The Sustainable Future of Cross-Modal Transportation and Container Supply Chain Through the Augmented Reality

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THE SUSTAINABLE FUTURE OF CROSS-MODAL TRANSPORTATION THROUGH THE AUGMENTED REALITY (AR)

"Let us transport ourselves to a very lonely region of boundless horizons, under a perfectly cloudless sky, trees and plants in the perfectly motionless air; no animals, no human beings, no moving masses of water; the profoundest silence. Such surroundings are as if they were a summons to seriousness, to contemplation, with complete emancipation from all willing and its cravings; but it is just this that gives to such a scene of mere solitude and profound peace a touch of the sublime": Schopenhauer; from page 198 of Frank Rosengarten (2012), "Giacomo Leopardi's Search For A Common Life Through Poetry", FAIRLEIGH DICKINSON UNIVERSITY PRESS, Madison, Teaneck.

IDEA ABSTRACT

The history of innovation in human life is full of the fantastic incremental ideas which sometimes resembled and aspired from an ancient contraption, or sought out through a futuristic idea but what is important is that they always attempt to illuminate and illustrate better expectations. However, concerning the Cross-modal freight transportation and European intermodal container logistics, reducing the time hesitating and minimizing the idling time is one of the compelling arguments. Unfortunately, the Cross-modal transportation still suffers from the series of factors those increase the intermodal delivery time in practical working life.

In such circumstances, "The Sustainable Future of Cross-Modal Transportation Through The Augmented Reality (AR)" project aims to significantly diminish the total idling time of the cross-modal and intermodal logistics among heavy trucks and trains. The bottlenecks and the critical points of delay or delivery inadequacies are retrieved from the "Intermodal Tree's Analysis". In another hand, the technological aids those used to correlate the real-life of Cross-modality into the virtual and augmented reality are Augment (http://www.augment.com/) and Aurasma (https://www.aurasma.com/) platforms. The project proposes to develop an influential relationship regarding the efficiency of Cross-modal transportation. In addition, the project extends an advanced solution for reducing the trucks, trains, and vessels idling time and determining a technological presentation for the pragmatic connection between the infinite world of virtual reality and logical Multi-modal logistics information in real-time.
Final Project Template – This template is to be used for submitting the final version of the project. The final deliverable should be submitted by the 31st of October 2017

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Project Title:

The Sustainable Future of Cross-Modal Transportation and Container Supply Chain Through the Augmented Reality (AR)
1. INTRODUCTION

The sustainable future of Cross-Modal Transportation and Container Supply Chain Management, in a global point of view, strictly needs a constant struggle to clarify and embellish vigorous methods and technologies. Therefore, a tolerable Cross-modal freight transportation of European intermodal container logistics requires advanced techniques which would significantly reduce the Time Hesitation and minimize the Idling Time (of trucks and vessels) as one of the compelling argument in further aeons.

In fact, the Cross-modal transportation needs some pivotal settlements those might prevent some series of factors those extend the Intermodal Delivery Time in practical working life. In such circumstances, "The Sustainable Future of Cross-Modal Transportation and Container Supply Chain Through the Augmented Reality (AR)" project, endeavoured to study and identify the more significant items those notably might diminish the total idling time of the cross-modality in all divisions of intermodal logistics between the heavy trucks, trains, and international vessels.

Therefore, in general concept, the team assumes that the Idling Time is a crucial bottleneck which remarkably changes the duration of transportation. The bottlenecks and the critical points of delays or inadequacies delivery are retrieved from the "Intermodal Tree's Analysis". This empirical result is the result of the three-month observation of whole operations of a long-haul truck's driver who was involved in Cross-modal transportation in North and centre of Italy. As the following Intermodal Tree (Fig. 1) illustrates, the gaps between Production Functions (PFs) are meaningful.

![Intermodal Tree's Analysis](image-url)
In conclusion, the results of the project determine that the platform of Augment (@agmt.co) and Aurasma (https://www.aurasma.com/), aid truck drivers, Dry-Port managers, and Sea-Port administrators to combine the real work-life into the virtual one. Also, AR and VR are digitally enhanced view of logistics and transportation’s real world. In fact, the Virtual Models, Virtual Signals, and QR-Scanning technology support logistics operators to work in safety, security, and resilient transport environment. Despite the fact that the “Sustainable Future of Cross-Modal Transportation and Container Supply Chain Through the Augmented Reality” project, proposed to develop and improve the associated efficiency of Cross-modality, Inter-modality, Combined transport, Integrated Infrastructures, and especially the Intermodal terminals; the future research concerning the reliability and security of AR in logistics industry is still an open issue. In another hand, some additional debatable arguments regard the comprehensive benefits of AR and VR technology in public transport, city logistics, airports string visibility, and instrumental performance in Dry-Ports business are in progress.

2. SELECTION OF RESEARCH AREA

The team selected the "Cross-modality" pillar and "RA6: Freight Transport and Logistics" transportation mode because of their crucial role in future of Green Transportation. In fact, many studies such as (CORDIS, 2015) demonstrate the advantages of Cross-modal transportation, particularly concerning the Carbon Footprint and reduction of CO2.\(^1\) Furthermore, given the ubiquity of smartphones, one of the most significant expected way, which apparently control and dominate the future of Cross-Modal Transportation in its digital era, would be the bright technology of VR. However, the VR technology is not just an application of scientific knowledge for practical purposes but it covers an enormous area of human life entirely, and it might revolutionized the whole Dry Ports and Sea Ports through the Augmented Reality.

While the container transport is on its steady growth trend, the number of bottlenecks in hinterland connections swelling as well. This constituent might increase the complexity of logistics chains those consisting of many actors such as clients, truckers, rail infrastructures, Dry-Ports, and Sea-Ports. In addition, an empirical research (Khaksari, 2015)\(^2\) in Piedmont region shows that the information gaps and some conventional administrative regulations are challenging. In that observational experimentation, the truck driver supposed to drive between several logistics locations such as Truck Deposit Center, Delivery Points of clients, Customs Brokers, Dry Ports (S.I.TO, Autostrada Ferroviaria Alpina, CIM Novara, Verona Europa Terminals, Terminal Busto Arsizio-Gallarate - HUPAC, Rivalta Scrivia, Parma, Piacenza, Livorno, etc.), and finally convey the containers to the Sea-Ports' traffic warden of Savona, Genova, La Spezia Container Terminal.

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\(^1\) CORDIS (2015), *Persuasive Advisor for CO2-reducing cross-modal Trip Planning (Peacox)*, EU Publications Office.

Wistfully, the statistics illustrated that even in this long-distance Cross-modal transportation, the portion of idling time or slot times for trucks and containers are significantly considerable. The telecommunication gaps, Login / Logout procedures, and occurred time-wasting between transportation pillars (Road, Sea, Rail, and Air) are decidedly substantial.

However, thanks to advancements in mobile technology, Virtual Reality (VR) solutions are driving to spread into more practical applications, permitting more accuracy in various container supply chain practices. In another hand, the VR and AR technologies may emerge as the next dominant computing platforms, with stretch growing of consumer spending in billions of dollars per each year. In fact, according to an intriguing analysis of Statista.com, the Virtual Reality software and hardware market size worldwide predicted to reach 40.4 (in billion U.S. dollars) by 2020.³

3. LITERATURE SURVEY

The idea of X-raying stuff always fascinated the human. While the use of virtual visibility in medical concept (J. D. Silverman, 2010)⁴ has a quite long history in recent centuries, the tale of virtual reality in logistics is curt.

However, despite its brief memoir, the VR technology notably was advantageous to capture the attention of biggest logistics companies around the world. Perhaps one of the most important examples is the "VISION PICKING DRIVING INNOVATION FOR MODERN SUPPLY CHAINS" case. In 2014, the DHL Trend Research, by publishing a report had announced the new way in which DHL comprehends logistics (Heutger and Kückelhaus, 2014).⁵ The report had described the perspectives of DHL concerning the invention of AUGMENTED REALITY and its permissible applications in diverse segments of LOGISTICS.

The logistics giant DHL, has practised Augmented Reality to enhance the effectiveness and accuracy of the picking method. When the vast majority of warehouses in the developed world still use a pick-by-paper approach, DHL claimed that their Vision Picking innovation which works on the base of Augmented Reality (AR) technology, had increased the productivity of logistics operators by an average of 15% (DHL Supply Chain, 2017).⁶

³ Statista.com: Virtual reality software and hardware market size worldwide from 2016 to 2020 (in billion U.S. dollars); (Accessed on 31 October 2017)
⁵ Matthias Heutger, Markus Kückelhaus (2014), AUGMENTED REALITY IN LOGISTICS, DHL, Germany.
⁶ DHL Supply Chain (2017), VISION PICKING DRIVING INNOVATION FOR MODERN SUPPLY CHAINS, Germany.
Consequently, another critical study is the HBS investigation concerning the fundamental obligation of possessing an Augmented Reality Strategy for every organization (Porter and Heppelmann, 2017). They research conclude that the "warehouse operations are estimated to account for about 20% of all logistics costs while picking items from shelves represents up to 65% of warehouse costs. In most warehouses, workers still perform this task by consulting a paper list of things to collect and then searching for them.

This method is slow and error-prone". Indeed, considerably comparable to the warehouses' circumstances, almost all Dry-Ports and nearly any Terminal and hinterland operations in the division of Cross-modal transportation, suffer from the costs of relocating, loading, unloading, picking, and moving the containers. Moreover, there are some leading centres for augmented and virtual reality, where a CAVE of 360° area has dedicated to test and prove the innovative design solutions in the provision of several businesses. The Reply Augmented AREA 360 which is located in ComoNExT Scientific Park, is one of them.

Notwithstanding, the connectivity might be some of the essential interests in contemporary freight distribution as it is concomitantly an intermodal and a transmodal venture, the critical problem is that the "transmodal connectivity (managing flows within the same mode) have received less attention, the main reason being that until recently they mainly took place within fragmented and regulated national transport systems". (Jean-Paul Rodrigue, 2017)

4. PROPOSED SOLUTION-DESCRIPTION OF IDEA

As mentioned in previous sections, the following project employed the principles and platforms of Augment and Aurasma to connect the real work-life of Cross-modal transportation to the virtual one.

Concerning the platform of Augment.com, it is necessary to highlight that the application offers an AR eCommerce and SDK (Software Development Kit) solutions available for both the native mobile app and web integrations. The accessibility of database is an essential property of the software because truckers and Cross-modal logistics planners can install the Augment application on their smartphone, and they will receive automatically all the beneficial information and contributions of the virtual models concerning the locations, positions, ports network signals, clients’ addresses (GPS), and documentation related to logistics and Door-to-Door container supply chain.

In Augment the models must be in formats of .DAE or .OBJ [compressed (.zip) with textures and materials], or in formats of .STL or .ZAE or .KMZ. Then once the model is uploaded to the platform (in this case: Cargo Container 01).

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7 Michael E. Porter, James E. Heppelmann (2017), Why Every Organization Needs an Augmented Reality Strategy, HBR.

Furthermore, in AUGMENT there are three (3) primary methods to share the final augmented reality and virtual reality 3D models with users:

1. Send the [download link via text](#) message.
2. Send or scan the proper QR code with a code reader (review the following screenshot (Fig. 2)).
3. Add the user telephone (smartphone) number to the list of users, in the space of manager in Augment.

![Fig. 2: A Screenshot of AUGMENT’s Model Management Area](#)

Models might be posted everywhere since the models are connected to the trackers or located merely on the floor of Dry or Sea Terminals. Moreover, once the model is assembled accurately, all users could track that virtual information. The following picture (Fig. 3) demonstrates an image which has captured in the parking lot of CIM ([Novara Dry-Interport](#)) and that displays the "Cargo Container 01" 3D model for the driver of that red color long-haul.

Moreover, the Fig. 3 strives to determine how a simple virtual logistics model might easily indicate a truck driver to recognize the anticipated location of the container in which she/he supposed to pick it up and handle it in (a real-time) condition in such highly competitive circumstances of logistics network and Cross-modal or Multi-modal transportation.
Fig. 3: The "Cargo Container 01" 3D Model in Parking Lot

Additionally, the following demographic image (Fig. 4) illustrates a Reach stacker’s model which had tracked on its peculiar location, thanks to the individual tracker of AUGMENT application.

Fig. 4: The AR Model of Reach Stacker
In conclusion of proposed solution, the following figure (Fig. 5) schematically outlines representation of "Sustainable Future of Cross-Modal Transportation Through the Augmented Reality" project. The icons depict the fashionable attitude of AR virtual COMMUNICATION through the three major pillars of ground transportation: Road, Rail, and Waterborne. The vital chain which connects strictly knit all individual sections is the AR databases.

![Diagram of AR in Cross-Modal Transportation]

Fig. 5: The AR Virtual Communication Through Transportation

5. ADDRESS POTENTIAL TECHNOLOGY GAPS

After all, notwithstanding the various advantages of Augmented Reality in Cross-modal transportation, that is expected to discuss the prevailing inherent of AR’s technological gaps those currently incommode some users of both AR and virtual reality applications. However, some prior possibility of failure or malfunctioning associated with the current technological gaps of augmented reality technology might be addressed as the following (review Fig. 6):

- Needs of Smartphone or Smart Glasses
- Austere Requirement of Internet Connection
- Heterogeneity of AR Databases and VR Applications
- Need of QR Applications
- Need of QR Code Scanners
- Essential Needs of Virtual 3D Models
- Necessity of Maintaining and Updating the AR Models
- Chance of Cyber Attacks and Inserting Naughtly Models
- Risk of Vehicles Accidents Prompted by Inimical Symbols
Furthermore, the risk of vehicles accidents inside a Multimodal terminal has recognized as a big mass. In following case, if the 3D models being tracked in an inappropriate location, somehow they have virtual potentiality to harm the logistics operations. For example, a vehicles accident in Dry-port Cross-modal Terminal would involve truckers, reach stackers, and whole team of internal terminal logistics operation managers. Concerning the AR logistics projects, such kind of crashes could be occurred because of some wrong AR models and by some virtually reversed traffic tokens.

![Fig. 6: The Balance of Risks Regarding AR Technology](image)

However, in some remarkable cross-modality cases, logistics companies tried to use some simulators and introduced them as an exploratory application to make a bridge between AR technology gaps, and traditional containers handling systems. These academic studies and enterprise projects attempt to improve the efficiency\(^9\) of Cross-modal transportation by atomizing and robotizing\(^10\) the behindhand jobs and time-wasting operations such as Container Identification in critical Sea Ports and Dry Ports industries.\(^11\)

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10 LaseAVP - Automatic Vehicle Position (Single-mode & Twin-mode Operation)
6. DETAILED DESIGN DESCRIPTION

Regarding the concept idea which had represented in this technical report, the expression of "Cross-modal Sustainability through Virtual Reality Methods", apparently is the best description of the project's central design. In fact, the leading purpose of the project was concentrated on defeating the time oscillations and minimizing the Idling time of trucks, trains, and ships.

Perhaps notable useful characteristic of concept idea is the possibility of augmented intelligence within virtual reality between the logistics partners. That original feature might increase the technical communication among the transportation pillars those are separated in their logistics workrooms and completely link them together in a real-time contest.

Besides, some technical feasibility of the AR in Cross-modal logistics has merely presented in Fig. 3. Moreover, the following figure (Fig. 7-8) illustrates some other utility of AR technology in the virtual perception and determination of futuristic Smart terminals and prospective Multi-modal transport methods.

![Model Test @ Truck Positioning in Dry Terminals](image_url)

Fig. 7: A VR 3D Test of Truck Positioning in Dry Terminals

Also, concerning the financial feasibility of the concept idea and the financial advantages of Augmented Reality in logistics, as mentioned in section 3, VRs market is predicted to reach 40.4 (in billion U.S. dollars) by 2020 while in parallel the logistics are growing too. Therefore, the BEVs team believes that the technical solutions of the project significantly would help logistics supplies and logistics providers to increase their costs and improve their productivities.
7. SOURCE OF ADDITIONAL INFORMATION USED & APPENDICES

In conclusion of the project's report, the author would like to acknowledge all contributors that kindly cooperation the conclusion of this literature by their academic papers or academic discussions or experiential interviews. Also, for further reading, the list of references is available in the following:

Trasporto merci su strada, è una pubblicazione a cura di: ANFIA - Associazione Nazionale Filiera Industria Automobilistica – Area Studi e Statistiche Automobile Club d'Italia – Area Professionale Statistica

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Dr. J. (Jafar) Rezaei - TU Delft, Transport and Logistics Group.


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