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Towards Logistics Exception Prioritisation: Ontological Approach

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Abstract

Logistics services consist of a complex network of processes where exception management is becoming increasingly critical. During the process of exception management, prioritisation of exceptions is necessary for the efficient use of resources resulting in successful logistics services. Previous efforts in logistics exception management systems have focused primarily on exception handling. Exception prioritisation does not have the necessary emphasis in current exception management systems and requires proper assessment of the priorities. This study presents an approach to logistics exception prioritisation by developing logistics service priority using ontological views together with the "Cynefin" model. The proposed approach provides better logistics exception prioritisation resulting in efficient use of organisational and logistics service resources and thereby achieving better logistics services.

Keywords

Logistics, Exception prioritisation, Ontology, SME, Cynefin framework.

INTRODUCTION

Logistics is a subset of a broader supply chain process (Bowersox et al. 2007) which is an integrated network of processes consisting of order processing, inventory, warehousing, transportation, and delivery. Integrated logistics processes serve as an essential part of effective supply chain processes (Bowersox et al. 2007). Due to recent globalisation, privatisations, technology usage and consolidations, the changes to logistics services have been significant (Helo et al. 2006). For example, the transportation services required to operate across borders (example: FedEx, the logistics services company delivering IBM products globally), and companies increasing use of specialised services from different geographical locations (example: production based in China and delivery handled by FedEx based in the USA). Consequently, along with larger organisations, there is a huge number of small and medium enterprises (SMEs) providing logistics services that have become key participants in logistics and supply chain processes (Vaaland et al. 2007). Even with these changes, the purpose of logistics services has remained the same over the years but the way they function continues to change radically (Bowersox et al. 2007) primarily due to continued globalisation and technology usage (Helo et al. 2006). In addition, logistics services play a critical role in every economy. For example, in 2006, logistics costs in the United States were approximately 1.3 trillion dollars which is equivalent of 9.9% of its GDP (Andel 2007; CSCMP 2007). Therefore, the success of logistics services has an enormous economic impact. Understanding these impacts and the potential research contribution for successful logistics services, research has continued looking for improvements in logistics services, namely exception management (Ozkohen et al. 2006; Xu et al. 2003).

Current approaches in exception management systems use patterns (Russell et al. 2006), AND/OR trees (Ozkohen et al. 2006), fishbone diagrams (Wang et al. 2004a), and ontology (Ozkohen et al. 2006). The primary focus of current exception management systems are exception handling processes while exception prioritisation is overlooked. Exception prioritisation requires an understanding of the priorities. To understand the realities of exception priorities, ontology is considered effective because ontology is a specification of a conceptualisation and a formal representation of the real world (Wand et al. 2004; Wang et al. 1997), which can help to understand the realities of the priorities. Specification of conceptualisation can be applied to an abstract, representative and simplified view of the logistics exceptions. Ontologies are equated with taxonomic hierarchies of classes, relationships and other entities (Noy et al. 2004; Wang et al. 1997). It has been noted by previous research that the use of taxonomy improves the understanding of the environment from a taxonomical perspective (Massad et al. 2008; Wemmerlöv 1990). The objective of this research is to present an approach to prioritise the logistics exceptions. Therefore, taxonomic hierarchies are used to develop the understanding of the logistics exception priorities. Further, as logistics is a network of processes (Svensson 2002), logistics participants depend on each other for the success of logistics services. These dependencies can be reflected through social ontology which can be useful in prioritising logistics exceptions from a dependency perspective. In addition, it has been noted that the use of several ontologies could increase the understanding (Fonseca et al. 2007) of the exception priorities from different ontological perspectives.

This document is organised as follows. The next section presents the literature review of logistics, logistics exception and prioritisation, ontology, taxonomy, dependencies and "Cynefin" framework. Section two presents the research development that includes a detailed description of static and social ontological views, and the research methodology. This section also consists of an explanation of the case study, sample selection, data collection and data analysis. This is followed by a descriptive proposed prioritisation framework and then the evaluation. The evaluation consists of an operation and a discussion of the proposed system as the research is currently in progress. Finally, the paper concludes with the potential contribution, and future directions.

BACKGROUND

Logistics

Logistics has been defined as follows,

> *"… logistics is a subset of and occurs within the broader framework of a supply chain … logistics is the combination of a firm's order management, inventory, transportation, warehousing, materials handling, and packaging as integrated throughout the facility network."* (Bowersox et al. 2007, p.4)

Further, logistics is seen as a network of processes which are inter-connected and inter-related (Svensson 2002). In addition, integrated logistics serves as the link and synchronises the overall supply chain as a continuous process and is necessary for effective supply chain connectivity (Bowersox et al. 2007). These logistics processes are performed by small, medium and large companies. For example, a local delivery company serves the delivery function for a larger global company such as IBM. The complexity of problems in logistics networks has increased primarily due to the emergence of globalisation, privatisation, and technology usage (Hertz et al. 2003; Hosie et al. 2007). In addition to the increased complexity, error free logistics service is becoming the industry standard and customers are no longer tolerant of failures (Helms et al. 2005; Holcomb et al. 2000). The same applies to the small to medium companies (SMEs) where higher service levels are expected. Consequently, better service level in logistics exceptions (Sheu 2007b) and efficient use of resources in logistics services are becoming necessary for the success of logistics services (Chow et al. 2006) where logistics exception prioritisation is essential.

Logistics Exceptions and Prioritisation

Logistics Exception**:** Exception can be defined as anything that deviates from the planned process (Wang et al. 2004; Wijesooriya et al. 2008) or as a violation of a commitment (Ozkohen et al. 2006). For example, if a receiver violates his/her commitment to facilitate the delivery, such as keeping the gates locked or being unavailable to accept the delivery. Since logistics is an inter-connected and inter-related process an exception could impact throughout the logistics network. Previous studies see managing logistics exception situations as a way to improve the logistics services (Ozkohen et al. 2006; Russell et al. 2006).

Exception Prioritisation: Once an exception is identified the users of the system must check the exception for its urgency and criticality before finding a solution. It requires careful analysis of the exception, including, but not limited to, business impact, urgency and resource requirements for a solution (Hassenzahl et al. 2007; Hertzum 2006). Further, manual analysis could have some level of subjectivity due to human involvement. On the other hand, time is valuable and can be costly due to a waste of labour and a possible loss of business until a solution is found. Therefore, making the exception management process efficient becomes necessary for successful logistics services. The importance of prioritisation has been highlighted by previous research (Choi et al. 2005; Hertzum 2006; Sheu 2007a). The proposed approach use ontology as a method of ascertaining these priorities.

Ontologies from Taxonomy and Dependencies

Ontology

Ontology is a branch of philosophy dealing with modelling reality, and has been used to model information systems concepts (Wand 1996). Ontology is a formal representation of the real world and could be defined as "*a specification of some conceptualization, which is an abstract simplified view of the world*" (Wang et al. 1997; Wijesooriya et al. 2008). Often ontology is used as a method or a tool to design and then develop a solution for a problem. Further, the use of ontology can help build a representation of the selected semantics about some real-world domains (Wand et al. 2004; Wang et al. 1997). This study uses two of the four ontologies (static and social), presented in previous research (Jurisca et al. 2004; Ye et al. 2008), due to their relevance which are briefly described below.

Static Ontology

Ontologies are equated with taxonomic hierarchies of classes, relationships and other entities (Noy et al. 2004; Wang et al. 1997). Use of taxonomic hierarchies should structure a complex field of interest and assist in developing the understanding (Wemmerlöv 1990) of the field of interest. Understanding the nature of the logistics exception priorities is essential for an effective exception prioritisation system. Taxonomy is used in related areas by researchers, such as in business intelligence (Velardi et al. 2007), insights into failure situations (Massad et al. 2008), for service system design (Wemmerlöv 1990), and error handling strategies (Bourguet 2006). But, the use of taxonomy in logistics exception prioritisation is not found. Consequently, in this paper, it is argued that the use of taxonomy provides a better understanding of logistics exceptions priorities and therefore effective use of organisational resources.

Social Ontology

Social ontology may present the social settings, organisational structures or networks of alliances and inter-dependencies (Galbraith 1973; Mintberg 1979; Scott 2002 as cited by Jurisca et al. 2004). They can be explained by using concepts such as actor, role, and commitment. Since the logistics service is a network of processes and its participants commit to perform the logistics tasks, the use of social ontology is effective in exception prioritisation. This is presented in detail in section 2.1.2. Ontological views can be used with five domains in Cynefin framework to develop a prioritisation system.

Cynefin Framework

The Cynefin framework includes five domains namely, known, knowable, complex, chaos, and disorder (Figure 1). These domains can be categorised into ordered (known and knowable category) and unordered (complex and chaos categories) systems (Kurtz et al. 2003; Snowden 2005). The ordered systems are those with identifiable cause and effect that facilitate decision-making. Unordered systems are those where the cause and effect relationship is not clear. Therefore, making a decision about the issues in an unordered domain is complicated and requires extensive effort.

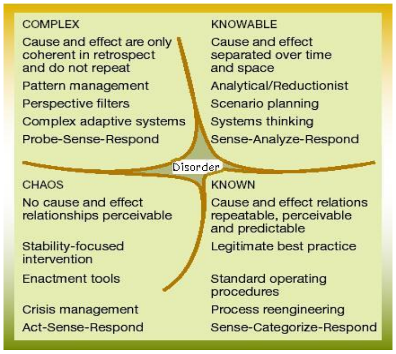

Figure 1 - Cynefin framework adopted and modified (Kurtz et al. 2003)

In the 'known' domain, there is a relationship between the cause and effect, empirical in nature, and repeatable. The incoming data is to be sensed, categorised and then responded to accordingly. In the 'knowable' domain a clear cause and effect relationship exists but all the details necessary to find a solution may not be available. Therefore, some work or advice may be required to find a solution. After finding the necessary information, it can be moved to the 'known' domain. As described in Figure 1, the decision process in this domain is sensing the incoming data, analysing it and responding accordingly. In the 'complex' domain, the cause and effect relationship is not clear and is not repeatable. However, there can be patterns that cannot be used to predict the outcome but can be used to perceive the patterns although there is no guarantee that the patterns will repeat. Therefore, the decision process in this domain is to create patterns before making a decision. In the 'chaos' domain, there is no cause and effect relationship and often there is no data to analyse. The objective in this process is to maintain a stable system. The 'disorder' domain can be critical in understanding the conflict among decision makers looking at the same situation from different perspectives (Kurtz et al. 2003). According to Kurtz and Snowden, there is a disagreement on the centre of the space, namely the disorder domain. Consequently, there are competing interpretations of the central space based on individual preferences.

RESEARCH DEVELOPMENT

Ontological Views

Static Ontology

This study uses static ontology to view the static aspect of the logistics exception priorities. The static aspect can be represented with the things that exist, attributes, and relationships that are usually reflected with taxonomy. To develop the taxonomy of logistics network priorities for exceptions, a separate study is required because different organisations and different logistics networks may have different exception priorities, and exceptions are not always repeatable. Exceptions can change from time to time, and also not all exceptions are expected to be recorded. Therefore, it is necessary to conduct an exploratory study to understand the organisational exception priorities to develop the taxonomy. The intention of this exploratory study is to develop a representative or realistic taxonomy of exception priorities for the logistics process. Since today's logistics processes consist of many SMEs, this study is particularly important for them as well as organisations that depend on services from SMEs. Additionally, SMEs can make use of the proposed approach to better relate to the logistics processes, by understanding the logistics exceptions from a logistics process view (Logistics network level) rather than from an organisational view (Logistics participant level) as shown in Figure 2.

The data collected from the documented exception reviews and staff interviews will be used to develop the exception themes. The themes will be critically analysed to develop the consolidated categories in an iterative process. Categories may cover many types of exceptions and provide a broader view of the exceptions. Developing the categories from the themes is necessary to create the business rules which in turn can be used for a prioritisation assignment. Findings from this process will be used to develop the prioritisation taxonomy. Taxonomy helps to understand the exceptions from a taxonomical perspective and thereby results in effective prioritisation. A similar approach has been used in previous research (Hassenzahl 2000) using two different views, namely 'Judgment-driven' (Figure 2) and 'Data-driven'. Similarly, this research will use documented exceptions review and interviews to develop taxonomy to provide a 'judgment-driven' priority. Then the research will use historical data to develop a 'data-driven' priority using the Cynefin model. The resulting priorities are expected to provide users with a better picture of the exception priorities so that the users can allocate their resources effectively.

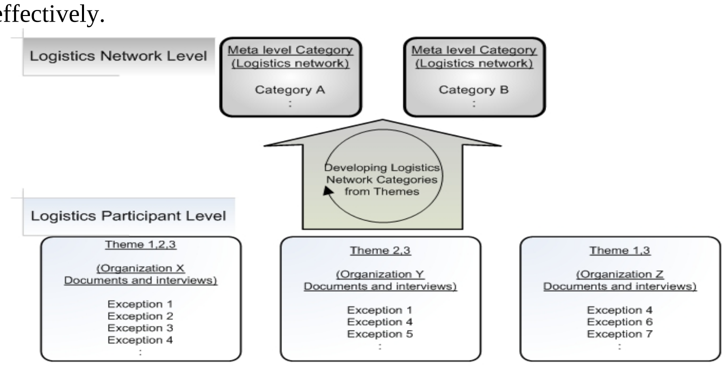

Figure 2: Judgement driven logistics priorities

Social Ontology

Logistics is an inter-connected network of processes (Svensson 2002) and its participants are members of the logistics network. Social ontology can be described by using, actors (participants) and commitment (dependencies). Therefore, this study considers that social ontology can be effective in presenting the logistics participant's dependencies (or commitments) in exception situations. Failure of a commitment can cause an exception that can impact the logistics network. By reviewing the dependencies, exceptions are seen from a commitment perspective, not as static perspective, which was described in section 2.1.1.

Logistics participants have dependencies on each other to perform a logistics task. For example, a computer manufacturing company such as DELL may depend on a specialised logistics service company such as DHL for its global delivery requirements. DHL may require some specialised services such as information systems or other technical services from another company to provide shipment tracking services. Therefore, the logistics services may have a complex network of dependencies. This is reflected in social ontology by identifying the actors, roles and dependencies between the logistics' participants. Further, an exception could occur due to commitment failure (failure of a participant's commitment to another participant), tasks failure and also due to resource unavailability (Ozkohen et al. 2006; Russell et al. 2006). Therefore, investigating logistics participants' dependencies in a logistics exception situation is necessary. In this process, based on previous work (Jurisca et al. 2004; Ye et al. 2008), this study investigated several dependencies such as goal dependency, task dependency, resource dependency, and soft-goal dependency. Figure 3 shows an example of the dependencies that are developed based on the logistics process.

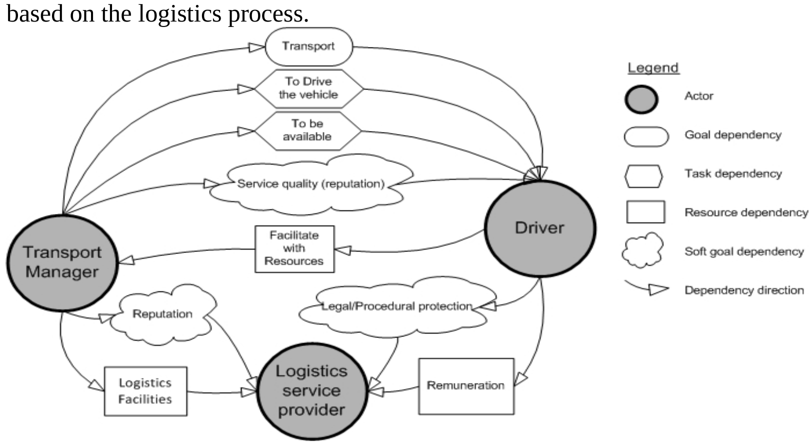

Figure 3: Example of dependencies of logistics participants

Further to the above ontology development, several ontological perspectives could be useful to increase the understanding (Fonseca et al. 2007) such as the use of static ontology, dynamic ontology, social ontology and also intention ontology (Jurisca et al. 2004). The proposed study views that the increased understanding helps effective exception prioritisation. However, for this study, it was decided to use primarily static and social ontology due to their relevance as shown above and also due to the limitation with the length of this paper. Nevertheless, other ontological views could be used in future work.

Research Method

Case Study

Case study is a research strategy which focuses on understanding the dynamics present within single settings (Eisenhardt 1989). A case study may involve one or more cases, multiple levels of analysis, a combination of data collection methods such as interviews, questionnaires and observations, and this information may be qualitative or quantitative or both (Yin 2003). A case study approach is suitable when little is known empirically about the phenomenon, conflicting theories exist, and existing theories seems to be inadequate to explain a phenomenon (Yin 2003). Case study research may use a single person (individual), a social community (family), or an institution (school, company) as the subject of a case study analysis (Flick 2006, p.141). For the purpose of this study it was considered that the logistics process (within the logistics network) was the subject of the study and the unit of analysis was the logistics exception.

Initially, a preliminary article review and a meta-analysis of these articles were performed by listing, summarising and analysing all the related articles in a spreadsheet to get a sense of the logistics exceptions. Based on the findings from the logistics exceptions published in the articles, it was decided that a single source of data may not provide the necessary richness of the exception prioritisation requirements as well as a sufficient range of logistics exceptions. Preliminary article reviews presented heavy focus on limited exception types such as transportation (Helms et al. 2005; Holcomb et al. 2000) and warehousing (Chow et al. 2006; Mueller et al.). It was not clear if all the possible exceptions were represented in the articles published. Therefore, it was considered that the data collection had to be exploratory so that it allowed the capture of the unknown and a wide range of exceptions from which realistic and reflective themes could be developed. Consequently, case study was an effective approach for this research which allowed the researcher to explore the phenomenon and allowed a combination of data collection methods (Yin 2003).

Sample

Two sets of data are investigated during this study. First, the documented exceptions and then a series of interviews of the staff are investigated. The objective of this research is to find the exception priorities within the logistics process. Therefore, a minimum of one logistics process is required to be investigated in detail. The sample must reflect at least a complete logistics process and may include one or many organisations. Consequently, all the available documented exceptions related to the selected logistics process(s) are to be reviewed. Then the staff involved in exception management will be interviewed. Their knowledge and experience in the process may provide the research with valuable information. Further, if any questions arise with regard to the case study, the guidelines provided primarily by Yin and then alternatively by Flick are to be followed for a resolution (Flick 2006; Yin 2003).

Data Collection

The data are to be collected from a survey of documented exceptions for its priority and then followed up with interviews. Using this approach, two sets of data are collected which will provide the research with a rich data set and also capture the maximum variations. Capturing a rich data set is necessary and critical in a case study situation (Benbasat et al. 1987; Yin 2003).

First the available documentations are to be reviewed and transcribed while making notes of the logistics process priority. This will be cross-checked with the respective staff who were involved in the data recording to make sure the interpretations and the notes are accurate. The second data set is collected by interviewing the staff who are responsible for exception management. Proper procedures and the issues related to ethical clearance will be obtained before proceeding with the interviews (Yin 2003). Interviews will be conducted in the participants' natural environment (Flick 2006) and will be guided initially by an open ended question and then followed up with probing questions triggered by the interviewee's answers. Based on the research objective, the first questions we could ask the interviewee are, "What jobs have the highest priority when a problem (exception) occurs?", "How do you prioritise the problem (exception) to find a solution?" Follow-up questions are expected to explore a broader focus area to find what and how the logistics exceptions are prioritised. Interviews will be audio recorded with alternatives, such as field notes.

Data Analysis

The objective of the data analysis is to search for the actual priorities of the logistics exceptions. Initially, all the transcripts will be read to grasp the broader understanding of the exceptions. From this reading a broader group of themes will be developed and the transcripts will be sorted into arbitrary groups using the themes (Akerlind 2005). Then the transcripts will be re-read to ensure that the arbitrary groupings are correct and a consolidation of the developed themes will be attempted. This process has to be continued iteratively until no further developments are possible resulting in the developed themes becoming an essence of the phenomenon (Marton 1986). Finally, the findings will be cross-checked with the interviewees to make sure that the themes developed accurately represent the logistics process exceptions.

PROPOSED PRIORITISATION FRAMEWORK

The proposed framework functions in two different contexts. The first is to categorise the exceptions based on the existing exceptions data using the ontologies presented. Exceptions occur at the smaller task level (Wijesooriya et al. 2008) and themes in the taxonomy and dependency are used for a better understanding of the exceptions. This understanding leads to better decisions (Wijesooriya et al. 2008) in handling exceptions, particularly resource allocation. The data repository is maintained at the same level as the exceptions, therefore makings it easier to assess the exceptions against the data repository. The assessing process is required to categorise the exceptions with the Cynefin framework. If the exception is known and the solution is a standard operating procedure, then the exception is considered in the 'known' domain. The system can be designed to handle solutions for exceptions in this domain by itself. In the second domain, the data repository may not have the relevant information. But the solution for the problem is 'knowable' and the system can be designed to send a message to the user with information, such as the problem description and the cause. In the third domain, the exceptions can be solved but because there is no previous record in the repository, no clear solution, and no clear cause and effect relationship is available. Further, it can be a unique exception. Therefore, it is necessary to make sense of the situation (Kurtz et al. 2003) by making patterns. In this case, the existing data repository may be of little help. However, the proposed approach provides the leads with the necessary information (such as taxonomy and dependency views) related to the problem and also categorises the exception as 'complex'. This process identifies the exception as a task that requires attention. The exceptions in the 'chaos' domain are the exceptions that are totally unknown. This exception may not have any information and requires previous experience to find a solution which may be an extensive and time consuming investigation. However, the proposed system could at least provide the problem-related information to the investigator. The last domain 'disorder', can include all other exceptions that do not fall into any of the above categories.

Figure 4 shown below is the proposed exception prioritisation framework. When an exception is received it must be processed for its priority based on the business rules and the existing data repository. Findings are mapped to exception level priority. These are then checked based on the taxonomy and dependency. The results provide the two ontological views that are used to develop the business rules.

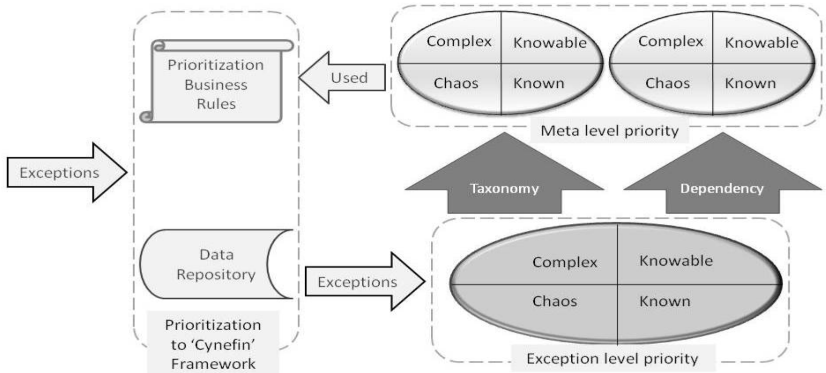

Figure 4: Static and Social Ontological Views in Prioritisation Framework

The framework proposed provides a better understanding of the exceptions by using ontologies which facilitate better decision-making. In particular, the ontologies proposed are used at the logistics network level (Meta-level). Note that the theme development and dependencies are developed based on the logistics network. Therefore, the logistics participants who use the framework can contribute to the success of the logistics services by using the logistics view (logistics network view) rather than their individual view. If an organisation would like to see the priority at the organisation level, based on the above framework, they can see it at the exception level priority along with the network priority at the meta-level. The meta-level view is considered a broader view compared to the exception level and could be used to develop business rules which in-turn can apply to prioritise the exceptions.

EVALUATION

Operation

Since this study is still in progress, an example of an exception prioritisation operation is provided below. A hypothetical situation is a product-tracking scenario where the product cannot be tracked due to a problem with the product identification (ID) and the exception is a known situation. The product in question uses 'color' instead of 'colour' in its ID. From a logistics process perspective within the tracking process, the task of tracking the particular product using the product ID cannot be performed, therefore an exception occurs. From the proposed taxonomy perspective, an error in ID causes a tracking (tracking is assumed as an example theme in the hypothetical case) exception, which represents the static ontology. From the social ontological perspective the actors in this process could be the tracking system, the tracking person, and the product ID provider. The following dependencies are noted. Goal dependency: the tracking person depends on the product ID provider for its task of tracking; Task dependency: the tracking person depends on the tracking system to verify the product ID; Resource dependency: the tracking system facilitates the tracking person with tracking resources; Resource dependency: the tracking system depends on the tracking person for maintenance. Further, if the exception has previously recorded information based on the exception data repository that is repeatable, the exception could be classified under the Cynefin classification 'known'. In most cases, exceptions classified as 'known' could be automated through programming the scenario. In this hypothetical case, the code could be corrected automatically by changing 'color' to 'colour'. If it was the solution used in previous similar cases, the same solution could be applied through the automated process.

However, the second type of exception, 'knowable', may not have previously recorded information. The second hypothetical case is a product tracking exception where the product could not be found and there is no existing data about the exception. Although the exception is classified as 'knowable', it may require some intervention such as a manual data search or a manual data change in the system. Once the intervention or the change is completed, the exception could be handled by automated means. For an example, a product code provided could be different than the product code in the logistics system and therefore the product tracking system cannot find the product. Manual intervention may be required to fix the problem, followed by an automated process which completes the task.

The third type of exception prioritisation may need to be handled with business rules as no existing cause and effect relationship can be found and no known related information is available. In the 'complex' category, it requires the development of patterns to make sense of the information, which is considered not possible to be handled by automated means at this stage. However, in this type of exception, it is necessary to capture as many details as possible to develop the patterns. The creation of patterns is beyond the scope of this study.

The fourth type of exception, 'chaos', is not relevant to the example provided. An example of the "chaos" category could be that no information is available about the goods transportation. Further, transportation cannot be performed as committed by the logistics participant (driver or the transport agent). In this case, the only known fact could be that a transportation exception exists. Failure to fulfil the commitment can be reflected in social ontology. In addition, it can be viewed from the dependency perspective.

Discussion

In the above presented hypothetical cases, it was shown that static and social ontologies could be used and are effective in viewing the exceptions from a different perspective. The ontologies presented use taxonomy and dependency which facilitate an increase in understanding (Wemmerlöv 1990) of logistics exception priorities from ontological perspectives. The concepts of ontology, taxonomy and the Cynefin framework use in exception prioritisation are considered effective. Previous related research can be used as examples of the success of ontological approaches, particularly the use of ontology to increase the understanding of a phenomena (Wemmerlöv 1990; Wijesooriya et al. 2008). Further, it allows the exception priorities to be viewed from an exceptions level (operational level), and also from a logistics network level (meta-level). Even though ontology is not new in research studies (Gruber 1993; Wand 1996), the use of ontology in logistics, particularly investigating benefits for SMEs, is rare. Since logistics is a complex network of processes (Svensson 2002), the existence, contribution and the value of SMEs in today's logistic networks must be recognised (Vaaland et al. 2007). The proposed approach in this study views the logistics services as a network of processes and its participants as actors in this network. Therefore, it is argued that the logistics network process view is better than the organisational view for the success of logistics services. The use of the proposed approach helps logistics participants solve the organisational as well as the logistics service issues, thereby making the logistics network efficient. Further, the success of the logistics participants is essential for the success of a logistics network. The proposed approach is justified with a hypothetical case in evaluation. This research is still in progress and the complete study, which includes a system development and implementation, is considered out of scope for this document.

CONCLUSION

As described in the introduction, the need for improvements in logistics exception handling particularly exception prioritisation is crucial. The approach presented in this study investigated the logistics participants' role in the logistics processes (at the network level) in addition to the organisational level (at the exception level). Therefore, the proposed approach provides benefits for all logistics participants (large organisations and SMEs) as well as practitioners. By using the approach presented in this study, organisations can better relate to the logistics network and improve their use of available resources. Further, this process helps to improve the logistics network as a whole. In addition, the study contributes to the research in many ways, by joining several theoretical concepts such as ontological views (static and social ontology), the use of ontology with the Cynefin framework, and also the use of a qualitative approach to develop themes. The development of themes is an effort to relate to the organisational and also logistics network realities in exception priorities. Therefore, the study contributes to the practitioners and the research equally.

The proposed approach requires an existing exception data repository. Therefore, the dependency on the existing data repository could be critical for the effectiveness of the proposed approach. As an alternative for this issue, the proposed approach could be used along with an initiative to develop an exception data repository. The data repository could be developed depending on the scope of the exceptions prioritisation such as the organisational scope or the logistics network scope. This study suggests that developing the logistics network and organisational data repository is necessary. Therefore, integration of these two data repositories is important but considered out of scope for this research. Further, the existing exception documentation in organizations is expected to be in a staggered context as not all organizations follow the same standards. Therefore, difficulties may arise when analysing the documented exceptions. The researcher must be aware of this situation and must interpret the findings from a holistic and not an individual level. In addition, organisations need to have logistics network focus rather than an organisational focus in prioritisation. Therefore, the researcher may have to consolidate the findings before any conclusions are drawn. Again, the holistic view becomes critical throughout this research process.

As for the future work of this research, adding dynamic ontology and intention ontology will increase the understanding. Further, a complete study is required for the final conclusion. Due to constraints, such as the length of the document, it was decided to present the study in its current state. The proposed approach provides sufficient justification and guidelines for an effective exception prioritisation and it is expected that the study will stimulate future related research.

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