

BACKGROUND INFORMATION

Field/Industry: Data Analytics, Quality and Information Systems Engineering.

Summary of Work in the Field/Industry: I, Taiwo Olubunmi ADETILOYE, work in the areas of smart city technology. The applications of smart city technology include but are not limited to applying data mining/machine learning and artificial intelligence for predicting traffic in urban motorway networks, evaluating the collaboration strategies of city logistics stakeholder, validating electronic medical records, hospital patient' lengths of stay, analysis of oil well datasets etc

Summary of Top Achievements:

- I have developed data mining models for predicting short-term traffic-flow congestion on urban motorway networks
- I have developed algorithm for validating electronic medical health data records, analyzing patients' length of stay to reduce cost and time spent in hospital etc.s
- I have provided two mathematical models to understand the complexity of city logistics systems: one, to explain the uncertainty effect using axioms; and second, to categorize elements of city logistics system using spider networks.
- I have presented a fuzzy BOCR-GRA approach for collaboration partner selection for city logistics planning under the presence of municipal freight regulations.
- I have investigated the role of collaboration as enabler for sustainable city logistics with focus on four basic and key subsystems namely Business to Business(B2B), Business to Customer(B2C), Customer to Business(C2B) and Customer to Customer(C2C).
- I have received major awards and recognition in the field of Information Systems Engineering for my outstanding research(See "Awards for more information)

- **Please indicate and describe the top 3-6 contributions you have brought to the field or industry using the template below.**

A. “PREDICTING SHORT-TERM CONGESTED TRAFFIC FLOW ON URBAN MOTORWAYS NETWORK”

Date of Project Initialization: September, 2013

Date of Project Completion: August 2018

Results of Publication(s) (if applicable):

Two Book Chapters

1. **T. Adetiloye** and A. Awasthi (2017), “Predicting short-term congested traffic flow on urban motorway networks”, In P. Samui, S.S Roy, V.E. Balas(Eds.), Handbook of Neural Computation(pg. 145–165).
2. **T. Adetiloye** and A. Awasthi(2018), “Traffic condition monitoring using social media analytics”, In S. S. Roy et al. (Eds.), Big Data in Engineering Applications, Studies in Big Data. Springer Nature Singapore Pte Ltd

Two conference presentations

T. Adetiloye and A. Awasthi(2018), “Short term traffic flow prediction on urban motorway networks”, Workshop on Data-Information Knowledge Application. Held at the Data Science Research Centre, Concordia University, Montreal, Quebec, Canada..

T. Adetiloye and A. Awasthi(2017), “Applying Twitter sentiment and cluster classification for traffic flow prediction”, IEEE International Conference on Systems, Man, and Cybernetics, held at the Banff Centre, Banff, Alberta, Canada.

Technical Summary of Work:

(Please provide two paragraphs describing the work using the technical terminology and explanation of work that an expert would be able to understand and evaluate.)

Predicting short-term congested traffic flow on urban motorway networks

In recent years, there has been increased research interest on modeling urban traffic congestions. This come in various forms from finding the right type of traffic recording equipment, the techniques of data collection, cleaning data, accurate and reliable analytic methods to adequate means of simulating traffic scenarios before putting them to actual use.

We investigate the use of data mining for modeling short-term traffic congestion on urban motorway networks into two main categories: neural networks, and random forest classifiers. The neural networks can be further classified into back propagation neural network, neuro-fuzzy, and the deep belief network. Our preliminary experimental tests showed that they can both offer a reliable and effective means of predicting short term traffic congestion towards better traffic management. We assume that while there may be some limitations, such as obtaining real-time traffic data, our practical solution can engender better ways to improve traffic flow in municipalities.

Plain Language Summary of Work:

(Please provide two paragraphs describing the work in layman's terms or plain language that an average person without special expertise would be able to understand and evaluate.)

Traffic congestion is a widely occurring phenomenon caused by increased use of vehicles on roads resulting in slower speeds, longer delays, and increased vehicular queueing in traffic. Every year, over a thousand hours are spent in traffic congestion leading to great cost and time losses. In this research, the problem is addressed using machine learning technique and traffic image recognition to analyze real-time traffic data. Both approach can be used to classify the traffic congestion pattern into high, medium, or low and to estimate the trends of the traffic over a short term duration. Machine learning is simply developing machines that learn from data. It is noteworthy that the application of machine learning algorithms like the deep neural network for traffic congestion prediction has attracted big companies like Google, and Uber with investments going to several billions of dollars.

This has strong practical applicability as it can be used by traffic planners and decision makers in traffic congestion monitoring, prediction and route generation under disruption.

Summary of the Significance of the Work:

(Please provide one paragraph describing the general significance of this work. Why is work in this area important to the field and the nation?)

Major cities in the United States and in other countries of the world have serious problems of traffic congestion. The outcome of this research is very useful to academics and industries that are working in the field of transportation management. The usefulness includes better intelligent route planning, monitoring and mitigation of traffic congestion on urban motorways by traffic management system, reduction of traffic delays, waiting times, air pollution and noise in the cities. In addition, it would help the road vehicle drivers to avoid congested traffic route. It would also assist the first responders to determine the root cause traffic congestion and assist the traffic managers to design better road infrastructure.

Summary of the Implementation/Influence of the Work:

(Please provide at least one paragraph describing how this work has already been influential in the field. You should provide specific examples of where and how your work has been used by others, giving as much detail as possible. Examples of implementation include (but are not limited to) licenses or contracts, collaborations, technology transfer agreements, patent commercialization, clinical guidelines, clinical trials, or emails asking for your work.)

My resulting publications is available as a book chapter in the Handbook of Neural Computation, published by Elsevier Inc. This book has contributions from notable researchers that are teaching and applying neural computation in various data engineering fields such as healthcare, transportation, and so on. It is noteworthy, that Elsevier publications have wide readings from data science and engineering students all over the world. Please, refer to sample emails from two students requesting for my publications on ResearchGate — a research portal for academics and students.

In addition, during the duration of this work, there was collaboration with Genetec Ltd. This company is fully involved in traffic intelligent monitoring and real time updates. The Genetec blufax cloud travel times engine system data that we obtained from their analytics department was very helpful; in particular, towards validating our proposed algorithms, reaching meaningful results and drawing far-reaching conclusions based on our research findings. Also, an invitation was received from the Concordia University Data Science Research Centre, Montreal, Quebec, Canada, to present my research to technocrats at its annual event. It also formed a section of my doctoral thesis submitted to the Institute for Information and Systems Engineering, Montreal, Canada. The citations has the following:

1. U. Soni(2019), “Integration of traffic data from social media and physical sensors for near real time road traffic analysis”, Master of Science in Geo-information Science and Earth Observation Thesis submitted to the Faculty of Geo-Information Science and Earth Observation of the University of Twente

According to the authors: “Traffic congestion has become a serious problem in the present scenario. The economy of a country mostly relies on the transportation system of the country. The development of new transportation system require large amount of money and time as well. For a developing country like India, the best approach is to improve the efficiency of the existing system. This can be achieved by making use of the traffic related data from different sources and provide a real time information system to the people. The attainment of this information became possible due to the availability of the data from inductive loops installed at 5 location in Dehradun city. The inductive loop data was available in xml format, which consists of information like speed of the vehicle, vehicle length, road width, class, headway, date and time of acquisition etc. A model based on vehicle density and speed was utilised to estimate the level of traffic congestion (low, medium and high) from the inductive loop data. To enrich this information, data from another source was required. Earlier GPS data has been used for the same but its results were not that promising due to the poor accuracy of the GPS. So, this study attempts to integrate social media data with the inductive loop data to enrich the information and disseminate it in real time. Among all the social media platforms, the Twitter data is gaining popularity among the researcher community to gather the information of the events occurring in real time. The data was in the form of tweets which were extracted by using Twitter API. This data was classified into 7 different classes that are accident, event, congestion, weather, diversion, construction and other by using Naïve Bayes classification algorithm with the classification accuracy of 79.15%. Also, the sentiment analysis of tweets was done to understand the sentiment behind the tweets. These sentiments could be positive, neutral and negative. To develop a real time information system, the data obtained from both of these sources; inductive loops and Twitter data, was integrated by using the fuzzy rule method. As a result a web GIS based effective information system was developed for the users. Through this platform the users will be able to get the real time information regarding the cause and level of congestion and also the historical trend of traffic. Also, the transport engineers can make use of this information to improve the traffic condition and road network. This study concludes that the Twitter data can be used effectively to supplement the missing information of the inductive loop data. And it can be efficiently used with inductive loop data to provide the real time information to the transport engineers and general public through the web GIS based platform. This study shows how the freely available social media data can act as a valuable asset in the field of traffic monitoring.”

B. “MODELLING AND EVALUATING OF STAKEHOLDERS COLLABORATION STRATEGIES FOR SUSTAINABLE CITY LOGISTICS OPERATIONS”

Date of Project Initialization: September, 2011

Data of Project Completion: January 2016

Results of Publication(s) (if applicable):

Two Journal Publication

1. A. Awasthi, **T. Adetiloye**, T. G. Crainic (2015) “Collaboration partner selection for city logistics planning under municipal freight regulations”, Applied Mathematical Modelling, doi: 10.1016/j.apm.2015.04.058. Elsevier Ltd.
2. **T. Adetiloye** and G. Pervez(2015) “A macro and micro-level evaluation of stakeholders’ collaboration for sustainable city logistics operations” , Operations and Supply Chain Management 8(2) pp. 90-100, Available online: <http://www.journal.oscm-forum.org/journal/abstract/oscm-volume-8-issue-2-2015/a-macro-and-micro-level-evaluation-of-stakeholders-collaboration-for-sustainable-city-logistics-oper>

Three Conference Presentations and Two Conferences with Proceedings

1. A. Awasthi, **T. Adetiloye**, M. Badakhshian(2015), “Evaluation of stakeholders collaboration strategies for sustainable city logistics operations” Montreal2015 INFORMS/CORS 2015 held at the Le Centre Sheraton Montreal Hotel.
2. **T. Adetiloye**, S. Chauhan, M. Ouhimmou, A. Awasthi (2014), “The 3D- truck loading problem with routing constraints application to the lumber wood and moulding industry”. Presented at the 56th CORS Annual Conference, Ottawa.
3. **T. Adetiloye** and A. Awasthi (2013) “Evaluating stakeholders collaboration strategies for sustainable city logistics operations”. Presented at the 55th CORS Annual Conference, Hyatt-Regency, Vancouver, Canada.
4. **T. Adetiloye** and G. Pervez(2015) “A macro and micro-level evaluation of stakeholders’ collaboration for sustainable city logistics operations” , Presented at the 6th International Conference on Operations and Supply Chain Management (OSCM), Bali, Indonesia

5. G. Pervez and T. Adetiloye(2019) “Collaboration planning among supply chain partners using an ANP - game theory based approach”. In A. Awasthi (Eds.), Handbook of Research on Interdisciplinary Approaches to Decision Making for Sustainable Supply Chain. Published by IGI Global eEditorial Discovery.

Technical Summary of Work:

(Please provide two paragraphs describing the work using the technical terminology and explanation of work that an expert would be able to understand and evaluate.)

Collaboration partner selection for city logistics planning under municipal freight regulations

Collaboration planning among city logistics operators is important to achieve operational efficiency under municipal freight regulations such as access, sizing and timing restrictions etc. In this research, we present a fuzzy BOCR-GRA approach for collaboration partner selection for city logistics planning under the presence of municipal freight regulations. A multi-step approach is proposed.

In the first step, we identify collaboration partner evaluation criteria using BOCR framework. In the second step, linguistic assessment of criteria and alternatives (collaboration partners) is performed by a decision making committee. The linguistic data is treated via fuzzy triangular numbers for analytical processing. In the third step, alternatives are ranked using Grey Relational Analysis technique (GRA) and five BOCR scoring methods. The different alternative ranks are subject to veto and the alternative(s) with highest top ranks are considered for sensitivity analysis whereby we analyze the influence of changes in criteria weights and scoring methods on their ranks. If the rankings remain unchanged, then the veto retained alternative(s) are declared as winner(s) and recommended for collaboration. This is one of the first works to address the collaboration partner selection problem in the context of city logistics under limited or lack of quantitative data. A comprehensive set of criteria are proposed and the best solution is generated using veto role on various scores obtained from BOCR and fuzzy GRA, thereby eliminating any bias arising from method selection.

Plain Language Summary of Work:

(Please provide two paragraphs describing the work in layman's terms or plain language that an average person without special expertise would be able to understand and evaluate.)

In several cities in North America, goods movements are done on daily basis using freight services such as FEDEX, DHL, AMAZON trucks, ships, and cargo flights. For efficiency, major

municipal freight regulations are required to address issues such as access, sizing, time restrictions etc. In the city framework are the shipper, freight carriers, customer and administrators that constitute the city logistics stakeholders. Therefore, it is very important to have effective collaboration among the stakeholders for excellent decision making that is defined by the collaboration planning. Thus, this collaboration planning among city logistics operations necessitate partners' selection to achieve operational efficiency. The collaboration selection committee have to score the Benefits, Opportunities, Costs and Risks(BOCR) involved in the partner selection process, the nature of which can be fuzzy or vague under the municipal freight regulations or criteria. This brings about our multi-step approaches using Grey Relational Analysis(GRA) technique for the fuzzy BOCR scoring.

In our scenarios, the GRA does not attempt to find the best solution but rather provides different alternative ranks that are subject to veto where the alternatives(s) i.e collaboration partners, with the highest top rank can be investigated further on the basis of the expected changes in the criteria weights and BOCR scoring methods so as to greatly reduce any bias arising from the method selection.

Summary of the Significance of the Work:

(Please provide one paragraph describing the general significance of this work. Why is work in this area important to the field and the nation?)

It is widely estimated that millions of US dollars per annum are incurred in economic loss due to the activities of city logistics operators. Moreover, practitioners and scientists are worried about the social, economic, and environment impacts arising from these daily activities. For instance, freight carriers, delivering goods to the customers, produce large quantities of greenhouse gases that cause pollutions and climate change; and the freights heavy load capacity cause road damage that would require frequent maintenance and costly repairs; as well as the increased risks of road accidents and traffic congestions. In addition, city administrators must provide adequate freight regulations to reduce the impacts of these operations on their municipalities. The general significance of this work in the field of smart city technology vis-a-vis city logistics is foremost from expressing priorities on benefits, opportunities, costs and risks that are in commensurate terms with the ranking of the partner selection process. Secondly, this research emphasize collaboration planning as the basis for proper partner selection by the selection committee to enable effective and efficient performance under the municipal freight regulations. Otherwise, suggesting profitability of alternatives and contradictory decisions by individuals that fail to collaborate may lead to bad decisions that worsen the problems.

Summary of the Implementation/Influence of the Work:

(Please provide at least one paragraph describing how this work has already been influential in

the field. You should provide specific examples of where and how your work has been used by others, giving as much detail as possible. Examples of implementation include (but are not limited to) licenses or contracts, collaborations, technology transfer agreements, patent commercialization, clinical guidelines, clinical trials, or emails asking for your work.)

My resulting publication has been cited thirty-two times by quality systems and operations researchers in countries like the US, Canada, and several countries in Asia, Africa and Europe. It is one of the first works to address the collaboration partner selection problem in the context of city logistics under limited or lack of quantitative data. The outputs of this work has been published in the Journal of Applied Mathematical Modelling, a reputable peer reviewed journal, and has been presented in the conference of the Canadian Operations Research Society. Please refer to my Google Scholar profile for up-to-date citation counts. Notably, these citations include some very prominent studies, including the following:

1. X-F. Xu, J. Hao, Y-R. Deng, Y. Wang(2017), “Design optimization for resource combination for collaborative logistics network under uncertainty”, Journal of Applied Soft Computing, Vol. 56, pp. 684-691.

The research proposed collaborative logistics networks (CLNs) as an effective organizational form for business cooperation that provides high stability and low cost. One common key issue regarding CLN resource combination is the network design optimization problem under discrete uncertainty (DU-CLNDOP). Operational environment changes and information uncertainty in network designs, due to partner selection, resource constrains and network robustness, must be effectively controlled from the system perspective. Therefore, a general two-stage quantitative framework that enables decision makers to select the optimal network design scheme for CLNs under uncertainty is proposed in this paper. Phase 1 calculates the simulation result of each hypothetical scenario of CLN resource combination using the expected value model with robust constraints. Phase 2 selects the optimal network design scheme for DU-CLNDOP using the orthogonal experiment design method.

2. G. Büyüközkan, S. Güleriyüz, B. Karpak(2017), “A new combined IF-DEMATEL and IF-ANP approach for CRM partner evaluation”, International Journal of Production Economics, Vol. 191, pp 194-206

According to the authors, “selection of the most suitable business partner is a strategic decision for outsourcing problems. This study aims to provide an effective evaluation approach for assessing alternative CRM partners. The choice of a suitable partner is a very complex decision, involving many conflicting objectives as well as complex considerations. Such decision processes involving several perspectives can be worked around by using Multi Criteria Decision Making (MCDM) techniques. MCDM can assist decision makers with reaching consensus with collective participation and objective decisions based on value judgments. This paper proposes a combined approach for effectively evaluating CRM partners that integrates Intuitionistic Fuzzy Sets (IFS) with Group Decision Making (GDM). It consists of Intuitionistic Fuzzy Analytic Net-

work Process (IF-ANP) for building and analyzing the criteria weights and Intuitionistic Fuzzy Decision Making Trial and Evaluation Laboratory (IF-DEMATEL), a useful technique for managing uncertainties to identify interrelations between criteria. As the IFS describe powerfully vagueness and uncertainty, IFS can depict decision makers' evaluations with a structure which is more rich, allowing for a more accurate description of the decision making process. The scientific value of the paper stems from its ability to present a novel study that makes use of GDM based MCDM with combined IF-DEMATEL and IF-ANP approaches. This study contributes to the existing literature by providing a combined IFS based DEMATEL-ANP framework for the first time and developing a novel evaluation model for a real industrial problem to improve the CRM partner selection process.”

3. M. Agrebi, M. Abed, M.N. Omri(2017), “ELECTRE I based relevance decision-makers feedback to the location selection of distribution centers”, Journal of Advanced Transportation, Vol. 2017, Article ID 7131094

The research focused on the “location selection of distribution centers as one of the important strategies to optimize the logistics system. To solve this problem, under certain environment, this paper presents a new multi-criteria decision-making method based on ELECTRE I. The proposed method helps decision-makers to select the best location from a given set of locations for implementing. After having identified decision-makers, the criteria, and the set of locations, the factors influencing the selection are analyzed in order to identify the best location. A sensitivity analysis is then performed to determine the influence of criteria weights on the selection decision. The strength of the proposed method is to incorporate decision-makers’ preferences into the decision-making process. In addition, the proposed method considers both quantitative and qualitative criteria. Finally, the selected solution is validated by both tests of concordance and discordance simultaneously. A case study is provided to illustrate the proposed method.”

4. A. Çalışkan, M. Kalkan, Y. Ozturkoglu, “City logistics: problems and recovery proposals”, International Journal of Logistics Systems and Management, Vol. 26 Issue 2

The research explained that “city logistics is the multidisciplinary science that makes a bridge between both urban freight transportation and sustainability of the cities. It has also focused on various subject matters such as populations, facilities, traffics and logistics activities. If all this dynamic criteria are consider, different logistics scheme must be prepared for each city. Cities have to be handled and analysed individually according to their own characteristics. In order to understand the current situation and problems of urban freight transport in Turkey, this paper examines the specific focus on Turkey's third largest city Izmir in terms of city logistics with the eye of logistics service providers. A qualitative approach was used and unstructured interviews with subject matter experts were conducted to gain general insight into how logistics service

providers perceive the problems in city logistics in Izmir and the solutions they propose. Regarding the gap between theory and practice, this study would be valuable for future research in city logistics studies, and the results of the study would be a practical tool for decision makers in their city logistics planning process.”

Technical Summary of Work:

(Please provide two paragraphs describing the work using the technical terminology and explanation of work that an expert would be able to understand and evaluate.)

A macro and micro-level evaluation of stakeholders' collaboration for sustainable city logistics operations

City logistics involves movement of city goods in urban areas respecting the municipal and administrative guidelines. The key goals of city logistics planning are maximizing vehicle movement and utilization, while minimising vehicle emissions and traffic congestion. Collaboration is vital to managing city logistics operations efficiently. Collaboration can take place in the form of goods consolidation, sharing of resources, information sharing, and so on. Two categories of models are proposed to evaluate these collaboration strategies. At the macro level, we present the collaboration matrix model; and at the micro level, we present the operational level model. The macro-level model focuses on the strategic decision making process necessary for stakeholders' collaboration given the socio-cultural characteristics, economic, and environmental constraint factors, while the micro-level model applies the collaboration decision-making criteria derived from the macro-level analytic result to improve the activities of the city logistics operators. Results of the computational testing of our methodology on vehicle selection, goods to vehicle assignment, goods distribution and environmental impact assessment are discussed, showing that the collaboration strategies of stakeholders, if optimized, can improve city logistics operations. The proposed work is novel and has strong practical applicability for logistics planners and decision makers in planning right collaboration strategies for sustainable city logistics operations.

Plain Language Summary of Work:

(Please provide two paragraphs describing the work in layman's terms or plain language that an average person without special expertise would be able to understand and evaluate.)

The collaboration of city logistics stakeholders is vital for sustainable urban transportation operations. It can help potential partners reduce excess inventory, shorten lead times, increase sales and customer service levels. Furthermore, it may allow organizations to enhance flexibility and capabilities by fostering relationships that increase skills and knowledge, facilitate easier logistic

operations, offer access to new technologies and reduce time that can be seen as important factors for effective and efficient supply chain management.

This collaboration method as modelled in our collaboration matrix illustrates the willingness of the stakeholders to collaborate with regards to their social, economy and environmental interests which could depend on the various strategies adopted by the city logistics stakeholders. The macro-level is designed to evaluate the social-cultural characteristics, economy and environment impacts of the activities of city dwellers. In addition, the collaboration strategies of the stakeholders at this macro-level can be useful at the micro or operational level of city logistics system. More so, the operational level model can help city logistics stakeholders, through partial and full collaboration, lessen vehicles emissions causing pollutions in the city.

Summary of the Significance of the Work:

(Please provide one paragraph describing the general significance of this work. Why is work in this area important to the field and the nation?)

In the last decade, there has been growing interest in sustainable urban transportation operations. This has been reflected in huge capital investments by countries like the US, Canada, Australia, China and so on, in transportation infrastructure and system design, and development. The underlying factor is motivated by the need to have effective collaboration strategies by the stakeholders involved in city logistics operations. The questions often asked in this regards are: “With whom to collaborate?”, “How to collaborate?” and “On what to collaborate? Thus, the research innovated evaluation techniques for address this concerns that will have tremendous impact on the collaboration strategies of the city logistics stakeholders with improvement in the social, economic and environment factors which are hitherto underemphasized.

As showing in our resulting publications, the outputs of the work have been published in reputable peer-reviewed journals and presented at the conference of operational research in Canada and Indonesia. Another notable output of the research findings of this work is in my master’s dissertation at the Concordia Institute for Informations Systems Engineering, Montreal Canada; and the findings, significance and originality of the work had been independently examined and critically evaluated by these three notable researchers in this field: Professor Benjamin Fung(my doctoral thesis’ external examiner), McGill University; Professor Jamar Bentahar, Concordia University(internal examiner from my department), Professor Navneet Vidyarthi(external examiner from the Department of Decision Sciences and Management Information Systems at the John Molson School of Business, Concordia University).

Summary of the Implementation/Influence of the Work:

(Please provide at least one paragraph describing how this work has already been influential in the field. You should provide specific examples of where and how your work has been used by

others, giving as much detail as possible. Examples of implementation include (but are not limited to) licenses or contracts, collaborations, technology transfer agreements, patent commercialization, clinical guidelines, clinical trials, or emails asking for your work.)

My research earned me a graduation bonus award in recognition of good academic progress towards my degree and best efforts to graduate as early as possible. My master's thesis available online, based on recent counts, has been downloaded 1099 times between 2012 to 2018. In addition, my outstanding contributions that can be found in my master's thesis and journal publication have been cited over 10 times. Please refer to my Google Scholar profile for up-to-date information. This citations include prominent studies such as the following:

1. Y. He, X. Wang, Y. Ling, and F. Zhou(2016), “Optimal partner combination for joint distribution alliance using integrated fuzzy EW-AHP and TOPSIS for online shopping”, International Journal of Sustainability, Vol. 8, Issue 341

Their research study explained that “with the globalization of online shopping, deterioration of the ecological environment and the increasing pressure of urban transportation, a novel logistics service mode—joint distribution (JD)—was developed. Selecting the optimal partner combination is important to ensure the joint distribution alliance (JDA) is sustainable and stable, taking into consideration conflicting criteria. In this paper, we present an integrated fuzzy entropy weight, fuzzy analytic hierarchy process (fuzzy EW-AHP) and fuzzy technique for order preference by similarity to an ideal solution (TOPSIS) approach to select the optimal partner combination of JDA. A three-phase approach is proposed. In the first phase, we identify partner combination evaluation criteria using an economy-society-environment-flexibility (ESEF) framework from a perspective that considers sustainability. In the second phase, the criteria weights and criteria combination performance of different partner combinations were calculated by using an integrated fuzzy EW-AHP approach considering the objective and subjective factors of experts. In the third phase, the JDA partner combinations are ranked by employing fuzzy TOPSIS approach. The sensitivity analysis is considered for the optimal partner combination. Taking JDA in Chongqing for example, the results indicate the alternative partner combination 3 (PC3) is always ranked first no matter how the criteria weights change. It is effective and robust to apply the integrated fuzzy EW-AHP and TOPSIS approach to the partner selection of JDA.”

2. K. Grzybowska, K., and A. Awasthi(2014), “Modeling enablers for sustainable logistics collaboration integrating Canadian and Polish perspectives”, 2014 Federated Conference on Computer Science and Information Systems”, IEEE publication.

The authors' abstract states that “Collaboration planning is vital for achieving sustainable logistics. In this paper, we present an ISM based approach for modeling enablers for sustainable logistics collaboration integrating Canadian and Polish perspectives. Enablers can be defined as the key elements (or drivers) for achieving successful collaboration. A comprehensive literature re-

view is conducted to identify 17 enablers for sustainable logistics collaboration. Based on these enablers, a questionnaire study is conducted with 20 logistics experts in Canada and Poland to identify their importance. Based on the aggregated expert ratings, an Interpretive Structural Model (ISM) is developed to identify the relationships among the various enablers. The results of our study show that not all enablers to sustainability collaboration between logistics partners require the same amount of attention. This classification will help Supply Chain managers to help them to focus on those variables that are most important for the transformation of collaboration between logistics partners.”

3. S. Hong, R. Lv, P. Long(2018), “Cost sharing of terminal joint distribution of express industry”, IET Intelligent Transport Systems, Vol 12, Issue 18, pp. 730-734

This journal impact is very significant given the opinions of the authors that “the express industry has developed rapidly, showing a picture of prosperity, but there are several problems behind its prosperity, such as lower efficiency, higher costs, more traffic pressures and increased disorder. To enhance operating efficiency, reduce delivery costs and ease both traffic pressures and disorder, the authors use the Shapley value method to establish a cost sharing model of terminal joint distribution for express enterprises. This model converts the proportion of income allocation into a cost sharing ratio and proposes a correction scheme of personal delivery service costs. The results of a case analysis show that the terminal joint distribution could reduce costs, such as wage costs and traffic costs, reduce both the costs of vehicle distribution and the number of vehicles distributed, and shortens the total distance travelled and time required for distribution. The model of cost sharing of terminal joint distribution for express enterprises could be fair. The cost sharing of terminal joint distribution depends on the personal level of the distribution service for express enterprises. They discuss the implications of the case analysis that jointly distributes costs among express enterprises along terminal routes for both the firms and for the emerging research on the joint distribution of costs.”

Technical Summary of Work:

Collaboration planning among supply chain partners using an ANP: Game theory based approach

(Please provide two paragraphs describing the work using the technical terminology and explanation of work that an expert would be able to understand and evaluate.)

In response to current economic downturn coupled with intense global competition, concept of supply chain collaboration has emerged as a possible solution for firms aiming to gain competitive advantage through cost reduction, increased asset utilization and improving service levels. In this paper, we address the problem of collaboration planning between multiple retailers and/or

suppliers in a supply chain network. Three problems are considered namely partner selection, collaboration strategy selection, and profit allocation among the partners entering into collaboration. Three techniques namely cluster analysis, analytical network process (ANP) and game theory are used for this purpose. Partner selection for collaboration is done using cluster analysis and analytical network process (ANP) while collaboration strategy selection is made through application of game theory. The profit allocation among collaborating partners is performed using Shapley method. A numerical application is provided.

Plain Language Summary of Work:

(Please provide two paragraphs describing the work in layman's terms or plain language that an average person without special expertise would be able to understand and evaluate.)

Intense global competition and fast changing customer demands, have made it difficult for organizations to stay competitive in the current market place. Recession scarred customers are constantly looking for better quality and innovative products at a relatively low price. In the nutshell, organizations which are capable of selling products or services which satisfy the above mentioned specifications will be able to dominate the market.

In response to this challenge, the concept of supply chain collaboration has emerged as a new approach to attaining competitive advantage through cost reduction, increased asset utilization, reduced inventories, and shared business risk that arises as a result from the coordination of actual customer demand with supplier production plans. Effective supply chain collaboration can help organizations reduce excess inventory, shorten lead times and increase sales and customer service level. Furthermore, supply chain collaboration has allowed organizations to enhance flexibility and capabilities by fostering relationships that increase skills and knowledge, facilitate easier product development, offer access to new technologies and reduce time to market. Our solution approach seeks to address the concerns.

D. VALIDATION ALGORITHM FOR ELECTRONIC HEALTH RECORDS

Date of Project Initialization: October 2018

Date of Project completion: March 2018

Employer: CHRISTUS Health

Technical Summary of Work:

(Please provide two paragraphs describing the work using the technical terminology and explanation of work that an expert would be able to understand and evaluate.)

In health care, ensuring the accuracy of electronic record is of utmost importance. I worked with CHRISTUS data analytics team to develop validation algorithm using pyspark. PySpark is the interface that gives access to Spark (machine learning) library using the Python programming language. The purpose of this project is to implement validation audit to find the accuracy of two or more big data considered very similar from a manual perspective but which machine learning helps to detect the inaccuracy of some of the data records. From the insight generated in logs files and data samples evaluated, we identified various factors that might be responsible for the dissimilarities. They include new updates, human and system errors, as well as creation of a new records. Our algorithm can help in proper model validation on the basis of a machine audit. However, the human and system errors remains a challenge that would require continuous quality improvement and appropriate system design.

Summary of the Significance of the Work:

(Please provide one paragraph describing the general significance of this work. Why is work in this area important to the field and the nation?)

The algorithm is helping CHRISTUS Health located in Irving, Texas, United States save costs on their electronic medical records loaded to Teradata and Hadoop Hive data warehouse as well as the ones ingested as HL7 messages in batch and real time streaming. This also helps ensure that entity resolution can be done there by avoiding patients' mis-identification such as during the change of address and marital status, abbreviation of names and so on. Furthermore the process is automated using cron - a time-based job scheduler in Unix-like computer operating systems. This is used to schedule the validation jobs with commands or shell scripts to run periodically at fixed times, dates, or intervals.

E. PATIENTS' LENGHT OF STAY

Date of Project Initialization: January 2019

Date of Project completion: April 2019

Employer: CHRISTUS Health

Technical Summary of Work:

(Please provide two paragraphs describing the work using the technical terminology and explanation of work that an expert would be able to understand and evaluate.)

Healthcare data analytics employing machine learning to improve hospital performance has witnessed significant growth over the past decade. One of such efforts is focused on the average length of stay(LOS), as an indicator of efficiency aimed at achieving shorter LOS, which serves as an important metrics for both health care provides and patients and for combinations of clinical and financial reasons. The goals are to reduce the cost per discharge and shift care from inpatient to less expensive post-acute settings and to improve their intensive care unit statistics by reducing the number of patients dying inside the intensive care unit as determined by the diagnosis related group (DRG) into which each patient is classified. In our project, to predict the LOS, working with my data analytic team, I considered numerous factors such as mortality, readmission, severity of illness, DRG, administer drug types, and the drug administer days, patient start and discharge date as well as health care resource utilizations.

The outcome examines a range of length of stay, readmission and mortality prediction applications in acute medicine and the critical care unit while also computing the geometric mean and variance with regards to the LOS in order to eliminate outliers in the electronic health records and to estimate the future average LOS.

Summary of the Significance of the Work:

(Please provide one paragraph describing the general significance of this work. Why is work in this area important to the field and the nation?)

It is widely estimated that the national average for a hospital stay is 4.5 days, and according to the Agency for Healthcare Research and Quality, this is at an average cost of \$10,400 per day. This project amplify the impact of the application of machine learning to LOS in the population health of the U.S. healthcare system. It contributes significantly to decrease the cost of healthcare delivery, freeing up beds to allow hospitals treat more patients, and decreases mortality within U.S. healthcare system.

F. USING TENSORFLOW TO PREDICT TRAFFIC CONGESTION ON URBAN MOTORWAY NETWORK

Date of Project Initialization: January 2017

Date of Project completion: July 2017

Traffic congestion, also known as traffic jam, has become a major issue all around the world, thus policy makers and city managers have huge challenges to improve the quality of life in urban areas. It is a widely occurring traffic phenomenon in metropolitan areas due to the increasing number of road vehicle users and is characterized by slower vehicles' speeds, longer travel times, queues etc. My project idea is the design and development of Mobility as a Service(MaaS) traffic prediction application using machine learning. It will allow users to input a region and receive traffic information about major roads and highways in the region. For each major road, a machine learning algorithm is applied to a live image of the road, and returns the image and the level of congestion (low, medium, or high). Having such an application can allow users to check traffic patterns before they leave or on the go, to decide the best route to take.

Summary of the Significance of the Work:

(Please provide one paragraph describing the general significance of this work. Why is work in this area important to the field and the nation?)

This project got me selected to participate in the Spring 2019 cohort of the Quebec Scientific Entrepreneurship Program (QcSE) in Canada. It signifies the importance of addressing traffic congestion not only in Canada but in the United States as millions of dollar and man hours are incurred due to the time spent in traffic jam. The lesson learned over this period for the QcSE would be useful to transportation managers in cities within the United States where traffic congestion has become a major issue. Also, it has a US provisional patent pending status with details as follow:

T. Adetiloye(2019). Predicting short-term traffic flow congestion on urban motorway networks. US Patent Application Number: 62874748, Reference No.: 18045.0001

G. DEVELOPMENT OF PROACTIVE ALGORITHMS FOR OPTIMIZING THE PERFORMANCE OF INTELLIGENT COMPLETION WELLS IN COMPLEX RESERVOIRS

Date of Project Initialization: May 2016

Date of Project completion: June 2017

Technical Summary of Work:

(Please provide two paragraphs describing the work using the technical terminology and explanation of work that an expert would be able to understand and evaluate.)

Intelligent completion well technologies, including single and multi-point sensors, packers and fluid control devices cum valves, have helped optimize production, reduce or eliminate intervention, and increase recovery factors. However, the intelligent completion systems complexity and cost have also increased. However, the available tools used by the petroleum industry are not capable of performing the observe-invert-predict cycle in the time frame required to estimate reconstructed input data in order to forecast, optimize and control intelligent well system production performance under closed-loop conditions. Currently, there is an increased need to develop algorithms that could continuously process gigabytes of information from a variety of multi-sensors, as well as seismic, electromagnetic, PLT and production. A single intelligent completion well often produces enormous amount of data points, and the engineers needed tools for efficiently acquiring, aggregating, transmitting, storing, filtering, processing, analyzing and visualizing this data.

To run optimization algorithms for supporting real-time performance assessment and decision making, the engineers had to create an accurate mathematical model of a coupled transient multiphase flow and heat transport processes in multi-layered heterogeneous reservoirs completed with and without intelligent completion systems under uncertainties. The algorithms would use this calculated model to run constrained optimizations that maximize cumulative production and net present value while minimizing water and gas production rates. Intelligent oilfield operations require tools that can enable automated action for cloud-based scalable data-driven inversion, dynamic reservoir characterization, and continuous forecasting-optimization of intelligent well performance using real-time and prediction (look ahead) information.

Summary of the Significance of the Work:

Intelligent well technologies allow operators with unprecedented control of their wellbore and reservoir. As a standalone tool, however, intelligent well technology does not give the operator the ability to measure the production from each zone nor estimate how a change to the choke position will alter the production or injection profile. When the intelligent is coupled with cloud-based forecasting and optimization systems, however, the operator now has the ability to get true insight to the behavior of the reservoir and make the necessary changes to optimize their production or injection

operations. The integration of performance prediction and decision making in real-time decision support systems (DSS) using cloud-based forecasting and optimization systems provide a powerful tool to oil and gas operators for monitoring, evaluating and controlling intelligent fields and wells. Using model predictive control algorithms and machine/deep learning models to run multi-objective optimizations with hundreds of parameters, as well as non-linear cost functions and constraints to continuously optimize intelligent well completion performance in real time. These optimizations take into account projected state variables and crude oil prices over the next 12 hours, and identify optimal inflow control valve/active flow control device set points. In operation, Java® software in the cloud invokes the scalable distributed optimization algorithms periodically throughout the day.

The KNIME analytics platform is used to build a machine and deep learning models that captures the effect of the intelligent completion system and reservoir-wellbore conditions on pressure, temperature, fluid phase saturations, absolute permeability, relative permeability, porosity, near wellbore formation damage skin, as well as flow rate in each zone. Using model predictive control engine, the intelligent well completion system is analyzed to estimate reservoir fluids' cumulative for the well and determine how quickly each zone is likely to converge to its optimal set point.

Plain Language Summary of Work:

(Please provide two paragraphs describing the work in layman's terms or plain language that an average person without special expertise would be able to understand and evaluate.)

- Gigabytes of downhole multi-sensor data analyzed and visualized. The proposed system makes it easy to process and visualize the downhole big data sets
- Plotting 2D and 3D graphs, and other charts that display in a meaningful way how the intelligent well completion system is performing
- Construction of robust and scalable algorithms for online real-time solution of the underlying large-scale inverse problems
- Development of the proactive algorithm development enables computational speed to increase increased tenfold than developing in Java
- Proposed methodology enables the testing of several optimization approaches before selecting sequential quadratic programming,
- The KNIME analytics platform enables surrogate forward modeling using several distributed machine/deep learning algorithms. It is a huge advantage to explore different methods so quickly and rapidly find the best algorithmic that works best for downhole multi-sensor and simulation data
- Trained and tested machine/deep learning models on a database of validated transient thermal multiphase reservoir-wellbore models
- Built and validated transient thermal multiphase reservoir-wellbore models to simulate flow response of intelligent well completion systems to varying reservoir properties and operating conditions
- The software development time is cut by at least 50% using python. The prototype software was developed within four months and a working version within six months. The development would have taken two or three times longer using C or C++
- The predictive accuracy near 100%. Our proposed solution outperforms legacy tools