

Original article

## Developing Software Requirements Specification for a strategic goods air transportation system

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### INFORMATION

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### ABSTRACT

Management of air transportation of strategic goods is a very complex task with many challenges. This paper describes the method used in documenting the requirements for an IT system intended to support management of air transportation of military and dual-use goods. The work was completed in conjunction with a private logistics company. The project produced a Software Requirements Specification document and a working prototype. The document and prototype are held by the Military University of Land Forces of Poland.

Requirements were solicited from numerous sources. A private logistics company, numerous books and personal experience of the team members all contributed to requirements. These requirements were then analyzed and a final set of requirements was produced.

Screen mock-ups and a working prototype were developed. Selected screen shots are within the paper. The working prototype was developed by constructing a database and using a code generator to produce a web application.

### KEYWORDS

Air Cargo Management, military cargo, dual-use cargo, logistics, Software Requirements Specification, user screen mockup

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## Introduction

Air Cargo Management is a very complex task, and many factors contribute to this complexity. For example, aircraft fleets are susceptible to breakdowns and need routine maintenance;

there is limited amount of storage physicality at airports, while specially trained personnel are needed to fly aircraft. Furthermore, packing cargo into aircraft optimally is not obvious. Finally, flights and aircraft availability constraints make problems with Air Cargo Management worthy of investigation.

Moving strategic goods adds a new dimension of complexity. Company black-lists, hazardous materials, personnel certifications and corporate certifications make military and dual use cargo handling even more difficult. These additional requirements prevent traditional management systems from supporting this type of goods movement.

The main aim of the work presented in this article was to identify needs in the field of IT support for air transport of strategic goods and to formulate an initial dedicated IT system concept that will streamline planning, organization and control of the process under consideration.

The system is designed for logistic companies that are armed forces contractors and provides solutions to dealing with the tasks related with transportation of strategic goods, including organization of that kind of transport. The system has been divided into the following modules: Maintenance, Repairs and Overhaul (MRO), Personnel Management (PM), Operations Management (OM), Load Planning and Weight and Balance (LPWB), Military and Dual Use Cargo Handling (CH) and Fleet Management (FM).

This paper describes a project and its construction conducted at the Military University of Land Forces of Poland, with the coordination of private companies, to generate the documentation required for a strategic cargo handling system.

## **1. Background**

### **1.1. Management of air transportation of military and dual-use goods**

Strategic goods include goods that are used for military purposes (military goods) or that can be used for both military and civil purposes (dual-use goods). This includes goods that can be used for manufacturing weapons (or carriers of weapons) of mass destruction. Import, export and transit of strategic goods are only allowed under certain conditions. This is due to international agreements and security reasons.

Information provided by the Ministry of Foreign Affairs of the Republic of Poland on their website is that “The Polish government controls trade in these goods for the security of the country, the Polish foreign policy interests, as well as obligations under international and alliance agreements”. Since Poland is a member state of the European Union, “The Polish foreign policy is consistent with the policy of the European Union in matters covered by control of the export of arms and dual-use goods” [1].

Management of air transportation of strategic goods (just like other management activities in different sectors) has as its main goals, meeting customer needs, and (being a business) making a profit. There is, however, a specific kind of background that it is functioning in. It is an international environment that is strictly regulated by law within the context of international agreements, internal procedures, trade control regulations and needed permissions. Activities related with transportation of strategic goods require licenses and must be reported. There is also a need for checking black-lists (denial lists), embargo lists and other documents prepared by international organizations (for example, lists publicized by U.S. Department of

Treasury or The World Bank) which contain persons, companies and countries that are not allowed to be involved in any part of transactions of military and dual-use goods. Managers who work in the field of strategic goods transportation service have to ensure that potential operations do not result in an activity prohibited by trade regulations and other restrictions. Any mistake here may result in a financial penalty and legal consequences. It is an important and very complex process, that for sure, needs to be supported by specialized IT tools. Although there are various types of IT solutions that are (or potentially can be) used as a support for air cargo management processes, there is a lack of systems dedicated to supporting the specific tasks involved in managing the air transportation of military and dual-use goods.

## **1.2. Software Requirements Specification documentation**

A Software Requirements Specification (SRS) document describes the requirements of the system [2]. The document is used as a conduit between stakeholders and developers and forms a common understanding between the two groups [3].

There are a number of commonly used format for SRSs. The IEEE 830 is a functional decomposition of system features using “shall” statements [4]. For example, “The system shall allow the user to enter salary requirements for the open position”. This format is an older one. More recently there is the Use Case. A Use Case is a description of a feature of the software [5]. There are a few Use Case forms, however. The Use Case Diagram is a diagram that shows the relationship between different user roles and the Use Cases. In contrast, the Textual Use Case shows details of the feature in text format. This includes: Use Case Name, Preconditions, Triggers, Basic course of events, Alternate Paths and Post Conditions. There are other formats that contain less details. For example, Storyboards and Screen Mock-ups.

This project began by using Use Cases. After completing one of the many modules it was determined that there was not enough time in the project to complete all modules using this format. The remaining modules used Screen Mock-ups, allowing the project to be completed on time.

## **2. Software requirements**

### **2.1. Maintenance, Repairs and Overhaul (MRO)**

The formal definition of Maintenance, Repairs and Overhaul (MRO) describes it as “all actions that have the objective of retaining or restoring an item in or to a state in which it can perform its required function. The actions include the combination of all technical and corresponding administrative, managerial, and supervision actions” [6]. A lot of different types of actions can be performed within MRO tasks and there are many forms of them, including predictive, planned, preventative and non-routine maintenance. In aviation, it has a special role in guaranteeing safety in both passenger and cargo air transportation. MRO is a complex process with precise and strict requirements defined by airworthiness authorities and airplane manufacturers [6].

The MRO module described in the SRS contains the following type of data: aircraft type, serial number, date of purchase, history of events related to a given aircraft, known problems, information on operating fluids, parts and tools, warranty and service information.

## 2.2. Personnel Management (PM)

Personnel management is an important part of management concerned with employees at work within the company. For the topic under consideration, the most important part of the PM module is related with documenting the activity of the personnel responsible for military and dual-use cargo operations. One should be aware of the fact that there is also another type of user (employees who have different roles in the organization, such as, for example, maintenance personnel).

The PM module contains basic data about users (name, contact details) information about the certificates held by employees (with expiration dates), access rights to system modules and assignment to specific tasks. Figure 1 shows the screen for task assignments.

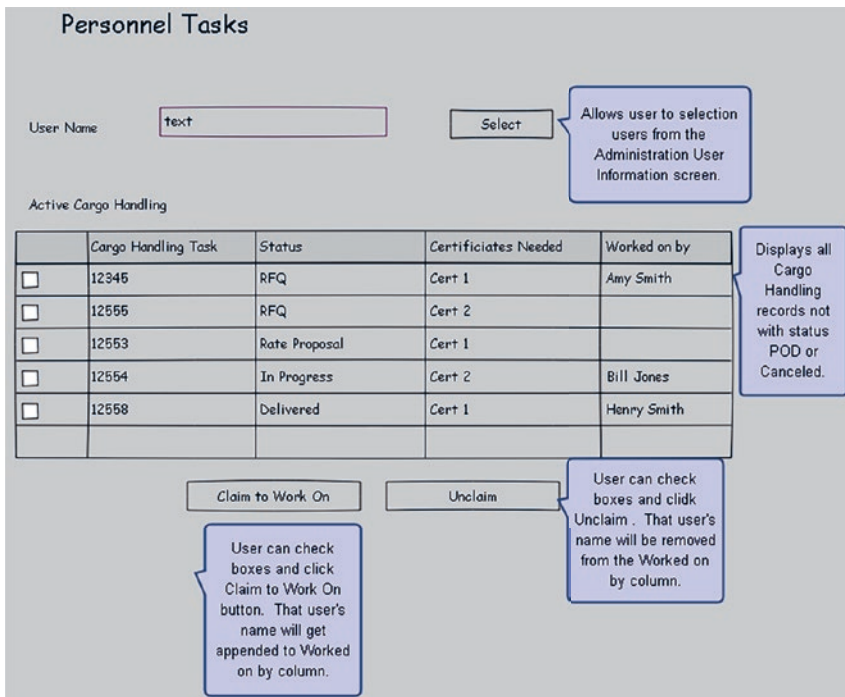


Fig. 1. Task assignment screen

Source: Screenshot of the user interface designed (authors' own study) in Pencil tool.

## 2.3. Operations Management (OM)

Flight operations management (or air operations management) requires knowing of law/regulatory requirements, general operating procedures, flight scheduling, knowledge about flight operations, the environment and others. It concerns the planning and organization of air cargo operations (including preparation of documentation and other tasks related to freight forwarding like identifying best route, choosing aircraft or negotiating space/price with a carrier), coordinating resources and activities and controlling the implementation of the plan. A significant part of OM is tracking. The creation of various types of standard reports and summaries can also be very important here (e.g. flights, cargo flown, revenue information).

This part of the designed system contains cargo identifier, method of transport, indication whether the cargo belongs to the group of dangerous goods, current location of goods, tracking number, list of documents required for a specific transport in the form of attachments, departure, destination and intermediate airports, information about the cost of the transport service.

#### **2.4. Load Planning and Weight and Balance (LPWB)**

This is one of the factors that is connected with efficiency and safety of the air transportation. Improper loading of a plane affects its performance. Indeed, it even can be a cause of failure to take-off or in-flight incidents. Thus, holding the plane's weight and balance parameters within the limits specified by its manufacturer is extremely important [7]. Also, inefficient use of the cargo space may result in the flight becoming unprofitable.

This module contains, among others, the type of aircraft used for transport, its basic technical specification and instructions for proper loading of the plane.

#### **2.5. Military and Dual Use Cargo Handling (CH)**

This refers to the specific type of cargo – strategic goods (arms and dual-use goods that are enumerated in the appropriate control lists). The turnover of strategic goods is strictly regulated and movement should only occur in a safe environment.

In the designed system, CH is one of the most important modules. It contains cargo identifier, transport status, type of cargo (military/dual-use) and a list of documents required for its turnover (in the form of attachments), type of operation, date of shipment, details of the customer ordering the transport, information about problems arising during the execution of the order (if occurred), red flags in case of suspicious customer behavior or other events that may result in the need to analyze the transaction risk or the need to cancel it, comments and other (additional) information. Figure 2 shows the military and dual-use cargo handling screen. Figure 3 shows the black list screen.

#### **2.6. Fleet Management (FM)**

The accepted definition states that “fleet management is the optimization of costs, risks and efficiency in fleet operations” [8]. There are many of benefits that come out of performing it correctly, among which are increased productivity, customer service improvements and fuel savings. Some logistic companies own their own fleet of aircrafts and some use common carriers. There are three types of carriers – passenger airlines (combination carriers) that can transport passengers and cargo, all-cargo carriers and charter airlines [9].

The FM module contains aircraft information, such as: serial number, aircraft type (name, model, manufacturer), aircraft registration number, status (ready for use, in maintenance), aircraft operator, basic technical specification, instructions (attachments) on how to load the aircraft. Figure 4 shows the airplane screen.

### Military and Dual Use Cargo Handling Operations

Cargo ID Number  Type of Cargo

Status  Type of Operation

Details of Cargo  Details of Operation

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Cargo ID	Status	Type of Cargo	Details of Cargo	Type of Operation	Details of Operation
111.11.2019	Delivered	Military	ML6a	Transportation	Import

**Fig. 2.** Military and dual use cargo-handling operations searching screen  
 Source: Screenshot of the user interface designed (authors' own study) in Pencil tool.

### Black List Search

Company/PersonName  Partial Name match on person's name or company's name.

Country

Does a partial match on company/person name along with country. Shows results in table below.

Company/Person Name	Address	City	Postal	Country	Source
ABC Inc.	123 Main St	Chicago	20192	USA	US State Dept Nonproliferation List
Bad Guys Inc.	56 W. 15 St	London	BC123	GB	NATO Bad Guys List
Iranian Transport	1 Main St	Tehran	12345	Iran	US Trade

**Fig. 3.** Black list searching screen  
 Source: screenshot of the user interface designed (authors' own study) in Pencil tool.

# Airplane

Serial Number

Airplane Type  ▼ This will be populated from the Airplane types in RMO. Name, Model and Manufacturer

Registration Number

Aircraft Status  ▼ Ready for Use | In Maintenance

Operator

Dimensions

Wing Span

Height

Overall length

Payload-Range Capability

Main Deck

Lower compartments (bellies)

Bulk

Loading Information

Attachments
Loading Doc 1.docx
Loading Doc 2.pdf
Loading Doc 3.jpg

Fig. 4. Airplane screen from FM module

Source: Screenshot of the user interface designed (authors' own study) in Pencil tool.

### 3. Tools

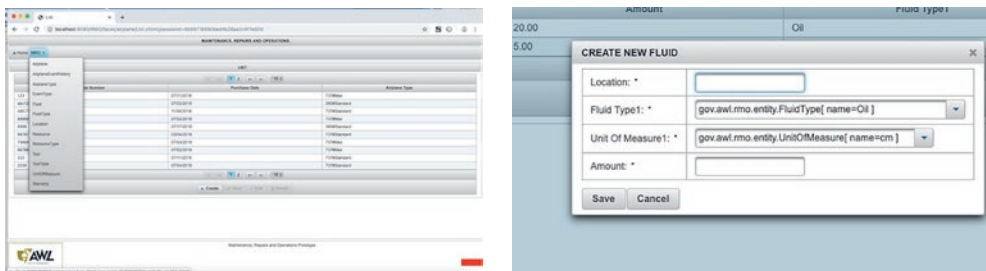
In soliciting and documenting requirements, a number of technical tools were used. These tools allowed for the creation of screen mock-ups and to develop a working prototype using a code generator. All products used in this project are free opensource and multiplatform. The tools used were NetBeans, Java, PrimeFaces, ArgoUML, Derby and Glassfish.

#### 3.1. NetBeans

NetBeans is an Integrated Development Environment that aides in developing software [10]. It can be used with multiple programming languages, but is generally associated with Java. One of the many modules in NetBeans is a code generator. Given a database, NetBeans code generator can create a web application to perform create, read, update and delete (generally called CRUD), operations on the database tables. This aide in NetBeans can be beneficial in creating simple working applications to use in requirements gathering sessions. Users can see a working prototype and then describe additional features that each screen needs.

##### 3.1.1. Java and PrimeFaces

Java is a computer programming language that is multiplatform, meaning that compiled Java code can run on any type of computer using a Java Virtual Machine. Java Enterprise Edition has an edition of Java used for creating large web-based applications. The web interface part of Java EE is Java Server Faces (JSF). An extension to JSF that uses more rich web features is called PrimeFaces [11]. The NetBeans code generator used in this project used PrimeFaces as the interface. Figure 5 contains some screen shots from the Maintenance, Repairs and Operations module of the system.



**Fig. 5.** Sample screens from working prototype  
Source: Screenshot generated from NetBeans tool.

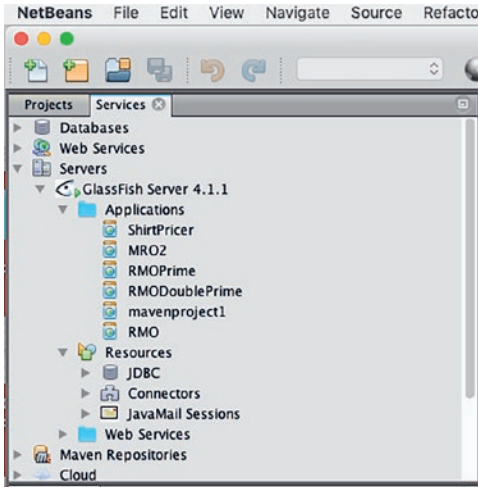
##### 3.1.2. Glassfish

Glassfish is a free opensource Java application server [12]. It comes bundled with NetBeans. The prototype is created as a Java EE application and runs on Glassfish. Figure 6 shows a screenshot of Glassfish Interface in NetBeans.

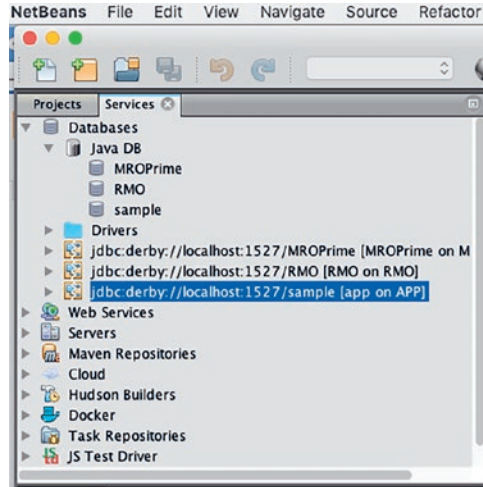
##### 3.1.3. Derby Relational Database

Derby, or Java DB, is a free opensource Relational Database System that supports SQL [13]. It also comes bundled with NetBeans. The prototype uses Derby to store persistent data. Figure 7 is a screenshot of Derby in NetBeans.





**Fig. 6.** Glassfish Interface in NetBeans  
*Source: Screenshot generated from NetBeans tool.*



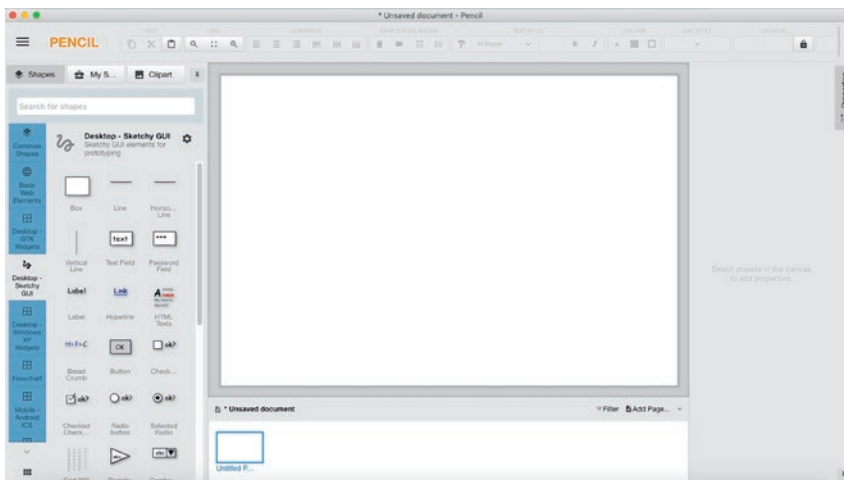
**Fig. 7.** Derby (ie Java DB) Interface in NetBeans  
*Source: Screenshot generated from NetBeans tool.*

### 3.2. Pencil User Interface Designer

Pencil is a free, downloadable, multiplatform user interface modeling tool. It has a simple drag and drop design with components to create screen mockups for desktop, web and mobile applications. A screenshot of Pencil can be seen in Figure 8.

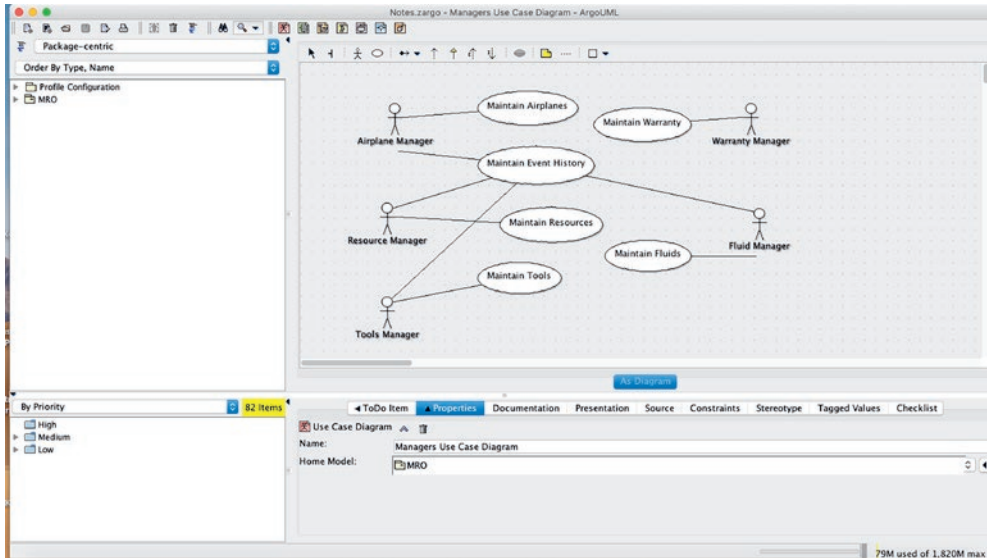
### 3.3. ArgoUML

ArgoUML is a free Unified Model Language (UML) modeling tool. Users can create a number of UML models including Class Diagrams, Sequence Diagrams and Use Case Diagrams. In this



**Fig. 8.** Pencil User Interface Designer  
*Source: Screenshot generated from Pencil tool.*

project ArgoUML was used to create Use Case Diagrams. A screenshot of ArgoUML can be found in Figure 9.



**Fig. 9.** Sample Use Case Diagram in ArgoUML  
*Source: Screenshot generated from ArgoUML tool.*

## Conclusions

In the future, work will be continued using the same technologies and tools. The current version of the SRS will be consulted a second time with specialists who are responsible for the management of air transport of strategic goods. Any remarks will be included in subsequent versions.

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## Conflict of interests

All authors declared no conflict of interests.

## Author contributions

All authors contributed to the interpretation of results and writing of the paper. All authors read and approved the final manuscript.

## Ethical statement

The research complies with all national and international ethical requirements.

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## Biographical note

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**Tomasz Smal** – DSc. graduated from the Military University of Technology in Warsaw and the University of Defence in the Czech Republic. He conducts scientific activities in operation of weapon systems and management in logistics and transportation systems. He has conducted over 20 scientific projects. Moreover, he is the author or co-author of more than 100 articles and 10 monographs. The most important are there in journals indexed in the list of ISI Web of Science and SCOPUS. He served as a professional soldier in the logistics system of the Polish Armed Forces, then he conducted scientific and didactic activities in military academies. He has been multi-awarded for his scientific and military activity.

### **Tworzenie specyfikacji wymagań oprogramowania dla systemu zarządzania transportem lotniczym towarów strategicznych**

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#### **STRESZCZENIE**

Zarządzanie transportem lotniczym towarów strategicznych jest zagadnieniem niezwykle złożonym, a jakość realizacji zadań z tego zakresu może zostać poprawiona poprzez wdrożenie odpowiedniego oprogramowania. W artykule opisano metody zastosowane do opracowania specyfikacji wymagań systemu informatycznego (ang. Software Requirements Specification, SRS) przeznaczonego do wsparcia zarządzania transportem lotniczym towarów strategicznych. W ramach projektu utworzono również działający prototyp aplikacji internetowej.

Sformułowanie wymagań zostało oparte o wiele źródeł. Wykorzystano wiedzę pozyskaną ze współpracy z prywatną firmą logistyczną, informacje zawarte w literaturze, a także osobiste doświadczenie autorów. Wszystko to przyczyniło się do określenia wstępnych potrzeb (zakresu informacyjnego i funkcjonalności), które zostały następnie przeanalizowane i wykorzystane do sformułowania zestawu wymagań zawartych w dokumencie SRS. W celu wizualizacji elementów programu utworzono makiety interfejsu użytkownika. Prototyp funkcjonalny został przygotowany poprzez zbudowanie bazy danych i użycie generatora kodu do stworzenia aplikacji internetowej.

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**SŁOWA KLUCZOWE** informatyka w zarządzaniu, transport lotniczy, specyfikacja wymagań

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