Evaluation of DRMFSS commodity tracking databases

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Executive summary

- WFP requires reports for four main items: dispatches, food distribution, actual stock levels and food losses. The current DRMFSS systems can report only on dispatches and planned distributions and they cannot be easily extended to cover actual distributions, stock levels or losses. They do not record planned versus actual movements and the system is not double entry and does not use double dates. Adding these features would not be easy and would require significant work. Other functionality such as loans and swaps is not offered either.

- Extending the existing systems is only a tactical short-term approach that will not provide the overall functionality required. A long-term strategic choice that offers better functionality and extensibility than the RMS + ITSH systems is to create a new system based on a low-end ERP system

- The main recommendation is to develop and customise a low-end ERP system using a development partner. If possible, this should be a local or nearby partner familiar with both the product and working conditions in Ethiopia. An obvious commercial package choice would be Microsoft Dynamics AX or NAV. If an open-source package is preferable in terms of licensing costs then OpenERP would be a candidate.

- There is a need to change and enforce business processes in order to gain the benefits of either the existing or new systems, particularly around distribution and utilisation data capture and reporting. This is covered by FMIP Pillar 3.

- Estimated timescales (for budgetary purposes only and based on UK experience) would be 6-9 months with a team of 4-5 people to provide a workable first system. Additional functional upgrades could then be added over time if the system is used to handle other food aid distribution. These figures are relatively conservative and assume a fairly short requirements gathering and analysis phase as there are existing systems in place. Caution should be exercised to prevent scope creep expanding the project until after the initial implementation.

1 Overview and background

The Ethiopian Government has an agency called Disaster Risk Management and Food Security Sector (DRMFSS) that coordinates the distribution of food aid throughout Ethiopia. The World Food Programme (WFP) provides food aid to Ethiopia. DRMFSS has a combination of manual and computer systems to facilitate this process. WFP has requirements to report to its donors how much food is distributed, where and to whom. DRMFSS is not currently able to provide such information to WFP easily (leading to withheld payments to DRMFSS) and WFP has suggested that a new computer system would help as well as allowing DRMFSS to manage their processes better. DRMFSS believes that their current processes and systems are adequate. The two parties agreed to commission this independent third-party report to comment on the suitability of RMS and to advise on the best way forward.

DRMFSS and WFP created a project called the Food Management Improvement Project (FMIP). This project has three "pillars". The first pillar's aim is to gather data to produce reports to WFP for 2007 to 2009. The aim of the second pillar is to produce a new commodity tracking system and this report forms an integral part of Pillar Two. Pillar Three focuses on building capacity and capabilities within the food distribution process.

This report is based on interviews with both DRMFSS and WFP staff and visits to warehouses during a five-day visit to Ethiopia at the end of December 2010.

2 Overall requirements and business context

2.1 Business process, physical and data flows

Figure 1 below illustrates the flows of the overall process.

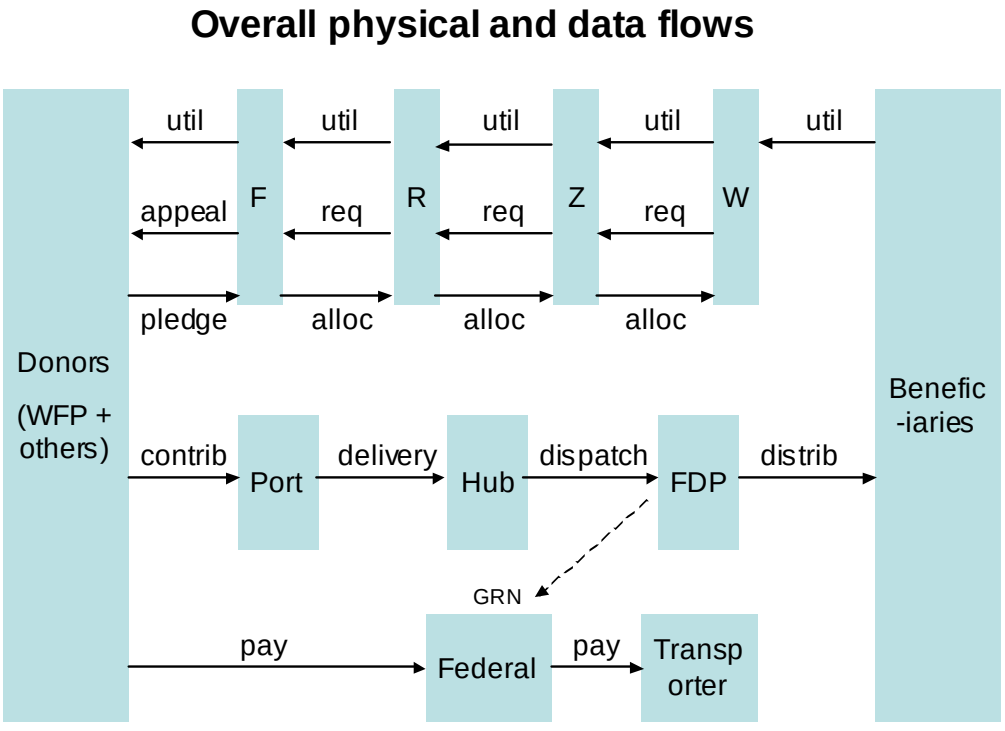

Figure 1 – overall physical and data flows

(F, R, Z and W stand for federal, regional, zone and woreda (district) level respectively). Requisitions – assessments of food needs – are created at the woreda level and move up the hierarchy to the regional or federal level where they are formed into an appeal to a donor for food. A pledge for some amount of food is made by a donor and allocated accordingly. Food shipments then arrive at ports (Djibouti being the main port of entry for food aid to Ethiopia) and are moved to warehouses at hubs. These hubs then dispatch food to final distributions points (FDPs) where it is distributed to the intended beneficiaries. Reports of these distributions are gathered and formed into reports known as utilisation reports. Payments are made in three trenches of 70%, 20% and 10% by WFP to DRMFSS triggered on delivery to DRMFSS, delivery to the FDPs, and distribution to beneficiaries, respectively. DRMFSS is responsible for paying transport companies for in-country shipments and these are based on goods receiving notes (GRNs) authorised by government officials at the FDP or woreda level.

2.2 Functional requirements

There are a number of key pieces of functionality that this food distribution system should provide:

- commodity shipping and tracking (custody chain)
- traceability of food back to the original donation
- food requests, pledges and allocations
- links to financial systems for payments to and by the government
- handling of multiple warehouses, both government and those run by WFP and NGOs
- food loans and swaps (food reserves)
- actual stock levels and physical inventory counts
- reporting and visibility across the whole supply chain, particularly of distribution to beneficiaries

A more detailed table of high-level functional areas (Table 2) is given in the gap analysis section. This list of functional areas is similar to most supply chain execution and management systems (see 2.4). The primary differences are that the number of products and donors is small (tens) and there is less emphasis on supply-chain planning or optimisation.

2.3 Architectural constraints

The system will need to operate in a very different environment from a typical Western business environment, both culturally and technically. One of the primary constraints is that there is limited communication with the woredas and the FDPs. Some woredas have telephone connectivity, some are going to be linked to WoredaNet (a government networking initiative), some may gain connectivity via satellite as part of the NOMAD project or via the use of PDAs, but some have no electronic connectivity at all. This makes tracking and tracing difficult and means that there are long delays in obtaining information, making it difficult to correct problems quickly. Any system will have to be able to combine online real-time information with data that is keyed in much later.

Another constraining factor is the level of written and computer literacy, particularly at the point of distribution (food distribution uses fingerprints instead of signatures as a form of receipt).

Overall system costs for development, hosting, operations and software licensing should also be kept low where possible as well as technical complexity. This precludes the use of high-end commercial packages for supply-chain execution and management because of high licensing fees, expensive consulting services and high technical complexity levels.

2.4 Similarity to other supply chain systems

The overall food distribution and monitoring systems are structurally analogous to systems used in commercial retail environments. This similarity is more obvious if the terms used in the current process are renamed to those used in a commercial system:

DRMFSS systems	Commercial retail systems
Requisition	Sales forecast
Appeal	Request for quotation (RFQ)
Pledge	Confirmed purchase order
Allocation	Range planning and stocking
Delivery and dispatch	Shipment
Distribution	Sales order
Utilisation report	Sales report
Loans and swaps	Rentals

Table 1 – translation of terms

Given this structural similarity, it is likely that a commercial off-the-shelf (COTS) package could be tailored to meet DRMFSS's requirements rather than having no choice except to build their own systems. In other words there is a valid "build versus buy" decision to be considered.

3 Gap analysis

The RMS system is only one of the systems that DRMFSS uses. One other system that needs to be included in this assessment is ITSH (named after the 70/20/10% "internal transport, storage and handling" payments received by DRMFSS). This system records the payments linked to the GRNs presented by in-country transport companies. RMS provides only the planning of dispatches and does not record the arrival of food at the FDPs, so unless ITSH is included as well there is no way to track whether food shipments have arrived at all.

Figure 2 shows how the current RMS + ITSH systems cover the overall business process. The main gap is the utilisation reports. It is not clear whether the distribution reports from RMS relate to planned or actual distributions; the assumption here is that they are plans (see 3.1 below).

Some areas where the current systems and processes could be improved are given below.

3.1 No clear distinction between plans and actuals

A major part of any tracking system is to distinguish between what was planned and what actually happened. RMS is primarily a plan-based system – what is supposed to happen – and has only certain elements of tracking of what actually did happen. For instance, it is not clear whether the distribution reports in RMS are of what was planned based on allocations or whether they capture the physical paper distribution records created at FDPs (the data model does not make this clear either). Also, only calculated stock levels are reported and not actual stock levels (there appears to be no mechanism for updating actual stock levels based on physical counting). However, ITSH does distinguish between what was dispatched and what did arrive on the GRN. Reporting on actual deliveries is what is required by donors and the differences between plans and actuals are important for the overall management of food distribution.

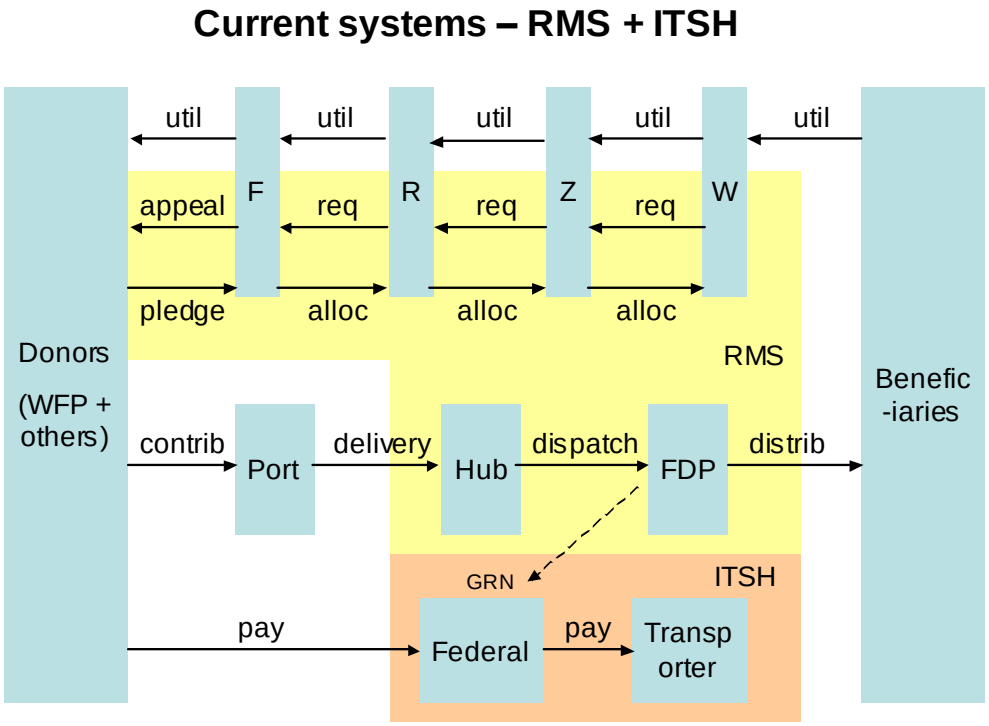

Figure 2 – current RMS and ITSH systems

3.2 Not double entry

Most commercial supply-chain software, accounting or ERP[1] packages use double-entry accounting based on a general ledger system. This provides a strong cross-check and means that no money or items can be created or destroyed within the system – everything is accounted for as transfers between accounts. RMS and ITSH are not double entry systems. This means that it is not possible to check for errors in the system itself or for data errors. Having a ledger-based system would make it much easier to automate payments both to and from the government with a strong audit trail. Also, additional functionality such as loans and swaps will be easier with an accrual-based approach, as would custody chain tracking (who is responsible for what during transport).

3.3 Not double dated

Most commercial supply-chain systems will store two timestamps: one is the time that the information is valid (the value date) and one timestamp for when it was recorded (the transaction date). This is essential for loans and swaps (information is recorded now about future transactions to repay a loan, for instance) and also important because of the length of time it takes for information to move across a large country using paper (such as paper distribution reports).

3.4 Limited forward visibility of deliveries (ASNs)

Currently, the regions are informed by letter when food is dispatched from a warehouse. There is a delay while the letter is in transit to the regional office and then there is a further

[1] ERP systems are enterprise resource planning systems. They are software systems used to automate and integrate business processes ranging from order management through customer relationship management, human resources, case management, etc. SAP and Oracle are well-known high-end ERP systems but there are low-end alternatives that are smaller and cheaper such as Microsoft Dynamics or OpenERP.

delay in communicating the expected arrival to the woreda. Because of these delays, woredas and FDPs have little or no warning of food arrivals. They also therefore are not able easily to report that a dispatch has not arrived in a reasonable time, making correction of errors (incorrect addresses) or losses difficult. A suggestion would be to send a fax automatically on dispatch to those woredas that have phone lines so that they have near real-time information about expected arrivals. These notices are usually referred to as advanced shipment notes (ASNs).

A similar issue occurs in what is referred to as the "national pipeline". DRMFSS would like to have forward visibility on shipments before they arrive at the port to allow them to plan better.

3.5 Notification of arrival (GRNs)

Similarly to the faxing of ASNs to woredas, goods receiving notes (GRNs) could also be faxed back to an office (probably at one of the hubs) to be entered into the system. This would provide more up-to-date information about arrivals and help with tracking and correcting any mistakes. It would also allow the GRNs to be checked against what was dispatched and to where, providing information about losses and triggering payments to transporters.

3.6 Stock levels

There is some basic stock level reporting in RMS. This shows only the calculated stock level based on shipments in and out and not actual physical stock levels. There appears to be no functionality to allow for updating of stock levels based on annual stock counts and therefore no way of reporting on actual stock levels or warehouse losses.

3.7 Missing traceability data

The ability to trace the origin of any food item back to the donor and the original shipment is currently impaired by two breaks in the data chain. The first break occurs when a delivery arrives at the hub it currently is missing the shipment information (bill of lading). The second break occurs when food is allocated to FDPs, as there is no means for specifying which shipment each allocation comes from. All of the necessary information exists but is not available at the relevant point in the process.

3.8 Limited extension and customisation capabilities

The only obvious extension mechanism of the current systems is the use of Crystal Reports[2] to produce reports. New screens or functionality have to be hand-coded in ASP.NET and SQL with no tools or frameworks. There are no obvious ways to add in new functionality, such as notifications via email or fax, links to external systems via web services, etc.

3.9 Data validation

The lack of double entry accounting means that data errors can easily accumulate. Also, there appears to be limited validation on data entry. Having shared key data with other systems (such as importing a list of shipping instructions, shipment references, etc) would allow for better validation of trace data.

[2] Crystal Reports is a commercial software package used to produce reports from databases. It allows developers to focus more on the content of the report by providing formatting functionality

3.10 Lack of shared understanding of system capabilities

DRMFSS and WFP do not have a common understanding of DRMFSS's systems, leading to confusion about what is and what is not possible currently. Until recently, WFP were not aware of the existence of the ITSH system at all.

3.11 Functional gap summary

The first column of Table 2 shows how the current systems (RMS + ITSH) map to a selection of common functional areas that would be normal to have in a logistics and supply chain management solution. These areas have been enriched with functionality specific to food aid distribution (such as utilisation reports). The second column shows the increase in functionality that could be achieved by extending the current systems and making some simple business process changes (such as the use of faxes). The third column shows what could be achieved using a new fully-integrated system.

	RMS + ITSH now	RMS + ITSH with extensions	New system
Traceability from bag back to donor	Missing bill of loading and allocation links	1) Add bill of loading to inbound donor receipts at hubs 2) Maintain link to shipment when allocating	(Will require same linking information)
Tracking of logistics custody chain	Provided by ITSH tracking of GRNs when entered (may take up to 2 months)	Provided by ITSH tracking of GRNs when entered (could be faxed from woreda)	Would require GRN notification (fax from woreda)
Tracking of actual receipts against what was sent	Provided by ITSH tracking of GRNs when entered (may take up to 2 months)	Provided by ITSH tracking of GRNs when entered (could be faxed from woreda)	Would require GRN notification (fax from woreda)
Allocation linking	Missing link from allocation to shipment	Maintain link to shipment when allocating	Maintain link to shipment when allocating
Stock levels	Expected levels only in RMS + ITSH	Expected levels only in RMS + ITSH	Expected stock levels based on movements plus physical stock count updates
Inbound shipment visibility	One-week notification from port system, nothing at woreda level	One-week notification from port system, fax ASN to woreda	One-week notification from port system, fax ASN to woreda
Anomaly detection	Not available in RMS + ITSH	Not available in RMS + ITSH	Anomaly reporting
Audit	Only at document level with little tracing information	Only at document level with little tracing information	Full traceability
Linking of common data across systems	Some shared data between RMS and ITSH	Some shared data between RMS and ITSH	Fully integrated system
Linking of shared keys across systems	None	Provide a list of issued SIs to RMS+ITSH and enforce their use	Fully integrated system
Utilisation reports	Not available in RMS + ITSH	Not available in RMS + ITSH	Fully integrated system
Loss reports	Not available in RMS + ITSH	Not available in RMS + ITSH	Automatic preparation

Key	
	No functionality
	Partial functionality
	Full functionality

Table 2 – gap analysis

This table shows that in order to achieve DRMFSS's long-term goals and to be able to manage and report the types of information requested by donors such as WFP then a new system should be considered. Attempting to migrate current systems to achieve this is unlikely to succeed given their current architecture.

4 Implementation options

There are a number of possible implementation choices going forward.

1) Status quo (retain RMS + ITSH as-is)
2) Extend RMS + ITSH plus some process extensions
3) New integrated system
   a) Build from scratch
   b) Build using standard web frameworks
   c) Build using model-based frameworks (Ruby on Rails, Grails, Symfony, etc)
   d) Use a low-to-medium range ERP (OpenERP, MS Dynamics NAV, etc)
   e) Use a commercial supply-chain package (JDA, Manhattan, Red Prairie, etc)

Of these, the status quo option is not worth pursuing as there is no clear agreement between DRMFSS and WFP as to whether the systems are fit for purpose. This lack of agreement has led to the need for this external report. At the opposite extreme, using a commercial supply-chain package is unlikely to be satisfactory from a cost and complexity point of view, so this choice can also be eliminated. This leaves options 2, 3a, 3b, 3c and 3d.

5 Selection criteria

5.1 Functional scoring

In terms of functionality, based on Table 2, the above options could be scored as below on a 1 to 5 scale (with 1 being least important and 5 being the most important) :

	Extend (2)	Scratch build (3a)	Frm/wk build (3b)	Model build (3c)	ERP (3d)
Functional reqts	3	5	5	5	5

Table 3 – functional scoring

This gives a clear indication that a new system is the preferred approach in order to meet the functional requirements.

5.2 Non-functional scoring

Other selection criteria not based on functionality also need to be considered as DRMFSS and its partners need to be able to modify, build and operate such a system. In order to assess these aspects, another scoring table is shown below (Table 4).

The scoring criteria have been weighted on a scale of 1 to 5. Similarly, each approach has been scored on a 1 to 5 range with 1 meaning that the approach offers the least support for that item and 5 means that it easily provides or supports that item. Each column's total represents the weighted sum of the scores for that approach.

	Weight	Extend (2)	Scratch build (3a)	Frm/wk build (3b)	Model build (3c)	ERP (3d)
Cost and time to implement	5	5	1	2	3	3
Low technical complexity	3	5	5	4	4	3
Learning curve - implementation	3	5	5	4	4	3
Learning curve - use	3	5	4	4	4	4
Incremental improvement	5	3	4	4	4	5
Handle mixed computer/paper solution	5	4	4	4	4	4
Local implementors	2	5	5	5	5	4
Extensibility and customisation	5	2	2	3	4	5
Technology familiarity	2	5	5	4	3	3
Specialist knowledge	4	5	5	4	4	3
Minimal external consultancy	3	5	5	5	5	4
Access control	5	1	2	3	3	5
Total		**175**	**162**	**165**	**173**	**178**

Table 4 – non-functional scoring

Using the above scoring table, the difference between the solutions on non-functional aspects is not dramatic or clear cut. If a few key strategic criteria are chosen instead of the full set – access control, incremental improvement and extensibility – then an ERP-based solution is a clear-cut choice. If, on the other hand, only short-term tactical criteria are selected instead – cost, time, learning curve – than extending the current solution would be the choice.

5.3 Selection summary

Based on the above scoring tables, an ERP-based solution offers both the best functionality and the best overall project attributes. Extending the current systems is only a tactical short-term approach and an ERP-based solution is the choice for a strategic long-term view. This sort of dilemma is common when deciding whether to replace existing systems: "is the cost, delay and disruption justified by the new functionality?" Or "can we continue to extend our current systems to meet new requirements or will it be too painful and costly?" The normal replacement frequency for business IT systems is every five or six years as requirements and technology changes. RMS is currently seven years old and there are requirements that it does not meet (loans and swaps, for example). It is therefore probably time that a new generation of systems is considered that will cater for the next seven years and that take a long-term strategic view. Continually extending current systems will not allow the leap in functionality needed to meet future demands.

6 Recommendation

The recommendation based on the above scoring tables and the need for a long-term strategic system is to build a new system based on a low-end ERP package. This would provide a number of key advantages:

- The system would be built on a solid foundation with double entry bookkeeping
- A reduced emphasis on technical implementation issues allowing for more focus on business-related functionality and reporting

- Clear extensibility and customisation mechanisms
- Clear integration interfaces for linking to other systems (such as web services)
- Modern technology with a long lifetime
- Excellent built-in security and access control mechanisms
- Built-in data management and reporting mechanisms
- Additional modules for other business areas (HR, timesheets, document management, etc)
- Financial underpinning (links to chart of accounts)
- Ability to expand to cover other forms of relief aid, including non-food aid

6.1 Overall architecture

The overall architecture of the system would be relatively simple with a centralised ERP system accessed via web pages for remote or occasional users and potentially a rich-client interface for regular users. Given the expected volumes (70,000 GRNs per year currently) then there is probably no need for multiple application servers and a single server and database combination should suffice. Some thought needs to be given to failover and backup mechanisms.

The current systems are used in Addis Ababa and not in Nazareth or any of the other hubs. For the system to be able to provide more up-to-date information its use should be extended to the hubs too. Further extensions to regional government could also be considered, and this would be greatly aided by a strong security mechanism to constrain each region to be able to access only its own data.

Faxing of ASNs and GRNs could be easily achieved using an email-to-fax gateway, both for inbound and outbound faxes. Again, this would speed up the flow of data into and out of the system. For outbound faxes, the system would generate emails that are sent to a fax server that converts the emails to a fax and sends it via the telephone system. Incoming faxes are received by the fax server and then sent as images to an email address from where they can be either processed and entered into the system or forwarded by email to the appropriate person for processing. Archiving of these emails would provide an audit trail of documents sent and received.

Using an ERP package reduces the need for a systems architect as all major functionality is in one package and system. This reduces the integration risk primarily to data integration issues.

6.2 New functionality

An ERP system provides some basic entities and functionality but this will need to be enhanced with additional application-specific features. The primary areas to add would be:

- Utilisation reports (capturing data from the paper reports gathered at FDPs)
- Food requisitions and allocation (along with traceability information)
- GRN handling
- ASNs via an email notification mechanism on dispatch

6.3 Risks

All new systems involve a certain level of risk. Some of the key risks for an ERP-based approach are:

- The functionality may potentially be limited by the ERP framework – limited in what can be programmed or customised easily. An open-source version would allow for complete customisation but at the cost of additional time and would require specialist knowledge

- It may require the renaming of fields and non application-specific terminology to fit to standard ERP data fields and screens
- ERP systems are double entry, but they may not be able to use double dates easily
- There can be a tendency to try to do too much in an initial ERP implementation, leading to scope creep, delayed projects and higher costs
- Users may reject a new system, particularly if they have not been involved in designing it and the work processes around it
- Attempting to automate poorly defined processes is unlikely to succeed
- There may be network connectivity issues when rolling out to non Addis-based users
- More complex technical support

Mitigation for these risks is primarily based on setting realistic ambitions and expectations for the system and developing it in an incremental fashion based on frequent user feedback.

6.4 Critical success factors

Key factors in a successful implementation include an emphasis on process compliance and governance – it's no good having a system if it's not used or used incorrectly – and having DRMFSS involved in the implementation process – whether doing analysis, design and test or involved in development as well. Having a partner organisation that has experience with the chosen ERP package is important too, as this will derisk the implementation and provide greater confidence in the time and cost estimates.

Driving system development based on what reports are required (both for effective management of food distribution and for donor reporting) will ensure that the primary goals of the system are met. It will also tend to reduce the likelihood of scope creep in the first iterations of the system. Starting with distribution and utilisation reports would be sensible.

The overall project management will need to include a business process change activity as well as the technology part of the solution. The difficulty of this aspect of the project should not be underestimated.

Due consideration should be given to having multiple parallel environments for production, test and development. This can usually be achieved by running parallel instances of the application on the same hardware but using different instances of the database.

7 Next steps

A rough estimate of the resources required to implement an ERP-based approach system would be 6-9 months with a team of 4-5 people. This is based on UK estimates and will need to be confirmed with local suppliers. A suitable sequence of steps might be:

1. Create a "request for proposal" (RFP) for suppliers containing high-level requirements and processes
2. Circulate and short list suitable suppliers
3. Select supplier based on commercial and technical suitability
4. Incremental implementation – prototyping approach with frequent user feedback
5. Define and plan any business process changes
6. Plan for data migration
7. Rollout system to core users
8. Rollout to non-core users

Appendix - Technical evaluation of RMS and ITSH systems

This Appendix contains technical details of the RMS and ITSH systems based on the data models, user manuals and a tour of the systems given by DRMFSS staff. The original terms of reference were to analyse the RMS system only but since payments and GRNs are handled by the ITSH system, the following comments apply to both.

1 Notes on database structure

(Only a fragment of the data model was provided so this is based on potentially incomplete information. The assumption is that only subsidiary lookup tables have been omitted and not major transactional tables.)

The first impression is of a data storage model with no obvious defined processes. Few transactional classes have times or dates so they are unlikely to be able to record and therefore report on events within the business process. It is unclear whether the information stored is historic or planning information, which will make reconciliation difficult (plans v. actuals) as well as auditing of shrinkage, misappropriation and write-offs (sent v. received). Dates, where there are any, are stored as single dates only so there is no notion of value date v. recording or transaction date. This makes handling features such as loans and swaps difficult, as there appears to be no way to deal with accrual-based future transactions. Some tables have just a date field, some have date and month and yet others have date, month and year. The data model is only single entry and not double entry which makes checking the integrity of the database difficult as values can be created, destroyed or omitted without any cross checks being possible.

The main transactional tables are split into header and details tables. This is a common pattern used when a transaction such as an order has multiple lines – the header row contains the delivery address and the detail rows contain the individual items. RMS and ITSH use this pattern frequently but the one-to-many header-detail relationship in data is actually in only a few tables; mostly header-to-detail usage is one-to-one. This adds complexity to the system for data entry, viewing and reporting for little benefit.

The database uses reasonable naming conventions with foreign keys easily identifiable. There are, however, a lot of foreign-key relationships that create a very dense structure (some tables have eight foreign keys). Often links are between detail tables and not to header tables, again increasing the density of links. A more normal approach would be to have header tables linked to indicate the flow of events in the business process. These extra links appear to be included in order to provide traceability of shipments back to the request for food (called a requisition) giving the impression of a plan-based system rather than an execution-tracking system.

The links in the RMS data model do not appear to follow the main flow of data as shown in Figure 1. Pledge is a central table with lots of links, presumably to provide traceability information. This again hints at a lack of a defined process. For instance, if the data flow were mapped to the data model then the chain of tables for the planning part would be Requisition → Appeal → Pledge → Allocation and for the execution part would be Delivery → Dispatch → Distribution. Instead of this, Pledge and Requisition are linked in multiple times. A number of the foreign key relationships could be derived through joins instead of

being stored directly. Removing this redundancy would reduce the possibilities for data inconsistency as well as making the database smaller and easier to understand.

The data model for ITSH has some oddities such as Payment (the 70/20/10% payments due to the government) not being linked to any other tables and several foreign keys not being shown as links in the provided diagram (probably indicating that no explicit foreign key relationship exists in the database). The ITSH schema seems to imply the transfer of responsibility for a shipment to and from a transporter using a TransitAccount. This is confusingly linked to DispatchDetail and Receiving Header, again showing that the header-detail split is unclear. ITSH has entities that overlap with the RMS model, such as DispatchHeader that contain duplicate fields such warehouse number.

There are no fields on warehouse tables for stock levels. The stock reports that are produced would appear to be calculated purely based on movements in and out. There is also no means of recording any storage losses. Transport losses – i.e. differences between what was dispatched and what was delivered – are noted in the ITSH data model (DispatchDetail and ReceivingDetail) but it is not clear whether transport payments (in the ITSHFinance table) take this difference into account.

There are fields intended for externally provided IDs and reference numbers (such as SI number) to provide traceability information. There are, however, no tables to allow lists of these numbers to be stored for validation purposes. Such tables along with import/export functions would be necessary to achieve the "linking of shared keys across systems" mentioned in the gap analysis table (Table 2).

2 Data quality issues

Dates can be expressed in either the Western calendar or in Ethiopian calendar. These two formats require conversion and can easily be confused. Similarly, there are two major units of weight used: metric tonnes and quintals (1/10 of a metric tonne). To avoid confusion, there should be a 'units' field for each date and weight that clearly identifies which of the two possibilities are being used. This unit should be shown to the user when the relevant value is entered into the system. Note that this does not prevent unit-based errors being propagated to the system from other parts of the system (such as hand-written documents).

There is also an issue with transliteration of names from Amharic and other regional languages to English as there are many possible transliterations and often no official one. This could be addressed by offering a drop-down list in the user interface