supply chain organizes along four tiers and three geographical categories (M – mountains, H – hills, T – plains). Mountain and hill regions have a significantly greater distribution lead times and greater buffer stock to account for this. Plains have greater populations and flow of product, but tend to have smaller warehouses and rely on new deliveries at more regular rate.

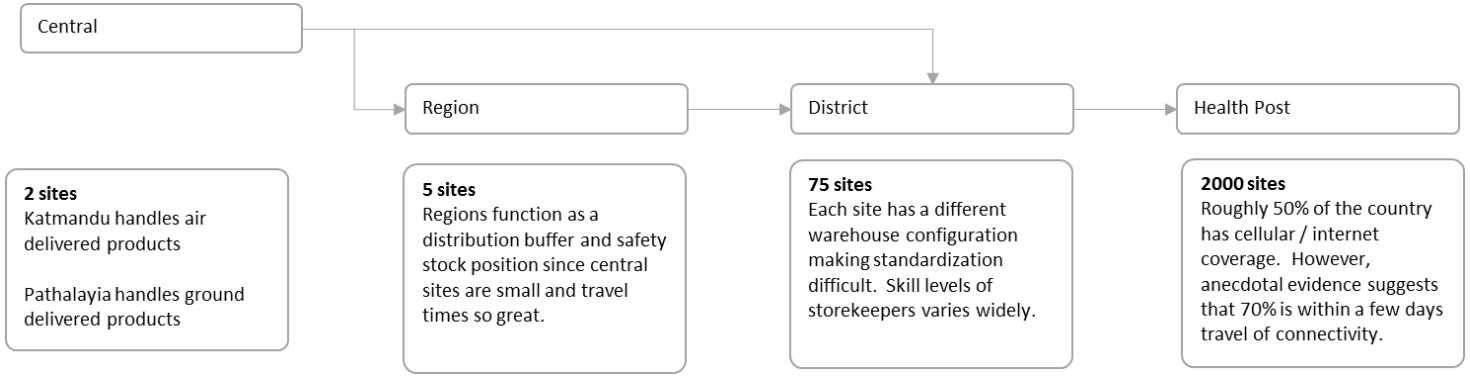


Figure 5 – Distribution Tiers

Physical storage space at each tier's warehouse is limited and is a concern for the ability to effectively hold the volume of essential commodities, particularly with the recent expansion to 107, and to meet the desired safety stock levels, accounting for distribution lead times. If fewer stock-outs are to be avoided, then an increase in the frequency of distribution routes will likely be necessary.

	Total Warehouse Count	Total Size sq.ft.	Total Pop. 2011	Mountain			Hills			Plains		
				Warehouse Count	Size sq.ft.	Pop. 2011	Warehouse Count	Size sq.ft.	Pop. 2011	Warehouse Count	Size sq.ft.	Pop. 2011
Central												
Central	2	3,000					1	1,500		1	1,500	
Regional												
Central	1	-	7,912,745							1	-	7,912,745
Eastern	1	-	5,811,555							1	-	5,811,555
Far West	1	-	2,552,517							1	-	2,552,517
Mid West	1	-	3,546,682							1	-	3,546,682
West	1	-	4,926,765							1	-	4,926,765
District												
Central	18	21,500	7,912,745	3	3,000	517,655	8	6,000	2,687,573	7	12,500	4,707,517
Eastern	16	11,000	5,811,555	3	2,500	392,089	8	5,500	1,601,347	5	3,000	3,818,119
Far West	9	7,000	2,552,517	3	-	463,345	4	4,000	862,215	2	3,000	1,226,957
Mid West	15	15,000	3,546,682	5	1,500	388,713	7	9,000	1,687,497	3	4,500	1,470,472
West	16	15,000	4,926,765	2	-	19,990	11	12,000	2,811,135	3	3,000	2,095,640
Grand Total	**81**	**72,500**		**16**	**7,000**		**39**	**38,000**		**26**	**27,500**	

** 29 warehouses do not have size estimates*

*** Population data based of 2011 census infromation from wolfram*

Figure 6 – Warehouse Size vs. Population

Both power and internet connectivity (although limited) are available down to the District level. Any technology implemented will need to be designed to work in high latency with frequent outages. Power management is also a consideration where having sufficient voltage to handle multiples pieces of electronics (i.e. printers) can also be severely a limiting factor.

Central

Technology in Use (LMD)

Network / Power: good
Client: mixture of laptops and desktops running windows; everybody we connected with at the central level had smartphones.

eLMIS (USAID / legacy version); focused on data entry tasks from health posts, districts and regions
IMS (UNICEF / web version); focused on cold chain management, however possible, to handle dry store commodities

Core Challenges

- **Data entry is slow and error prone**
  Each quarter, the districts submit their status reports in paper format. In districts that have the eLMIS, they reprint these forms and then send them in (frequently via mail to support physical signatures). A team of three people then re-enters the data electronically into the eLMIS system.

  Figure 8 – Data Entry Form (printed)

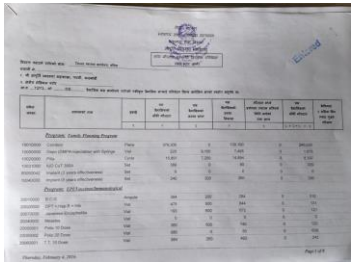


  Figure 7 – Kanban Board for Tracking Data Entry by District

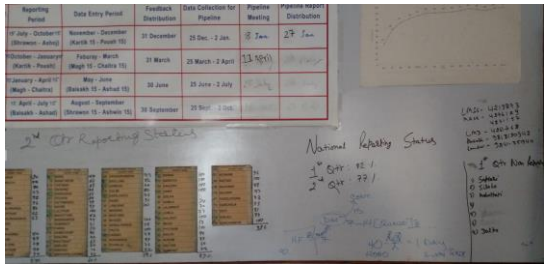
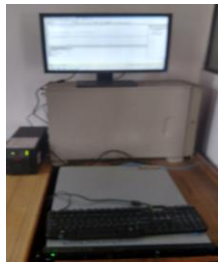


  Figure 9 – Data Entry 1 quarter, Takes 3 Months to Perform

  This process takes roughly three months to complete for 80% reporting rate if there are no delays in receiving reports, errors, or staffing shortages. The advantage of the existing eLMIS system is that at the District level it performs checks on numbers to ensure that simple mistakes are prevented and that the printouts are cleaner and much easier to read for data re-entry at central. If errors are discovered the central team calls the source district to attempt to reconcile the issue. However, this is now frequently as much as four to six months out from the time that the mistake was made to the time it was discovered.

- **Trust issues with the data**
  It is important to note that the District-level data and web-based views into the system are separate from the Health Post reported data. The analysis done on the data collected from the lmis.dohslmd.gov.np and hflmis.dohslmd.gov.np for the Bardia District showed data quality problems in classification and product IDs. Part of this may stem from the challenge that distributing updates requires that it be handled manually by Lifeline. Regardless, comparing the two systems to attempt to derive the flow of commodities becomes a time-consuming manual process.

  Figure 10 – eLMIS Server



  There is no management or data quality reporting interface for the team performing the data entry. The server is placed in their work area and the Manager will run custom SQL statements to perform his checks.

- **No Integrations with HMIS / District Health Information Software (DHIS2)/etc.**
  The ability to do higher level analytics that combine the various data sources available to the MoH is currently not easily possible without help with generating custom reports on a regular basis.

- **Physical security / fire**
  Physical security and monitoring is insufficient, particularly at the Pathalaiya location. There is nothing to monitor conditions after hours or on weekends and one of the warehouses was lost to a fire earlier this year. These warehouses are a significant financial investment in both the facility and in the commodities that they store and need additional controls in place to protect that level of investment.

- **Physical space to store 107 essential commodities insufficient**
  With the combination of expanding the essential commodities to 107 and the loss of a warehouse at Pathalaiya it becomes apparent that there is insufficient room to physically hold all of the commodities and maintain the safety / buffer stock at the desired levels.

- **Commercial Trucking forcing a "push" condition**
  The Central and Regional levels use commercial trucking for their distribution mechanism. These trucks require a full load. This creates a delay in the desired pull-based supply chain as partial orders must be queued to achieve the correct balance of commodities to fill a truck. The warehouse staff "calculates" warehouse capacity and orders as a function of how many trucks can be filled.

  Route planning for a distribution run is done manually. There is also a frequent issue of whose role it is (the commercial trucking or the recipients) to unload the truck. Additionally, one of the challenges is in being able to track / audit transactions on what was ordered, issued, and received. Since only the issued is tracked electronically, auditing for wastage / loss in transit is a near impossible task and can be easily abused.

- **Operational Budget**
  With the addition of cold chain at Pathalaiya, budget to cover the increase in electricity and resources to keep the general facility upkeep was insufficient.

Figure 11 - Pathalaiya - Remains of Warehouse Post Fire

Figure 12 - Commercial Trucking Forces Batches for Distribution from Central and Regional

Data / Technology readiness	Lifeline provides custom reports and data analytics for LMD on a regular basis. The existing websites for eLMIS appear to be only lightly used. The need for reports is driven largely by the budget and forecasting cycle. Due to the highly distributed nature of the data and the time lags involved external assistance is critical for being able to normalize the data into formats that can be leveraged by decisions makers inside of LMD. Also, with the multiple systems and processes to be maintained between the manual / paper-based, the older eLMIS, and the new IMS system in pilot for handling cold chain is creating unnecessary overhead on limited staff resources. It is important that the next generation of tools ease the reporting / recording burden.

Regional

Technology in Use (LMD)	• **Network / Power: good** Client: Mixture of laptops and desktops running Windows; everybody we connected with at the regional level had smartphones with a few feature phones. Feature phones typically followed generational age. Technology use: Minimal.
Core Challenges	• **Data entry is slow and error prone** The Regional tier receives paper copies of the stock status reports that are also sent to the Central tier for data entry and analytics. The team here also compiles high level stock status numbers manually. • **Commercial trucking forcing a "push" condition** Same conditions as at Central – lacking the shipping data to be able to quantify impacts of increased flow. • **Physical space to store 107 essential commodities insufficient** Same conditions as at Central. • **Lack of structured input for forecasting / demand management** The Regional warehouses don't currently have much input into the annual quantification and forecasting process, making what insights they have in cycle of demand and challenges unable to be accounted for in planning. **Figure 13 - Regional Stock Tracking board – manually calculated**
Data / Technology readiness	Interest level and readiness is high. Electronic signature will be a point for the auditors. The current system requires the signature to be tracked on paper forms that are collected and stored for tracking. Also, with the multiple systems and processes to be maintained between the manual / paper-based, the older eLMIS, and the new IMS system in pilot for handling cold chain is creating unnecessary overhead on limited staff resources. It is important that the next generation of tools ease the reporting / recording burden.

District

Technology in Use (LMD)	Network / Power: acceptable for low bandwidth considerations Client: Mixture of laptops and desktops running Windows; everybody we connected with at the District level had smartphones with a few feature phones. Feature phones typically followed generational age. eLMIS (USAID / legacy version); focused on data entry tasks from Health Posts, Districts and Regions.
Core Challenges	• **Staff rotation of storekeepers** In theory, the storekeepers rotate their position roughly every two years. This creates a training and effectiveness challenge as these individuals rarely have a background in either public health or logistics. • **Warehouse management discipline breaking down** While new storekeepers are receiving training in Pull methodology, they do not appear to be getting training in basic warehouse management. Additionally, while there is a defined process for running auctions to help clean / maintain warehouses of older and defunct equipment, it appears that few of the newer storekeepers knew the process. This combination slowly erodes the effectiveness of the supply chain at the District level. • **Data entry time is too high and frequently used for HMIS/DHIS instead** While the desktop version at this tier works well for offline conditions, the principle use is to store the data, print out the final versions for signature, and then route those versions up to the Regional and Central levels for manual re-entry. While it is less error prone than purely paper-based, the multiple re-entry of data creates both a cost and time penalty to LMD effectiveness as a whole. The challenge of keeping the system up-to-date with commodity definitions is also difficult. Staff are frequently pulled to do data entry for the HMIS tracking as well. Changes to the commodities (new vendors, new products, etc.) have to be distributed to the computers manually. This can take substantial time to achieve and results in creating misclassification of new deliveries if they are not present in the system. There is a general sense of disbelief that the data reported is being used in any meaningful way. There are few incentives to report data in a timely and accurate way and the systems are difficult to use. • **Physical space to store 107 essential commodities insufficient** Storage of commodities is generally poor and frequently pressed into rooms or hallways were the commodities are damaged and lost. This also makes creating simple visual control systems to help the store keeper track current levels of product nearly impossible.
Data / Technology readiness	The readiness at this level varies widely. The District Public Health Officers (DPHOs) that were interviewed had a high degree of interest in better reports, but would need to have staff to help develop these with their input. Electronic signature or approval will be a challenge at this level as changing the DPHOs' schedule to stop and read email or sign a document on their smartphone would be very disruptive without additional incentives. The storekeeper role is very technology-challenged as well. Given that the rate of turnover is unlikely to change, the most appropriate strategy is to focus on simplifying systems and processes for these individuals to best set them up for success.

Figure 14 - Warehouse Sample

Health Post

Technology in Use (LMD)	Network / Power: Limited to no network connectivity and power frequently disrupted or provided via solar Client: Laptops. Workers all had personal cell phone with feature phones vs. smartphones typically following generational age lines. eLMIS (USAID / legacy version); focused on data entry tasks from Health Posts
Core Challenges	• **Last mile conditions** Distribution network and delays create challenges across Nepal, forcing buffer stocks to be maintained as close to the health service as possible, creating a fundamental challenge to the desired Pull methodology. • **Frequent stock-outs / Multiple books** As the rate of stock-outs of essential commodities has increased, the more innovative Health Posts have been working with the Health Facility Operation and Management Committees (HFOMCs) to purchase needed commodities. This has the unfortunate effect that the Health Posts are maintaining multiple stock ledgers to account for commodities from different sources. • **Frequently sent commodities not requested** A common story was receiving commodities not requested or receiving incomplete deliveries (such as saline but no IVs). There is a general lack of belief that the data reported is being used in any meaningful way. There are few incentives to report data in a timely and accurate way and the systems are difficult to use. • **Wastage pushed to the last level for disposal** The current supply chain has no return network. The result is that handling wastage is pushed to the lowest level. At best, these products are getting burned in local burn pile. The current reporting is not tracking wastage volumes and the disposal method making underreporting of this portion of the stock likely. • **Low / too little bandwidth for network communications** In the locations where the eLMIS client had been deployed to the Health Post Workers (HPW), they struggled with not knowing enough about how to use the laptop, as this was their first time using a computer. Additionally, the process of uploading reports was very time consuming and frequently failed with bandwidth being unable to support the communication required. The more typical use case is to print out the forms needed; however, solar power frequently was unable to provide sufficient voltage to drive the printer for the entire print job required. Finally, the environment is hard on printers with the amount of dust, and getting replacement ink cartridges and paper is challenging at best.
Data / Technology readiness	Low. This was typically the first time most of these people had ever worked with a computer. However, even those with feature phones had used Facebook. If the system is designed to be simple and meet their needs, uptake can be very rapid. One of the unintended consequences of moving to an electronic system is that previously, Health Post workers had a travel budget to go to the District and would effectively "haggle" over the commodities needed. With the shift to eLMIS they no longer had this ability to haggle and now feel like they have less ability to get the product they need than before.

Figure 15 -- Printer protected from dust, insufficient solar power to run

Current Solutions – eLMIS and IMS

The original eLMIS solution that was developed under the DELIVER project has now aged sufficiently to need replacement. The key issues with this system are that it is very process-intensive and requires multiple points of data re-entry. This creates a dis-incentive to report timely and accurate information. The current system is also lacking in master data management in keeping definitions, and product codes in alignment between the various tiers. Part of this is due to the challenge that distributing updates in definitions across the country has to be done manually and is inherently slow. Ultimately, rebuilding this application to take advantage in newer technologies and development approaches would be too costly in comparison to the solutions that are already present in the market.

UNICEF has funded the creation of an Inventory Management System (IMS) to help meet their needs in managing the logistics in cold chain management across the country. This is a recent development and at the time of this writing, we were unable to get access to the system or to the code/data to provide a detailed assessment.

It is often tempting to custom develop software to meet specific needs. The power of software development comes in how flexible it is to build solutions and can be very empowering. However, the challenge comes with handling the sustainability of the solution over time. The impact creates a hidden cost to organizations that require significant investments of resources (human, financial, hardware, maintenance, training) to scale up. This has been one of the principal challenges of the current web-based LMIS system that is now at scale in Nepal. It is our understanding that UNICEF is planning an assessment later this year of its system.

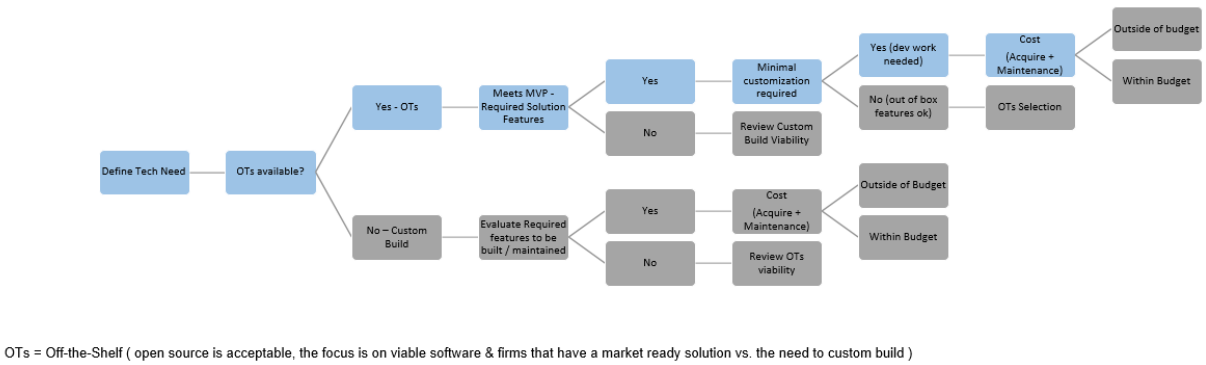


Figure 16 – Decision Tree on Build vs. Buy

It has never been cheaper to develop software than it is today. However, the cost is not in writing a line of code, the cost is managing the logistics in maintaining that line of code. If a custom solution is chosen a concern is in securing commitment from the EDP community to continue funding a single country implementation or to attempt to develop the product for other countries. Two very good examples of this situation currently in this field are the implementations for eLMIS in Pakistan and OpenLMIS in Ethiopia. The Pakistan implementation is a solid product but was never designed to be a platform for use in other countries, so to retrofit it to do so will be very expensive and time intensive. OpenLMIS is more mature and is attempting to become a such a platform but has several technical challenges in the current version that is preventing this from being a cost-effective option. These two instance provide some valuable lessons.

Gaps and Opportunities Analysis

	Critical Challenges	Key Opportunities
EDPs	• Visibility into the state of the supply chain	• Visibility into the upcoming procurement schedules • Visibility into the current warehouse capacities • Visibility into the Acceptable Loss Ratio / Wastage levels
CENTRAL (2)	• Data entry is slow and error prone • No Integrations with HMIS/DHIS2 • Lack of trust in the data • Commercial Trucking forcing a "push" condition • Master data management is weak • Physical space to store 107 essential commodities insufficient	• Electronic signature support • Cloud / Hosted is now acceptable • Immediate data access with no redundant / manual data entry • Organized MDM to enable scanning by batch • Procurement pipeline visibility for the Divisions • Order and Receipt tracking for visibility into distribution effectiveness • Shift to a Informed Push as data becomes more accurate / visible
REGIONAL (5)	• Data entry is slow and error prone • Commercial Trucking forcing a "push" condition • Physical space to store 107 essential commodities insufficient • Lack of structured input for forecasting / demand management	• Immediate data access with no redundant / manual data entry • Enable scanning by batch • Order and Receipt tracking for visibility into distribution effectiveness
DISTRICT (75)	• Staff rotation of store keepers • Warehouse management discipline breaking down • Data Entry time is too high and frequently used for HMIS/DHIS instead • Physical space to store 107 essential commodities insufficient • Lack of structured input for forecasting / demand management	• Clean / auction / Re-establish warehouse discipline • Simplify SoPs with easier technology and visual control systems to support high rates of turn over • Immediate data access with no redundant / manual data entry • Enable scanning by batch • Order and Receipt tracking for visibility into distribution effectiveness
HEALTHPOST (~2000)	• Last mile conditions • Frequent stock outs • Frequently sent commodities not requested • Wastage pushed to the last level for disposal • Low / to little bandwidth for network communications	• Mobile options including "baton" methods for easy data collection • Successful mobile roll outs happening in other parts of the MoH

Figure 17 - Key Gaps and Opportunities by Tier

While there are many challenges to operating in the current environment, this represents an excellent time to intervene into the ecosystem to create high levels of impact on producing better health outcomes.

Each tier of the supply chain has a distinct set of challenges and needs. Technology cannot solve all problems; however, it can play a critical role in enabling visibility and helping speed decision making to prevent small problems from becoming large problems.

In particular, with the increase in affordable cell phones with low power consumption, the ability to gather high quality data in near real time is a game changer for managing supply chains in resource challenged areas.

Given the amount of manual and often repetitive tasks that are happening across the supply chain there are many opportunities to enhance the operational effectiveness of the staff.

Next Generation e-LMIS Solution Design Recommendations

This time offers an incredible opportunity for enabling the supply chain for the people of Nepal. The advances in technology, especially on mobile platforms, has lowered the bar for access and affordability to a much greater range than ever possible before. To describe the potential future state, a set of design principles were used to guide the thinking on what critical path elements are for Process, Solution and System architecture choices.

Design Principles:

- **Nothing works without Data**
  Focus on creating near real-time visibility into the "ORDER" -> "ISSUE" -> "RECEIVED" cycle across the entire supply chain. Without data that is more accurate and timely, the consequence is that forecasting and order management become increasingly disconnected from reality and lead to the bullwhip effect of over- / under-stocking of essential commodities.

- **Simplify**
  Keep the system(s) simple to use and simple to run. This is especially true for the District store keeper where job rotation will keep this a vulnerable position from a skill development perspective. Workflow must match the technology readiness of each tier without creating overhead or redundant data entry.

- **Offline / Low Bandwidth is assumed**
  Paper will continue to be used / leveraged for a large portion of health posts. However, the ability to leverage inexpensive mobile clients that can work offline and burst communications in low bandwidth conditions is a significant opportunity. Focus on eliminating redundant data entry tasks and tracking the most critical activities (order, issue, received) in electronic form at all levels of the supply chain.

- **Master Data Management (MDM) Process must be created and changes quickly distributed to all clients**
  Commodity naming and categorization must be handled promptly and in a centralized fashion or the data collected will quickly become meaningless.

- **Warehouse Management**
  The central and regional level warehouses are suffering from a lack of sufficient space and need better physical security to protect the level of investment that is being managed at these locations. At the District level, the rotation of staff creates issues that require assistance in many of the District-level warehouses in running auctions, cleaning, and establishing solid visual control systems.

- **PO / Tender process visibility**
  The lack of visibility into the tender / procurement process is creating unnecessary issues with the supply chain.

Basic Process Architecture – Critical Workflows

Technology merely enhances the underlying processes of an organization. Making the transition from paper-based processes, with its inherent limitations and control points require a careful review. When moving to the world of electronic transactions a whole new set of capabilities emerge, particularly in the ability to create transparency. This provides management with a whole new array of tools by which to sense and react to conditions much more quickly. In a system that is used with several months' delay from data collection to analytics, having near real-time visibility can feel invasive and negative incentives arise (i.e. hiding the disposal of expired products rather than reporting it). It is important to work with the management teams on rewarding transparency.

When implementing new tooling it is easy to attempt to take on more than can be absorbed by both the people and the larger system. Success in large projects is more often driven by the ability to stay focused on core features and allowing time for people to learn. Of the many workflows that are needed to support a national supply chain, these two are recommended as being the most critical for automation due to the level of positive impact they can bring.

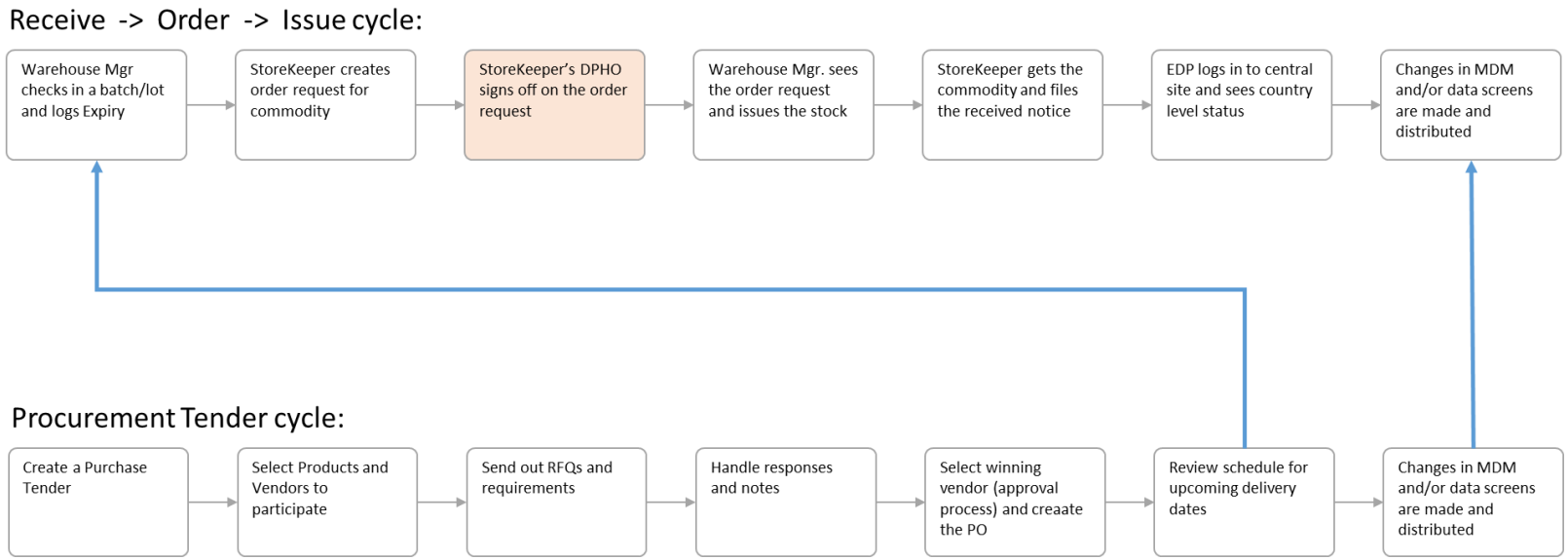


Figure 18 - Critical Process Workflows

One of the key drivers of complexity and delay in the current environment is the handling of paper for tracking signatures. Each of the recommended solutions have the capacity to handle some form of electronic approval varying from the ability to capture a signature on a smartphone up to capturing a photo of the physical form and attaching to an electronic record. The key will be in partnering with the Auditors to ensure that they are comfortable with the level of controls in place and understand how the system creates stronger audit trails of activity. There is already precedence for the GoN using electronic signatures with the electoral commission in a system that has been developed with the United Nations Development Program (UNDP) showcasing that it is indeed possible.

Basic Solution Architecture

Each tier has different needs of the solution and different ways of interacting with the system. Overall, internet connectivity has exploded in Nepal over the past five years but it remains weak in rural areas. By far, the increase in connectivity has centered around mobile, which is inherently better at dealing with offline / limited connections.

The solution will leverage this and provide an optimal experience for each tier that expects to have low bandwidth with frequent disruptions.

The Central Tier has responsibility for mastering commodity definition and setting the system with the key attributes that others will use.

The Regionals function as the safety stock and storage hub. Increasing their visibility into the true state of stock conditions in their districts will speed reaction time substantially.

The Districts' experience has to be simplified and changed to a checkbox/matching exercise. Many Health Posts will continue to provide orders in paper form during the transition period and this has to be streamlined by making the issuance process easy and electronic so that they are not being asked to perform additional work.

The Health Posts effectively have three different experiences based on the level of connectivity that they have available to them. Fully connected, near-range connectivity (with in a travel day of connectivity) and unconnected.

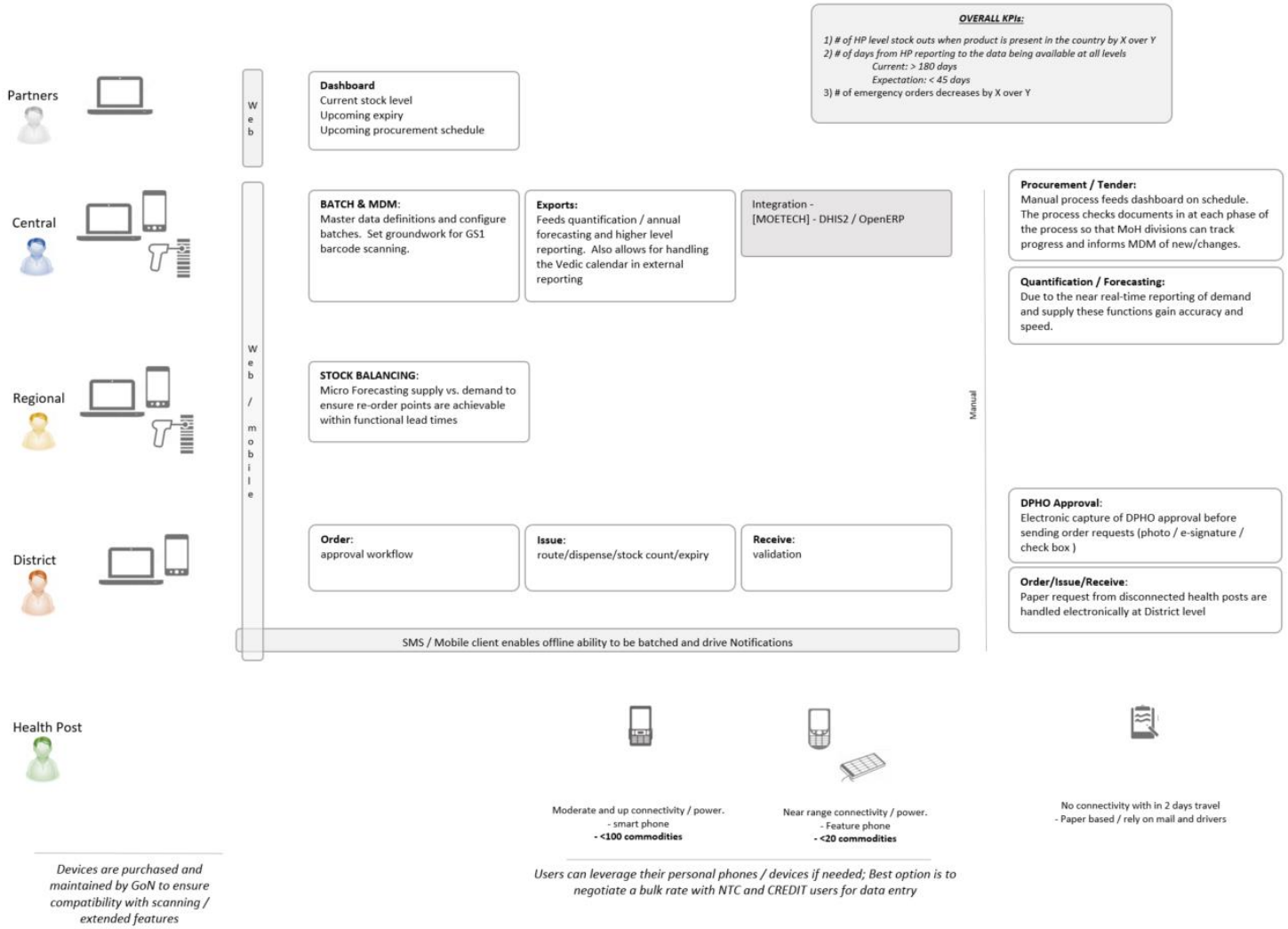


Figure 19 - Basic Solution Architecture

Personas and Functional Requirements

Each tier has a different set of users. Central to this approach is considering what the needs are, their level of technology readiness, and what issues need to be considered from a change management perspective.

Nepal Supply Chain User Personas

Preliminary Draft Only [Validation Needed]

Persona Description

Persona Title	Exemplary Roles	Sample Names	Catch Phrase	Summary	Goal 1	Goal 2	Goal 3	Influencer 1	Influencer 2	Influencer 3	Questions 1	Questions 2	Questions 3	Approach 1	Approach 2
Partners - Funder	Funder	UUU	"Integrating,Planning and Managing for Product Success"		- Confidence in knowing the product being selected / purchased will	- Comfortable with an Acceptable Loss Ratio of <x% is actually	-Use disciplined planning to give us higher confidence on	- Ministry of Health			- How much of my portfolio's product made it to the	- What is the current status of stock levels		- Delivery on visibility & transparency for	
Central-Division Director	Division Director		"Big Picture...Big Impact"	I have overall ownership for the pneumonia program, and I am	-Maximize impact & achieve goals through program investments.	-Understand my portfolio across program initiatives. Identify	-Invest in and budget for the products that have the best cost/impact	-Partners	-Auditors		-Across initiatives, how do we ensure an appropriate	-How do I know what my priority products are, and	-How can I feel comfortable that are making data-	-Visibility	
Central-Forecaster	Forecaster		"Using data to predict future demand"		-Better data / faster and easier to work with						- What are the assumptions in this model?	-What is the status of products in the initiative portfolio	-Where is the portfolio concentrated	-Better data and easy to export	
Central-Warehouse Mgr.	Warehouse Manager	WWW	"Managing stock and capcity for the country"	As a the warehouse manager for one of the two Central warehouses	- Single easy-to-use system for capturing, reporting on, and	- Maximize limited staff		- Auditors	- LMD Director		-What shipments are coming up and will I have	-What product batches are nearing expiry?	-What is the state of the stock at the Regional / District	- Time saving options	
Central-Procurement Officer	Procurment Officer	VVV	"Stewarding the GoN Investments"		-Understand what is in my product portfolio, and what key milestones are	-Understand potential return of products in my portfolio, as well as		-MoH Directors	-Suppliers	-Partners	-What is in the pipeline?	-What are the historical prices and trends of		-Better data	-Time saving options
Central-Supplier	Supplier / Vendor		"Supplying drugs and pharmaceuticals"					- Procurement Officers							
Central-Auditor	Auditor		"Traceability to show		-Visibility into the						-How can I see			-Governance and	
Regional-Warehouse Mgr.	Warehouse Manager	XX													
Regional-Auditor	Auditor														
District-DPHO	DPHO														
District-StoreKeeper	Store Keeper (non-CC)	YY													
District-Cold Chain Manager	Cold Chain Manager														
Community-HealthPost Worker-No Connectivity	Health Post Worker														
Community-HealthPost Worker-Near Connectivity	Health Post Worker	ZZ													
Community-HealthPost Worker-Connectivity	Health Post Worker														

Central-Warehouse Mgr.

Warehouse Manager

WWW

"Managing stock and capcity for the country"

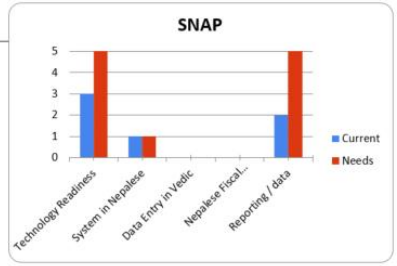
As a the warehouse manager for one of the two Central warehouses I am constantly working to manage the state of stock flowing into the country and getting it moved into position for the Regions and Districts. Physical security is a big issue as we recently lost a whole warehouse to fire and we have no security guards or systems at night or over the weekend. Additionally, physical space is an issue with the recent expansion to 107 essential commodities. We measure space in 'trucks' since the commercial trucking company's won't take a partial load we batch together requests and routes - all this activity has to happen manually.

Key words:

Simple
Streamlined
Consistent
Planning
Analysis

Segment Needs and Performance (SNAP)

Category	Current	Needs
Technology Readiness	3	5
System in Nepalese	1	1
Data Entry in Vedic	0	0
Nepalese Fiscal Calendar Reporting	0	0
Reporting / data	2	5



Entry point:

-Order -> Issue -> Receive workflow

Goals:

- Single easy-to-use system for capturing, reporting on, and analyzing product portfolio data. Reduce complexity and need to use mutliple systems.

- Maximize limited staff

Influencers:

- Auditors

- LMD Director

Frustrations & Pain Points:

-Many requests for program data require ad hoc and intensive analysis. I often have to enter the same data in multiple reports or IT tools...isn't there a better way?

-Physical capacity is limited, physical security is absent - especially at night and weekends

-The time it takes for data entry and tracking is too much / too long

Reason to Return:

-Ad hoc request for status on a given product, and/or request for analysis

-Manage capacity, batch and expiry

Questions:

-What shipments are coming up and will I have enough capacity to store them?

-What product batches are nearing expiry?

-What is the state of the stock at the Regional / District warehouses?

Approach:

- Time saving options

Figure 20 - Persona Matrix Sample

Basic Process Architecture – Conceptual

The key processes that need to be optimized are the "Issue -> Receive -> Order" and the "Procurement" workflows. While the mechanics might be slightly different for the "Issue -> Receive -> Order" workflow at each tier, the functions are not. Standardizing this process will enable easy reporting and data analytics across the distribution network.

The greater challenge lies with the procurement side. No supply chain works if there is no procurement.

Once procurement starts happening again, the mastering of the definition of the commodities attributes must be systemized and distributed throughout the supply chain.

We did not see evidence of a formal process to cover this in the existing implementation so this will likely be a new process step for LMD staff. Each of the recommended systems handle this in a different way so the implementation will vary.

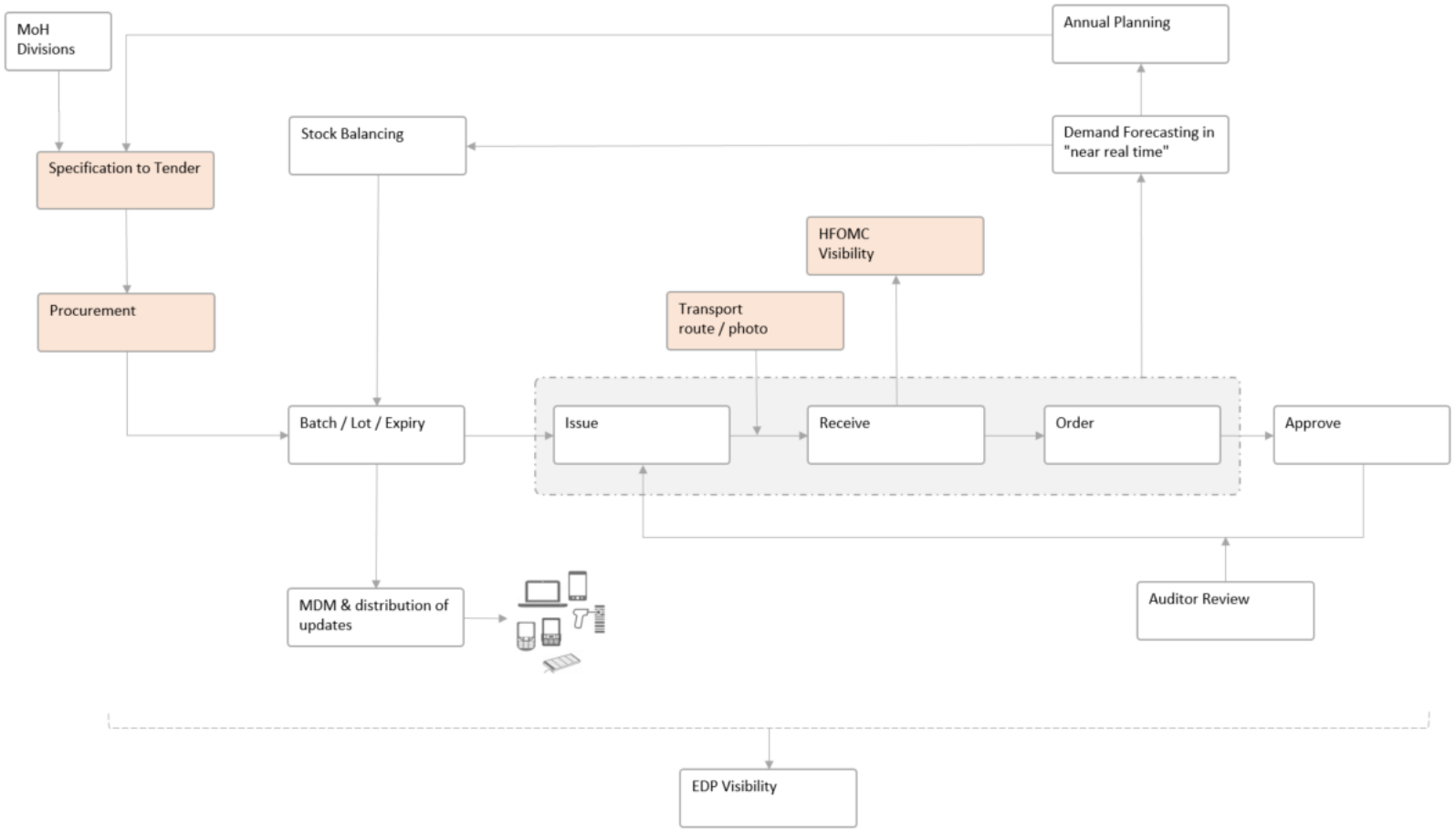
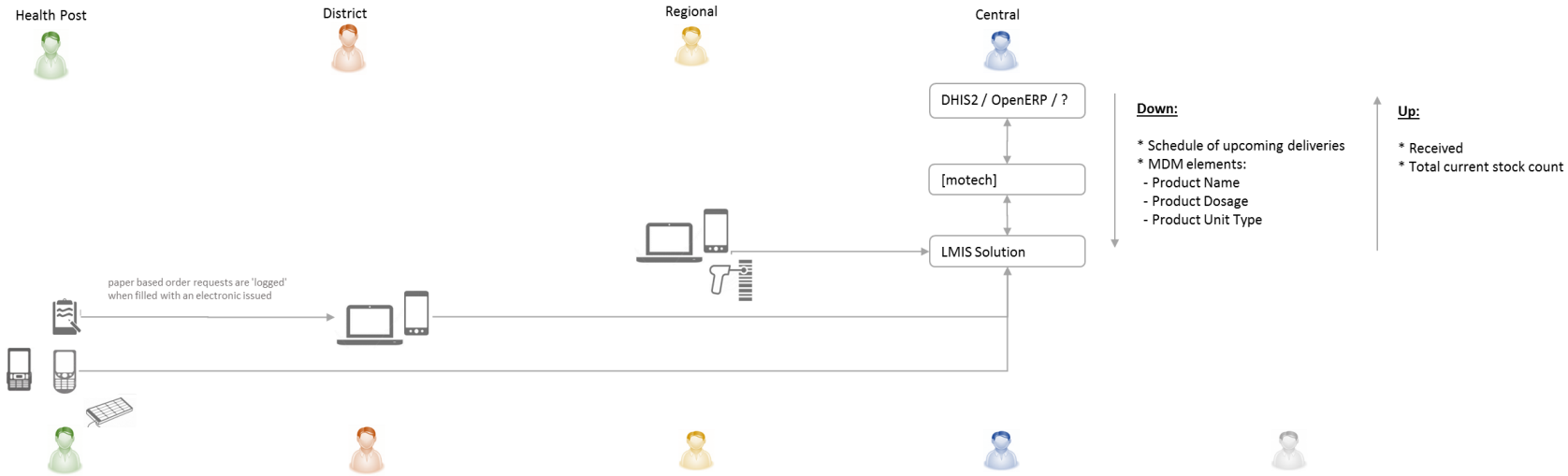


Figure 21 - Conceptual Process Architecture

Basic Process Architecture – Narrative

This provides a "day in the life of" perspective into the various key actors.

The intent is to understand how these individual actors' day-to-day jobs will change with the implementation of a new system while keeping a perspective on what is the whole picture working to accomplish.



ZZZ has limited power at his health post, but using the small solar charger he is able to power his Feature Phone easily, and easily pull together his stock status for the month in the phone. There is one specific hilltop, about a day's walk away, were he gets enough connectivity that his messages to **YYY** regarding current stock, and needed supplies and commodities will upload automatically. He heads out to this spot once every couple of weeks.

While he is connected he also gets a sms notification back that the DTP that he had requested last month has just been delivered from the Regional warehouse to the District level which is a good sign that he will get some this month.

YYY is the new stock manager for the District. His prior posting was in Agriculture and he doesn't have much of a background in Health issues or warehousing. Thankfully, the website is very simple to use. He gets an SMS text notification that a shipment of DTP has arrived at the Regional warehouse, which is good news since he has several Health Posts that are requisition the commodity, and he has been afraid to release any.

He logs into the website and sees the latest status / order requests from 60% of his Health Posts and also sees that he has enough requests to put together an order for the DPHO to sign. He prints the order form for the DPHO and gets the signature. Thankfully, he can just snap a picture of the signature and release the order request right away.

XXX has just finished scanning in the commodities that just came in. The new scanner makes checking in batches much faster and notifications are automatically routed out, so he no longer has to call anyone. He pulls up the dashboard to review the conditions across all of his Districts and immediately sees the pending orders for DTP that have come in.

He looks at his forecast and can see that, even with the latest addition, 2 of his districts will likely move through the commodity too quickly. However, 1 district has a projected surplus and he decides it is worth giving them a phone call to see if some of the stock could be transferred to help with the shortage.

WWW has visibility into the stock across the entire country and can see that more than 80% of the districts have already checked in during the past week and that more than 40% of the Health posts have also put in their orders for the latest batch of commodities just came in and his team are busy scanning them into the system where they can then set up the batch / lot information and set the expiry information for tracking.

He sees that the country remains chronically short of Depo and that orders for it have stacked up. He switches to the new procurement dashboard, located on the internet, and can see that **VVV** is still has this in the tender stage with a target date of next month.

It has been great to have dashboard now, as it has vastly shortened the amount of time to generate and track reporting requirements for the external development partners.

UUU checks in on the Nepal dashboard because he knows that he is getting close to scheduling / sending a shipment of condoms to Katmandu. From the main page he sees that DFID is also planning a shipment on the same week. He needs to add this to the agenda for the next EDP logistics working group meeting to see if these should be staggered to prevent the warehouse from being overwhelmed and not displacing other essential commodities.

He also sees that the overall portfolio of commodities that he is funding has been fully distributed throughout the county and is on track with last year's forecast.

Figure 22 – Process Narrative

Basic System Architecture – Options

There are three basic approaches to deploying the technology for use. These are laid out below in order of recommendation.

There is not a strong information and communications technology (ICT) environment available to LMD to leverage for the day-to-day running of technology. Given that the e-Health strategy developed by GoN has explicitly allowed for SaaS (software as a service) and Hosted solutions to be leveraged, the preferred approach would be Option 1 or Option 2.

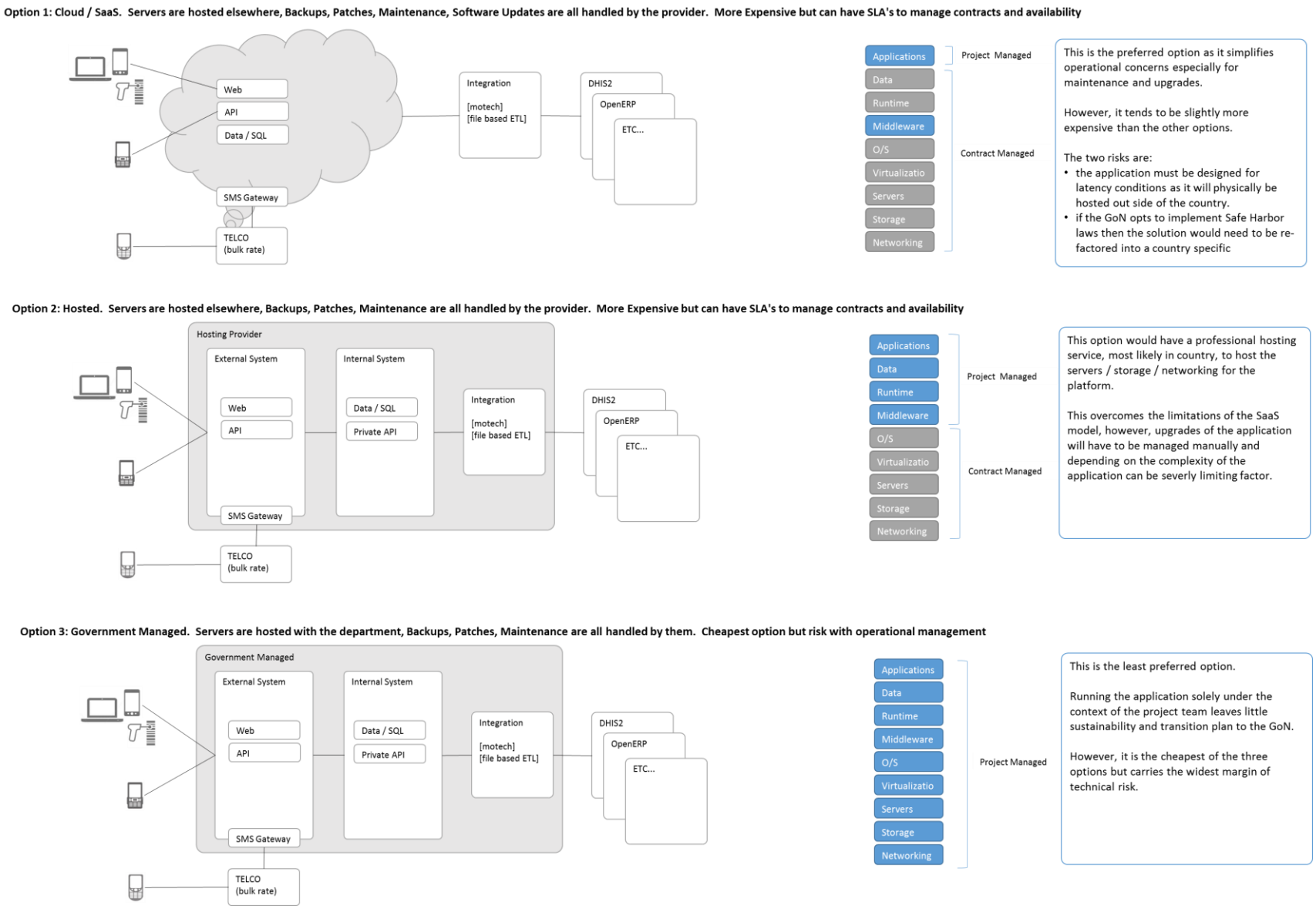


Figure 23 – System Architecture Options

Integrations

The current environment for Nepal is one of vertical technology silos where cross-integrations happen manually. Such capabilities as creating a report that connects HMIS/DHIS2 patient tracking with the logistics tracking of commodities is not currently possible. Looking to the future, the ability to effectively connect reporting on supply and demand will be a powerful tool for the Government of Nepal.

At the time of writing, the GoN was working on implementing DHIS2 and moving away from the custom developed HMIS. The installation of this has been on hold to resolve issues with reporting and working with the Vedic Calendar. However, the operating design assumption is that DHIS2 will be the central target for integration.

There are several different integration design patterns to choose from. For Nepal, we recommend that these should be limited to an "Extract – Transform – Load" (ETL) design pattern and set in what is called a "one-way integration." This pattern is the simplest to implement and operates on a batch or queued schedule. The critical decision process to enable this is ensuring that there is only one source for a given record type; this is often referred to as either the "system of record" or the "mastered data." Downstream systems are not permitted to change the data.

At a minimum, the solution will provide an ETL-based integration to DHIS2 stock counts by product, location, received and issued so that this will be available for combined reporting and analysis on a weekly basis.

Each of the recommended solutions will provide notifications, reporting, and upcoming schedules inside of their product suite. Where they differ is in how to handle procurements and the subsequent definition of commodities. eZICS will natively provide this functionality inside of its suite and will be considered the system of record and master for commodity definitions, acronyms, attributes, and upcoming schedule of expected deliveries. Dimagi and Logistimo, however, will need these to be handled outside of their systems.

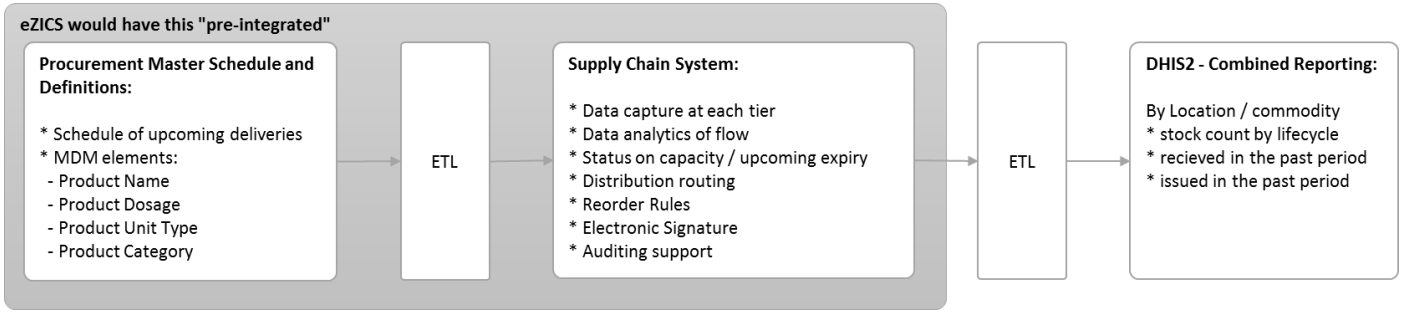


Figure 24 – Potential Integrations

There is a high degree of complexity and process risk on having overlap with the UNICEF IMS system for the cold chain. If the two system will exist side by side, then the key will be to not have any stock keeping unit (SKUs) managed in both. This will create a process burden for the Central and Regional staff as they manage both cold chain and dry store commodities. At the District level these are separate staff, so the overlap would at that point would be minimal.

Implementation – Phased approach

Once a product has been selected, the recommended implementation approach is to use a step-wise phase that is focused on managing the complete supply chain, end-to-end, for a few key products and then focus on expansion. It is easier to learn and adjust with on-the-ground realities when working with a smaller number of commodities – and also much easier to approach training.

It is important to note that product selection will follow GoN and USAID practices for RFPs. The implementation phases, with key milestones, are as follows:

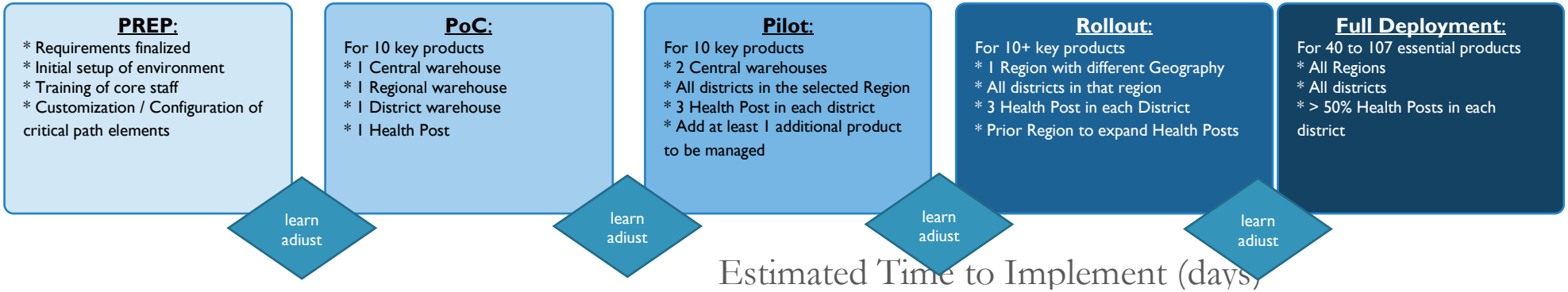


Figure 25 – Implementation Phases

Each of the recommended products has a slightly different estimate on how long it will take to move through each phase. By far, the biggest distinction is the PREP phase, which is driven by the degree of effort for configuration to setup and in customization that must be performed.

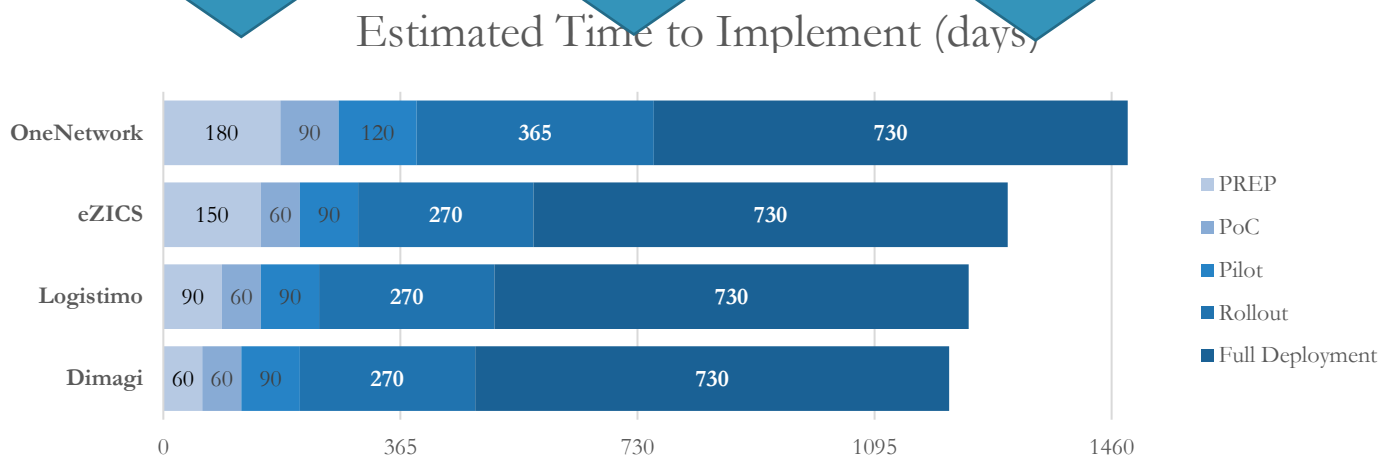


Figure 26 – Implementation Time Comparison

Project Plan

To the right is a high level project plan for implementation that calls out the critical path elements to each phase on an optimal timeline.

The key design assumption is that it is possible to rollout to a full region (assuming the two central stores have already been handled) every six months. This averages out to 19 stores per Region (the Regional store itself along with 18 District stores). Note, a gap may be necessary depending on the timing of weather conditions and when a rollout is scheduled, so it important to keep this in mind.

Since the District stores are in a wide range of states, a central portion of the rollout is to assist these with clean-up, running an auction, and training to get these back into a known good condition.

As noted above, the PREP Phase has the largest variation between the different options. The main reason for the variation is to account for the level of effort necessary to get the product installed, configured, and the implementation team trained.

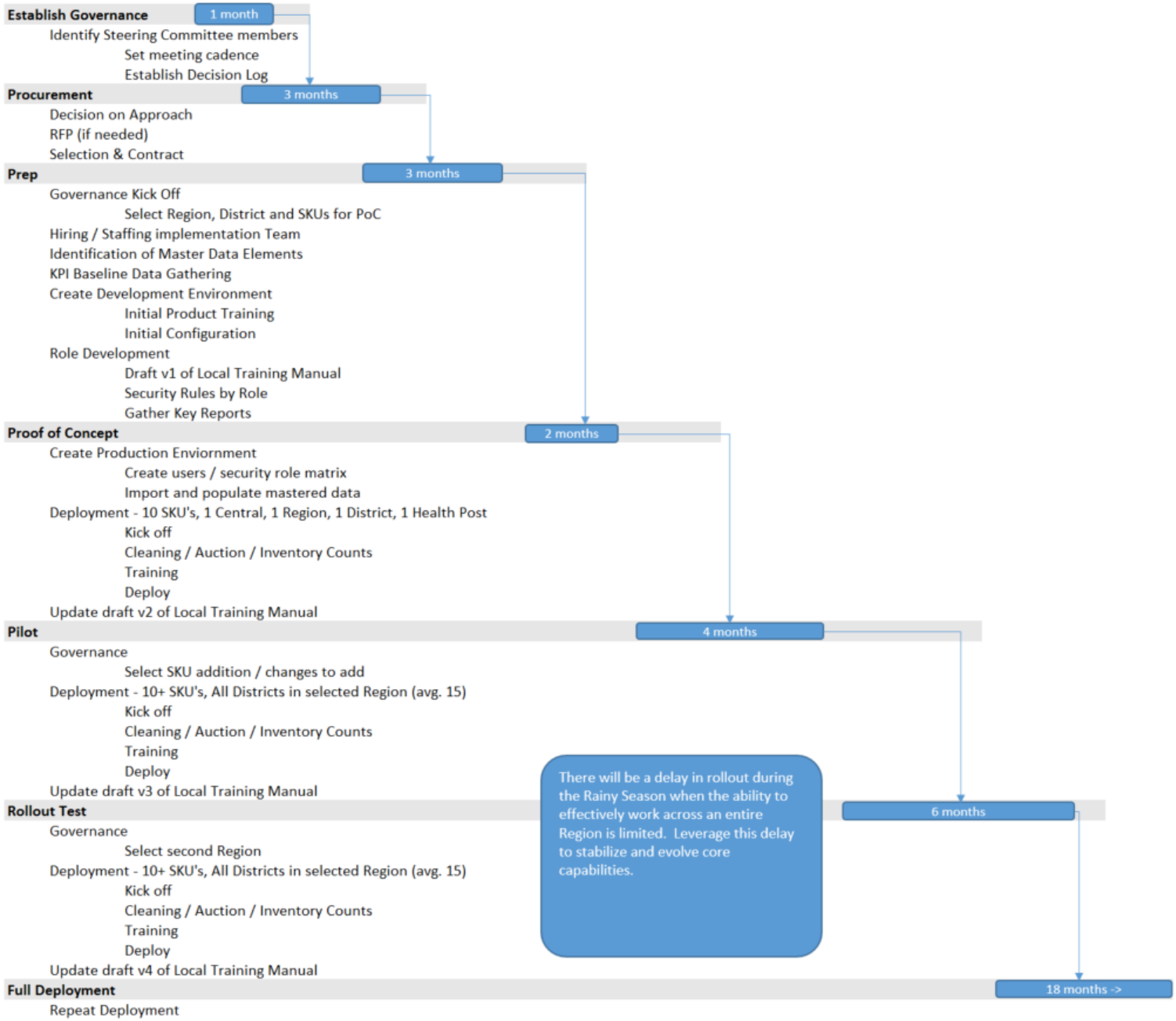


Figure 27 – Sample Project Plan

Governance

Nepal is a consensus-driven culture and success in governance will be to tap into this culture and work to continually discover issues and build alignment while maintaining forward progress.

Program governance is divided into four functional levels. Each level has a different meeting cadence and scope of decision authority with lower levels escalating to the level above it if there is a condition that cannot be resolved.

The Steering Committee should be a longstanding set of personnel and be key decision makers for the EDP and MoH communities.

In contrast, the Stakeholder group will be actively changing as the project evolves and moves into new Regions and Districts to have local representation.

It is expected that Procurement and Supply Management (PSM) will be facilitating the meetings at each tier and will manage the agenda, scheduling and decision log, and minutes for each tier.

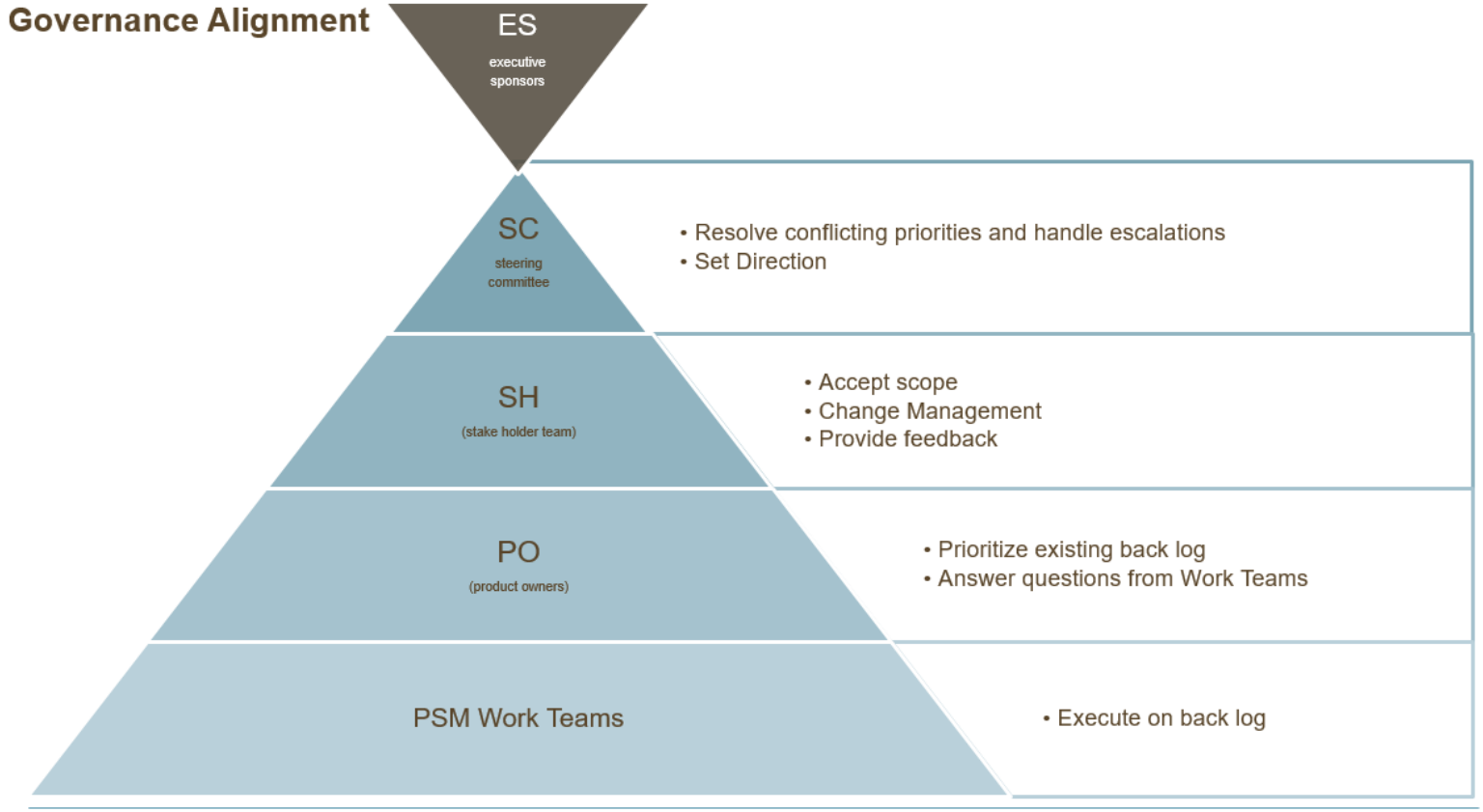


Figure 28 – Governance Alignment Model

Meeting Rhythm

Each tier of the governance structure has a different meeting rhythm, with the Steering Committee meeting roughly three times a year to assess progress, deal with any issues that have required escalation, and set next priorities. Once the program is being actively used in the field, the Steering Committee will review progress towards the key performance indicators (KPIs) and can assist with handling political resistance or accountability issues.

The stakeholders are meeting every eight weeks and are accountable for setting granular priorities, accepting work products, and providing feedback.

The Product Owners are a part of the PSM implementation team and have the dual responsibility of acting as a proxy to the user community and helping drive each of the needed work streams. The Product Owners connect with one another in a formal meeting every two weeks to assess progress towards the larger priorities and if the effort is on track to the targeted eight-week point for the "Demo Day."

It is important to keep touch points with any other projects that have either technology or process integration. These efforts should be invited to the Demo Days and, depending on the complexity, into the Product Owners meetings for coordination.

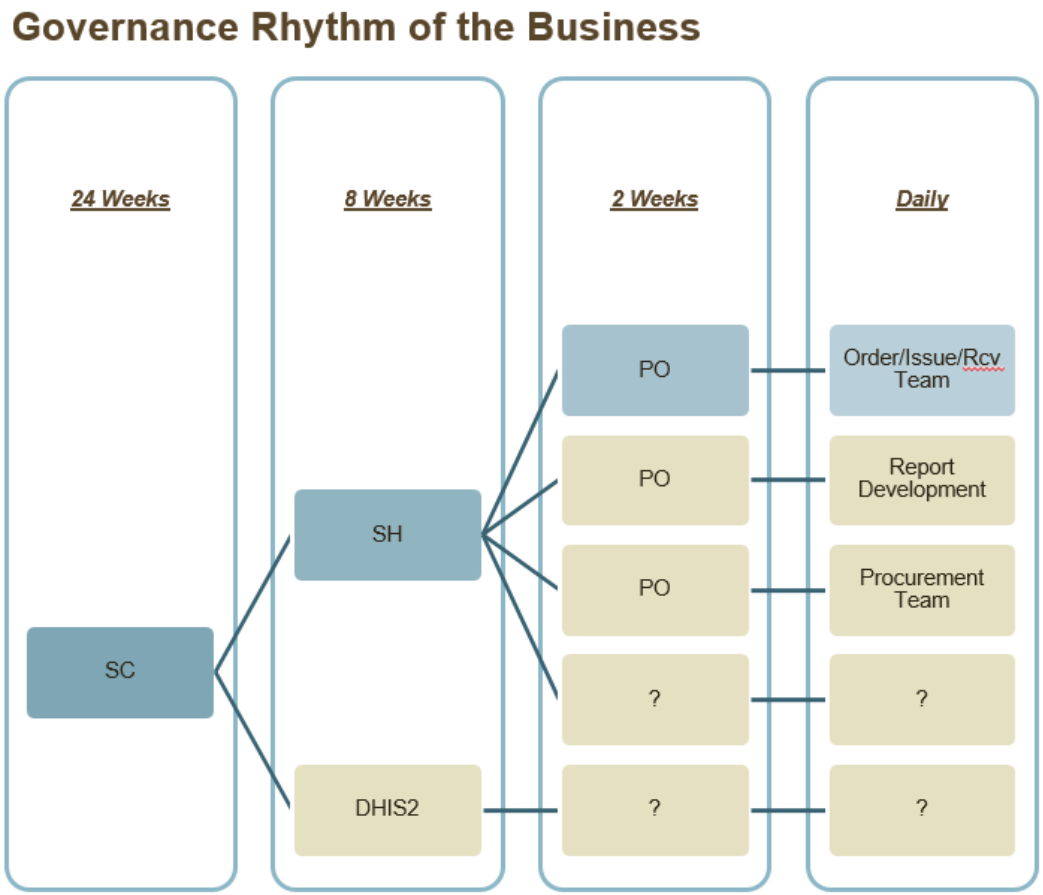


Figure 29 – Recommended Cadence of Governance Meetings

Delivery Cadence

We recommend using an ***Agile Program Management*** style. The core principle to follow is that every eight weeks the work teams will be demonstrating a "**production ready**" product on what is called a "**Demo Day.**"

"Production ready" means that if the Stakeholders / Steering Committee accepted the demo and desired the team could release that work into production for use within the following two weeks.

This style of management produces a continuous improvement cycle due to the feedback loop it creates and the consensus-driven nature in prioritizing the backlog of ongoing activity together.

Additionally, by forcing the work to be broken down into small manageable chunks of work that can be released to production quickly, this creates a faster value proposition and allows the team to learn from the realities on the ground as they emerge. The power of the "Demo Days" should not be underestimated. These are a powerful resource to be leveraged for handling change management, gathering feedback, and building operational trust between the various actors.

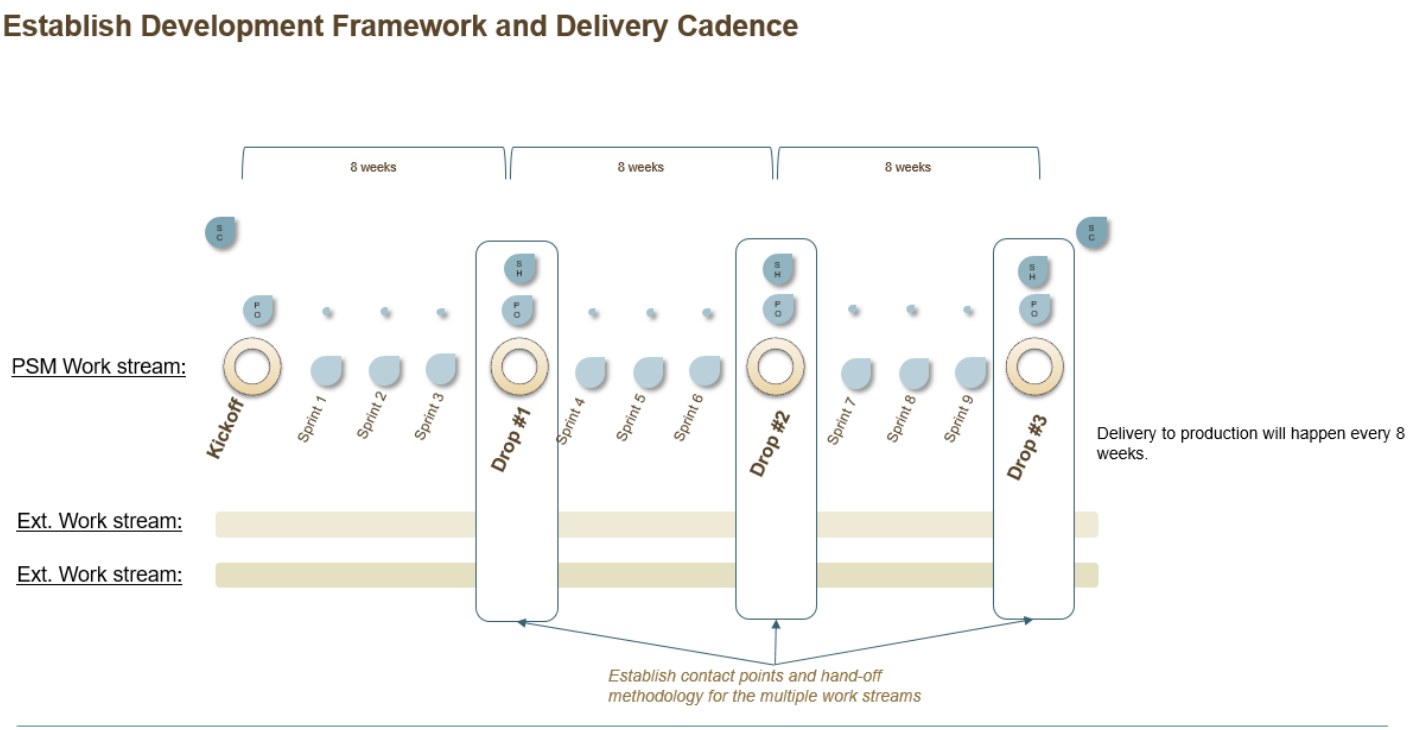


Figure 30 – Recommended Delivery Cadence

Governance Forums

Forum	Role & Decision Types	Proposed Members & Decision Process
SC	• Director Level LMD • At least one Director from MoH programs • At least one representative from EDP community • *Facilitated by PSM*	**Voting members** • ? • ? • ? ***Rules: Quorum & Consensus*** **Non-Voting members** • Open sessions and may be attended by any interested party Decision Process: Collaborative Majority with a Fist of Fives approach (3 or better to proceed, less than 3 and the board has to continue to work the issue or escalate to resolve.
SH	• Central level Warehouse representative • Central level procurement / forecasting representative • Regional level Warehouse representative • District level warehouse representative • Auditing depart representative • *Facilitated by PSM*	**Voting members** • ? • ? • ? ***Rules: minimum of 3 members must be present*** **Non-Voting members** • Open sessions and may be attended by any interested party Decision: Collaborative Majority with a Fist of Fives approach (3 or better to proceed, less than 3 and the board has to continue to work the issue or escalate to resolve. Escalation sent to the SC.
PO	• PSM Program/Project Management	**Voting members** • PSM – PM 1 • PMS – PM 2 ***Rules: at least 1 member or delegate must be present.*** **Non-Voting members** • Open sessions and may be attended by any interested party Decision: Collaborative Majority with a Fist of Fives approach (3 or better to proceed, less than 3 and the board has to continue to work the issue or escalate to resolve. Escalation sent to the **SH.**
Work Team	• Accepts / Executes on work • Commits to provide Demo days every 2 weeks • Commits to provide Major drops days every 8 weeks • Escalates concerns / roadblocks to PO's	**Voting members** • ? • ? • ? • ? • ? • ? • ? • ? • ? ***Rules: 2 / 3 member must be present*** **Non-Voting members** • Open sessions and may be attended by any interested party Decision: Collaborative Majority with a Fist of Fives approach (3 or better to proceed, less than 3 and the board has to continue to work the issue or escalate to resolve. Escalation sent to the **PO**.

Figure 31 – Sample Governance Decision Guidelines

Forum	Intake & Agenda setting		Logging & Communications	
Steering Committee	1. Email to chair 2. Chair Triages 3. Email socialization 4. Chair sets agenda	OOB: ?	1. Agenda's stored: yyy 2. Decision Log stored: zzz 3. Quarterly Review of log for effectiveness stored: xxx	1. ?
Stake Holders	1. Email to chair 2. Chair Triages 3. Email socialization 4. Chair sets agenda	OOB: ?	1. Agenda's stored: yyy 2. Decision Log stored: zzz 3. Quarterly Review of log for effectiveness stored: xxx	1. Communicate status of decisions to the Steering Committee 2. ?
Product Owners	1. Review the backlog 2. Prioritize items 3. Respond to questions from the team	OOB: ?	1. Backlog stored: yyy	1. Keep the backlog groomed / prioritized 2. Communicate / share status with Stake Holder community 3. ?
Work Team	1. Work is pulled from the product backlog 2. Anybody can add to the backlog	OOB: Only work prioritized by the PO's can be acted on.	1. Backlog stored: yyy 2. Sprint Log stored: zzz 3. Retrospectives / demo days stored: xxx	1. Keep the action items of the backlog up to date.

Figure 32 – Sample Governance Intake and Logging Points

Staffing Model

Here is the recommended Staffing Model for the implementation team by role title along with a high level description of basic responsibilities. Staffing levels will vary per recommended solution:

	Title	Basic Responsibilities
ExPat / External Resources	**Director**	Overall strategy, direction of the effort Coordination with all stakeholders Handles escalations and expectation management
	External Sr. Developer	SME developer in the chosen product to split role as architect / mentor for the local team. Also to assist with any integrations that need to be coded / developed
Local Resources	Management	Day-to-day operational management Project / Program Management background Budget / Progress reporting
	System Admin	Ensures healthy infrastructure for servers (backups / patching / availability) Typically has background in Windows / Linux Handles security and user / role provisioning
	Sr. Developer	Lead / Sr. Developer. Must have strong knowledge in SQL and at least one core programming language (aka, PHP, .NET, Java)
	Jr. Developer	Entry level developer Strong technical skills (excel, vb, macros, etc.).
	Tester	Frequently a cross between an entry level developer and business analyst. Duties are shared with other functions, such as support. Experience in test automation is a bonus if dealing with raw software development. If dealing with just configuration this is not needed.
	Trainer	Outgoing and friendly personality. Crosses with business analyst capabilities and documentation writer. Expected to learn and become a subject matter expert in both the technical elements of the system and needs of supply chain management. Since this will be the “face” of the program these people are to be considered on the most critical.
	Business Analyst	SME in the cross-section of supply chain management, warehouse management, and leveraging the application to meet the needs. Leads the Trainer and Report writer roles in developing materials and delivering content.
	Report writer	Strong knowledge of SQL. Statistics background is a bonus. Strong knowledge of a visualization tool such as excel, tableau, reporting services, etc.
	Support	Crossover person with the testers to be able to handle tier 1 bugs / issues and questions.
	Data Entry (legacy)	The existing implementation has three people at central to manage the manual data entry of paper forms. This will need to continue and steadily reduce over the course of three years as the paper forms are replaced with electronic data entry / reporting at the source locations.

Figure 33 – Recommended Staffing Model

Three-Year Cost and Staffing Estimates Model

Cost estimates were developed on a three-year timeline that considered:

- Product Licensing
- Hosting (servers / storage)
- Hardware (users only)
- Staffing

The approach is to take a gradual roll out on the user count allowing to distribute the costs over the three years. It is important to note that while eZICS will reach full licensing in the third year, full deployment will likely take longer due for the need of a longer prep and development phase than the other products.

Product Licensing is list only so it does not take into account the negotiation process and that better rates may apply.

Hosting was costed for the preferred SaaS option outlined in the Basic System Architecture. While this tends to be more expensive than hosting internally it provides a higher level of service and usually manages upgrades and system updates automatically, which is highly recommended.

The true variation in costs come in the staffing levels estimated for each product. Products that require more development time require more staff. Likewise, those that require more access to external staff have a higher cost than in-country resources. There is also the question of how perspective on how quickly the system can be operationalized and transitioned to LMD staff affects the draw down rate.

Category	System eZICS	OneNetwork	Logistimo	Dimagi
year 1				
Licensing:	$ 295,960	$ 90,000	$ 200,000	$ 1,800
Hosting:	$ 50,000	$ -	$ 9,000	$ -
Hardware:	$ 6,430	$ 12,700	$ 13,720	$ 7,330
Staffing:	**$ 2,195,302**	**$ 1,990,296**	**$ 1,266,458**	**$ 1,118,793**
Staffing count:	30	31	20	21
year 2				
Licensing:	$ 342,800	$ 250,000	$ -	$ 2,970
Hosting:	$ 50,000	$ -	$ 19,800	$ -
Hardware:	$ 37,050	$ 180,400	$ 23,950	$ 37,350
Staffing:	**$ 1,804,153**	**$ 1,530,276**	**$ 999,299**	**$ 1,054,737**
Staffing count:	24	23	17	18
year 3				
Licensing:	$ 1,318,500	$ 250,000	$ -	$ 24,000
Hosting:	$ 50,000	$ -	$ 120,000	$ -
Hardware:	$ 207,500	$ 1,022,850	$ 65,850	$ 207,950
Staffing:	**$ 1,404,217**	**$ 1,121,938**	**$ 777,492**	**$ 843,847**
Staffing count:	22	21	15	18

Figure 34 – Projected Cost Comparison

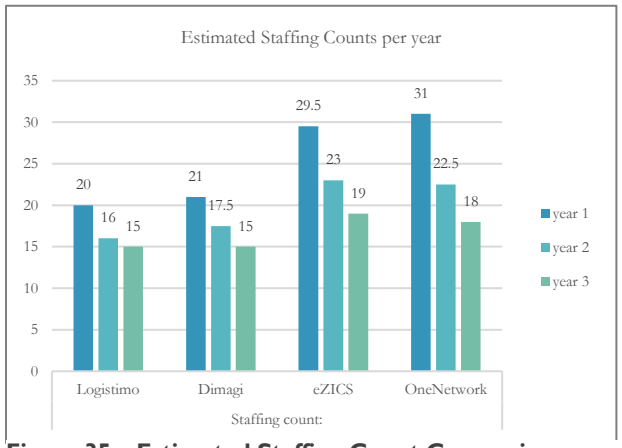


Figure 35 – Estimated Staffing Count Comparison

While every role is necessary, there are three roles that stand out as critical: Trainer, Report Writer, Legacy Data Entry. Ultimately, this is less about a technology implementation and more about change management. These three roles will make the difference in a successful deployment for the following:

Trainer: This will be the "face" of the program to the various parties. They will need to be subject matter experts in both the technology and in the process of Supply Chain Management with enough presence and ability to work with Store Room Managers and DPHOs on the process.

Report Writers: The level of data literacy in Nepal is fairly low. If the effort is to be successful people will need to see how the data that they put into the system is having an impact on decisions. The Report Writers' role in helping each tier find the data that they need in a format that works for them will be a key aspect in driving adoption.

Legacy Data Entry: While the existing data entry of the central level is slow and prone to issues, it is better than the absence of data entirely. This process needs to continue while the new system is rolled out and steadily displaces it.

Additional Considerations

Systems Dynamics

In the language of System Dynamics, supply chains are a "Stock & Flow" problem. These can be visualized like a bathtub where you are tracking the rate of water flowing into the tub, the volume of the tub, and the rate of water exiting the tub. While it is easy to see how much water may be in the tub (stock), the much more important variable is in tracking the rate of water entering vs the rate of water leaving (the flow).

In Nepal, the focus has been largely on the state of the stock. By implementing an easy-to-maintain system that is tracking the movement of products throughout the country, all the actors in the system will be able to understand the flow, which leads to better decision-making by each actor in the system.

MIT developed a simulation game that is used to teach what the effects are of having (or not having) visibility into both the condition of Stock and Flow data when managing a supply chain. The game is structured much like the current conditions are in Nepal. The players have limited visibility into the state of stock and the conditions of flow. Invariably, the system begins an accelerating path towards oscillating behaviors that create the "bullwhip" effect.

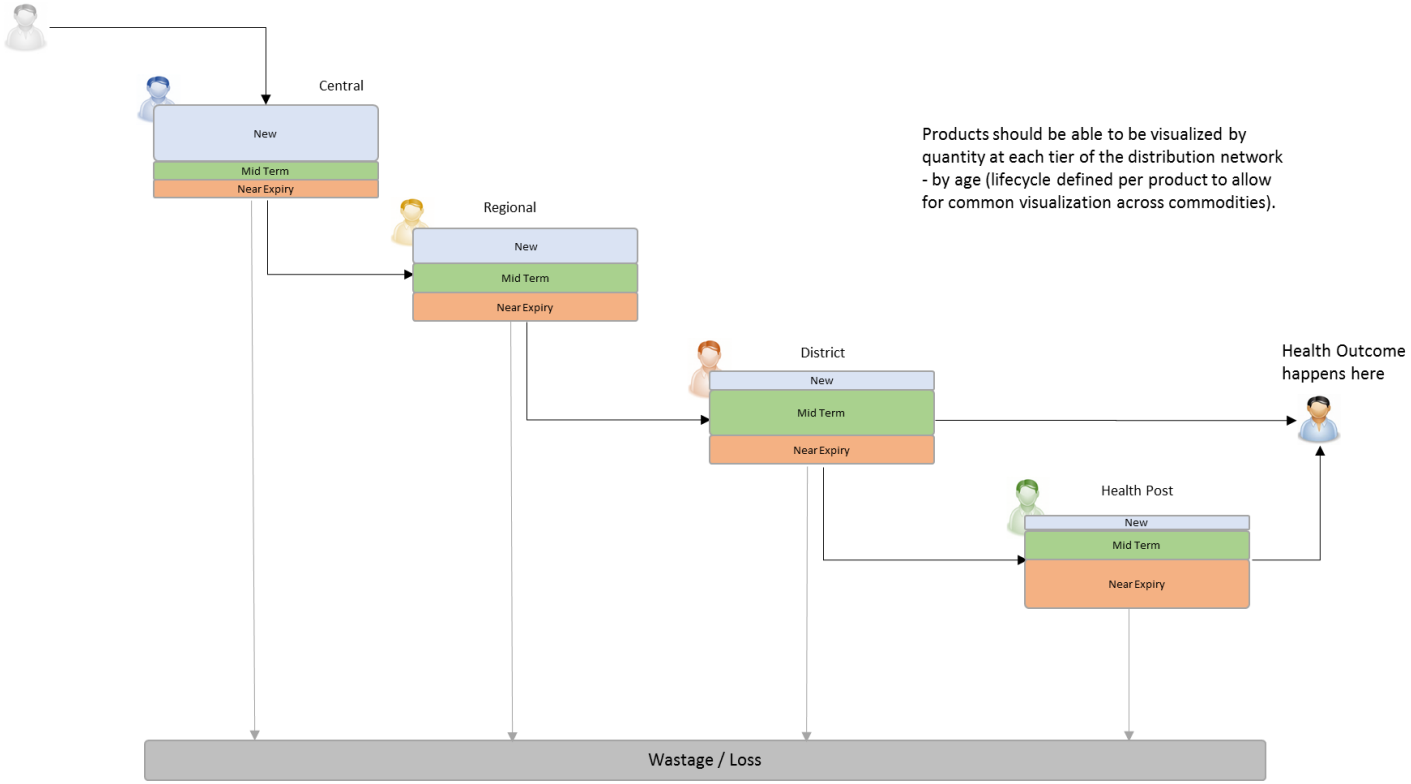


Figure 36 - Expiration Flow by Tier

The "fix" for the simulation comes in two steps. **One** – change the rules that allow for visibility for both stock and flow. **Two** – shift the decision making function away from risk-based / hoarding behaviors by either automating the rules or enabling coordination stock and actively developing operational trust.

Regional Approach

Complete an entire Region before moving on to the next one and do so within the quarterly / bi-annual cycle as this affects the reporting and ordering process. At a minimum, this would mean an average of 18 District warehouses to perform an auction / cleaning / training inside of a six-month period. The reason for this is to drive success early and create stronger demand from other Regions to be the next one selected.

Regional warehouses are an under-utilized resource that could be leveraged for assessing the state of the District warehouses they provide for. Since the commercial trucking companies will not be trained in warehouse management, nor can we place mobile application requirements on them, one alternative is to supply each Regional with a single truck to service micro pull requests. These drivers would then have a requirement to deliver and photograph the District warehouses once every six months. If these drivers were trained in the best practices of physical warehouse management, then this provides an excellent feedback and sensing mechanism to indicate when a particular District warehouse is beginning to struggle.

Leverage Allies

The Agile Program Management Governance structure is well suited for Nepal. It works well to build allies and to keep multiple stakeholders engaged in the process. The "Demo Days" that happen every eight weeks are a key marketing opportunity to pull together competing perspectives, gather feedback, and provide incremental training and awareness development.

For implementation, pick initial commodities by Program lines to create strong allies / drivers inside the MoH for adoption. The best course of action would be to partner with two MoH Programs and have these Directors on the Steering Committee right from the beginning and combine some of the incentives from the EDP community to match.

Connecting with the HFMOC will be key. This creates an accountability loop between the HPW, the District storekeeper, and the DPHO and works to convert the stock into "community stock." I would strongly encourage a strong line of communication and invitation to each "Demo Day" for The Health for Life (H4L) Project and HFMOC representation.

The level of data literacy is fairly low, so attention should be placed on the development of compelling graphs that help tell the story of the state of the supply chain in a way that is relevant to each stakeholder. Report development to help the MoH see and adjust on its own will be a central key to the sustainability of the program.

Localization Development Challenges

Of the things that drive expense in software development for Nepal the following are key:

1. **Nepalese language support** – the two critical areas for this are on data entry for the HPW and on Report Headings. It would also be helpful if report and menu headings onscreen could also be translated. For most modern, well-designed software this is a fairly straightforward task.

2. **Nepalese Vedic Calendar support** – the key issue here is handling this for data entry vs. display. It is assumed that dates will be stored in Gregorian calendar format and then an additional field added to display in Vedic format. The key is whether data entry has to be done in Vedic. What we have found is that other NGOs are simply providing their staff with calendars and entering in Gregorian.

3. **Nepalese Fiscal Year support** – this is perhaps one of the more difficult items to consider when working with ERP capabilities and has the potential to drive substantial cost and time into development to be able to accommodate it effectively. At this stage, the recommendation is to only attempt to manage the contract development process and not the full financial transaction due to the increase in complexity. However, if Central Bidding / Local Purchasing were to become a design requirement then this will need to be tackled in order to create a system with the appropriate checks and balances in place to prevent abuse.

Connectivity

Connectivity is a challenge in Nepal and in taking a long-term view of the problem, here are four things to consider:

1. Development and deployment of this solution should be run through a Bandwidth Throttling tool to test for the latency response. (See http://www.measurementlab.net/ for examples.) In this manner, it is possible to understand the experience for the remote locations before starting to train them and make adjustments in advance.

2. Begin mapping the state of cellular and wireless communications throughout the country by adding a mapping applications to drivers with smartphones. (See stumblr and Mozilla location service https://location.services.mozilla.com/map#2/15.0/10.0 for examples.)

3. There are some very interesting examples of rural connectivity efforts happening around the world. Perhaps the most relevant for this context is Rhizomatica (https://rhizomatica.org/), which leverages a community based co-op model. This works very well in areas that have a highly collaborative culture and there are possible applications in the hill and mountain regions where the national carriers are not finding it cost effective to expand services.

4. Even with connectivity being limited, there has been an explosion of usage throughout the country, with mobile usage having expanded five-fold since 2011. (See: http://www.internetworldstats.com/asia.htm showing 18.1% of the population using Facebook and http://tech.aakarpost.com/2014/08/facebook-users-in-nepal.html for preferred device choices and https://www.budde.com.au/Research/Nepal-Telecoms-Mobile-and-Internet.html?r=51 for the growth rate of the telco/ISP market.) Facebook appears to be the most commonly used application and showcases that if a system is designed to be simple enough the users can actively engage deeply with minimal training.

Additional Reading

1. MIT simulation on how supply chains respond with and without visibility into stock status throughout
   a. Information: http://supplychain.mit.edu/supply-chain-games/beer-game/ and https://en.wikipedia.org/wiki/Beer_distribution_game
   b. Run a simulation: http://www.runthemodel.com/models/507/
   c. Impact of risk-based decision making (hoarding) on the model

2. Logistimo – Improving Performance of Rural Supply Chains Using Mobile Phones
   a. Reducing Information Asymmetry to Improve Stock Availability in Low-resource Environments

3. LEAN Supply Chain and Logistics Management

Appendix

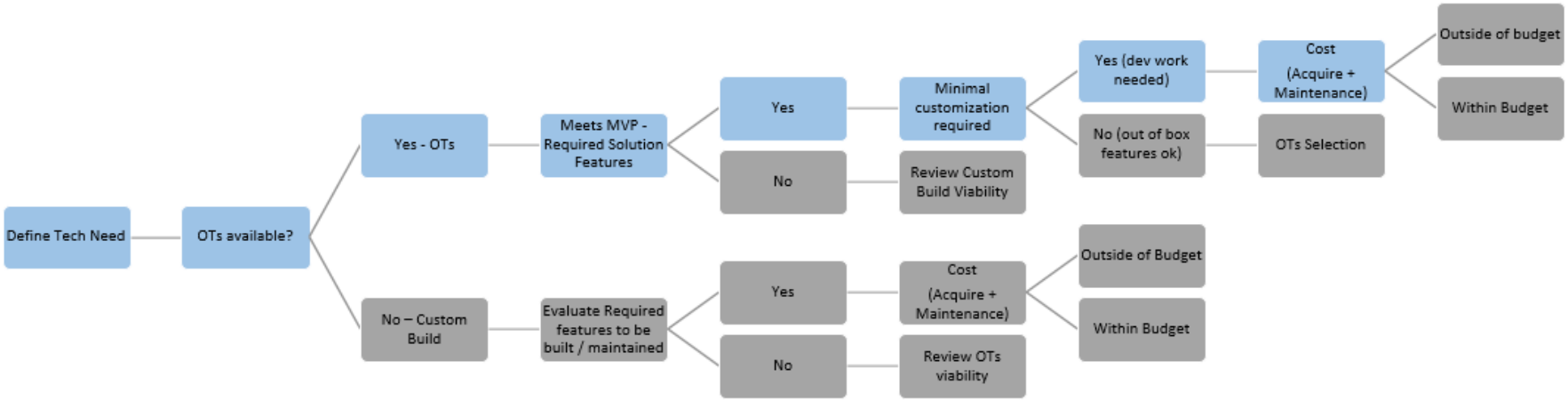
Decision Tree on Build vs. Buy

Key Differentiators

Operational Model
Technical Stack
Vendor Availability
Sustainability / Cost
Country Readiness to Leverage

Key Technical Capabilities

Hosting Model
Visualization (Native / External)
User Experience (UX)
Access / API
Ease data extraction

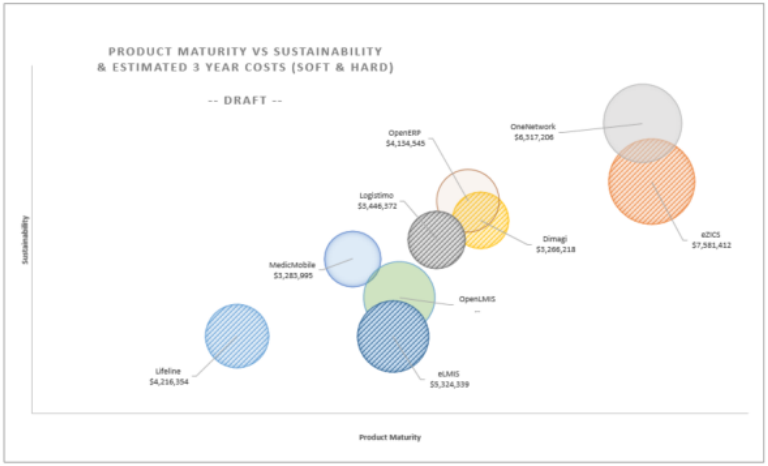


OTs = Off-the-Shelf (open source is acceptable, the focus is on viable software & firms that have a market ready solution vs. the need to custom build)

Figure 37 – Decision Tree on Buy vs. Build

Product Comparison

WHAT FEATURES AM I BUYING?

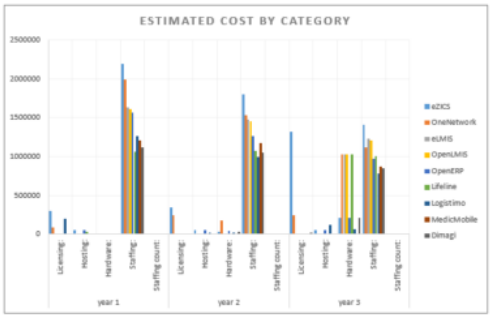


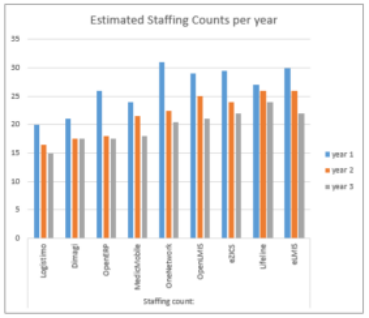
Scoring: 0 = unknown/NA; 1 = development resources required; 3 = base functionality available; 9 = good offering and/or core strength

Average of Score	System								
Category	eZICS	OneNetwork	Dimagi	OpenERP	Logistimo	OpenLMIS	eLMIS	MedicMobile	Lifeline
Simplicity									
Simple SysAdmin	3	3	9	9	9	3	1	9	1
Simple UI	9	3	9	9	9	3	3	9	3
Tech Stack / configuratior	3	9	9	9	9	3	1	1	1
Technology Governance	3	9	9	9	3	9	1	1	0
Mobile / Offline	9	3	9	3	9	1	1	9	0
Procurement Mgmt									
Contract / Tender develop	0	3	0	3	0	0	0	0	0
PO process	3	9	0	9	0	0	0	0	0
Warehouse Mgmt									
MDM	3	9	1	1	1	1	1	0	1
Approval	9	9	9	3	1	3	3	1	0
Batch / scan	9	9	3	1	1	3	3	0	1
ReOrder point	9	9	1	3	3	3	3	0	3
Store / location	9	9	1	9	1	1	9	0	0
Commodities Scale up	9	9	1	3	3	9	9	0	3
Transport Mgmt									
Delivery tracking	3	3	1	1	1	1	1	0	0
Notification	9	9	9	1	3	3	3	3	0
Routing	9	9	1	3	3	1	1	0	0
Service / Inventory Mgmt									
Equipment / Maint. track	9	9	1	3	1	9	9	0	1
Inventory count	9	3	3	3	3	9	9	3	3
Receive	9	3	9	3	9	3	3	9	0
Request	9	3	9	3	9	3	3	9	0
Planning Mgmt									
Quantification	0	0	0	0	0	0	0	0	0
Forecasting	9	9	1	3	3	1	3	0	0
Reporting / Baseline	9	9	3	3	3	3	3	3	3
Average of Score	**7**	**7**	**4**	**4**	**4**	**3**	**3**	**2**	**1**

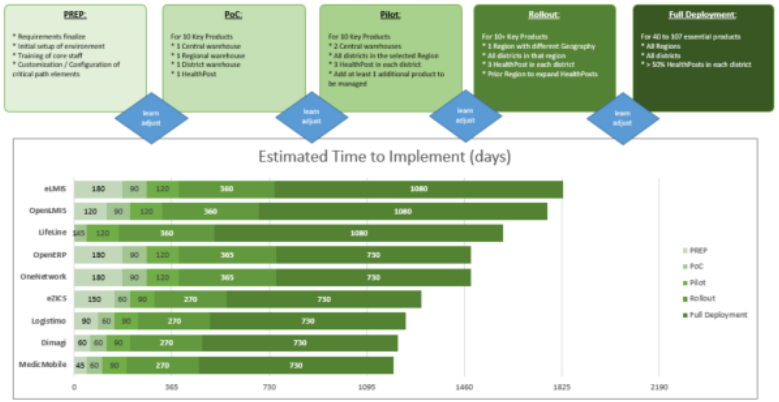
HOW MUCH DOES IT COST?

Category	System eZICS	OneNetwork	eLMIS	OpenLMIS	OpenERP	Lifeline	Logistimo	MedicMobile	Dimagi
year 1									
Licensing:	$ 295,960	$ 90,000	$ -	$ -	$ -	$ -	$ 200,000	$ -	$ 1,800
Hosting:	$ 50,000	$ -	$ 14,400	$ 14,400	$ 50,000	$ 30,000	$ 9,000	$ 7,200	$ -
Hardware:	$ 6,430	$ 12,700	$ 12,700	$ 5,700	$ 12,700	$ 12,700	$ 13,720	$ 4,440	$ 7,330
Staffing:	**$ 2,195,302**	**$ 1,990,296**	**$ 1,634,661**	**$ 1,611,142**	**$ 1,562,422**	**$ 1,061,064**	**$ 1,266,458**	**$ 1,212,868**	**$ 1,118,793**
Staffing count:	30	31	30	29	26	27	20	24	21
year 2									
Licensing:	$ 342,800	$ 250,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,970
Hosting:	$ 50,000	$ -	$ 14,400	$ 14,400	$ 50,000	$ 6,000	$ 19,800	$ 10,800	$ -
Hardware:	$ 37,050	$ 180,400	$ 1,900	$ 1,900	$ 37,950	$ 1,900	$ 23,950	$ 12,850	$ 37,350
Staffing:	**$ 1,804,153**	**$ 1,530,276**	**$ 1,476,455**	**$ 1,456,295**	**$ 1,268,145**	**$ 1,069,800**	**$ 999,299**	**$ 1,168,973**	**$ 1,054,737**
Staffing count:	24	23	26	25	18	26	17	22	18
year 3									
Licensing:	$ 1,318,500	$ 250,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 24,000
Hosting:	$ 50,000	$ -	$ 14,400	$ 14,400	$ 50,000	$ 6,000	$ 120,000	$ 14,400	$ -
Hardware:	$ 207,500	$ 1,022,850	$ 1,022,850	$ 1,022,850	$ 208,850	$ 1,022,850	$ 65,850	$ 13,450	$ 207,950
Staffing:	**$ 1,404,217**	**$ 1,121,938**	**$ 1,224,727**	**$ 1,204,566**	**$ 976,748**	**$ 1,005,963**	**$ 777,492**	**$ 871,567**	**$ 843,847**
Staffing count:	22	21	22	21	18	24	15	18	18
Grand Total	**$ 7,761,988**	**$ 6,448,534**	**$ 5,416,571**	**$ 5,345,728**	**$ 4,216,877**	**$ 4,216,354**	**$ 3,495,620**	**$ 3,316,611**	**$ 3,298,834**





HOW SOON DO I GET IT?



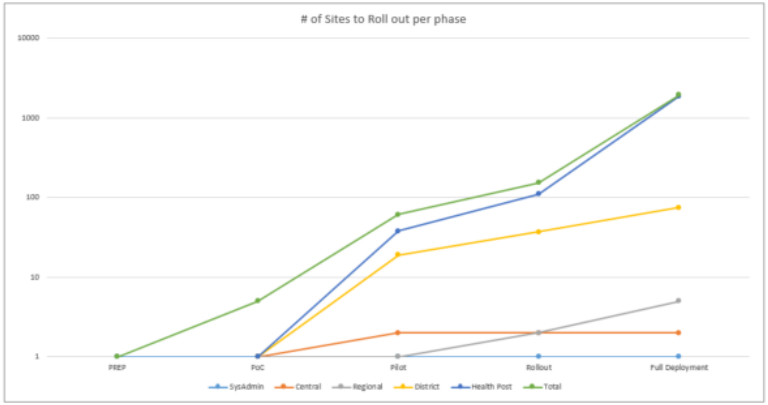


Figure 38 – Overall Product Comparison

Supply Chain Product Comparison

	Lifeline	eZICS http://www-03.ibm.com/software/products/en/warehouse-management	OneNetwork http://www.onenetwork.com/
System			
Software Licensing	OpenSource*	Tiered per user type and system per cpu	Per user / per transaction / per month
Hosting / Hardware	Local Servers	IBM Hosting Provider	Cloud Based
Tech Stack	*AMP	Java	Java
Client			
mobile	TBD	mobile client	TBD
laptop	web based	web based	web based / spread sheets
Development			
Customization	TBD	Moderate-Hard	Moderate-Hard
Configuration	TBD	Moderate	Moderate
Integrations	TBD	Moderate-Hard	Moderate
Vedic Support	Yes	Pending	Pending
Training			
Simplified Interface	TBD	**Easy**	Moderate-Hard
Time to Implement (days)	Lifeline	eZICS	OneNetwork
Prep	1	150	180
PoC	45	60	90
Pilot	120	90	120
RO	360	270	365
FC	1080	730	730
Rating	Lifeline	eZICS	OneNetwork
Maturity	0.9	6.7	6.5
Sustainability	2	6	7.5
Strength Points			
	Locally developed Already in progress	**Mobile client simplified** **Mobile client has 'baton' capability in dev** **Pull / Informed Push capable** **Batch / scanning capability well defined** **Additional capabilities already present** Has a developed API	**Great PO and workflow process** Already have integrations with DHIS2 **Additional capabilities already present** Upgrades / feature enhancements easy **SaaS based** Has a developed API
Sustainability			
	Long term sustainability in question	Commercial grade	Commercial grade
Key notes			
	UNICEF continues funding Viable for IMS Training challenge at District Level Connectivity Mobile scanning in development Upgrade cycle to be considered	Hosting would be in Nepal by IBM partner Integrations via mQueue will require outside development **Upgrade cycle to be considered**	**Not designed for Mobile / limited access** **Best used in good infrastructure conditions** **Complicated / heavy training required** **Licensing risk in being negotiated to commercial rate**

Supply Chain Product Comparison - continued

		Dimagi commcarehq.org	Medic Mobile http://medicmobile.org/	OpenLMIS http://openlmis.org/
System				
	Software Licensing	Per user / per month	Open Source	Open Source
	Hosting / Hardware	Cloud Based	Hosted options available	Would need a hosting provider
	Tech Stack	Java	Feature Phone / web	Java
Client				
	mobile	mobile client	mobile client	In Development
	laptop	web based	web based	java / some offline capability
Development				
	Customization	**Easy**	**Easy**	Moderate-Hard
	Configuration	**Easy**	**Easy**	Moderate
	Integrations	**Easy**	**Easy**	Easy-Moderate
	Vedic Support	Yes	Yes	Vedic support possible via manual scheduling
Training				
	Simplified Interface	**Easy**	**Easy**	Moderate
Time to Implement (days)	Dimagi		Medic Mobile	OpenLMIS
	Prep	60	45	120
	PoC	60	60	90
	Pilot	90	90	120
	RO	270	270	360
	FC	730	730	1080
Rating	Dimagi		Medic Mobile	OpenLMIS
	Maturity	4.3	2.5	3.1
	Sustainability	5	4	3
Strength Points				
		Fast deployment **Free version in use in Nepal** **Additional capabilities already present** Training integrated with platform Has a developed API	Fast deployment **Already present in Nepal / staffed HQ** **Upgrades / feature enhancements easy** Upgrades / feature enhancements easy Has phone credit / payback with NTC Can work with personal phones	Growing community **Informed Push model in use in Mozambique** Over 1,000 users already / leveraging current phones
Sustainability				
		Commercial grade		**Long-term sustainability in question**
Key notes				
		Key issues with scaling to 100+ products	**Key issues with scaling to 100+ products** Not a structured platform; will require customization Has no real IMS capabilities	**Significant risk with v3.0 rewrite and timing of features** Not a strong IMS - would be better to partner Upgrade cycle to be considered

Supply Chain Product Comparison – continued

	eLMIS http://c.lmis.gov.pk/	OpenERP https://www.odoo.com/page/warehouse	Logistimo http://logistimo.com/
System			
Software Licensing	Open Source	Open Source - License for Apps	Onetime per user cost
Hosting / Hardware	Would need a hosting provider	SaaS / Hosted	SaaS / Hosted
Tech Stack	*AMP	*AMP	
Client			
mobile	TBD	mobile client	TBD
laptop	web based	web based	web based
Development			
Customization	Hard	Moderate	Hard
Configuration	Moderate	Easy-Moderate	Moderate
Integrations	Moderate-Hard	Easy-Moderate	Easy-Moderate
Vedic Support	**Requires development**	No	**Requires development**
Training			
Simplified Interface	Moderate	Easy	Easy
Time to Implement (days)			
Prep	180	180	90
PoC	90	180	90
Pilot	120	180	90
RO	360	180	90
FC	1080	180	90
Rating			
Maturity	3.0	4.1	3.7
Sustainability	2	5.5	4.5
Strength Points			
	Solid data model	Easy to use Development Community Has a developed API Community version (free) could be leveraged for Tenders	Easy to use **Developed in India / success in Himalaya region** **Mobile / Web optimized for low bandwidth / resources** Can work with both feature / smartphones & personal phones Has a developed API
Sustainability			
	Long term sustainability in question		
Key notes			
	Would take a lot of development time to prepare for Nepal Lack of Open Source documentation / implementer guides	A customized version is being developed by PossibleHealth This customized version is leveraging Dimagi / MOETECH Right now only supports EAN-13 and can read 1d images only **No support for Nepal Calendar / Fiscal year**	Development issues with Vedic calendar Lack of Open Source documentation / implementer guides Barcode scanning on roadmap

Acronyms

DHIS2	District Health Information Software 2
DPHO	District Public Health Officer
EDP	External Development Partner
eLMIS	electronic LMIS
ETL	Extract – Transform – Load
GoN	Government of Nepal
H4L	The Health for Life Project
HPW	Health Post Workers
HFOMC	Health Facility Operation and Management Committees
ICT	Information and Communications Technology
IMS	Inventory Management System
KPI	Key Performance Indicator
LMD	Logistics Management Division
LMIS	Logistics Management Information System
MDM	Master Data Management
MoH	Ministry of Health
PSM	Procurement and Supply Management
SaaS	Software as a Service
SK	Stock Keeping Unit
UNDP	United Nations Development Program

Glossary

Operational Expense	**OpEx**	Money a company spends on an ongoing, day-to-day basis in order to run a business or system
Capital Expense	CapEx	Money invested by a company to acquire or upgrade fixed, physical, non-consumable assets, such as buildings and equipment or a new system
Master Data Management	MDM	The process of defining, tracking and distributing definitions and key attributes for an organization
Back End		Systems involved in processing and storing data for an organization
Front End		Systems involved in presenting interface for users to perform their work
Middle Tier		Systems involved in providing integration services between the Front End and the Back End as well as other systems
Application Programming Interface	API	Application Programming Interface: a method of providing integrations between systems.
Agile Program Management		Iterative, incremental method of managing the design and build activities of engineering, information technology and other business areas that aim to provide new product or service development in a highly flexible and interactive manner
Demo Days		A scheduled occurrence at the end of each iteration to demonstrate the work of the teams to the Product Owner(s) and Stakeholders.
Production Ready		Work is developed to be capable of being released to "Production" at the end of each iteration. It can be queued up over the course of several iterations before finally being moved to production.
Product Owners	PO	The product owner represents the stakeholders and is the voice of the customer, who is accountable for ensuring that the team delivers value to the business. The product owner writes customer-centric items (typically user stories), ranks and prioritizes them, and adds them to the product backlog.