Supply Chain Management Software for Humanitarian Operations: Review and Assessment of Current Tools

Alexander F. Blecken
University of Paderborn
blecken@hni.upb.de

Bernd Hellingrath
University of Paderborn, Fraunhofer-Institute for Material Flow and Logistics
hellingr@hni.upb.de

ABSTRACT

Humanitarian operations in response to sudden and slow-onset crises have increased considerably both in terms of size and complexity over the last decade. This requires a coordinated approach by all actors involved in disaster or humanitarian relief efforts. Since the logistics part of disaster relief spending is accountable for a major part of disaster relief spending, it is natural to look at the supply chains of humanitarian organizations when searching for potentials for cooperation during humanitarian operations. In this paper, we have reviewed Supply Chain Management software currently used or piloted in humanitarian organizations. Their main features are presented and the tools are assessed according to criteria specific to supply chain management requirements of humanitarian operations. We find that while there is one tool which has the potential of becoming a de-facto standard, there are still gaps to be filled.

Keywords

Supply Chain Management, Software, State-of-the-Art, Humanitarian Operations, Disasters

INTRODUCTION

Humanitarian operations take place in response to sudden and slow-onset as well as natural and man-made crises and seek to alleviate suffering and save lives of members of communities affected by theses crises. These kinds of operations rely as much on support activities as on direct operational assistance. Support activities in humanitarian operations are carried out by logisticians or supply chain managers who take care of tasks including assessment, procurement, warehousing, transport and distribution of goods and services as well as other operational support activities such as setup and maintenance of communication and IT equipment. Their work is enabled by appropriate IT support systems such as computer hardware and software as well as communication infrastructure and equipment.

The area of humanitarian logistics, or more broadly speaking humanitarian supply chain management, faces a number of challenges which have been reviewed by van Wassenhove (2006), Kovács and Spens (2007), Thomas and Kopczak (2005), Tufinkgi (2006), and Blecken, Klöpper and Dangelmaier (2008). Thomas and Kopczak remark that the inadequate use of technology, the lack of professional staff and limited collaboration between humanitarian organizations are among the main challenges that need to be tackled. One possible solution to these issues is the use of standardized and integrated Supply Chain Management (SCM) software. This kind of software improves supply chain visibility and responsiveness as well as giving rise to appropriate documentation and reporting mechanisms. It is thus an enabler for effective and efficient SCM in humanitarian response operations.

In the following, we use a short case example from two humanitarian operations conducted by the International Federation of the Red Cross and Red Crescent Societies (IFRC) in order to illustrate what influence responsive and adapted SCM can have on the effectiveness of humanitarian operations. Bernhard Chomilier, Director of the Logistics and Resource Mobilisation Department at IFRC describes the following two situations (Chomilier, Samii and van Wasssenhove, 2003):

In 1998 Hurricane Mitch hit a number of Central American Countries. […] "During that emergency, it [the IFRC] had failed to coordinate the relief contributions of the donating National Societies; its technical staff and relief delegates had arrived on the disaster scene far too late; its specialised equipment was only deployed at the eleventh hour; and basic supplies took weeks to mobilise and distribute to the population."	In January 2001, an earthquake of magnitude 7.9 on the Richter scale hit the area of Gujarat in western India and eastern Pakistan. "The arrival of a Field Assessment Coordination Team 48 hours after the disaster helped gauge relief requirements and develop plans for resource mobilisation. The quick deployment of the Emergency Response Units allowed relief activities to be swiftly kicked off. […] [T]he commodity tracking system helped mobilise, organise and coordinate the arrival of relief supplies. […] frame agreements with key suppliers ensured the quality of relief items and their prompt delivery at competitive prices. Three days after the Gujarat earthquake, IFRC's response plan was already in full swing."

Table 1. Two examples of humanitarian supply chain management

The obvious differences in the success of these two operations can partly be attributed to the fact that IFRC was able to improve visibility and responsiveness in its supply chain by the use of appropriate SCM tools. The remainder of this paper is structured as follows. In the next section, we develop criteria for SCM software specific for the requirements of humanitarian operations. Building on this we review some of the most widely used tools in humanitarian organizations as well as one tool which is currently piloted in some organizations, present their main features in a systematic way and assess these tools according to the criteria. We analyze the specific advantages and drawbacks of the tools before synthesizing our findings and closing this paper with a short conclusion and outlook on further research.

REQUIREMENTS ON SCM SOFTWARE FOR HUMANITARIAN OPERATIONS

In the following, the specific requirements on SCM software for humanitarian operations will be developed. These requirements will later on be the basis for assessing the SCM tools currently used or piloted in humanitarian organizations.

- Documentation

The SCM software needs to encompass comprehensive documentation capabilities. This is a necessary prerequisite for any kind of planning, analysis or evaluation of crisis response operations. Documentation includes warehouse and order management incorporating all material and information flow from the suppliers to the beneficiaries. Documentation needs to be possible in a rapid and simple way and thus deliver the basis for timely and accurate reports.

- Reporting

Appropriate reporting is related to documenting, while it has a slightly different emphasis. Reporting refers to the capacity of an SCM tool to generate reports adapted to the regulations of donors or more broadly speaking the requesting internal or external entity. Thus, proper reporting is a means to increase accountability and transparency in operations. Since more and more institutions put increased accountability requirements on their financial input, reporting capacity become an important asset in securing funds and planning operations. Besides being the main interface to donors, reporting is also the interface to the media.

- Planning

Any SCM tool should offer planning mechanisms for material and/or human resources. Planning needs to take into account the often volatile and rarely predictable environment, in which humanitarian operations take place and thus be robust and adaptable. Examples of possible planning mechanisms include automated order generation when a safety stock level is reached for a certain item or route planning and vehicle scheduling taking into account different routes.

- Cross-linking of systems

Two different aspects are captured under this issue. On the one hand, it is desirable to have an intra-organizational networking functionality, i.e. regional warehouses can be cross-linked with central warehouses to gain visibility of supply chain stocks rather than local stocks only. On the other hand, also inter-organizational networking can be desired when there are multiple organizations present in the field with partially overlapping mandates and

objectives. Inter-organizational networking can ease coordination and cooperation and thus improve efficiency of operations and balance one-sided affluence or scarcity of goods. Cross-linking of systems also supports an integrated view on data of regional and central warehouses, headquarters or even other humanitarian actors present in the field.

- Offline use and synchronization

When systems are cross-linked as described above, an internet connection can be used as the most rapid way to transfer data. However, in crisis situations, an internet connection or much less a permanent internet connection is often not available. Thus, it is beneficial for any SCM tool to offer an online as well as offline mode with deferred synchronization. Data can then be collected locally and synchronized when an internet connection is established.

- Modularity and Adaptability

There are two aspects covered under this heading: Modularity refers to the possibility of using only those modules of the software which are necessary at a given time. Also, different modules or functionalities may be required for the different levels in the humanitarian supply chain, e.g. the field level, coordination level or headquarter level. At headquarter level the most sophisticated features might be required while only a simple stock management or order management module might be necessary at a remote field location. Adaptability denotes the more general features of a software to be adapted by organizations or used in operations differing both in size and objective.

- Tracking & Tracing

One of the main features of an SCM tool for humanitarian operations is a comprehensive tracking and tracing module. It enables the prediction and timely adaptation of arrival times for orders. The existence of such a module supports supply chain planning and increases the transparency of an organization and its processes. Another benefit of a proper tracking system is that it enables statements about the location of goods in the supply chain at any given time.

- User friendliness and training opportunities

This issue is especially important to humanitarian supply chain management since logisticians often lack adequate professional training. Thus, the tool therefore needs to be operable in an intuitive way since training time is unfortunately often very limited. Moreover, training opportunities should exist both in the form of hands-on training and written or electronic software documentation. This material should be readily accessible for the user and be goal-oriented such that occurring problems can rapidly be resolved.

- Software costs

Since costs for SCM software will probably be accounted to headquarters costs (as opposed to field costs which can more easily be justified), it becomes especially important to consider the costs involved in purchasing, implementing and running of these tools. Costs can be divided into software and hardware costs. Software costs include both purchasing and running costs such as updates and upgrades. Open-source software and freeware is to be preferred over proprietary or commercial software tools due to the licensing fees involved. Additionally, open-source software has the advantage of being adaptable to changing needs in the field and of having the potential to become a standard, since many experts from the community are involved in its development.

- Hardware costs

In the introduction, it has already been stated that the use of inadequate technology is a major challenge for humanitarian supply chain management. Only limited technology is available which requires that the hardware necessary to run the SCM software needs to be kept at a minimum. At the same time, this requirement for low hardware costs needs to be carefully balanced against hardware which is both rugged and resilient and thus, is suitable to operate in the field.

In the following section, SCM tools currently used for humanitarian operations will be presented and assessed according to the requirements above.

SUPPLY CHAIN MANAGEMENT SOFTWARE FOR HUMANITARIAN OPERATIONS

Supply Chain Management can be understood as the integrated process-oriented planning and control of material, information and financial flows along the entire value chain from the customer to the raw material producer, with certain objectives such as improvement of customer orientation, synchronization of supply and demand, flexible and demand oriented production, and reduction of inventory along the value chain (Kuhn and Hellingrath, 2002). This

definition of SCM has been drawn up for the commercial domain but can hold true for the humanitarian domain, too. Here, SCM has the general objectives to reduce supply chain inventory and order lead time and improve responsiveness and service levels. IT systems are a key enabler for efficient and effective SCM. Figure 1 displays the classification scheme we use to present the SCM tools in the following. The three categories are Order Management, including all decisions concerning orders and deliveries; Warehouse Management, including all tasks related to warehousing such as inventory turns and stock-taking, picking and packing, and reorder policies; and Evaluation, including analysis of data and reporting. The coloring scheme used in Figure 1 is also applied in the following when the SCM tools are presented in order to denote which functionalities are comprised in the modules of the SCM tools.

Figure 1. Classification scheme of SCM tools for humanitarian operations

SUMA

The Supply Management system (SUMA) was one of the first SCM tools specifically designed for humanitarian crises. It has been developed in 1992 by the Pan American Health Organization. SUMA aims to improve management when supplying goods to victims of disasters. The coordination of goods independently from their origin and associated tasks such as sorting, inventory management, priority setting etc. are among the core elements of SUMA and intend to improve coordination and efficiency in disaster response.

Functions

SUMA contains three different modules: SUMA Central, Field Unit, and Warehouse (Figure 2). During crisis response, these three modules are used at different organizational levels. SUMA Central is used at the central coordination hub where all data is merged from the other modules. The Field Unit module is used at points of entry such as ports and airports for a first registration and sorting as well as prioritizing of incoming goods. These data are transmitted to the central coordination hub and the regional warehouses. In the warehouses, the module Warehouse is used to register the reception and delivery of goods as well as other warehouse management tasks. Reports for the central coordination hub are also generated at this level (cf. SUMA, 2000a-c).

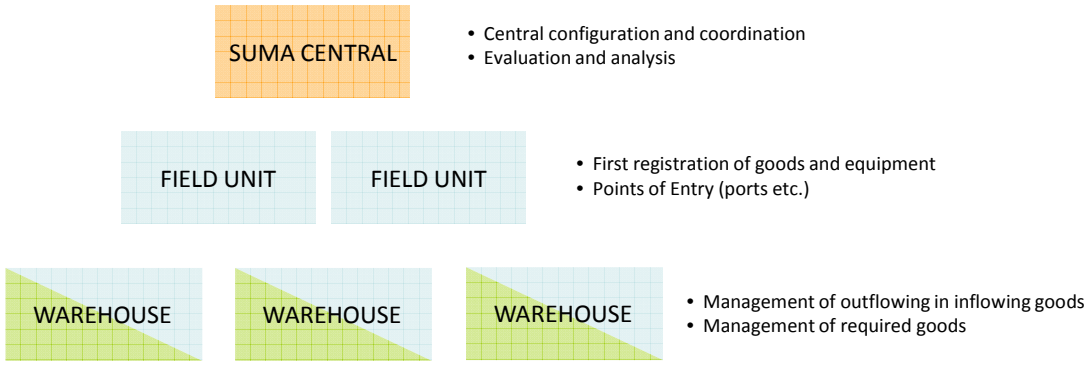

Figure 2. SUMA

Assessment

When assessing SUMA it should be stressed that the software is not the only part of the SUMA project. Another contribution is the human resource part which has not been in the focus of our research. The key idea of SUMA was to keep the software as simple as possible. Thus, it becomes possible to use the system in the most remote areas with only limited hardware available. However, technological development also in the humanitarian operations has been significant, which convinced the developers to come up with a successor to SUMA (presented in the following

section). Cross-linking of systems is only possible with data transfer on diskettes which makes it both slow and vulnerable. The system is not compatible or connectible with other systems and offers few possibilities for adaptation. Proactive planning is not possible. Introductory workshops are available. SUMA has been used up to 2005 in many natural and man-made disasters but is being displaced by more recent and powerful SCM tools.

LSS

The Logistics Support System (LSS) is a direct successor of SUMA and is an SCM tool which is available free of charge for all humanitarian organizations. It has been developed taking into account experience of SUMA and recommendations given by different countries, NGOs and UN entities. The main objectives of LSS are to use the available stock and transport capacities more efficiently (LSS, 2006).

Functions

In order to reach these objectives, incoming goods are acknowledged and categorized when arriving in the field. Detailed stock information therefore becomes available. Outgoing goods are managed with the deliveries module which can be used to create waybills. All required material is processed in the system with the requests module which has an interface to the pipeline module. In the pipeline module, all promised and expected shipments are administered. All the information available in the system can be analyzed with the reports function. According to the user preferences, data can be analyzed under different criteria and thus be compiled for different addressees (Figure 3).

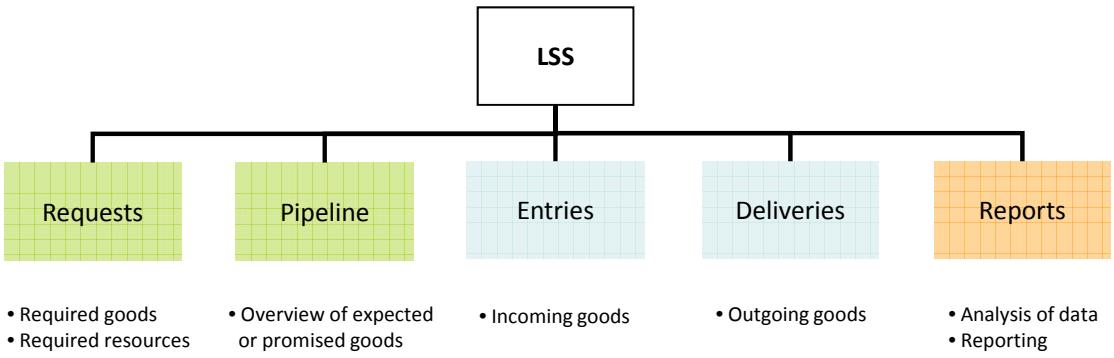

Figure 3. LSS

Assessment

LSS addresses a wide array of documentation requirements: All material flow processes including inventory, demand, and transport execution can be documented. Some planning can be done with the pipeline module. Among the greatest advantages of LSS are the networking and synchronization capabilities, which integrate the information flow in the system and improve transparency in the supply chain. Additionally, flexible import and export of data is possible even with different systems. Tracking is also not possible. Training possibilities exist. The reporting module offers various analysis schemes. However, some basic procurement features are not covered and warehouse management tasks are restricted to the rather limited entries and deliveries modules.

Helios

Helios has been developed by the Fritz Institute which was founded in 2001 as a non-profit organization that works in partnership with governments, NGOs and corporations to innovate solutions and facilitate the adoption of best practices for rapid and effective disaster response and recovery. Helios is the successor of the Humanitarian Logistics Software (HLS) and is currently piloted in several humanitarian organizations such as Oxfam, World Vision International and International Medical Corps.

Functions

The software works on a project basis: Every disaster or humanitarian operation is set up with the help of a project for which a number of master data needs to be entered. The software then offers five optional modules which are Request Processing, Procurement, Warehousing, Mobilization, and Reports (Figure 4). At the Request Processing module, complete information concerning the issued requests is managed. The issuer, addressee, required goods, date, address etc. are compiled and assigned to a project. If a request is issued, the freight can be prepared with the Warehousing module, in which all warehouse or stock management tasks can be executed. Amongst others, full or partial deliveries can be processed, identification tags can be printed, and reports can be generated. The Mobilization module deals with donations in kind and their distribution to one or several projects. Proper accounting and follow-up of donations as well as planning, monitoring and reporting is also possible. The procurement module deals with the administration and purchasing of goods and services. Orders, which can be executed partly autonomously depending on the resource usage over the previous periods, are generated. Quotations can be generated, checked and analyzed. In addition to these modules, Helios also offers additional functionalities such as assessment of suppliers, tax calculation and a calendar in which relevant data such as scheduled delivery dates can be entered or displayed.

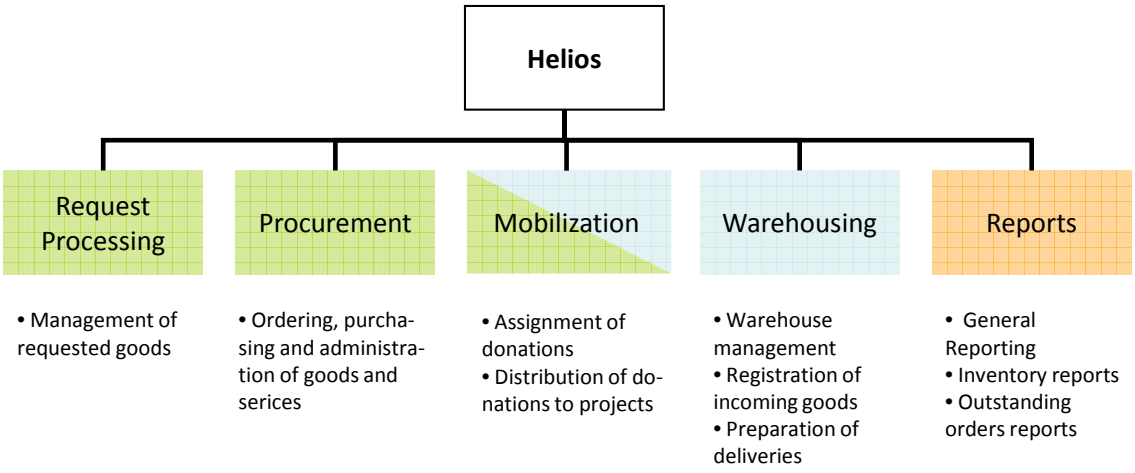

Figure 4. Helios

Assessment

Helios has been developed for use in humanitarian operations of differing sizes. It intends to enable even small humanitarian organizations to deliver their goods and services in a rapid and efficient manner. The cross-linking possibilities are beneficial for a central coordination of the projects. Helios will be offered as freeware which can help to lower costs especially for small humanitarian organizations. Hardware requirements are low. Through the option to work offline as well as online, it is possible to use it in disaster areas without a permanent internet connection. The structure of the software with menus is quite user friendly but due to the vast array of different parameters which can be adjusted, navigation can become quite complex. Also, many abbreviations are used, which makes it hard for the novice logistician to obtain a bigger picture. While the software itself will be available free of charge, the central server option will be offered commercially. Among the biggest drawbacks of Helios are a missing warehouse layout tool, and route planning and vehicle scheduling mechanisms.

LogistiX

LogistiX is an SCM tool for humanitarian logistics which was developed in 2006 by the humanitarian medical aid organization Médecins sans Frontières (MSF). The software is proprietary but does not have a commercial background and is becoming more widely used in MSF missions.

Functions

The software is executed on two different organizational levels: Mission Coordination and Project Coordination. The Mission Coordination is the super ordinate level, which mainly deals with procurement and administration issues. The Project Coordination level is concerned with the actual consumption of goods and order and request management tasks. Between these two levels, LogistiX captures the entire material and information flow (Figure 5).

Material flow is initiated by requests generated at project level, for which the software offers the "Document Out" option which is received as "Request In" at mission level. At mission level, requests can be assigned to local purchases, stock transfers or international orders. All incoming goods are acknowledged by receptions; for all outgoing goods the packing module can be used to issue waybills or freight manifests. The stock management module as well as a monitoring module which merges information from both levels can be used at either level.

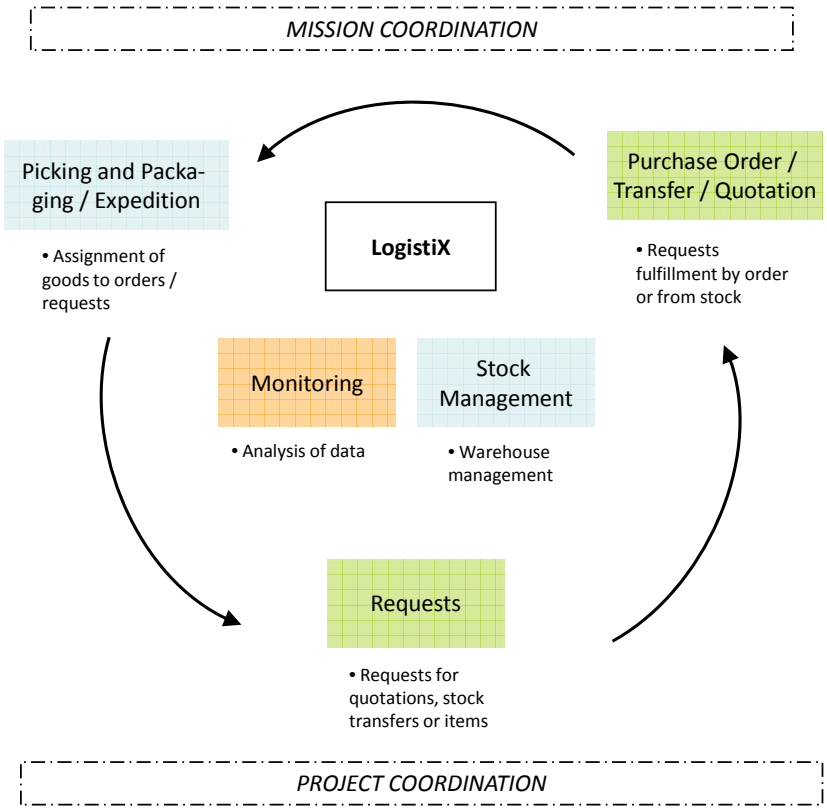

Figure 5. LogistiX

Assessment

LogistiX is a system which can be used for many supply chain management activities. In particular, tracking becomes possible through the comprehensive monitoring of the physical and information flows. Three performance indicators are measured automatically with LogistiX: Lead time, order display and commitment. Networking or inter-linking of systems is not possible with LogistiX. Data can be imported and exported, but not through a central server. Data exchange is thus not possible in real time. Another main drawback of LogistiX is the fact that user friendliness could be improved further by introducing a clearer structure in the modules and reducing the number of abbreviations. Documentation and Reporting functions are well integrated and inventory planning is possible with forecasting based on past consumption data or via an alarm function in the stock management module.

Sahana

The Sahana Disaster Management System is an open source project which has been developed in the aftermath of the South-east Asian tsunamis of late 2004. Sahana is the Singhalese word for "Relief" and the system has been developed to provide an automated system to manage disaster relief efforts. Sahana has been used in several disasters, such as the earthquakes in Pakistan in 2005 and in Indonesia in 2006.

Functions

Sahana encompasses several optional modules in an internet-based application for disaster management. There are a number of modules which are not directly related to Supply Chain Management tasks but for other disaster

management tasks and coordination of organizations and institutions. Figure 6 displays the modules relevant to SCM tasks, i.e. Request/Aid Management, Inventory Management and the Reporting System and indicates the other components which are Missing Person Registry, Organization and Camp/Shelter Registry, Volunteer Coordination, and Situation Mapping. At the Request/Aid Management module, data is entered concerning the required goods and services as well as promised support. Thus, all participating organizations can gain an overview of the situation and offer support if resources are available. The Inventory Management module offers standard warehouse management features. All incoming goods are registered with detailed information such as quantity, description, expiration date etc. An integrated report function offers the possibility to create individual reports. All functions of a module can be evaluated and graphically displayed which eases the analysis of the data. Some additional modules such as a catalogue system, administration and preferences module allow the users to set their own parameters and select the modules which they intend to use.

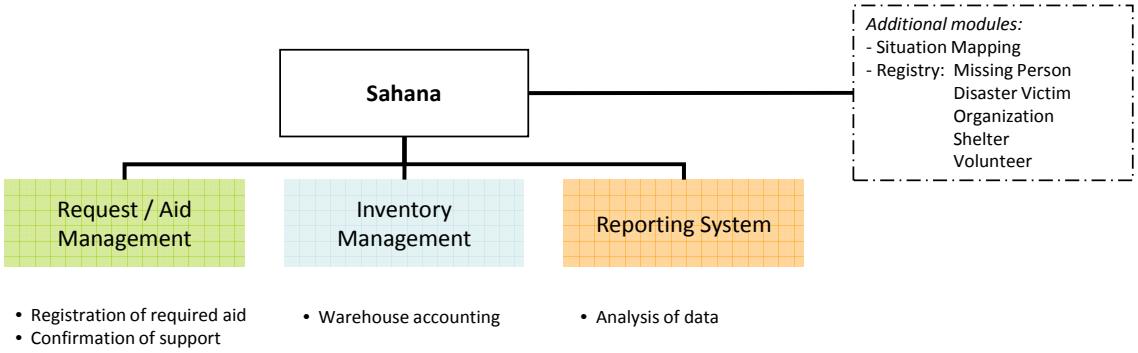

Figure 6. Sahana

Assessment

The focus of Sahana is not on Supply Chain Management tasks but rather on coordination and planning of humanitarian operations. Thus, the material and information flows are not (yet) captured completely by this system. The open source approach, which also keeps software costs very low, may allow this problem to be tackled in the future. The software is set up in a highly modular way and therefore is adaptable and flexible. Cross-linking of systems is not only possible but one of the core ideas of Sahana. Synchronization of stations is possible and Sahana offers sophisticated documentation and reporting mechanisms. The main drawbacks of Sahana remain that SCM tasks are not approached in a consistent and comprehensive way and that data or information cannot be imported or exported to other systems or databases (De Silva, Raschid, Careem, De Silva and Weerawarana, 2006).

Discussion of findings

Table 2 displays a synthesis of the discussions above. Planning capacities remain limited for all tools covered by our study. This is especially true for transport planning which is not offered by any software. Comprehensive resource planning is offered by Sahana only. LogistiX and Helios offer demand planning by forecasting of past consumption data. When it comes to documentation however, all tools show their strengths. While the same holds true for reporting, the objective and coverage of reports is differing between the tools. All tools but SUMA offer internal and external reporting formats. Cross-linking of systems is possible with LSS, Helios and Sahana. Even cross-organizational linking is possible with Helios and Sahana. With all tools presented, offline processing of data is possible. Synchronization of data is possible in all systems with cross-linking capacities and is achieved using different file formats. All tools are constructed in a somewhat modular way. Sahana can most freely be parameterized, while LogistiX offers different modules for different coordination levels. Helios allows for access restrictions. Helios, LSS, and LogistiX are not explicitly extensible but it is probable that there will be future updates. Tracking is not possible with SUMA, LSS, and Sahana. However, both Helios and LogistiX offer this functionality, especially the calendar option in Helios seems to be a useful feature to keep track of delivery dates, unexpected interruptions in the material flow or events. SUMA is the least user friendly software in our study. This was improved with LSS, but problems with a clear and transparent design remain. This is also true for LogistiX, for where the user needs some time and patience to familiarize himself with it. Sahana has the clearest and most user-friendly interface. For SUMA, LSS, and LogistiX comprehensive user manuals and self-learning material exist.

Training is offered for SUMA and LSS. SUMA, LSS, Helios and Sahana are available free of charge. All systems limit their requirements on the underlying hardware to a minimum.

From all the tools which have been reviewed during the course of this study, both Helios and LogistiX seem to be the most promising. Sahana has a lot of potential for future developments due to its open-source architecture, while the other two already offer well-adapted SCM functionalities for the humanitarian domain.

	SUMA	LSS	Helios	LogistiX	Sahana
Planning	-	-	-	+	+
Documentation	+	++	++	++	++
Reporting	+	++	++	++	+
Cross-linking of systems	-	+	++	-	++
Offline use and synchronization	-	++	++	+	++
Modularity & Adaptability	+	+	++	+	++
Tracking & Tracing	-	-	+	+	-
User friendliness, Training	+	++	+	+	+
Software costs	+	++	+	-	++
Hardware costs	+	++	++	++	+

Table 2. Summary of the assessment of SCM Software for Humanitarian Operations

CONCLUSIONS AND OUTLOOK ON FURTHER RESEARCH

In this paper, we have reviewed and assessed five SCM tools for humanitarian operations. It has been found that these tools have been developed under differing priorities and objectives. SUMA, which has been one of the first SCM tools specifically for the humanitarian domain has been developed for small humanitarian operations and is kept very simple. SUMA has been rendered almost obsolete due to technological developments and growing complexity of humanitarian operations. LSS is the consequent successor of SUMA. It mainly incorporates a web interface but lacks a comprehensive tracking and tracing module. This is achieved by Helios which is the most recent software of our study and which is currently piloted in some humanitarian organizations. Helios considers the entire material and information flow from suppliers to regional warehouses. However, stock organization and final distribution is not in the scope of Helios. LogistiX also captures the entire material and information flow from headquarters to the field. Finally, Sahana is an open-source project which focuses on several issues of disaster relief, such as the registration of injured and missing persons as well as coordination of organizations and volunteers. Thus, while supply chain management is not in the center of this software, the open-source approach makes it highly extensible and a promising tool for the future.

It can be concluded that while some of the tools in our study fulfill several of the requirements and functionalities very well, none of the tools is able to completely satisfy all requirements. Specifically, stock organization, final distribution issues such as route planning and scheduling and resource planning are not addressed by any of the tools. On the other hand, these issues are considered in commercial SCM software which makes it a logical next step in our research to extend the scope of our study to also include selected SCM software from the commercial domain. This approach is further supported by the fact, that applying methods and results from commercial supply chain management is recognized more and more to be beneficial to humanitarian supply chain management (van Wassenhove, 2006). This has been shown in practice by Blecken and Hellingrath (2007), and Deutsche Post World Net (DPWN, 2007). We will also include more SCM tools for humanitarian operations such as the Humanitarian Logistics Software, which is the predecessor of Helios and still in use at large humanitarian organizations such as IFRC. Thus, an even more complete overview and assessment of the state-of-the-art in SCM software for humanitarian operations becomes available.

ACKNOWLEDGMENTS

We would like to thank Jean-Eric Schaefer from MSF-Belgium and Fraser Stephens from Fritz Institute for their kind and ongoing support while carrying out the research for this paper.

REFERENCES

1. Blecken, A., Klöpper, B., Dangelmaier, W. (2008) Agile-responsive humanitarian supply chain management, *Proceedings of the 2nd International Conference on Software, Knowledge, Information Management and Applications*, 18-21 March 2008, Kathmandu, Nepal (in review).
2. Blecken, A. and Hellingrath, B. (2007) Optimisation of distribution processes for a humanitarian actor on the basis of formal process models, *Proceedings of the Cardiff/Cranfield International Humanitarian Logistics Symposium*, Faringdon, UK.
3. Chomilier, B., Samii, R. and van Wassenhove, L. (2003) The central role of supply chain management at IFRC, *Forced Migration Review*, 18, 18-19.
4. De Silva, C., Raschid, L., Careem, M., De Silva, R. and Weerawarana, S. (2006) Sahana: Overview of a Disaster Management System, *Proceedings of the 2nd International Conference on Information and Automation*, Colombo, Sri Lanka.
5. Deutsche Post World Net (2007) Die Herausforderungen globaler Logistik annehmen, Technical Report, Deutsche Post AG.
6. Kovács, G. and Spens, K. (2007) Humanitarian logistics in disaster relief operations, *International Journal of Physical Distribution and Logistics Management*, 37, 2, 99-114.
7. Kuhn, A. and Hellingrath, B. (2002) Supply Chain Management: optimierte Zusammenarbeit in der Wertschöpfungskette, Springer Verlag, Heidelberg, Berlin, Germany.
8. LSS (2006) LSS User Manual, March 2006; available online at http://www.lssweb.net, accessed January 6, 2008.
9. SUMA (2000a) Humanitarian Supply Management System SUMA Central Level, User's Manual, Version 5.1 for Windows, Mai 2000.
10. SUMA (2000b) Humanitarian Supply Management System SUMA Field Unit, User's Manual, Version 5.1 for Windows, Mai 2000.
11. SUMA (2000c) Humanitarian Supply Management System SUMA Module Warehouse Management, User's Manual, Version 5.1 for Windows, Mai 2000.
12. Thomas, A. and Kopczak, L. (2005) From Logistics to Supply Chain Management: The path forward in the humanitarian sector, Technical Report, Fritz Institute, San Francisco, CA, USA.
13. Tufinkgi, P. (2006) Logistik im Kontext internationaler Katastrophenhilfe: Entwicklung eines logistischen Referenzmodells für Katastrophenfälle, Haupt Verlag, Bern, Stuttgart, Wien.
14. van Wassenhove, L. (2006) Blackett Memorial Lecture Humanitarian aid logistics: supply chain management in high gear, *Journal of the Operational Research Society*, 57, 475-489.