Strategic Investment and Risk Analysis of Maritime Commerce at the Port of Virginia

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

In almost every industry, a wave of technological innovation is changing the business landscape and pushing firms as well as government agencies to innovate, integrate, and embrace new technology or fall into obsolescence. Innovations like automation, artificial/augmented intelligence (AI), big data, blockchain, and internet of things (IoT) are driving productivity to unprecedented levels and driving a changing commercial landscape for supply chains. Situated as one of the key players in global commerce, ports are no different, and while they are somewhat behind the curve in the adoption of technology, they have some of the greatest potential in taking advantage of these developments. (Deloitte, 2017)

The framework for the port of the future is the concept of a Smart Port. The Smart Port is the ultimate integration of the aforementioned technologies such that it is fully integrated within not only its own business functions but with shipping companies (maritime, rail, and truck) and the port's community at large. This research project is sponsored by the Port of Virginia, and thus will focus on the Hampton Roads area and the strategic investment of technology at their four terminals centered in that harbor. The port itself is a key player in international imports and exports on the East Coast. It operates largely as a business, but it is an autonomous agency of the Commonwealth of Virginia. As such, it has goals beyond simply profit, such as the economic success of the Commonwealth and the surrounding area of Norfolk and Hampton Roads.

The objective of the technical portion of this paper is to study industry leaders in technology integration of ports, and then use this information to identify the most critical technologies for investment. A technical analysis of the cutting-edge ports of Rotterdam, Netherlands; Antwerp, Belgium; Hamburg, Germany; and Shanghai, China will reveal key

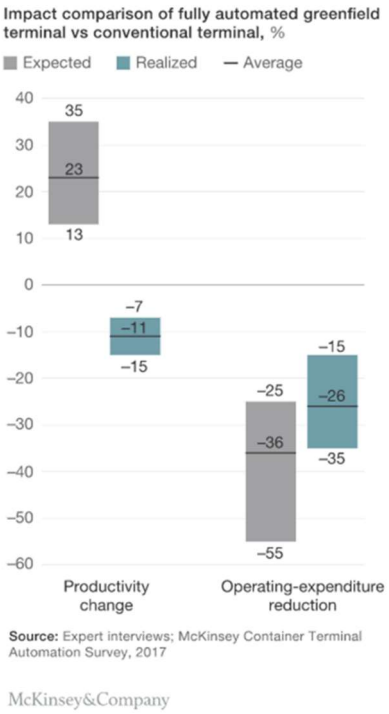
benefits of the adoption of these technologies. Then, information from these case studies will guide a critical scenario analysis for the Port of Virginia using stakeholder perspectives and emergent conditions to determine the best course of action for the port.

The corresponding STS research paper with use the framework of the Social Construction of Technology (SCOT) to analyze and explore how human action and social influence drive the innovation at the port, specifically automation. It will also analyze the social benefits and challenges of automation for the port and surrounding areas. Because such analysis has not been done specifically for ports, it will study other related sectors and extrapolate the analysis to the port.

Technical Topic

The technical portion of the thesis will focus on strategic investment of innovative technologies allowing for superior automation at the Port of Virginia, using case studies from cutting-edge ports around the world. The ultimate goal of this project is to create a framework for the Port of Virginia's future that incorporates innovative port technologies from global leaders. The focus will be on investigating the use of augmented intelligence, Internet of Things, and blockchain to assist in the integration of automation into the port, building towards becoming a smart port. The need to innovate towards automation is driven by three main drivers of the industry: Operational Excellence, Migrating Activities, and New Business Opportunities. This project will focus on operational excellence. Operational excellence means providing value

on both the supply and the demand side. On the supply side there is a drive to increase capacity, efficiency, reliability, and support while keeping costs low. On the demand side, this means improving the service provided to stakeholders such as reducing time in the port, improving security, and allowing for traceability of cargo. These technologies are necessary because of the many challenges with automation itself. A McKinsey study shows that automated ports improve safety, decrease human-related disruptions, and improve predictability of performance, but do not necessarily improve productivity. Return on invested capital of assets at some automated ports fell short by up to one percentage point from the industry norm of about 8%. Operating expenses fell by 15-35% versus the expected 25-50%, and productivity actually fell by 7-15%. What this report shows, is a need for proper integration of data driven technologies to aid in successful automation. (Chu, et al., 2018)



The first stage of research will focus on case studies of the ports of Antwerp, Belgium; Rotterdam, Netherlands; Hamburg, Germany; and Shanghai, China. Each of these ports have employed a specific technology that the study will focus on.

Antwerp uses a service called NxtPort, a data utility platform that facilitates data-sharing practices between users at the Port of Antwerp. One of the key groups of data NxtPort focuses on is data from terminal operators to other stakeholders, ensuring everyone gets the right information at the right time. In June 2018, Antwerp also began a pilot project to use blockchain to ensure secure exchange of phytosanitary certificates, a certificate required for the shipping of

plant products. This is a specific application, but the technology can be generalized to any kind of data being made available more quickly. (Carlan, Sys, Calatayud, & Vanelslander, 2018)

The Port of Rotterdam has employed a similar data integration platform called NextLogic. Its focus is on more efficient handling of inland container shipping by providing a platform where the entire supply chain of barge container shipping can be integrated. The applicability is in integrated planning, Information Exchange, a Performance Dashboard, and providing a general information platform. (Carlan, Sys, Calatayud, & Vanelslander, 2018)

The Port of Hamburg introduced and IoT framework with the smartPORT initiative that "includes modernizing its IT infrastructure to coordinate all aspects of port operations by installing sensors to coordinate ship–road traffic and monitor infrastructure performance (DHL, 2015). To realize the full potential benefits of this project, logistics operators are improving their information systems capabilities to receive and use the notifications sent by the port to truck drivers on available parking spaces and bridge closures. This allows drivers to optimize route planning and reduce travel time (Calatayud, 2017)." (Carlan, Sys, Calatayud, & Vanelslander, 2018)

Finally, the Port of Shanghai introduced China's first fully automated container terminal, and the largest intelligent container terminal in Asia. Although the Port of Virginia has no interest in full automation, this study will look at how this was successfully implemented.

The final phase of the project will look at the Port of Virginia and how they can invest in these emerging technologies using a scenario analysis. The scenario analysis takes in stakeholder perspectives, criteria, potential investment initiatives, and emergent conditions grouped into potential scenarios. A Criteria-Initiative assessment table it produced, giving one

of three levels of influence of each initiative on each criterion. A graph (example below) is then produced. For each initiative, the black marker shows its current ranking of importance. The blue line shows how far this ranking may move up given the potential emergent conditions, while the red bar shows how the ranking may move down. This provides insight into the importance of potential initiatives that the port may invest in.

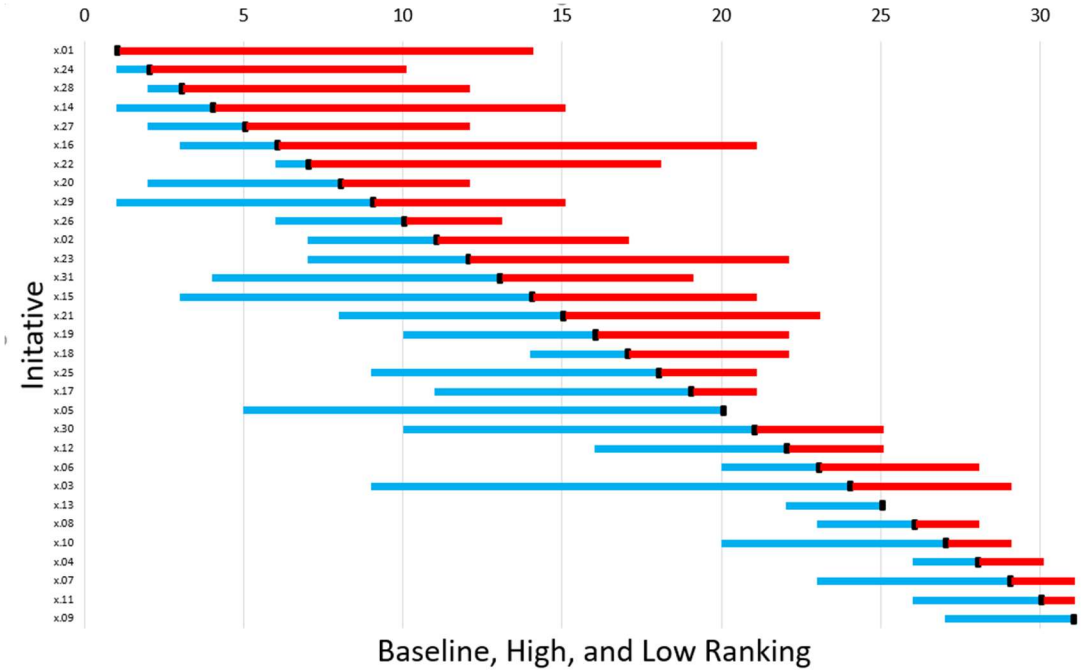


Figure 1. Sample Scenario Analysis Summary Graph

STS topic problem

As technology and competing ports continue to innovate, there is pressure on the Port of Virginia to employ automation in their port. However, in the Norfolk/Hampton Roads area, maritime commerce and the Port of Virginia are major drivers of employment. Furthermore, over 397,000 jobs or nearly 10% of Virginia's workforce, have ties to the port and automation may put some of those jobs at risk. (Port of Virginia, 2020) It is important to note that the Port of Virginia, while run like a business driven by profits, it is owned by the Virginia Port Authority

(VPA), which is an autonomous agency of the Commonwealth of Virginia. This is reflected in the PoV's mission statement, which reads "The Port of Virginia delivers opportunity by driving business to, *and through*, the Commonwealth". What this means is that although they are by and large run like a business, they have express interest in contributing to Virginia as a whole. As such, they do not want to cause the loss of jobs.

Because there is not a lot of literature on automation within ports specifically affecting jobs, the paper will largely focus on automation and jobs more broadly and then relate it to the port and the Hampton Roads area. It will also look at the Industrial Revolution of the 19th century and how many predicted a massive loss of jobs, when in reality the opposite happened. In essence, society looking at a 4th industrial revolution, so looking to the most important of the first three could help provide some insight. (Leopold, et al., 2016)

From the perspective of the Social Construction of Technology, I will look at the stakeholders of the port and how they influence the progression of automation. Social Construction of Technology is a theory that holds that human action and social forces drive the development of technology rather than the other way around. Technology exists, is created, and is adopted (or not adopted) as a function of the complex social groups and structures that form society. When assessing how or if a technology is adopted, one must look towards the stakeholders and social factors that affect its development and adoption. (Klein & Kleinman, 2002)

Wesam Salah Alaloul talks about the slow integration of automation in the construction industry and the social challenges within it. He identifies social factors as the greatest influence on successful implementation of automation in construction. However, he does not delve into the specific aspects of that social fact, only comparing it as a singular unit against political,

economic, technological, environmental, legal, and security factors. (Alaloul, et al., 2019) A major social organization and key stakeholder is the Port of Virginia's worker's union: The International Longshoremen's Association, ILA Local 1248 AFL-CIO. The union, along with the Norfolk Area at large, would not want to see a fully automated port, and is fully capable of taking action to prevent this. We can compare this to the fully automated port in Shanghai, where there is less regard for social factors and the government has full control to implement any technology they wish. However, as Chao Li discusses, "the port economy is a growth pole for Shanghai. The development of the port economy and the development of Shanghai's overall economy have a guiding and promoting role". It is possible that despite lost jobs at the port, job growth in other areas could create a net benefit. (Li, 2019)

Similarly, the government, which has regulatory and grant-giving power, towards port investments want to see not only greater cashflow through the port, but also greater economic opportunity through job creation. However, other stakeholders include other profit-driven businesses such as rail operators, truck operators, and maritime vessel operators. These businesses have much less interest in local economic development and more interest in simple optimization of port facilities, delivering greater efficiency and bringing in more business.

The STS research paper will take a deeper dive into these stakeholder perspectives, their interests, and the power they hold over the Port of Virginia. It will also look at how investment in various technologies within the port are thus influenced by these stakeholders. The stakeholders represent the social factors that drive the port's investment into new technologies, and the SCOT framework will thus drive the analysis.

Conclusion

The technical portion of the thesis will focus on strategic investment of innovative technologies allowing for superior automation at the Port of Virginia, using case studies from cutting-edge ports around the world. It will create a road map for the Port of Virginia's future. The focus will be on investigating the use of augmented intelligence, Internet of Things, and blockchain to assist in the integration of automation into the port, building towards becoming a smart port. The STS paper will use the Social Construction of Technology framework to analyze the social factors influencing the adoption of new technologies. Moving forward, further research could be done into integration of supply chains between links and with local communities which act as hubs for commercial freight. Another important area of research is toward more sustainable supply chains using alternative fuels, renewable energy, and reworked processes to increase efficiency.

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