Project plan for degree projects

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1 Introduction

Decision Support Systems (DSS) are a specific class of computerized information systems that supports business and organizational decision-making activities [1]. A properly designed DSS considered in this thesis to be an interactive software-based system which is intended to help decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions [4].

Typically, information that is required for decision support application would be:

- Accessing all of your current information assets, including legacy and relational data sources, cubes, data warehouses, and data marts [2].
- Comparative sales figures between one week and the next [2].
- Projected revenue figures based on new product sales assumptions [2].
- The consequences of different decision alternatives, given past experience in a context that is described [2].

The people who are in a position to solve structuring errors are usually upper managers of some kind [3]. With DSS, there's an extreme focus on solutions that are not only adaptable to changes in environment, but are flexible and facilitate easier decision making. Decision support systems help those in positions of authority compile enough information to make an informed decision about changes in policy, implementation and so forth. Data included in such a system

usually covers things like inventory, projected cycles of revenue based on trends in sales and comparative figures in sales from one cycle to the next [3].

An example where DSS can be applied is the case of Verified Gross Mass, which has gained enormous attention lately due to the concerns of safety, such as heavy containers falling, or hurting and even killing workers.

Verified Gross Mass (VGM)

The consequences of misdeclaring the gross mass of a packed container can be far-reaching. Should a discrepancy between the declared gross mass and the actual gross mass of a packed container go unnoticed, it could have an adverse impact on the safety of the ship, seafarers and shore-side workers, by leading to incorrect vessel stowage decisions and potentially collapsed container stacks or loss of containers overboard [5].

The International Maritime Organization, stated that "The Maritime Safety Committee (MSC), at its ninety-fourth session (17-21 November 2014), adopted, inter alia (among other things), amendments to Safety of Life at Sea (SOLAS) regulation VI/2 (see resolution MSC.380(94)), to require the mandatory verification of the gross mass of packed containers" [9].

In addition to the amendments to SOLAS regulation VI/2 and with a view to establishing a common approach for the implementation and enforcement of the SOLAS requirements regarding the verification of the gross mass of packed containers, the Maritime Safety Committee approved the Guidelines regarding the verified gross mass of a container carrying cargo (MSC.1/Circ.1475) [9].

The above mentioned SOLAS amendments introduce two main new requirements:

- The shipper is responsible for providing the verified weight by stating it in the shipping document and submitting it to the master or his representative and to the terminal representative sufficiently in advance to be used in the preparation of the ship stowage plan [9]; and
- The verified gross mass is a condition for loading a packed container onto a ship [9].

The verification of the gross mass can be achieved by either of two methods:

- Weighing the packed container [8]; or
- Weighing all packages and cargo items, including the mass of pallets, dunnage and other securing material to be packed in the container and adding the tare mass of the container to the sum of the single masses, using a certified method approved by the competent authority of the State in which packing of the container was completed [8].

Related Work

Due to the increasing gloablisation and trade, more and more goods are being transported currently, over 90% of world cargo is transported by ship with more cargo being transported, there has been increasing number of accidents leading at times to death. Hence, a solution is needed to stop this and maintain a balance.

Weight Tampering in Real Life

"Shortages" are a perennial problem and it seems there is an epidemic, particularly small shortages in shipments of consumer goods to retailers [15]. Many of these shortages are from sealed or "dropped" trailers, or shrink-wrapped pallets, and are not discovered or reported until after the truck driver leaves [15]. Vendors are often annoyed because their customers do not document or report the shortages promptly upon discovery, and merely deduct the shortages when paying the vendor's invoice - which could be weeks or months afterward [16].

Aggravating this situation is trend for purchasers to want to control their inbound freight [16]. Thus, many shipments are essentially "customer pickup", i.e., the customer designates the carrier, has a contract with the carrier, and pays the freight charges [16]. However, in many cases the vendor is required to assume risk of loss in transit under the terms of the purchase order [16]. This places the vendor-shipper in a difficult position to deal with the carriers and to recover on loss or damage claims [16].

Large losses such as resulting from a truck hijacking, overturn, fire, etc. receive immediate attention and often investigation by law enforcement agencies [15]. Small shortages, on the other hand, receive little if any serious attention because they are generally "under the radar screen" [15]. In fact, some transportation contracts have a minimum threshold for filing loss and damage claims, and many companies have a policy not to bother with claims under a certain amount, such as $100 or even $500 [15].

There are some instances of simple miscounting either when loading or unloading, or packages going astray in a terminal during cross-docking, etc [16]. However, the reality is that most of the time the goods have been stolen, and that the cumulative impact of thousands of these small shortages costs shippers millions of dollars every year [15].

There are only three explanations for these shortages:

- either the freight was not put on the truck at origin [15],
- or it was stolen during transit [15], or
- it was stolen after delivery and while in the consignee's facility [15].

Simulation for Multi-Agent Systems

The term computer simulation is related to the usage of a computational model in order to improve the understanding of a system's behavior and/or to evaluate strategies for its operation, in explanatory or predictive schemes [10]. There are cases in which practical or ethical reasons make it impossible to realize direct observations: in these cases, the possibility of realizing 'in-machina' experiments may represent the only way to study, analyze and evaluate models of those realities [13]. Different situations and systems are characterized by the presence of autonomous entities whose local behaviors (actions and interactions) determine the evolution of the overall system; agent-based models are particularly suited to support the definition of models of such systems, but also to support the design and implementation of simulators [13].

Agent-Based models and Multi-Agent Systems (MAS) have been adopted to simulate very different kinds of complex systems, from the simulation of socio-economic systems to the elaboration of scenarios for logistics optimization, from biological systems to urban planning [13].

An agent is a computer system that is capable of in- dependent action on behalf of its user or owner and a multi-agent system consists of a number of agents which interact with each other, typically by exchanging messages [14].

In the case of MAS, several agents are interacting in a goal or task oriented coordination that can be both cooperative and competitive [14]. The interaction between the various agents in the system provides an interesting way for solving problems [14].

In approaches that use different agents for simulation, the analytical unit is represented by an individual agent, acting and interacting with other entities in a shared environment [10]. The overall system dynamics is not defined in terms of a global function, but rather the result of individuals' actions and interactions [10]. While agents play thus a key role in this approach, it must also be noted that in most of the introduced application domains, the environment they are situated in plays a prominent role because [10]:

- it deeply influences the behaviors of the simulated entities, in terms of perceptions and allowed for actions of the agents [10];
- the aim of the simulation is to observe some aggregate level behavior (e.g. the density of certain types of agents in an area of the environment, the average length of a given path for mobile agents, the generation of clusters of agents etc.), that can actually only be observed in the environment [10].

2 Aim and objectives

The aim of this project is to study how DSS based on multi-agent could improve decision in solving complex problems in the field of logistics, such as VGM. The topic of VGM has been selected as the prime issue here because of it's importance with the new regulations set up by the International Maritime Organization regarding the SOLAS Convention.

A case study will be conducted on the same issue, to know in detail about the new regulations (and their relationships) that have been in effect since July 1, 2016 and formulate an artificially intelligent system that makes use of the basic concepts in decision support systems and also uses techniques and technologies of Multi-Agent System.

The project intends to find out the best points at which a container should be weighed in order to avoid tampering of weight at any point, as it would be loss of business at the port, and most importantly affect the safety of personnel at the port as well. This is aimed to be achieved using simulation techniques, from data collected during a certain period of time at two different ports.

2.1 Objectives

- Perform a literature review on DSS, VGM.
- Prepare a format for the semi-structured interviews that have to be conducted.
- Meet personnel at the ports to conduct interviews.
- Analyze the information collected from interviews.

- Collect data from different ports about containers, weight at the departure port, weight at the arrival port, and analyze if the data has been tampered. A possible prediction of chances where tampering of weight could be possible also should be analyzed, as this would help in the simulation process.
- Setup server program using the acquired data.
- Create QR code, and link the web page to mobile application.
- Analyse the differences of the current system with developed system to validate.

3 Research questions

RQ1. How can DSS improve the decision making for problems as complex as VGM?

RQ2. What is the impact of VGM on container port and terminal processes, in terms of physical handling and data flows, relating to data tampering?

RQ3. How can simulation be used to create an application that could possibly minimize if not avoid data tampering?

4 Method

Quantitative and Qualitative research methodologies will be performed to answer the research questions and find solutions to the problem discussed in the paper. Waterfall method of approach is introduced to develop the tool required for the project.

For RQ 1

A literature review will be done to understand the concepts of DSS for VGM problem. A case study on the amendments adopted by the International Maritime Organization to its Safety of Life at Sea Convention will give a better solution to the research question.

For RQ 2

The impact of verified gross mass on container port and terminal processes can be understood if interviews are taken from port officials who manage the in and out flow of container weights. A quantitative experiment is carried out from the results obtained after the interviews are collected. Personnel from Karlshamn port, Sweden have agreed to give interviews; also some personnel from Kakinada port, India have been contacted regarding the issue and they have agreed to give an interview.

For RQ 3

A detailed work report will be taken from the ports on the incoming and outgoing details of the container, for a certain period of time, and a discrete-event simulation will be developed in order to identify the pros and cons.The data for the time period October, 2016 to November, 2016 will be collected from both the ports and the experiment will be conducted from the received data. The simulation model developed will be compared with the current state for evaluation.

- **Simulation Model to be developed**

  All the data collected from the port will be digitalized using Apache tomcat on the server-side. This data will be made available only to people with authorised access (in real-time environment, it can be personnel selected by the International Maritime Organisation for this purpose) on HTTPSecure web links only. This is to make sure that the data is secure and will not go into wrong hands [17].

  A mobile application which can be accessed only when a QR code that is generated by the server is scanned will also be developed using Json libraries for appropriate location details, so the server can know the location from where data is being accessed. The reason to select QR code scanning as a medium of user authentication is that, this is a server-client kind of job which doesn't have the need to be accessed by people who are not directly involved in logistics, and specially, this application is a solution to prevent the tampering of data which can be avoided best if it can only be accessed with the help of one server itself, as the data can be validated when needed from one place itself, and that would solve problems easily, in case there is any [18]. Besides, scanning the QR code and authorising oneself into the application can only be possible if the person doing that is an authorised personnel, which would also guarantee the data's appropriate usage.

Validity Threat

As non-compliance can lead to casualties, it is best for ports to accept only those containers that adhere to the rules. However, this will have disastrous effects in shipping and may lead to huge losses. Incase, a container arrives without a VGM, it will have to be weighed at the first port of exit and has to be recorded into database for further retrieval and use of it.

5 Expected outcomes

There are both hardware and software solutions that exist. Due to the issues of misinformation or decisions not being taken, we believe that a DSS which is more proactive and executes better decisions is needed. As a part of the DSS, Multi-Agent Systems can be used in developing improvised and robust DSS for the VGM problem.

The literature review would help understand the relation between Decision Support Systems and Verified Gross Mass regulations. The case study will help in deciding how DSS can improve the decision making based on the adopted amendments. The interviews conducted will determine the impact of VGM on container port and terminal processes.

The simulation model developed will be help analyse the data taken from the ports, and also identify the advantages and disadvantages in the container weighing procedures. It will assist in suggesting an optimal solution to weigh containers and avoid tampering of weight in that process at any point.

6 Time and activity plan

This section deals with how the project is planned to be completed in Table 1.

Task no.	Description	Effort	Date of completion
1	Background Study	3 Weeks	September 22, 2016
2	Research Proposal Re-Submission	1 Week	November 17, 2016
3	Case Study	10 Days	October 2, 2016
4	Interviews-	4 weeks	October 30, 2016
4.1	Prepare outline for semi-structured interviews and develop questions, consent forms and recording devices	1 week	
4.2	Contact personnel at Karlshamn port, Kakinada port and make appointments	1 week	
4.3	Conduct Interviews	1 week	
4.4	Document Interviews	1 week	
5	Analyse feasibility of the Existing methods in accordance with the adherence of new rules	3 days	November 2, 2016
6	Study & Understanding each rule of weighing setup by the IMO under SOLAS act	2 weeks	November 16, 2016
7	Document the case study	1 week	November 23, 2016
8	Setup Environment for simulation	3 days	November 26, 2016
9	Understand compliance options	3 days	November 29, 2016
10	Running Experiment	1 week	December 6, 2016
11	Simulate the Result	2 weeks	December 20, 2016
12	Verify and validate of the result obtained: post-experiment interview and post-hoc test	2 weeks	January 3, 2017
13	Final thesis document submission	1 week	January 10, 2017

Table 1: Time and Activity Plan

7 Risk management

- **Risk 1**

  There is a risk that literature obtained may be vague, as both Decision Support System and Verified Gross Mass is a new subject, on which the research has not yet advanced, as the new rules for VGM compliance have come into practice since July 1, 2016.

  Management
  Individual literature reviews could be done, if related literature is not available, and then, that literature can be analyzed accordingly to suit the research question.

- **Risk 2**

  The incoming and outgoing details of the container may be wrong/faked, and that would mislead the simulation experiment.

  Management
  A baseline should be considered from the input taken, to check the tampering of data.

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