From EDIFACT to OpenTripModel: analysis, migration and guidelines based on data from real-world logistics companies

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This paper describes an investigation on the use of OpenTripModel (OTM) to check if it is a proper standard that is able to replace EDIFACT for the message exchange between companies in the logistics sector. While EDI standard defines the syntax for the messages, it lacks semantic definition, which results in the lack of semantic interoperability. In this research, we analyzed OTM and EDIFACT standards' documentation and real-world messages from an integration platform used by logistics companies in the European Union. Based on this analysis we propose mappings between EDIFACT and OTM, and demonstrate how these mappings should be executed for message translations. To that end, this paper presents a proof-of-concept migration that the IT sector can rely on to start preparing for complete migration.

Additional Key Words and Phrases: EDI, EDIFACT, OpenTripModel, data sharing model

1 INTRODUCTION

The logistics sector includes multiple actors, such as warehouses, government agencies, transport companies, and IT support companies. The interaction among these actors is mainly done through the electronic exchange of information. The most used set of standards for this data exchange is the Electronic Data Interchange (EDI), of which "Electronic Data Interchange for Administration, Commerce and Transport" (EDIFACT) is one of the norms. Within interorganizational business contexts, EDIFACT has been a major player for a long time in both logistics and transport industries [13, 15]. EDI provides a syntactic structure for the business messages, but it lacks a semantic definition for it [9]. Because of the lack of semantic interoperability, the actors in this sector need to bridge their IT systems with integration tools. Besides the extra work in building such integration platforms, setting up such a parser is strenuous, requiring several ad-hoc bridges to be built in the translating systems. A theoretical background on the standards for data exchange in the logistics sector is presented in Section 2.

The stakeholders of the logistic sector are looking for a new data exchange standard to improve the semantic interoperability without the hassle of building translating bridges. The most popular alternatives to EDIFACT are: Open Trip Model, iSHARE, eCMR platforms, and Paperless Transport and Elektronische Begeleidingsbrief Afval(EBA) [4]. These standards are recommended by Stichting Uniforme Transport Code (SUTC), which is an independent organization supported by the Top Sector Logistics from the Netherlands [4]. Among these standards, the Open Trip Model (OTM) stands out as the only open source project compared to other proprietary models [10].

In this work, we acknowledge some of the benefits in adopting OTM [8] as a replacement of UN/EDIFACT. In addition, we dig deeper to investigate how to support logistic sectors' actors willing to migrate from EDIFACT to OTM. In Section 3, we present a proof-of-concept of this migration featuring a subset of EDIFACT messages taken from real (anonymized) messages exchanged by logistic sector actors in 2021.

Limited to the scope of this work, the findings of our investigations indicate that this migration is possible and beneficial. These results are presented in Section 4, together with a set of guidelines for the OTM Open Source organization (to help further develop OTM) and to companies willing to migrate from EDIFACT to OTM. We consider this a relevant contribution, since the reduced capabilities of EDIFACT to achieve semantic interoperability are a current bottleneck for the development of such sector. Moreover, new companies are already adopting OTM [18]. Therefore, this work can also benefit well-established traditional companies of the sector that need to catch-up with their use of standards to keep their competitive advantage. As mentioned before, this work is mainly limited by the subset of messages available to be analysed. We draw these limitations together with conclusions, and future work in Section 5.

2 THEORETICAL BACKGROUND

This literature review encompasses an overview on interoperability and continues by discussing the fundamentals regarding UN/EDIFACT and Open Trip Model, as they can facilitate a better understanding of the current situation and present the current gap in literature.

2.1 Interoperability

Interoperability, according to the Institute of Electrical and Electronics Engineers [11], is the capacity of two or more systems or components to exchange and utilize information. It was born out of the demand to increase task coordination, the operational heterogeneous networked environment, and real-time information sharing [6]. However, due to the

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lack of standardized semantics (meaning and usage of business document content) and pragmatics (definition of inter-organizational process flow) of cross-organizational interaction, EDIFACT is unable to achieve complete interoperability [24].

The four tiers of big data interoperability address the interoperability difficulties at a high abstraction level [21]. First one is the technical level which addresses the hardware requirements and what performances they would serve for. Secondly, the syntactic level, also known as the variety challenge of big data [16] as cited in [21] refers to the several sources of data available in the logistics field which provide data in different formats: structured, semi structured and unstructured; and the need for all these to use a common format. Third level, semantic, suggests that the value of interpreted information should be consistent regardless of who needs to use the data. An example of issues occurring due to lack of semantic interoperability can be found in this paper [3]. Finally, the fourth tier of interoperability is called pragmatic and it addresses challenges such as the degree of practicality to which the consistency of data is achieved across departments of a company and whether that is enough to be considered as interoperable [12].

2.2 UN/EDIFACT

When it comes to EDI and its dominance it accounts for 78% of the total volume of electronic transactions done in 2019 [15]. Therefore, hundreds of thousands of businesses use either ANSI X12 or UN/EDIFACT. The EDIFACT standard establishes interfaces between business EDI networks. With the aid of EDIFACT, businesses from many sectors can transport data along the value-added chain outside of national borders without the need for manual intervention. As a result, it aids in breaking down technological and geographic frontiers. A company should be able to automatically transfer electronic data to every other company that has adopted EDIFACT [23]. Furthermore, using EDI facilitates the communication with other partners because EDIFACT documents can be used as a legal proof of business communication [7].

Given their significant industry adoption and longstanding history, EDIFACT standards are likely to continue to be crucial in Business-to-Business (B2B) communication for years to come. However, the semantics of data items communicated in EDIFACT messages are not fully consistent. They can be influenced by the values of other data items, known as qualifiers [7]. They represent code lists which are used to encrypt the additional semantic content of a certain segment. Qualifiers and encoded values must also be taken into account for proper interpretation of EDIFACT messages. Therefore, the following three factors must be considered while interpreting EDIFACT messages: the position of segments, optional qualifiers of a particular segment, and coded values of segments [13].

In order to correctly interpret a data piece, one must consider possible semantic links with other data items. While these relationships are frequently obvious from the EDIFACT requirements for humans, this information is neither technically nor explicitly stated in the standards. As a result, it is inherently inaccessible to machines who can not identify these semantic links. Past and current EDI system implementations are typically carefully programmed (i.e., hard coded) to handle specific semantic relationships appropriately. Furthermore, these systems are created specifically to implement exclusive bi- or multilateral agreements between trading partners regarding the "authorized" usage of data elements, known as Message Implementation Guidelines (MIG) [7].

2.3 OpenTripModel

The primary issue impeding the logistics industry from fully benefiting from IT innovations is represented by data exchange. This challenge consists of platforms that use these open standards for data sharing and open standards themselves [10]. An analysis of numerous publicly sponsored projects in the Netherlands and the EU reveals that many of them result in private solutions and possible de facto standards, where a single stakeholder plays the dominant role. The creation of the OpenTripModel [1] in the Netherlands, which was based on a large retailer’s proprietary visibility solution, is an example of the latter. OTM is different from the visibility solutions created by the H2020 Aeolix project [2] and from a private solution created by IBM and Maersk in the EU FP7 SEC CORE project [20]. Open standards are necessary because logistics technologies demand extensive data sharing in order to promote data consistency and completeness, such as the electronic data exchange that all parties must be involved in. More particularly, there is research [14] which demonstrates how various systems and gadgets can be connected to the OTM data model, removing some interoperability problems.

The OpenTripModel is an open-source, adaptable data-sharing platform that promotes standardized and regular information transmission between various information systems. The Stichting Uniforme Transport Code (SUTC), which oversees this model, established it with the intention of assisting Dutch logistics firms in effectively exchanging real-time logistic data [19].

The Open Trip Model specification has been designed to ease the information sharing between logistics and transporters [1]. Their solution model relies on an Event entity (see Figure 1) which can be created, read, updated and deleted by using actions. A set of entities and actions relates to a certain lifecycle. The available lifecycles are Projected,

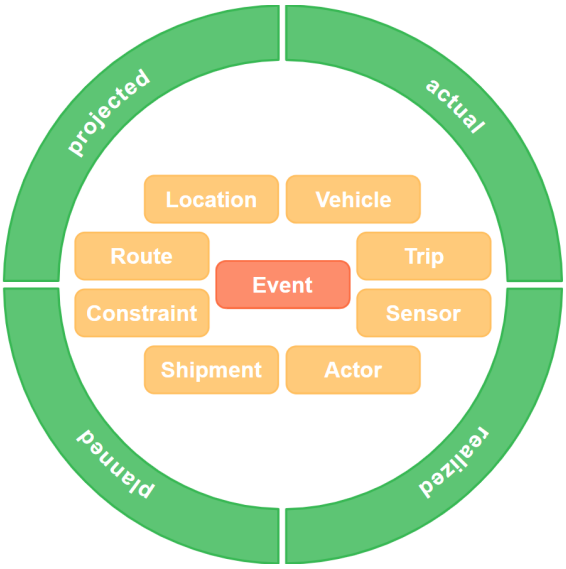

Fig. 1. OTM 5.0 data model

Actual, Realized and Planned. Once an entity has been initiated inside one lifecycle, it exists in all of them, which leaves a trail of event information (that can be used in other cycles as well). The lifecycle conveys the many stages of the transportation process and makes it possible for various perspectives on the operation. For example, it can be used to look ahead at events that have been planned, at what is taking place right now or to look back at what has already been realized. This can be used as a foundation for creating process mining applications, behavioral analysis and performance management which is provided by event data along with the linked entities and the lifecycles [19].

Finally, to reduce the ambiguity of the messages, the notion of a profile is introduced. A profile restricts what entities are available and which fields are required when using the data model. In order for two companies to be able to communicate they must reach an agreement on which profile they will use [8].

3 MIGRATION TO OPENTRIPMODEL

In this section we show the assumptions done based on the EDIFACT messages that were analysed and the profiles that OTM is currently supporting. In the first subsection we will present the general mappings and in the second one we will discuss how to build a message and validate it using the tools provided by OTM.

3.1 Assumptions

This subsection presents the process of migration from EDIFACT to OpenTripModel based on real-world messages received from an integration platform. In this migration process, we used the EDIFACT message type called DESADV (see row 1 of Table 1), which according to the documentation from UNECE, represents a dispatch advice. In general, information about the buyer, supplier and delivery parties involved in the transport process as well as the dispatched objects are included in this kind of message. In order to be able to migrate such messages from EDIFACT to OTM, some assumptions have to be made to facilitate this process. These assumptions were done based on the semantic interpretation of the EDIFACT message which can be seen in table 1. This table has the EDIFACT message in the left side and the interpretation of each EDIFACT segment on the right side.

Firstly, when looking at the profiles supported by OTM, only three of them were found which are TransportOrder, Trip and VESDI [1]. The assumption that was made here is that the profile that could be matched with our EDIFACT message as the most relatable one was TransportOrder. The relatedness of this profile and the DESADV message type is based on two arguments: (i) the fact that a dispatch advice message contains information only about the goods which are ready to be sent, not about how they will be transported neither details about the emissions of the trip nor other information needed to satisfy the requirements of the other two profile options; (ii) the information enclosed within such an EDIFACT message together with a minimum set of assumptions is enough to satisfy the requirements of the TransportOrder profile. Furthermore, the researcher also assumed during the mapping process of the messages that the estimated date and time mentioned in the message matches the timestamp by when the transport needs to get to the receiver, and therefore to be finalized. The data of issuance specified in the message is also considered to be the date when the message was created, so it can be assumed that it is the date when the order was made.

Each EDIFACT message analyzed contained NAD segments enclosing information from either the buyer, the delivery party, the supplier or the invoicee (see rows 7,8,9,10 from Table 1). All messages contained at least details about the buyer and supplier parties involved in the order. These were concealed inside the segments using references to the International Article Numbering association. To find the companies referenced by these values, the Global Language of Business(GS1) website was used [22]. Therefore, another assumption is that the information found on the GS1 website when searching for the reference codes of the buyer, supplier or delivery party from the message was correct and valid, and can be used in the mapping process.

A presumption also needed to be made about the address of the supplier. This consists of assuming that the supplier's address extracted from the EDIFACT message is the same with the location where the loading of the transported goods

Table 1. EDIFACT semantic interpretation

Nr.	EDIFACT	Semantic interpretation
1	UNH+1+DESADV:D:01B:UN:EAN007’	This is the header segment of the message and contains information such as the message type of the document which is DESADV, the UN/EDIFACT directory version 01B and the name of the organization in charge of creating and maintaining the aforementioned message type.
2	BGM+351:::351+10053924+9’	This segment marks the beginning of the message and aims to server as an identifier through giving information about the message type (351) and the document id 10053924
3	DTM+137:202205040000:203’	This is a date and time segment which encloses the timestamp 202205040000 in format CCYYMMDDHHMM. This timestamp clarifies when the message was issued.
4	DTM+17:202205110000:203’	This is a date and time segment which encloses the timestamp 202205040000 in format CCYYMMDDHHMM. This timestamp clarifies when the message was issued.
5	RFF+ON:70062937’	The order number(ON) reference is 70062937
6	RFF+ZZZ:EANNL1’	ZZZ marks the value EANNL1 as a mutually defined reference
7	NAD+BY+0000000000000::9’	Name and address of the buyer are given as a reference number from the International Article Numbering Association (EAN)
8	NAD+DP+3661382052628::9’	The name and address of the delivery party are given as a reference number from the EAN
9	NAD+IV+0000000000000::9’	The name and address of the invoicee are given as a reference number from the EAN
10	NAD+SU+0000000000000::9’	The name and address of the supplier are given as a reference number from the EAN
11	CPS+1’	This segment marks the beginning of the first consignment packing sequence
12	LIN+1++0000000000000:SRV’	This segment marks the first line item and encloses the GTIN which is administered by the EAN
13	QTY+12:100’	This segment mentions the quantity dispatched by the seller from the item referenced in row 12
14	LIN+2++0000000000000:SRV’	Same interpretation as for row 12 but with a different GTIN
15	QTY+12:60’	This segment mentions the quantity dispatched by the seller from the item referenced in row 14
16	LIN+3++0000000000000:SRV’	Same interpretation as for row 12 but with a different GTIN
17	QTY+12:60’	This segment mentions the quantity dispatched by the seller from the item referenced in row 16
18	LIN+4++0000000000000:SRV’	Same interpretation as for row 12 but with a different GTIN
19	QTY+12:100’	This segment mentions the quantity dispatched by the seller from the item referenced in row 18
20	LIN+5++0000000000000:SRV’	Same interpretation as for row 12 but with a different GTIN
21	QTY+12:60’	This segment mentions the quantity dispatched by the seller from the item referenced in row 20
22	LIN+6++0000000000000:SRV’	Same interpretation as for row 12 but with a different GTIN
23	QTY+12:38’	This segment mentions the quantity dispatched by the seller from the item referenced in row 22
24	LIN+7++0000000000000:SRV’	Same interpretation as for row 12 but with a different GTIN
25	QTY+12:38’	This segment mentions the quantity dispatched by the seller from the item referenced in row 24
26	UNT+26+1’	This segment marks the end of the message and it contains the number of segments that the message has

takes place. Another premise that is in close correlation with the previous one refers to the address of the buyer. The location where the transported objects need to be delivered also represents the address of the buyer and the point where the unloading process takes place. However, in practice this can differ because it is not mandatory that the supplier's address is identical with the address where the transactioned goods are stored and neither is the case for the buyer's location and where this party prefers to have the goods delivered.

Moreover, in the EDIFACT message goods were referenced by their Global Trade Item Number (GTIN) and we assumed that adding this information in the externalAttributes of the goods item from OTM message is the right place to find this information and that it would also be enough information for the destination party who receives the message to understand to which of the goods the message refers to.

Last but not least, when making the migration we discovered the fact that decimal values are not supported by OTM for the quantities of goods and that only integer numbers should be used. As a consequence, in the quantities segments using such decimal values, to avoid decreasing the accuracy of the data, we added quantity as an externalAttribute and converted the value in a string because that is the only data type supported by externalAttributes.

3.2 Mapping

In this subsection we present the mapping process and the results we reached starting from the EDIFACT messagess and the assumptions mentioned above.

The mapping can be seen in Table 2. In the first column of the table you can find the row number identifier. To make the reading easier, this is the same with the identifier which can be seen in the first column of Table 1. In the second column of the table we have an EDIFACT message and in the third one we have the path to where the extracted information can be found in the resulting JSON document (appendix A). In the fourth side of the table we added the piece of information extracted from the EDIFACT message and in the fifth column we added the number of the line where that information can be found in message enclosed within the appendix A.

In Table 2 we can see a couple of unusual things and they will be explained in this part of the paper. First one is the fact that the information contained in EDIFACT about the Invoicee was not mapped to OpenTripModel. The reason behind this is that the Open Trip Model is built for storing information about the transport related processes which do not involve directly the party playing the role of an Invoicee. Therefore, OpenTripModel does not even have such a role for when an actor is created in their model. For the roles of the other actors which were mapped in rows nr. 7,8,10 (see Table 2), information was found on the GS1 official website when searching for their Global Trade Item Number value given in the NAD segment from the EDIFACT message. A second one can be found in the last row of the Table 2. This segment is generally called the trailer of the message and it encloses one piece of information, namely the number of lines included in the EDIFACT message an therefore did not result in any information that could have have been mapped to the OTM message.

The complete OTM message can be found in appendix A and the other EDIFACT messages and their OTM corresponding documents can be accessed by following the instructions from appendix B. To ensure that the migration process was done correctly and the OTM specification was followed we used the validation API provided by OpenTripModel [17].

4 LESSONS LEARNED

Based on the assumption and outcomes from the migration process, some findings can be formulated. In this section we present these discoveries which can help facilitate a smoother transition process and provide useful information for the mapping process. We believe that this information has two major stakeholders: the current and future users of EDIFACT and the OpenTripModel OpenSource community. Therefore they will be presented specifically for each stakeholder.

4.1 Suggestions for the OpenTripModel community

A list of recommendations has been put together to help improve the Open Trip model so that it can increase the attractiveness to the current actors in the logistics and transport sectors.

A useful addition to the OpenTripModel would be supporting all types of references currently used in the industries. For example, when creating a location object within OTM, there is a possibility for the user to reference that object by using the Global Location Number part of the GS1 systems or the United Nations Code for Trade and Transport Locations. On the other hand, when creating goods items, there is no possibility for referencing those objects by their Global Trade Item Number which is part of the GS1 systems. Furthermore, the same is happening for the contactDetails object used for creating actor entities. A wide-known way of referencing companies is by using their corresponding International Article Number which is also known as European Article Number or EAN. This code contains the company code prefix which uniquely identifies a company and therefore can be used as a method to identify the company [5]. This is also the case for the consignment objects that can be created in OpenTripModel. A way of identifying the package in EDIFACT is by referencing it with the Serial Shipping Container Code, this can also be expressed as a European Article Number. Since there is no package object that can be created in OTM, this code can be added to a consignment object since conceptually they are closely related.

Table 2. EDIFACT to OpenTripModel mapping

Nr.	EDIFACT	OpenTripModel	Value in JSON doc	Line
1	UNH+1+DESADV:D:01B:UN:EAN007’	#/entityType	"transportOrder"	5
2	BGM+351:::351+10053924+9’	#/externalAttributes/DocumentId	"10053924"	7
3	DTM+137:202205040000:203’	#/creationDate	"2022-05-04T00:00:00Z"	2
4	DTM+17:202205110000:203’	#/constraint/entity/value/endDateTime	"2022-05-11T00:00:00Z"	70
5	RFF+ON:70062937’	#/externalAtributes/OrderId	"70062937"	8
6	RFF+ZZZ:EANNL1’	#/externalAttributes/ZZZ	"EANNL1"	9
7	NAD+BY+0000000000000::9’	#/actors/entity/contactDetails/value	"0000000000000"	18
8	NAD+DP+0000000000000::9’	#/actors/entity/contactDetails/value	"0000000000000"	35
9	NAD+IV+0000000000000::9’	not mapped because cannot be used in OTM	no information	
10	NAD+SU+0000000000000::9’	#/actors/entity/contactDetails/value	"0000000000000"	53
11	CPS+1’	#/consignments/entity	"entity":{...}	79
12	LIN+1++0000000000000:SRV’	#/consignments/entity/goods/entity/externalAttributes/GTIN	"0000000000000"	85
13	QTY+12:100’	#/consignments/entity/goods/entity/quantity	100	87
14	LIN+2++0000000000000:SRV’	#/consignments/entity/goods/entity/externalAttributes/GTIN	"0000000000000"	96
15	QTY+12:60’	#/consignments/entity/goods/entity/quantity	60	98
16	LIN+3++0000000000000:SRV’	#/consignments/entity/goods/entity/externalAttributes/GTIN	"0000000000000"	107
17	QTY+12:60’	#/consignments/entity/goods/entity/quantity	60	109
18	LIN+4++0000000000000:SRV’	#/consignments/entity/goods/entity/externalAttributes/GTIN	"0000000000000"	118
19	QTY+12:100’	#/consignments/entity/goods/entity/quantity	100	120
20	LIN+5++0000000000000:SRV’	#/consignments/entity/goods/entity/externalAttributes/GTIN	"0000000000000"	129
21	QTY+12:60’	#/consignments/entity/goods/entity/quantity	60	131
22	LIN+6++0000000000000:SRV’	#/consignments/entity/goods/entity/externalAttributes/GTIN	"0000000000000"	140
23	QTY+12:38’	#/consignments/entity/goods/entity/quantity	38	142
24	LIN+7++0000000000000:SRV’	#/consignments/entity/goods/entity/externalAttributes/GTIN	"0000000000000"	151
25	QTY+12:38’	#/consignments/entity/goods/entity/quantity	38	153
26	UNT+26+1’	end segment of EDIFACT	no information	

Furthermore, a user should take into account the fact that when working with quantities of items, a difference between EDIFACT and OTM is that for the former, decimal numbers are supported, as for the latter this is not the case. In other words, OTM only supports integer numbers as quantity values, therefore imposing a constraint on its users. Another constraint related to this is that the fields inside the externalAttribute object can only be strings. Supporting other types such as integers, boolean or decimals could help the users maintain the accuracy of the data they need in the message even though is not modeled in OTM.

4.2 Suggestions for companies

First of all, each EDIFACT message has a document ID which is mentioned in the beginning of every message. However, this cannot be used in the current form in OTM because in OTM all IDs need to be an Universal Unique ID (UUID). If the document ID is not in this format, you can omit this when creating the document and OTM will provide one for you.

When converting an EDIFACT message to an OpenTripModel message, you should be aware of the fact that there is no specific support for reference IDs related to orders or invoices. Taking into consideration the fact that losing such information can damage vital parts of your business process, it can be added in the externalAttributes part of the message. However, be aware the current version of OpenTripModel only supports string fields inside the externalAttributes object but also that adding this field as an external Attribute would change the semantical significance of the field because OTM will see this as just another external attribute value rather than the actual quantity and its meaning. Therefore, when adding an external attribute be thoughtful of the semantical meaning held by the information inside it and adapt your message processing accordingly.

Additionally, companies should be aware of the fact that it is not possible to work with decimal values in OTM when referring to the quantity field for an item object, and that the OpenTripModel limits it's users to using only integer numbers. This is an aspect that needs to be considered carefully, as using only integers would decrease the accuracy of the message as the value would not be according to the reality. Therefore, companies could consider adding the quantity as a field on externalAttributes object corresponding to the item object and converting it into a string value.

Migrating from EDIFACT to OTM is a complex and resource consuming process, but the overall benefits out weight the challenges.

5 CONCLUSION

In this paper, we investigated how to bridge the DESADV message type of EDIFACT to corresponding sections of OpenTripModel. While we analyzed the semantics of each field, we also proposed the best way to address this migration using current OTM specification. As a result, we obtained messages validated with the tools provided by OpenTripModel. Therefore, the method used in this paper can be used as a stepping stone for expanding the migration support.

The previously presented findings are subject to limitations that need to be considered. The first one refers to the limited time frame of eight weeks that was allocated for this research. Therefore, there was not enough time available to study this problem in more depth and to give more attention to details, and a longer period of time would be desirable in the future to be able to overcome this constraint.

As a consequence of this limitation, a second one emerges which refers to the number of six messages that were analyzed. There is a correlation between these two limitations, as taking into account the narrow period of time, it was not possible to analyze more messages while also maintaining a high quality of the results. In the future, the number could be increased, because if the sample expands (is larger) so does the knowledge derived from the process.

Moreover, the messages taken from the companies are based on old versions of the EDIFACT standard such as D96A from 1996 and D01B from 2001. This could represent a limitation because these versions are not up to date and do not take into account the recent updates thus possibly making the migration to newer standards such as OpenTripModel less straightforward. However, considering the fact that the companies still use these versions shows that they are reliable. Last but not least, another limitation refers to the current version of OpenTripModel. The present form of OTM has some features that can be improved based on this study. Therefore, fixing them by the time future research will be conducted on this topic can facilitate a smoother research process.

In terms of future work, apart from the suggestions mentioned above, there are other aspects that researchers could consider. Currently, this study is done for the DESADV EDIFACT message type, which according to the literature specifies details for goods dispatched. However, there are other EDIFACT message types that could be analyzed using the methods and recommendations from this research and which could benefit the transport and logistics industries.

All in all, diving deeper into this topic and taking into consideration all the suggestions mentioned in this research, the current findings represent some of the aspects that contribute to the first steps made in the direction where logistics and transport industries directly benefit from the IT innovations.

This proof of concept paper investigated the process of migrating from the currently most used data standard for electronic information interchange, EDIFACT, to a new solution represented by the OpenTripModel. Suggestions for both companies and the OpenTripModel community have been presented in order to soothe the migration process and increase the openness to the current state of the industry. Taking into account the fact that real life messages from a logistics company were analyzed, the practicability and reliability of the migration guidelines developed is underlined. The information and the results presented in this paper do not only contribute to narrowing the current gap in literature regarding this topic, but they also represent the base for future research and present practical implications that can be used by bona fide companies.

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APPENDIX

A OPENTRIPMODEL MESSAGE


```
{
  "creationDate": "2022-05-04T00:00:00Z",
  "name": "despatch advice message",
  "description": "Message translated to OTM
      transport order definition",
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    "OrderId": "70062937",
    "ZZZ": "EANNL1"
  },
  "actors": [
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      "associationType": "inline",
      "entity": {
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        "contactDetails": [
          {
            "value": "0000000000000",
            "remark": "it is a reference to
                International Article Numbering
                association",
            "type": "other"
          }
        ]
      }
    },
    {
      "associationType": "inline",
      "entity": {
        "name": "no name",
        "contactDetails": [
          {
            "value": "0000000000000",
            "remark": "it is a reference to
                International Article Numbering
                association",
            "type": "other"
          }
        ]
      }
    },
    {
      "associationType": "inline",
      "entity": {
        "name": "no name",
        "contactDetails": [
          {
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            "remark": "it is a reference to
                International Article Numbering
                association",
            "type": "other"
          }
        ]
      }
    }
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    "entity":{
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      "value":{
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        "description": "estimated delivery date
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        "type": "endDateTimeConstraint"
      }
    }
  },
  "consignments": [
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      "associationType": "inline",
      "entity": {
        "goods": [
          {
            "entity": {
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              "externalAttributes": {
                "GTIN": "0000000000000"
              },
              "quantity": 100,
              "type": "items"
            },
            "associationType": "inline"
          },
          {
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              "externalAttributes": {
                "GTIN": "0000000000000"
              },
              "quantity": 60,
              "type": "items"
            },
            "associationType": "inline"
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```

```
            },
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          "associationType": "inline"
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          "entity": {
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            "location": {
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                  "postalCode": "0000 AA",
                  "country": "NL"
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            }
          }
        },
        {
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          "entity": {
            "actionType": "load",
            "location": {
              "associationType": "inline",
              "entity": {
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                  "type": "addressGeoReference",
                  "name": "office",
                  "street": "no name",
                  "houseNumber": "0",
                  "postalCode": "0000 AA",
                  "country": "NL"
                },
                "externalAttributes": {
                  "EAN": "0000000000000"
                }
              }
            }
          }
        }
      ]
    }
  ]
}
```

B OTHER RESOURCES

Due to the length of the other JSON messages, we put the other resources we have used in this study in a repository from the university and you can use this link to access it.