Efosa Carroll Idemudia, Ph.D.

Professional Development Grant Final Report 2018-2019

Management & Marketing Department
College of Business
Arkansas Tech University

PROFESSIONAL DEVELOPMENT GRANT

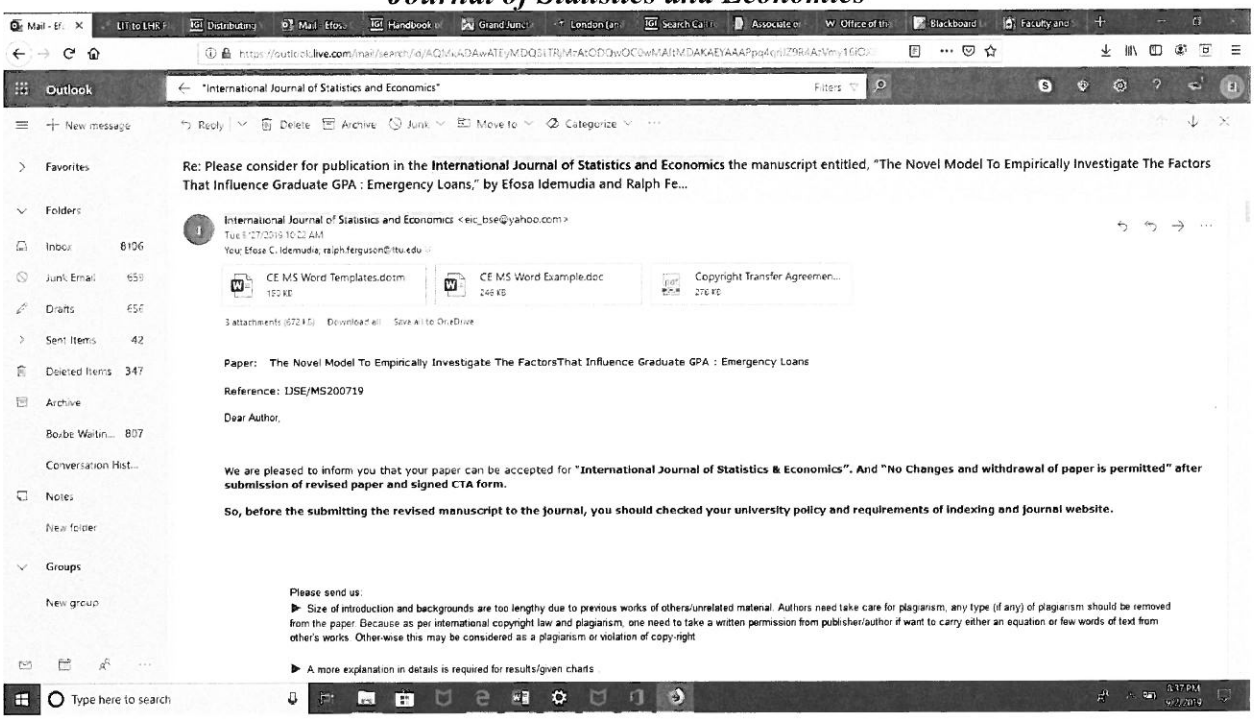
1. Professional Development Grants, Arkansas Tech University March 2019. I attended the conferences below to present the research paper with the title "The Novel Model To Empirically Investigate The Factors That Influence Graduate GPA : Emergency Loans."

    a. Southwest Decision sciences (http://www.swdsi.org/swdsi2019/Default.asp)
    b. Federation of Business Disciplines Conference (https://www.fbdonline.org/Conference)

2. Professional Development Grants, Arkansas Tech University August 2019. I attended the Americas Conference on Information Systems (AMCIS 2019) (https://amcis2019.aisconferences.org/) to present the following research papers:
    a. IS LEAN THE PATH?
    b. Image-based Methods for Character Recognition

The research paper I presented in both the Southwest Decision Sciences and the Federation of Business Discipline Conference was accepted for publication in the *International Journal of Statistics and Economics* as shown in Figure 1.

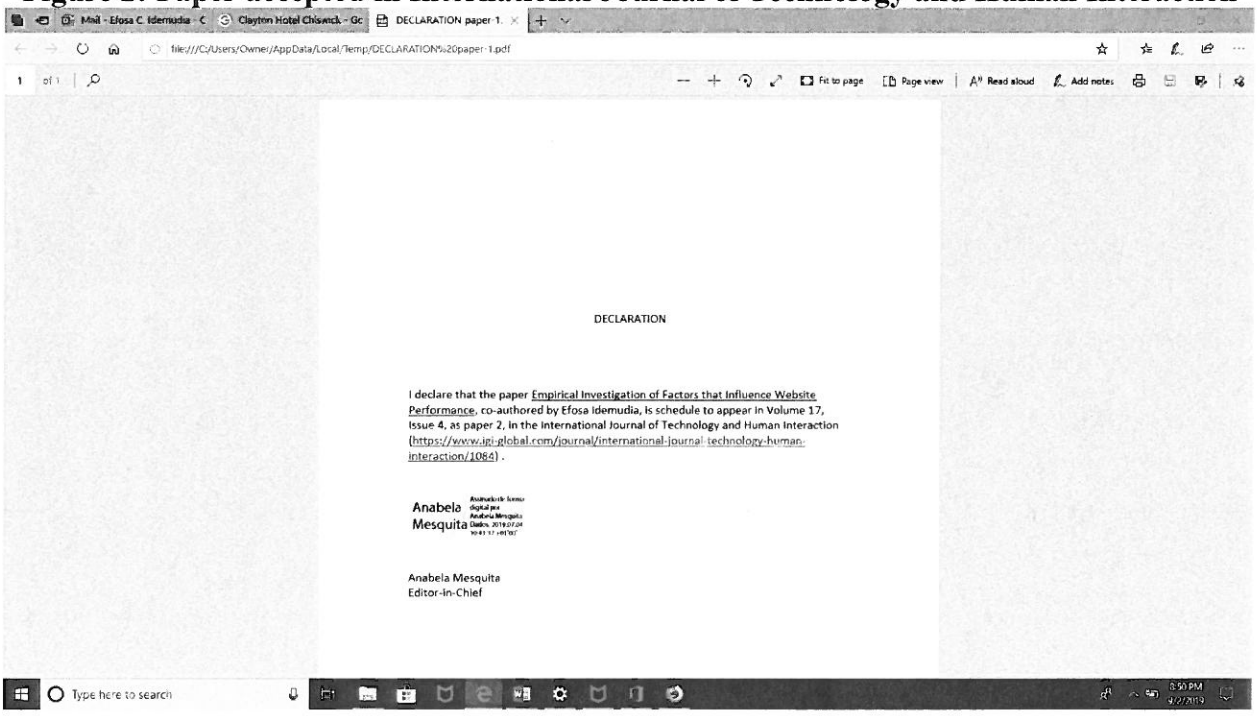
Figure 1: Proof that my paper has been accepted for publication in the *International Journal of Statistics and Economics*



In addition, the Professional Development Grants helped me to get feedback and comments from researchers, hence, one of my papers is recently accepted in the *International Journal of*

Technology and Human Interaction (https://www.igi-global.com/journal/international-journal-technology-humaninteraction/1084) as shown in Figure 2.

Figure 2: Paper accepted in International Journal of Technology and Human Interaction



DECLARATION

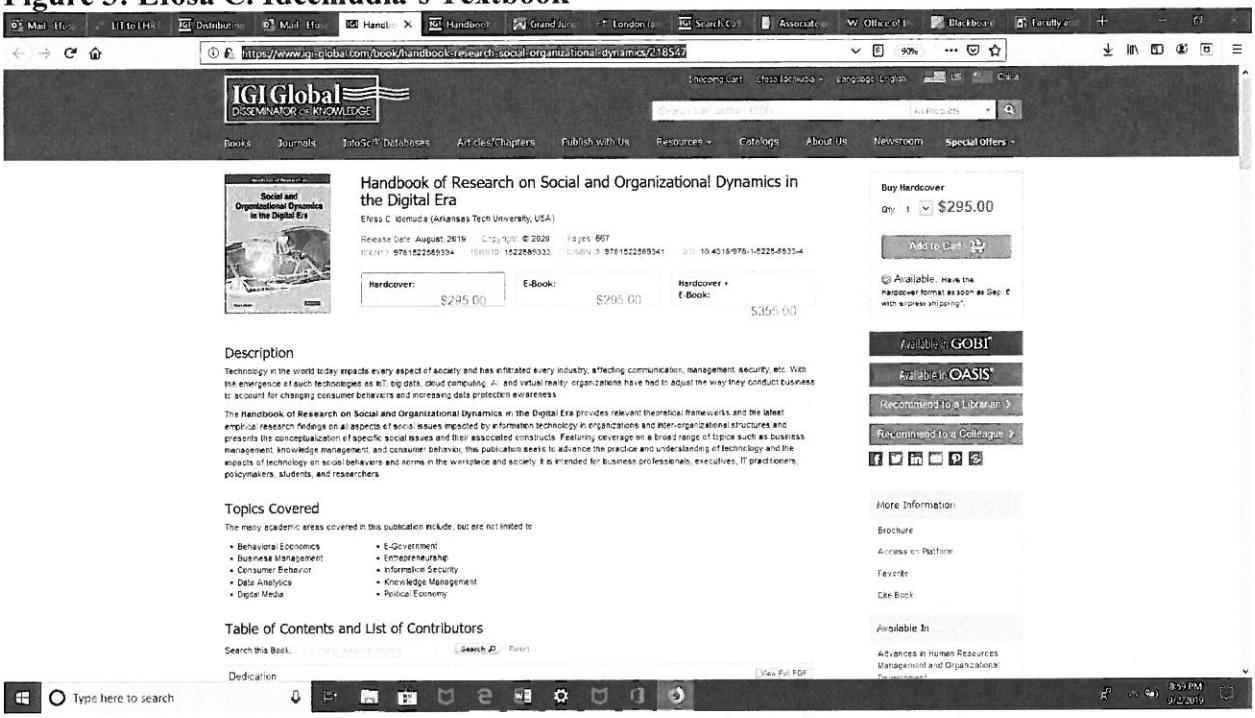
I declare that the paper Empirical Investigation of Factors that Influence Website Performance, co-authored by Efosa Idemudia, is schedule to appear in Volume 17, Issue 4, as paper 2, in the International Journal of Technology and Human Interaction (https://www.igi-global.com/journal/international-journal-technology-human-interaction/1084) .

Anabela Mesquita

Anabela Mesquita
Editor-In-Chief

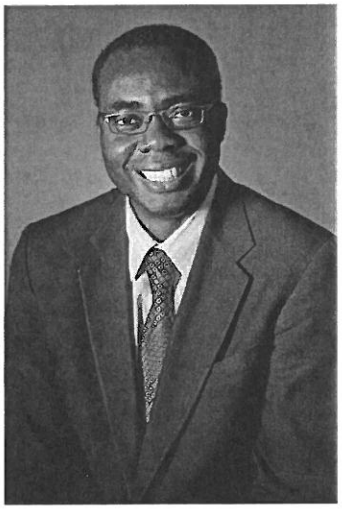
Finally, attending the conferences above significantly help me to published my textbook as shown in Figure 3 (https://www.igi-global.com/book/handbook-research-social-organizational-dynamics/218547)

Figure 3: Efosa C. Idcemudia's Textbook



Idemudia Book Explores Organizational Dynamics

September 3, 2019



Dr. Efosa C. Idemudia, associate professor of business data analytics at Arkansas Tech University, has written a textbook entitled "Handbook of Research on Social and Organizational Dynamics in the Digital Era."

According to a description of the book provided by publisher IGI Global, the textbook "provides relevant theoretical frameworks and the latest empirical research findings on all aspects of social issues impacted by information technology in organizations and inter-organizational structures and presents the conceptualization of specific social issues and their associated constructs."

The description goes on to state that business management, knowledge management and consumer behavior are among the topics covered in the book, which is the second textbook written by Idemudia. He previously wrote "Handbook of Research on Technology Integration in the Global World," which was published by IGI Global in 2018.

DECLARATION

I declare that the paper Empirical Investigation of Factors that Influence Website Performance, co-authored by Efosa Idemudia, is schedule to appear in Volume 17, Issue 4, as paper 2, in the International Journal of Technology and Human Interaction (https://www.igi-global.com/journal/international-journal-technology-human-interaction/1084) .

Anabela Mesquita

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The Novel Model To Empirically Investigate The Factors That Influence Graduate GPA : Emergency Loans

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ABSTRACT

To date a lot of studies have shown that students are depending on emergency loan to attend graduate schools in the US; and tuition and fees have been increasing steadily worldwide (Idemudia and Ferguson 2015, 2014, 2016). Need increases for international students when national economies shrink, Africa's most developed economy fell into its steepest quarterly contraction in a decade, shrinking at an annualized rate 3.2% in the first quarter (Steinhauser and Ntobela 2019). This indicates South African currency may be devalued against the dollar increasing sum required for an education in the United States. International students that suffer currency devaluation are less likely to consider the United States to study and those here face greater financial stress, which establishes emergency loan need to support academic sustainability. Prior studies have been very helpful; however, to the best of our knowledge there is no study that have use different models to investigate the factors that influence the GPA of students who take emergency loans. To fill the gaps and to make significant contribution to the literature, we conducted our research by collecting datasets from 342 graduate students enrolled in a large public university located in North America. As shown in Figure 5, the three models we used in our study to investigate the factors that have significant and positive effects on GPA relating to students who borrowed emergency loans are generalized regression, linear regression, and C&R Tree. In addition, Figure 5 show that the best and appropriate model that researchers should use to investigate GPA is generalized regression based on correlation and relative error criteria. Our study shows that Age, gender, marital status, and degree have a positive and significant influence on the GPA of students who borrowed emergency loan. The Data also forecast change in international students applying for graduate schools in the US. Students need greater than family and government resources to successfully complete their studies. Finally, our study has a lot of research and managerial implications for both academia and top managements.

Keywords: emergency loan, graduate students, US Citizen, Non-Resident Alien, loan and financial aid, generalized regression, linear regression, C&R Tree

INTRODUCTION

Emergency Loan borrowing need indicates a debt hazard for students greater than sum required to address an immediate revenue demand. Rising cost, global economic slowdown, U.S. race relations, and detrimental public rhetoric contribute to the reality that the U.S. learning community have immeasurable challenges to overcome to establish a hegemonic position in a transitioning world. New first-time international student enrollment fell by 3.3 percent in 2016 and 6.6 percent in 2017, according to IIE's "OpenDoors" reports (Johnson 2019). This loss of international students increases the financial burden on U.S. university because they account for over 40 billion dollars in the national economy. Universities suffer an unplanned forfeiture of tuition and fees with the shrinkage of international students selecting U.S. institutions for their higher education credentials. Student loans have seen almost 157 percent on cumulative growth over the last 11 years (Griffin 2018). This signals deficiency in general loan availability,

funds borrowed at loan plateau unable to get approval to exceed the cap or allocation cycle inflexible forces students to higher interest cost short-term lenders. Fewer know that growing alongside 42 million indebted students is a formidable private industry that has been enriched by those very loans (Steele and Williams 2016). This research alerts private and public sector leaders that the education debt system may place domestic and international students, future thought leaders, in untenable positions that contain their abilities to fully engage in the market economy.

Students who hold the perception that they have high student loan debt balances have increased likelihood of dropping out of college (Britt, Ammerman, Barrett, and Jones 2017). Debt becomes a de-investment in the future of the market economy that tethers expansion limitation on the estimated better than 50% of students borrowing to improve the trajectory of their fortunes. Forty-two million student borrowers have debt of $100,000 or less, while 2 million borrowers have debt greater than &100,000 and 415,000 hold debt greater than $200,000 (Friedman 2017). This forms a transparent firewall not unlike the glass ceiling that constrains disenfranchised populations from complete benefit of their higher education credential. Experts and analyst worry that the next generation of graduates could default on their loans at even higher rates than in the immediate wake of the financial crisis (Griffin 2018). Creativity and innovation suffer because burdensome debt adsorbs approximately a third of net income limiting purchasing power, restricts risk-taking motivation, and freedom to participate in market discourse through public and private activism. Today student debt is a $140 billion-a-year industry, and unlike many of its student customers, the industry's future looks bright (Steele and Williams 2016). Student debt has delayed household formation and led to a decline in homeownership (Griffin 2018).

METHODOLOGY

To empirically investigate the novel model to determine the factors that influence graduate GPA relating to emergency loans; we collected our dataset from 342 graduate students that are enrolled in a large public university located in North America. These graduate students collected emergency loans to financially support their education, personal, and family needs. The dataset for our study includes:

1. US Citizen
2. US Permanent Resident
3. Resident Aliens
4. Non-Resident Aliens

We used survey methodology for our study; and survey methodology is a reliable, appropriate, and robust methodology to empirically investigate issues and problems relating to education, emergency loans, academic performance, GPA, and financial aids (Idemudia and Ferguson 2012, 2013, 2014, 2015). The dataset for our study includes the following columns:

a. Full names
b. Loan amounts
c. Loan date
d. Interest
e. Amount paid
f. Amount due
g. Due date

h. Year entered graduate program
i. Birthday
j. Permanent/mailing addresses
k. Home and cell phone numbers
l. Academic college
m. Graduation date
n. Department
o. Major/minor degrees
p. Academic performance such as GPA, time to effectively complete studies, exit date etc.
q. Social security number
r. Student ID
s. Nationality
t. Financial capability of each graduate student
u. Gender
v. Ethnicity
w. Marital status
x. Graduate students signatures relating to emergency loans

According to the University's policies and procedures, some of the critical factors the graduate school committee consider when approving emergency loans for graduate students are: (1) insurance problems relating to family, health, car, house etc., (2) dental and medical expenses, (3) health issues/problems, (4) household, work, and family expenses, (5) teaching, service, and research productivities.

DATA ANALYSIS

We demonstrate the important of emergency loans by using visual techniques to indicate that emergency loan need exist in a worldwide and diverse spectrum of marital status, nationality, gender, race, ethnicity, colleges, and degree type. In addition, our current study opens the doors for future researchers and academia to implement data science, data analytics, text, and data mining techniques to empirically investigate academic performance and GPA relating to emergency loans. Figure 1A shows the amount of emergency loan borrowed by various colleges. To strongly support and validate that both US Citizen and international students are applying for emergency loans to successfully complete their studies, please see *Figures 1B & 1C* that focus respectively on US Citizen and International students. *Figures 1A, 1B, & 1C* are evidence and indicators that the top two colleges that borrowed emergency loans are the college of arts and sciences and the college of engineering. In addition, *Figures 1A, 1B, & 1C* show that the college that borrowed the least amount of emergency loan is the college of mass communication.

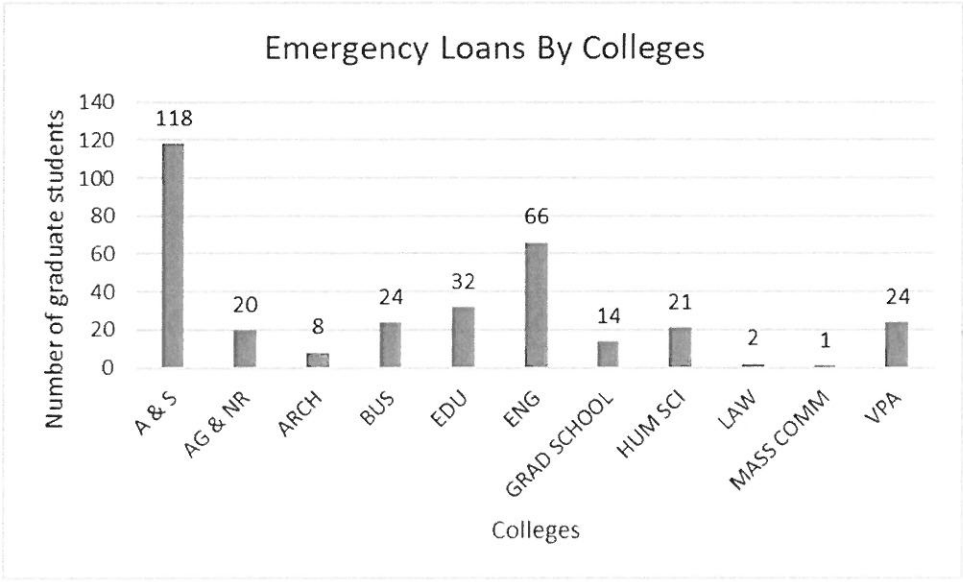

Figure 1A. Emergency Loan By Colleges

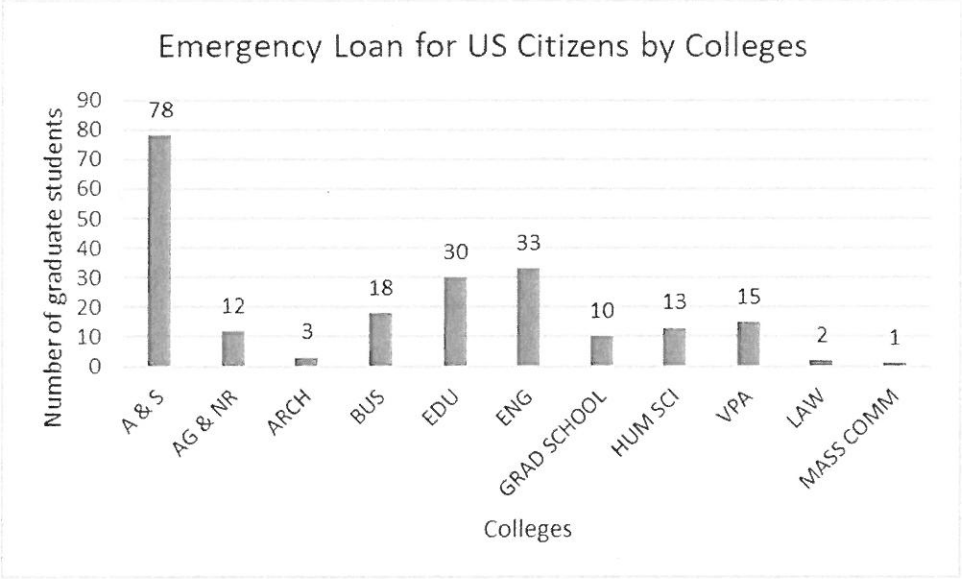

Figure 1B. Emergency Loan for US Citizen By Colleges

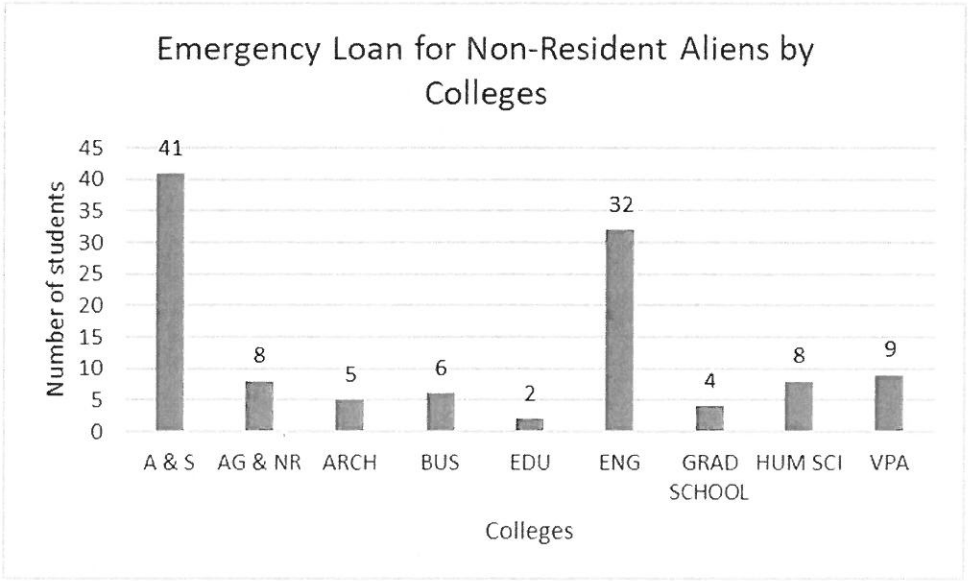

Figure 1C. Emergency Loan for Non-Resident Alien By Colleges

College legend: A & S: College of Arts & Sciences; AG & NR: College of Agriculture; ARCH: College of Architecture; BUS: College of Business; EDU: College of Education; ENG: College of Engineering; GRAD SCHOOL: Graduate School; HUMSCI: College of Human Sciences.

Figure 2A shows the various degree type that borrowed emergency loan; while *Figures 2B & 2C* focus on US citizen and international students respectively that borrowed emergency loan. These *Figures (i.e. 2A, 2B, & 2C)* are strong indicators and evidence that show that graduate students in North America are borrowing emergency to pursue graduate degrees. *Figure 2C* shows that in graduate schools in North America, that more doctoral students are borrowing the most emergency loans to successfully complete their studies because PhD programs are longer and international students do not have the permission to work off campus. In addition, *Figure 2C* clearly shows that international students hardly take emergency loan to obtain certificate from graduate schools in the US.

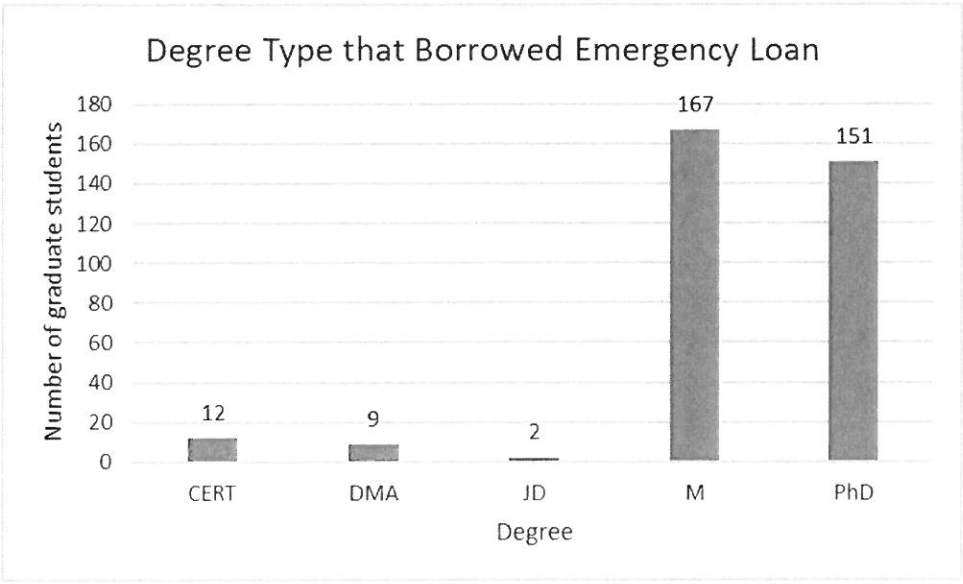

Figure 2A. Degree Type that Borrowed Emergency Loan

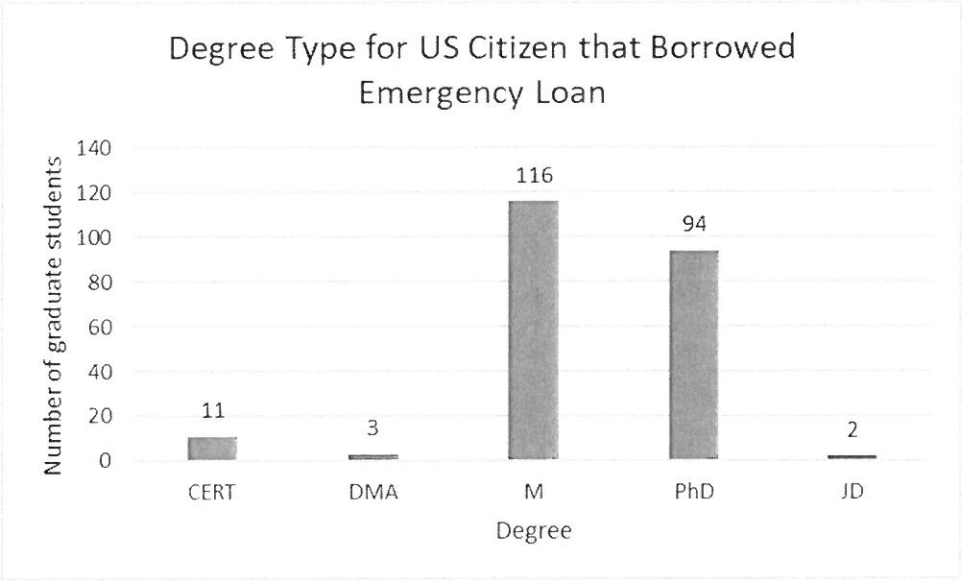

Figure 2B. Degree Type for US Citizen that Borrowed Emergency Loan

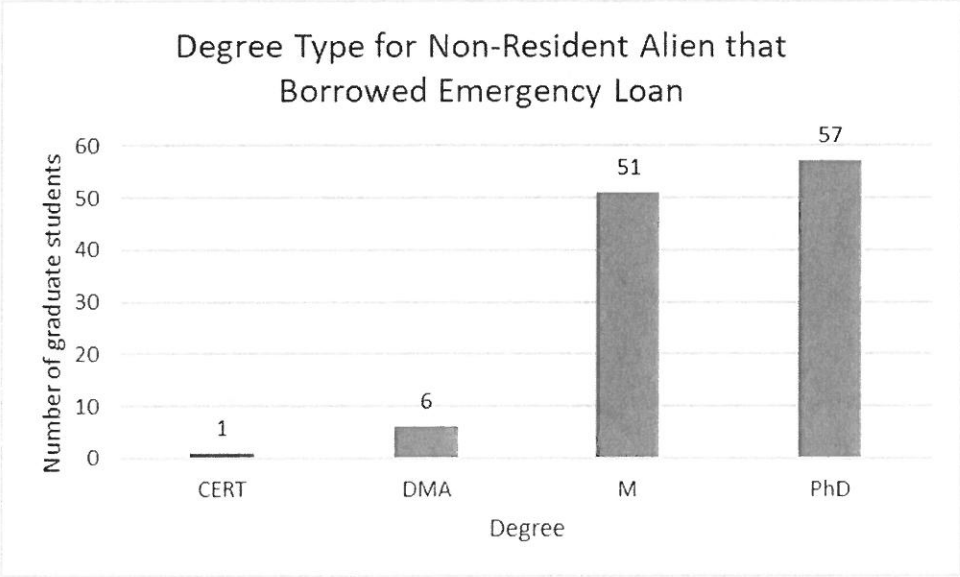

Figure 2C. Degree Type for Non-Resident Alien that Borrowed Emergency Loan

Degree legend: CERT: Graduate Certificate; DMA: Doctor of Music; M: Master; PhD: Doctor of Philosophy; JD: Juris Doctor

Figure 3 shows the marital status that borrowed the most and least emergency loan.

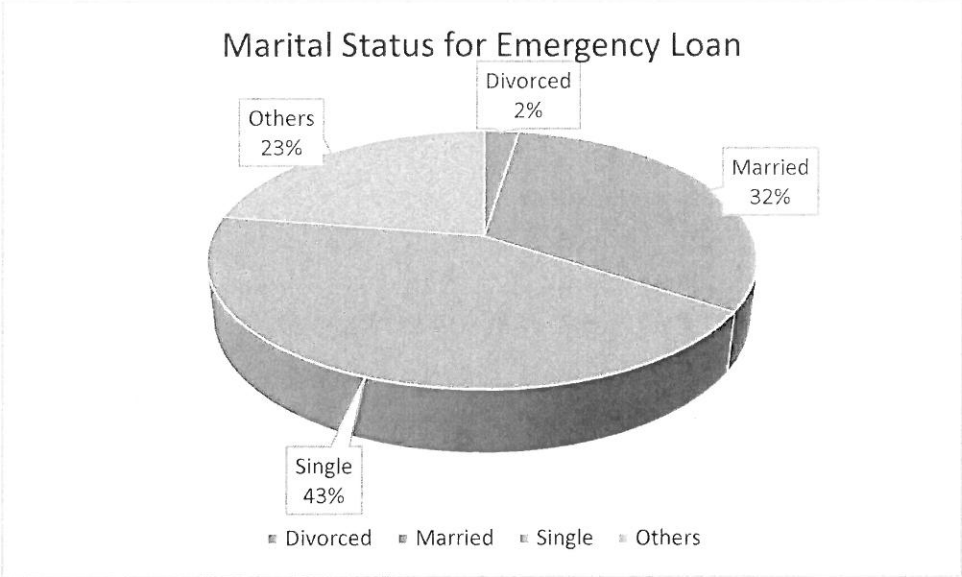

Figure 3. Marital Status for Emergency Loan

Finally, *Figure 4* show that male graduate students borrowed the most in emergency loans.

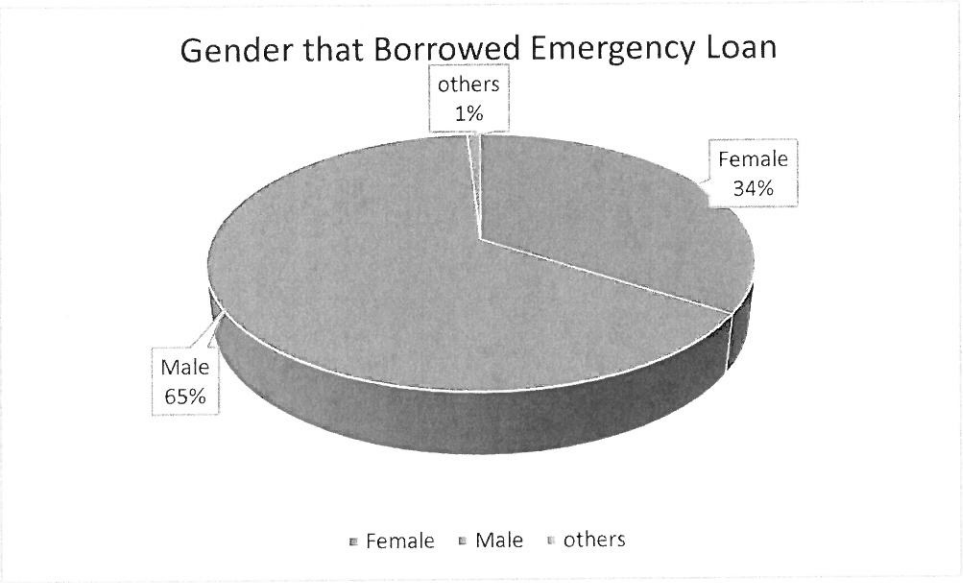

Figure 4. Gender that Borrowed Emergency Loan

THE NOVEL MODEL

We implemented the IBM Auto Numeric Node to determine the most appropriate and novel model on factors that influence GPA and academic performance relating to emergency loan. The Auto Numeric Node uses the concepts correlation and relative error to determine the best model. As shown in *Figure 5*, the top three models for our data analysis are generalized linear regression, linear regression, and C&R Tree. In addition, *Figure 5* shows that the best and novel model for our dataset is generalized linear regression based on correlation and relative error.

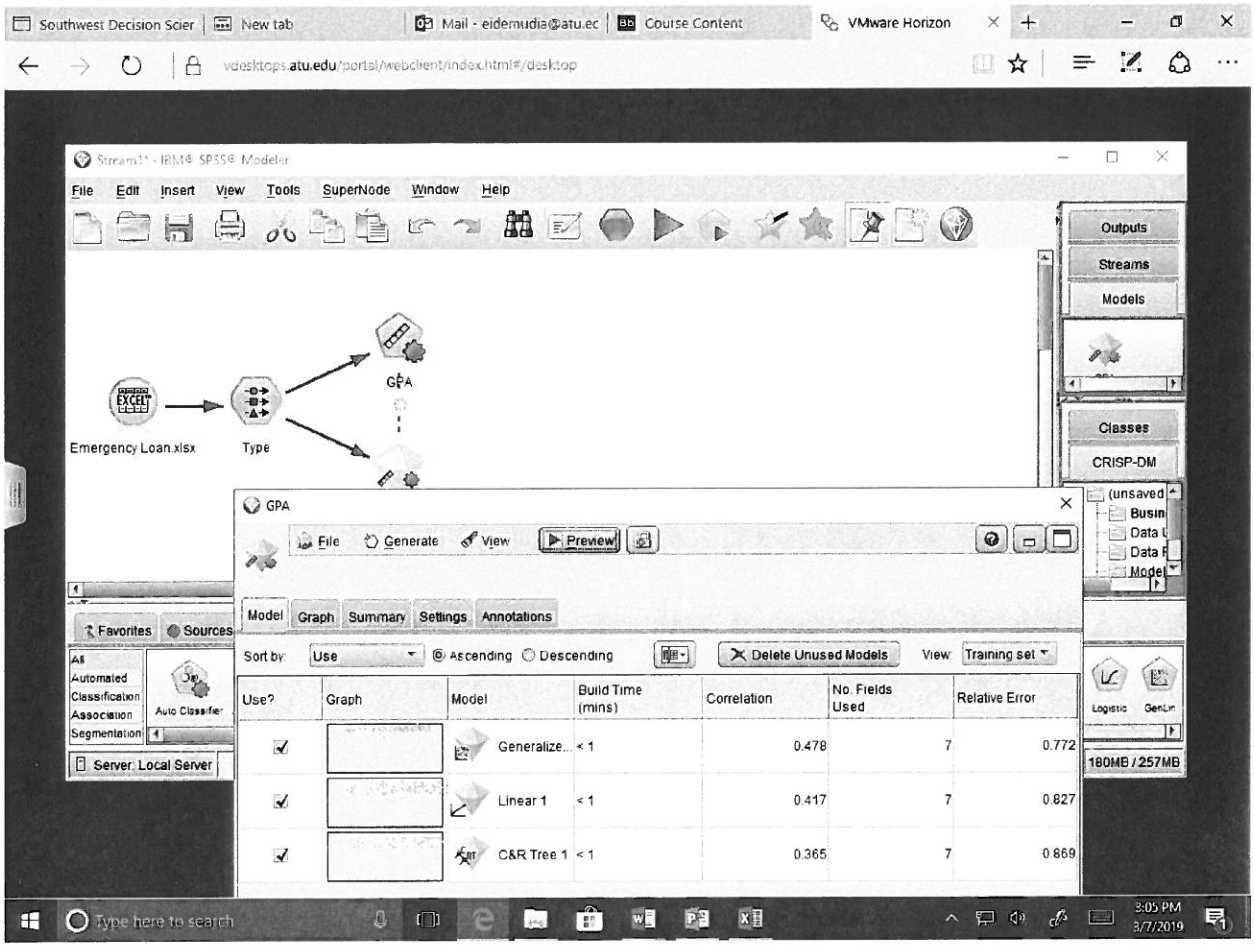

Figure 5. The Novel Model

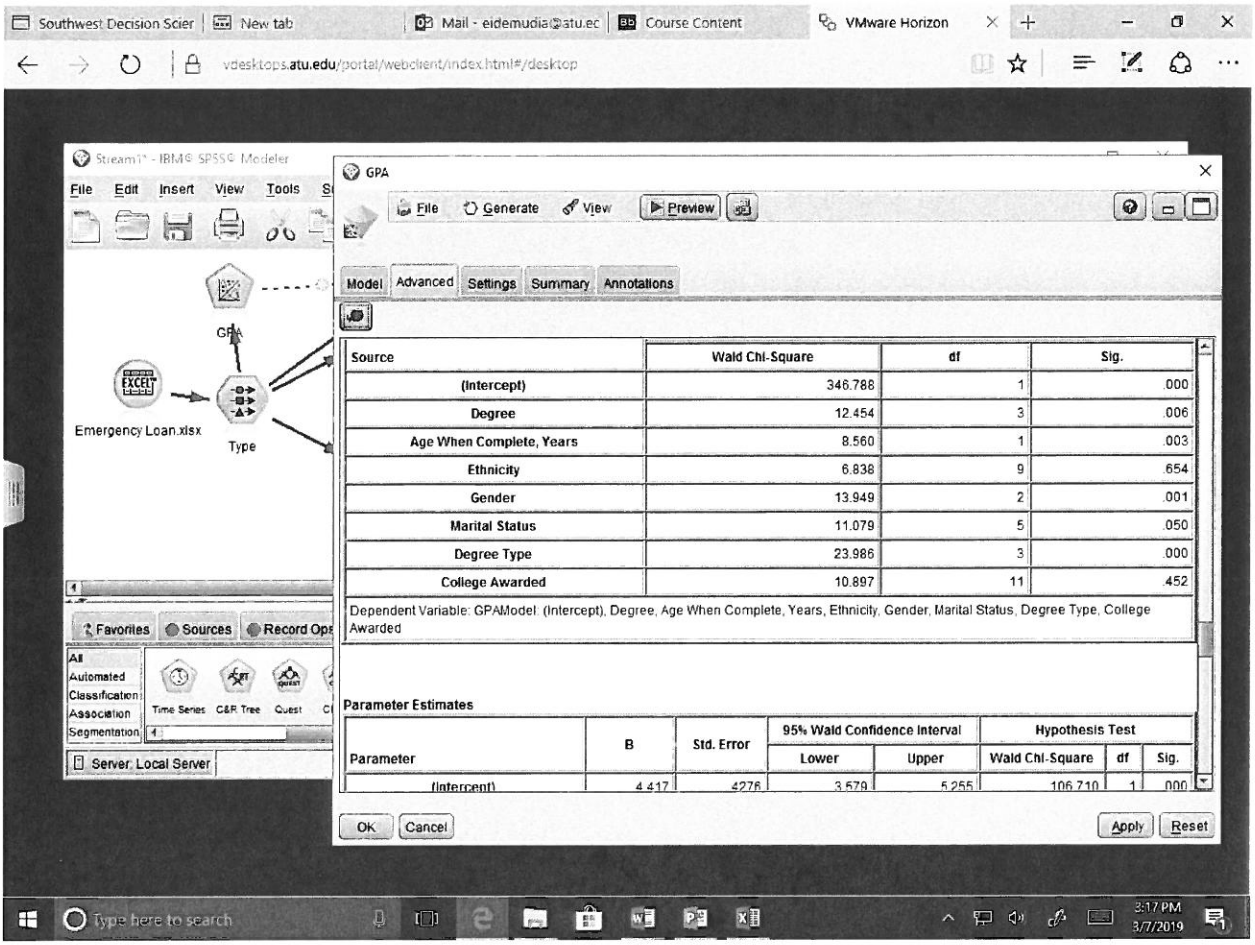

Figure 6. The Independent variables in the Novel Model

Our study shows that Age, gender, marital status, and degree have a positive and significant influence on the GPA of students who borrowed emergency loan. The Data also forecast change in international students applying for graduate schools in the US. Students need greater than family and government resources to successfully complete their studies. In addition, our study has a lot of research and managerial implications for both academia and top managements.

CONCLUSION

Emergency Loan need is the fire alarm warning that there is a bubble of an impending economic calamity with the potential ability to dampen the competitive market economy. On the global education stage, China is succeeding in emerging markets to enhance affordability. The United States is not seen as doing anything in Africa, while China is spending billions of dollars building infrastructure and actual universities in Sudan (NAFSA 2019). African students from across the continent are benefiting from scholars to study in China. A by-product of the Chinese effort to become a global education leader, students learn to be tolerance of less freedom of speech due to the Communist Party conduct toward an open society. The resolve for democratization in countries on the continent may dim with future African thought leaders trained in China.

The U.S. Department of Education reports that students seeking graduate and professional degrees now face a 6.6 percent interest rate (Griffin 2018). With a trillion dollars in student loan debt growing each graduation cycle, it is not dubious to consider political values and or social turmoil by the debt-ridden population may reshape the market economy through activism. One in four borrowers are behind in their payments, according to the Consumer Financial Protection Bureau, with an estimated 7.6 million in default (Steele and Williams 2016). Because most borrowers, domestic and international students, must work an uninterrupted 10 to 20 years to sufficiently reduce their debt load, they will have less income to spend toward entertainment and luxury items. Eighty percent of working professionals with student loan debt said it is a source of "significant or "very significant" stress, according to the of more than 3,000 Americans conducted online in May (Dickler 2017). This results from graduation marriages where the spouse likely has an equal sum of student loan debt. The real choice for couples may be to use limited discretionary revenue to start a family due to the aging clock of mother nature.

With demise and shrinking of numerous social safety nets, the next recession may significantly transform governance to protect the well-being of domestic and international intellectual capacity of individuals latent with educational debt. The indicators are with the slowing of the global economy researcher must look ahead to anticipate strategies to avert unmanageable challenges that evolve from this student loan debt bubble.

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Empirical Investigation of Factors that Influence Website Performance

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Empirical Investigation of Factors that Influence Website Performance

Abstract

Rapid advancements in digital technology have had a significant influence on businesses' websites. Companies and organizations with well-designed websites have the potential of attracting customers, generating revenues, and increasing market share. Nevertheless, many companies and organizations that are investing billions of US dollars on websites and page development are not attracting customers or generating revenues, incomes, and profits as expected. These e-commerce firms will lose market share and online advertising revenues if their websites are not effectively managed and monitored. With big data changing the way we think about technology and making it easier to collect data and gain knowledge from a large volume of dataset to make better decisions and gain competitive advantage, it becomes necessary to understand web analytics and improve e-commerce website performance. Our study focuses on bounce rate as a measure of website effectiveness. We investigated the influence of page view, unique page view, average time on page, entrances, and percent exit on bounce rate, in the context of a small e-commerce company in the United States and developed a research model on the effect of these identified variables on the bounce rate. The results from research have practical and research implications.

Keywords: Website performance, bounce rate, page view, unique page view, average time on page, entrance, and percentage (%) exit.

1 Introduction

Using a small e-commerce website, our study focuses on how to improve website performance. Websites are among the most innovative technological applications that have appeared in the last 25 years. The World Wide Web using the Internet platform has evolved as an essential mechanism for inter- and intra-organization information exchange [44]. The last decade has seen media delivery systems converge within single technologies such as mobile phones, personal computers, smart televisions, iPads, and other digital devices. Moreover, the Internet has led a revolution in e-commerce contributing to e-retailers like Amazon and Play.com having huge economic success in the sale of books and music. Most major commercial companies now have their own websites. This e-commerce trend has also resulted in more choices for consumers leading to increased competition, price reduction and empowers consumers who can compare prices for a large range of products and services.

According to Welling and White [49], 'the internet has been a key driver of corporate marketing during the past ten years." (p. 655). Significantly, in 2015, the US digital advertising revenue was assessed to be $59.6billion, a 20% rise from the already high 2014 revenue of $49.5billion [23]. Therefore, there are inherent opportunities in increasing the attractiveness of e-commerce websites particularly with the advantages big data presents regarding access to data on online users.

Companies worldwide harnessing the power of their websites in this Age of Big Data for activities such as advertising products to millions of customers, getting feedback from customers online on product improvement, selling goods and services to customers, expanding their market reach amongst others. Big Data should, however, mean Big Impact [50]. Such impact would include targeted marketing, business insights, client-based segmentation, sales and marketing opportunity identification, buyer preferences, customer feedback, risk analysis, data access amongst others [39, 26]. Though extraction of valuable data, however, remains a critical Big Data challenge, businesses gain many advantages by harnessing its capabilities for informed strategic directions and increased operational efficiency [30].

There are many ways web users can access webpages and websites: (1) direct traffic, i.e., directly typing the company or organization's URL, (2) indirect or referral traffic, i.e., linking through other domain websites/links, (3) search

traffic, i.e., using search engines such as Google and Yahoo, (4) using a computer mouse to click on the websites/links, and (5) using advance voice recognition and eye movement. Moral et al. (2014) explain that search traffic can be classified into two main groups: (1) paid search traffic and (2) unpaid traffic. Some examples of the leading paid search traffic are Google Adwords, Facebook Ads, Outbrain Amplify, LinkedIn Ads, and Twitter Ads. Several benefits accrue for companies and organizations using paid search engines for their websites/pages: exposure in the top three search engines, immediate traffic, consistent traffic, targeted ads to potential web users and online visitors, access to web users and online visitors worldwide, perceived relevance to web users and online visitors worldwide, positive branding implications, and an ability to track both web users' and online visitors' shopping and browsing online behaviors. Also, companies that are using Adwords should implement strategies to determine if the Adwords improve the quality of paid/search traffic compared to the unpaid traffic.

For organizations to benefit from the opportunities offered by their e-commerce websites, it becomes imperative for them to improve website performance to attract and retain customers [4]. Slow websites can cause users to abandon sites and in some cases, switch to a competitor when they experience performance issues [10]. An understanding of website performance has implication for user experience and satisfaction and will lead to the achievement favorable returns on investment. Therefore, website performance has become an important element for understanding the financial and operational performance of an organization [16]. According to Ghandour et al., the nature of the website usage, which includes user behavior on the web, navigation pattern, the number of website visitors and the time spent surfing a website, are important indicators of website performance and success.

Measurement of website performance is central to website management as this will help determine the extent to which goals are achieved (Butkiewicz et al. 2011, Madhyastha & Sekar, 2011). This study focuses on one key factor influencing website performance –surfer or user or customer satisfaction, the bounce rate, which Sculley, Basu, and Bayardo (2009) found to be an effective measure of user satisfaction in online advertisement. Our study looks at the effect of bounce rate on the website of the case company, a small e-commerce North American firm, experiencing low patronage. Our in-depth investigation focused on why the company was failing to attract customers online and had high bounce rate despite the online promotions. Perplexed by the diminishing sales reports, top management of the case company were worried about the loss of market share across their range of products, despite substantial investment on the site. To address these issues and provide insights and understanding to top management on why this e-commerce website is not productive and how to improve performance, we focused on factors that affect bounce rate of this e-commerce website, as a measure of user satisfaction. The definitions of the factors our case study research focus on are shown in Table 1.

Table 1: Key performance indicators used in this study

S/N	Key performance indicator in our research model	Description
1.	Page views	"Page views" refers to the total number of pages viewed on the website and is a general measure of how much the website is used [13, 18, 27]. According to Digital Analytics Association [14], page views is "the number of times a given page was used" (p. 10).
2.	Unique page views	Unique page views refer to the number of visits or sessions during which the specified webpage or webpages was viewed at least once [21, 47].
3.	Average time on page	Average time on page is the average amount of time web users or online visitors spent viewing a specified webpage or screen, or set of webpages or screens [21, 47].
4.	Entrances	Entrances is the number of times web users or online visitors entered your website through a specified webpage or set of webpages [47].

5.	% Exit	% Exit is the percentage of website exits that happened from a specified webpage or set of webpages [47]. Mathematical it can be express as % Exit = (number of exits) / (number of pageviews) for the page or set of pages [29, 47].
6.	Bounce rate	Bounce rate refers to the number of visitors who immediately leave upon arrival at a website [16]. Booth and Jansen [6] posit that a high bounce rate "may be a reflection of unintuitive site design or misdirected advertisement."

2 Literature Review and Synthesis

The importance of data collection on an e-commerce site cannot be overestimated. With the huge volume of information available online, it becomes imperative for businesses to make sense of this seemly explosion of data. Big data, the game changer, aptly describes this massive amount of data (sets) available for storage, processing, analyzing, management [1, 39] , which is beyond technology's capability to do so effectively [25]. Hence, the challenge is how to devise new tools and appropriate systems for effective collection, aggregation, and analysis of these data in order to "extract relevant meaning for decision making" [25: p.995].

Data can be automatically collected on trends of people visiting the website, and this crucial information aggregated across the web visitors gives managers needed insights, allowing them to evaluate the website effectiveness [40].

According to Tarafdar and Zhang [44], website performance can be measured by the traffic it attracts and retains, i.e., the number of people and the extent to which they make repeated use of the same website. Tarafdar and Zhang, therefore, conceptualize website performance regarding visits by customers which is linked to profitability. This is in line with the views of Bharadwaj [4], Heijden [20] and Huizingh [22].

Huizingh [22] identified four antecedents of website performance: company characteristics, web initiative, website characteristics, and web strategy. The author found out that these factors affect website performance in different ways. The author made use of the number of visitors and managerial satisfaction to measure website performance. However, Tarafdar and Zhang [44] argue that there are two main measures of website performance: reach and loyalty. The authors (Tarafdar & Zhang) used website characteristics as their independent variables, with *reach* and *loyalty* as their dependent variables. The Tarafdar and Zhang study looked at the influence of website characteristics on *website Reach* and *website Loyalty*, two important website performance measures.

The Tarafdar and Zhang [44] study can be seen as broad-based in their attempt to conduct a comprehensive study on factors influencing website performance, yet it does not cover every factor influencing website performance. As suggested by Bharadwaj [4], many factors influence website performance in different ways. According to Gomez Inc. [17], "[E]enterprise stakeholders viewed Website performance in a variety of ways. Business managers have measured site performance by page views, bounce rates, and conversion rates with tools such as Google Analytics or Omniture, while technology professionals have watched site availability and response time metrics" (p. 4). This shows that there are different ways of understanding factors influencing website performance depending on the interest of an individual researcher.

Information systems researchers have demonstrated that usage is a key variable in explaining the performance impact of website or information technology [16]. User satisfaction is a major factor in assessing website quality and can be a useful measure to understand the reach and loyalty for a website by customers. Tarafdar and Zhang [44] suggest that reach and loyalty are two important measures for understanding websites success. Grigoroudis, Litos, Vassilis, Moustakis, Politis and Tsironis [19] studied website characteristics associated with website quality. In other words, the features inherent in a website will determine its quality. Also, the quality of a website will determine whether the users will leave the website immediately without clicking any page, which is called bounce rate. According to Sculley et al. [41] bounce rate, which is less studied, is an important metric of understanding the performance of a sponsored search advertisement, directed to a landing page. Bounce rate is defined by Avinash Kaushik,

writing for Google Analytics as "...the number of people who entered the site on a page and left right away. They came, they said yuk and they were on their way" [41,(cited in Sculley et al., 2009, p. 1]. In other words, bounce rate refers to the number of visitors who immediately leave upon arrival at a website [16]. Booth and Jansen [6] posit that a high bounce rate "may be a reflection of unintuitive site design or misdirected advertisement" (p. 153).

Kaushik argues that bounce rate is important for advertisers to monitor because a user who bounces from a site is unlikely to perform a conversion action such as a purchase [41]. Also, of major concern is the proliferation of mobile phone users who expect web links to download as fast as on their personal computers [17]. These individuals are likely going to leave a site that does not offer them the opportunity to download on their mobiles or better still *bounce*. Therefore, businesses that take this factor into consideration may gain greater customer loyalty over those who refuse to adjust to this new phenomenon in technology space.

Poock and Bishop [38] found that most website users prefer sites that are intuitive and easy to use and that sites with these qualities are likely to be effective and have good usability. Usability is the ease of usage of an object [12]. According to Churm, [12], usability signifies the ease with which users can achieve specified goals with efficiency when visiting a website. Zhu, Vu and Proctor [51] argue that usability – the ability of individuals to easily interact with a website – is the most important characteristic to determine the success of a website.

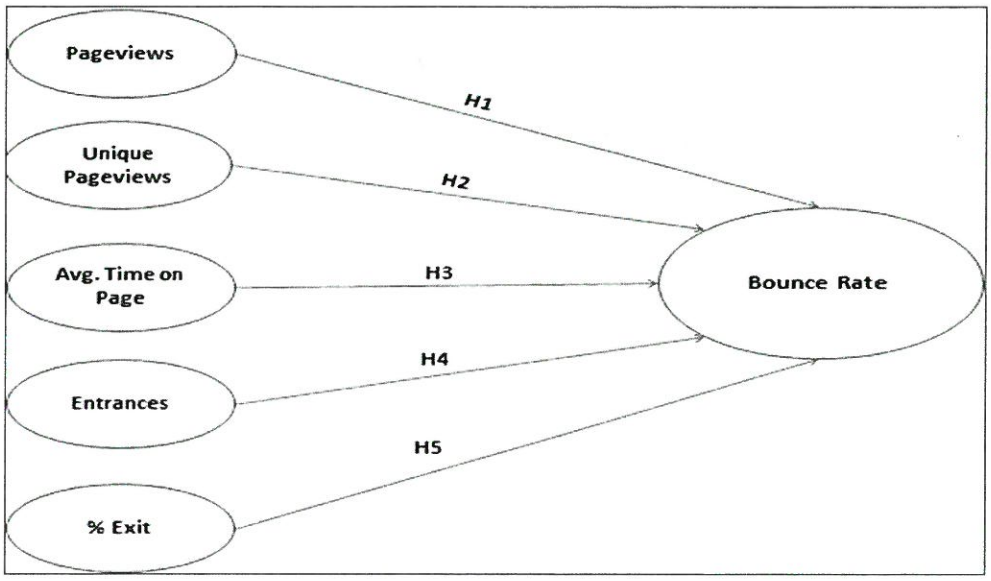
It becomes imperative for companies to improve the effectiveness of their IT capability, in this case, website performance, by capturing the value enabled by greater access to data - Big Data. Significantly, determining how to attract more potentials customers with billions of users now having access to websites and what can consist hindrances to access to their websites, should be key considerations for companies. The conceptual framework and hypotheses development section will consider the factors that have significantly influence on bounce rate using data collected via Google Analytics' e-metrics including pageviews, unique pageviews, average time on page, entrances, and % exit.

3 Conceptual Framework and Hypotheses Development

Bounce rate is considered one of the most important and overlooked performance statistics [2, 41]. A high bounce rate means that web users and online visitors do not find the landing page/web presence relevant [11]. Bounce rate reflects web users and online visitors' visual attention behavior [42]. Hence, the theoretical background for our research model is the visual attention behavior. Sha and Lu [42] argue that some example of visual attention behavior are page view, unique page view, average time on page, entrances, and percent exit on bounce rate.

The bounce rate can provide insights to companies and organization on many important things [8]. Hence, our dependent variable in our model is Bounce Rate. Based on the review of existing literature, a conceptual framework (research model) has been developed in Figure 1 below. The model shows that website performance measured in terms of bounce rate acting as a dependent variable is directly linked to page views, unique page views, average time on page, entrances and percent of exit. This implies that our dependent variable for this study, bounce rate, is directly related to our independent variables, key performance indicators (refer to Table 1 above).

Figure 1: The Research Model



3.1 Page Views and Bounce Rate

"Page views" refers to the total number of pages viewed on the website and is a general measure of how much the website is used [13, 18, 28]. Kaushik [28] avers that high bounce rate may indicate lack of user's satisfaction with the content of a page or layout and as such the user is not willing to open another page and leaves the website immediately. According to Digital Analytics Association [14], page views is "the number of times a given page was used" (p. 10). Web interfaces that use flash or AJAX may make it appear as if a particular user is visiting different pages, though the user is visiting the same or a single page [15]. According to Jansen [24] and Booth and Jansen [6], bounce rate is the proportion of visitors who exit the site after visiting only one page or the measurement of visitors that arrive at a homepage and leave immediately. Hence, the following hypothesis was developed based on the arguments above:

H1: Page views have a positive influence on bounce rate

3.2 Unique Page Views and Bounce Rate

"Unique page views" is defined as the number of sessions during which the specified webpage was viewed by webusers or online visitors at least once [47]. A unique pageview is counted for each page URL + page title combination [47]. The number of times that users are willing to view a page will depend not only on the content but may also be connected to referral by those who have visited the site. The high tendency for a specified page to be the source of traffic of users is possible. This can, therefore, help to prevent users from leaving the page or not visit the website again. The difference between unique page views and page views is that repeat viewers will only be counted once under unique page view [47]. Unlike page views, unique page views provide a more accurate count of website users as it helps prevent the counting of users more than once. An increase in the number of users will depend on how interesting these users find the site and their willingness to stay on the site, i.e., not to bounce [15]. This will have implications on whether they will encourage others to visit the site. Based on the arguments above, the following hypothesis is offered:

H2: Unique page views have a positive influence on bounce rate

3.3 Average Time on Page and Bounce Rate

The "average time on page" is a measure of the average length of time spent by users viewing a specific page or screen, or set of pages or screens [21, 29, 47]. At times, it might be difficult to measure average time on page. According to Kaushik [28], the measurement of average time on the page may be problematic when users walk away from their computers, close their web browsers or type in a URL for another site. Also,

a multitasking user who leaves the web page open in one browser or tab while using another may inflate the time on the page though not actively viewing that particular page [15]. Fagan [15] suggests that these problems arise because most analytics software calculates the time on page by subtracting the time a user visited one page on the website from the time they visited the next page on the same website. Therefore, this may lead to lack of accurate measurement of average time on page. Nevertheless, irrespective of the problem inherent in calculating average time on page, the proportion of people who leave the site immediately has implications on average time on page. In other words, low or high bounce rate has implications on average time on page. Hence, the following hypothesis was proposed based on the arguments mentioned above and explanations:

H3: Average time on page has a positive influence on bounce rate

3.4 Entrances and Bounce Rate

Teixeira [47] defines "entrances" as the number of visitor entries into website pages. Teixera defines bounce rate in terms of entrances when he suggests that bounce rate is calculated by dividing bounces into entrances. He gave this illustration: When a website has a 60% bounce rate, it means that 60% of entrances left the website from the same page they entered. In other words, users did not view another page. If the user visits another page or stays longer on a page which they have entered, this may indicate low bounce rate. Thus, bounce rate may be equal to the rate of entrances if the content of the website is not satisfactory or does not meet user's expectation. Based on this explanation, this research proposes the following hypothesis:

H4: Entrances have a positive influence on bounce rate

3.5 % Exit and Bounce Rate

"% Exit" is the percentage of exits from a website and is calculated by dividing exits into page views [45]. In other words, % exit = (number of exits) / (number of page views) for a page or set of pages [45, 29, 47]. This indicates the frequency users exit from a particular page or set of pages when they view the page(s) [29]. Teixeira [45] argues that the expectation would be that entrances equal 100%, therefore % exit will also be 100% because everyone who comes into a website is expected to leave the site. However, this is not the case. This is because the way Google Analytics calculates % exit involves exits being divided into page views, multiplying all by 100% [45]. This shows that the number of exits from a website will not be equal to the number of entrances for any given page, as not everyone will leave a website on the same page from which they entered it [45]. Thus, bounce rate has implications on whether the exit rate will be equal to entrances or not. In other words, the low bounce rate will indicate that the website is relevant to the users and thus lowering the % exit. The following hypothesis is proposed owing to the explanations above:

H5: % exit has a positive influence on bounce rate

3.6 Google Analytics Data

Most e-commerce firms are collecting Big Data using Google Analytics. Big Data is the process of gaining knowledge and insights from extremely large datasets to make better decisions/competitive advantage. For our study, we collected data using Google Analytics. Google Analytics is one of the leading free website services that helps to collect datasets and then provides a rich statistics reports relating to websites' traffics, performances, efficiency, and effectiveness. Google Analytics is a tool that can provide hourly, daily, weekly, monthly, and yearly data for all the indicators used to measure the quality of websites and webpages. For our study, we selected the daily data because Moral, Gonzalez, and Plaza [33] argue that the daily data is best for the continuous monitoring of websites quality, performance, effectiveness, and efficiency. Google Analytics have been applied to various website genres including tourism [36], medical [9, 31], and libraries [5,46].

Various Google Analytics' e-metrics as shown in Table 2 can be used to analyze the quality, effectiveness, and efficiency of websites

Table 2: Google Analytics' e-metrics

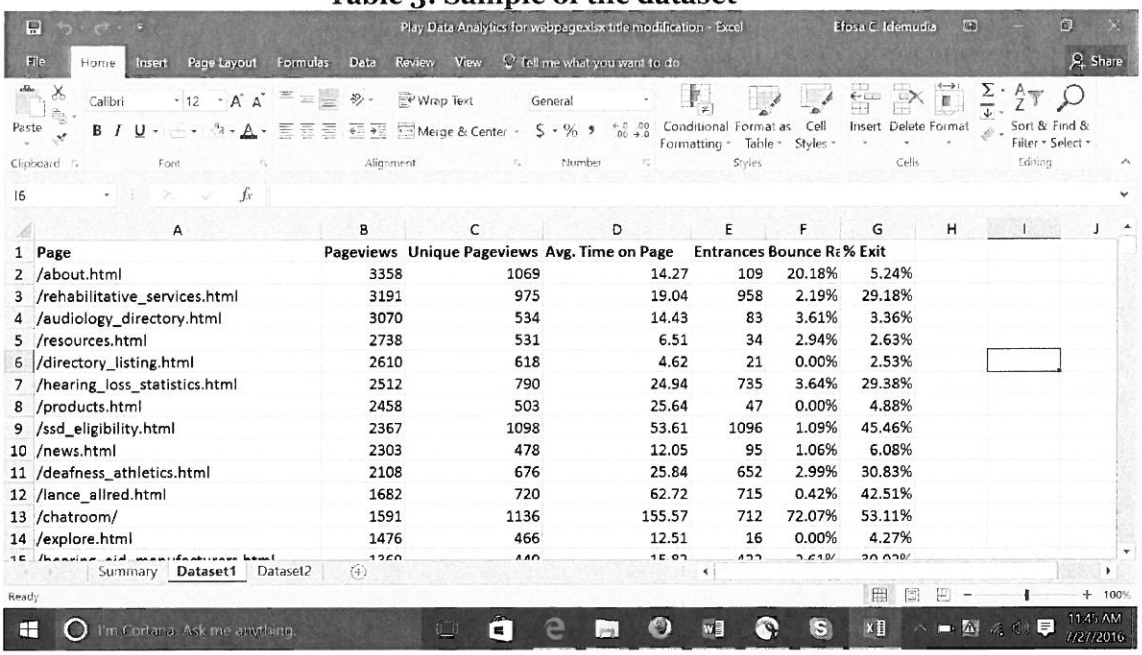
e-metrics	Definitions
Visits	The total number of websites that are visited by both web users and online visitors [33, 35, 36].

Pages per visit	The average number of pages that are visited by both web users and online visitors during a session [33, 35, 36].
Length of the visit	The average duration of web users' visit that is measured in minutes [33, 35, 36].
Bounce rate	The percentage of web users that leave websites from the entrance webpage [33, 35, 36].
Return rate	The percentage of visits by web users and online visitors who visited the website before [33, 35, 36].

4 Research Method and Data Analysis

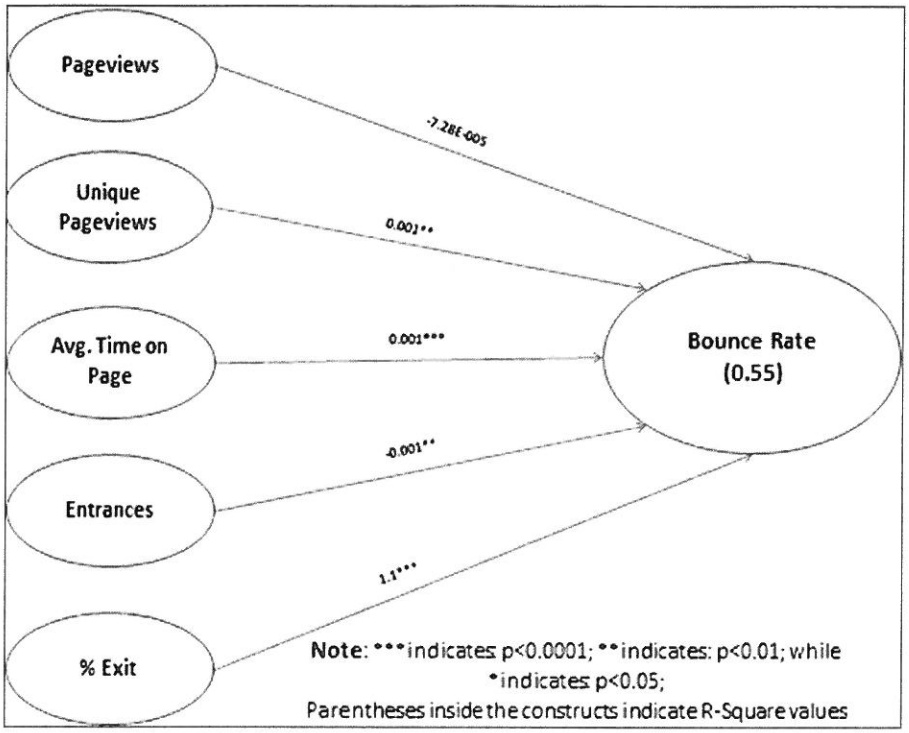
Most e-commerce firms are collecting Big Data using Google Analytics. Big Data is the process of gaining knowledge and insights from extremely large datasets to make better decisions/competitive advantage. The dataset for our study is provided to us by a small North American e-commerce firm that collected the data using Google Analytics and following these steps: (1) identify the issues or opportunities for data collection, (2) select the issues or opportunities for data collection, (3) set goals for data collection, (4) plan an approach and methods for data collection, (5) collect the data, (6) analyze and interpret the data, and (7) act on the results. It should be noted that the goal for our dataset by the e-commerce firm was to find the pages with the highest page views and events clicks so as to maximize advertising and set up the optimal pricing structure. The dataset collected include relevant factors that measure website effectiveness and efficiency as shown in *Table 3*. The dataset is extracted from Google Analytics, then inspected, cleaned, and transformed for relevant multiple regression analysis. It should be noted that the dataset for our study was collected from January 1, 2015, to October 21, 2015.

Table 3: Sample of the dataset



	A	B	C	D	E	F	G
1	Page	Pageviews	Unique Pageviews	Avg. Time on Page	Entrances	Bounce Ra	% Exit
2	/about.html	3358	1069	14.27	109	20.18%	5.24%
3	/rehabilitative_services.html	3191	975	19.04	958	2.19%	29.18%
4	/audiology_directory.html	3070	534	14.43	83	3.61%	3.36%
5	/resources.html	2738	531	6.51	34	2.94%	2.63%
6	/directory_listing.html	2610	618	4.62	21	0.00%	2.53%
7	/hearing_loss_statistics.html	2512	790	24.94	735	3.64%	29.38%
8	/products.html	2458	503	25.64	47	0.00%	4.88%
9	/ssd_eligibility.html	2367	1098	53.61	1096	1.09%	45.46%
10	/news.html	2303	478	12.05	95	1.06%	6.08%
11	/deafness_athletics.html	2108	676	25.84	652	2.99%	30.83%
12	/lance_allred.html	1682	720	62.72	715	0.42%	42.51%
13	/chatroom/	1591	1136	155.57	712	72.07%	53.11%
14	/explore.html	1476	466	12.51	16	0.00%	4.27%

Figure 3: Analysis with path coefficient and R-square



The tool we used for our multiple regression analysis is IBM SPSS Modeler as shown in Figure 2; and IBM is using IBM SPSS Modeler to process Big Data to gain insights and knowledge from Big Data to make better decisions/competitive advantage. Wang and Dinse [48] argue that multiple regression analysis is one of the most popular statistical tools that has been successfully applied in many disciplines and fields [7, 32]. To date, multiple regression models are widely used in business administration, economics, engineering, social, health, and biological sciences [34, 48]. Parvathi et al. [34] state that "Regression analysis is a methodology for analyzing phenomena in which a variable (output or response) depends on other variables called input (independent or explanatory) variables" (p. 216). Hence, in our study we used multiple regression analysis; and the result of our analysis is shown in Figures 3, 4, and 5.

Figure 2: IBM SPSS Modeler for Data Analysis of Big Data

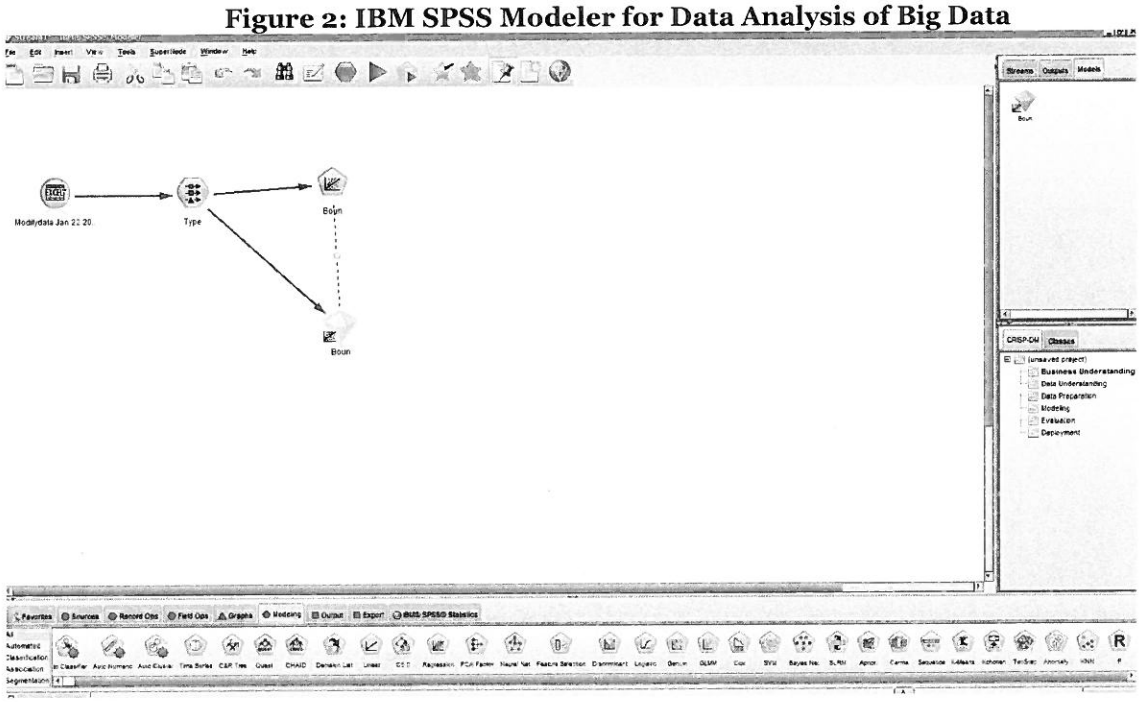
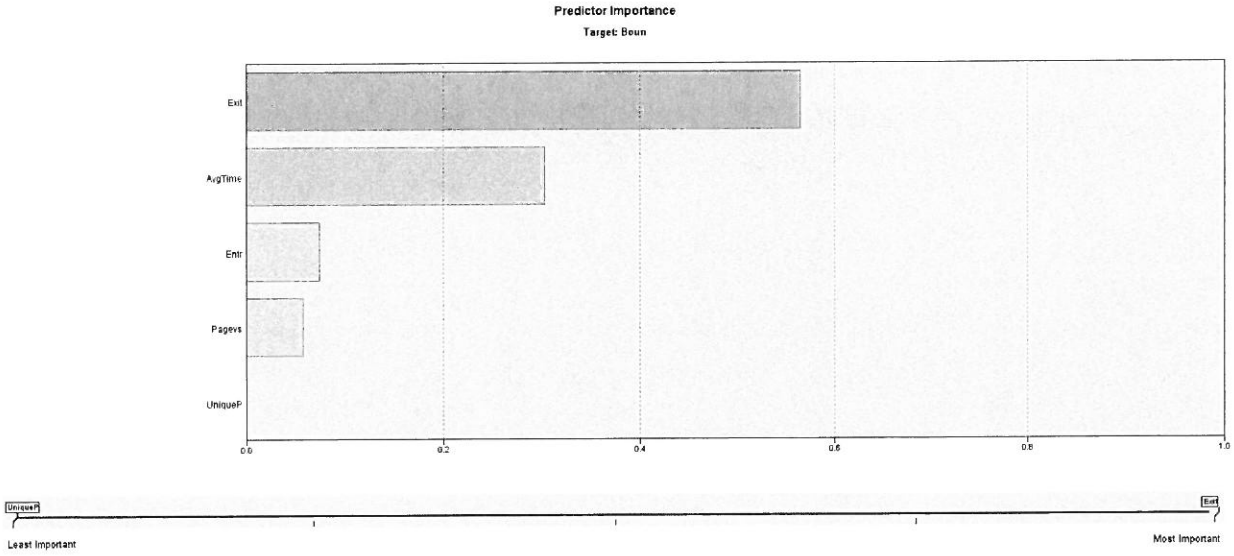


Figure 4: Predictor Importance



Notes: Variable legend:

Boun: Bounce Rate,
Exit: % Exit,
AvgTime: Avg.Time on Page,
Entr: Entrances,
Pagevs: Pageviews,
UniqueP: Unique Pageviews

Table 5: Regression Outputs

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.744(a)	.554	.550	.272722

a. Predictors: (Constant), Exit, Entr, AvgTime, Pagevs, UniqueP

ANOVA(a)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	50.332	5	10.066	135.342	.000(b)
	Residual	40.536	545	.074		
	Total	90.867	550			

a. Dependent Variable: Boun

b. Predictors: (Constant), Exit, Entr, AvgTime, Pagevs, UniqueP

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.231	.025		-9.298	.000
	Pagevs	-7.28E-005	.000	-.684	-1.441	.150
	UniqueP	.001	.000	2.372	2.900	.004
	AvgTime	.001	.000	.297	9.886	.000
	Entr	-.001	.000	-1.670	-3.425	.001
	Exit	1.053	.053	.607	19.755	.000

a. Dependent Variable: Boun

Notes: Variable legend:
Boun: Bounce Rate,
Exit: % Exit,
AvgTime: Avg.Time on Page,
Entr: Entrances,
Pagevs: Pageviews,
UniqueP: Unique Pageviews

5 Discussion of Key Findings

The analysis, as shown in Figure 2, indicates that pageviews, unique pageview, average time on page, entrances, and % exit explain 55% of webpage bounce rate. Pageviews (H1) has no significant effect on bounce rate. unique page views (H2), average time on page (H3), and % exit (H5) have a positive and significant effect on bounce Rate. Entrances has a negative and significant effect on bounce rate.

5.1 Implications for Research

Triggered by the increasing number of Internet users, the growing digitalization of physical information, and the web 2.0 phenomena, there is an exponential growth of data available on the web. The contributions of this study are significant because it combines our findings with data acquired via mash-ups or composed services, thereby adding value to the existing body of knowledge and more complex, individualized, and richer information is generated.

The limitations of this study are with respect to the scope of this study because the goal for our dataset was to find the pages with the highest page(s) views and events clicks in order to maximize advertising and set up an optimal pricing structure. Hence, generalizability is limited to websites similar to our dataset that include page(s) views, event clicks, and relevant factors designed to measure websites' effectiveness and efficiency. Although the dataset was extracted from Google Analytics, then inspected, cleaned, and transformed for relevant multiple regression analysis, a dataset with different demographic, psychographic, and geographic profiles, and analyzed using other qualitative and quantitative tools may have generated different results.

This study can also be expanded with datasets from big data, a term commonly used to refer to techniques and technologies that are capable of manipulating vast amounts of data (in the exabyte 10^{18} and zettabyte 10^{21} ranges). Normal software applications cannot function at that level; specialized tools are required. The Internet of Things (IoTs), is highly relevant to big data given the massive quantities of data generated. The class of data in social media analytics is often unstructured and publicly available from social media outlets using common measures and tools (e.g., Google Analytics). Due to the nature of the data in social media analytics, it is difficult to quantify and index for reuse. The postings are often context dependent, leading to rich information on a variety of topics.

Future research can explore the integration and composition of information services by adding semantics and context-sensitive searches to increase the amount of time a user spends online and enhance her/his experience with a website. In this growing data market, further research has also to be done on typical market structures; the players of the data market, including users, intermediates, and suppliers; the interactions of these players as well as their business models and strategies; and other inter- and intra-organizational questions that are relevant for an efficient production and usage of web-based information services. Finally, as suggested by Baird and Raghu [3], future research could examine digital services at an even more granular level by assessing perceived value at a feature level (i.e., which specific features do I find valuable?) rather than at a system level. The interactions between feature valuations and business model attribute valuations are likely to yield interesting insights.

5.2 Implications for Management

This research has implications for strategies of e-commerce companies as these organizations can utilize the opportunities Big Data presents by Google Analytics effectively to implement online strategies that produce the best return visits, session length and set targets. Based on the findings from this study, organizations that are using Google Analytics should implement the online strategies that produce the best return visits and session length. For example, new firms such as UpCouncil (sometimes called "Uber for Attorneys") and Realty Shack can maximize the value for its current and potential customers by focusing on their targeted needs and minimizing the bounce rate. Companies that are using Adwords should implement strategies to learn if the Adwords improve the quality of paid/search traffic compared to the unpaid traffic.

By associating consumers perceived value with business models for digital services, the findings by Baird and Rahu [3] indicate that the respective digital service model/s are likely to have a significant impact on the customer's perceived value, even though perceived value may be high for generally considered digital services. Similarly in this study, comparing and

contrasting mobile and social media platforms vs traditional personal computer platforms; or by comparing the consumption models among companies such as Zillow, Homesearch, and Trulia; or comparing latency measures (i.e., the time it takes a website to load) in competing digital delivery services (e.g., AT&T, Verizon, Charter Communications) could yield additional insights. Given that consumer choice is complex in digital markets characterized by many alternatives, research into how consumers perceive and value the underlying factors among such alternatives is paramount to our understanding of diffusion and adoption in this new area of consumer-oriented information systems. These considerations could help inform business strategists with a deeper understanding of the factors that influence website performance.

There are some caveats for managers/practitioners to consider. First, big data, knowledge management, and business intelligence continue to be emerging disciplines. Managers must continuously scan for new technologies. Second, making knowledge more visible is not always the objective. Managers should be cognizant of competitors seeking information on their business performance. Third, knowledge can be used to develop predictive models and develop future directions. Lastly, it is all about the people – the analysts with technical skills, the managers making better business decisions, and the employees collecting accurate data at the source. Knowledge sharing from the present research study or an expanded study that encompasses datasets from big data and social media analytics is critical to realizing value from these analyses and processes [37].

5.3 Conclusion

To stay competitive in today's highly interconnected economy, most companies must go beyond cost-cutting. They need to apply new technologies to be innovative in responding to the demands of a fast-moving, intensely competitive, global, digital economy. Technology advancements, combined with the evolution of our behavior and expectations, is affecting businesses, governments, education, and, well, just about everything. With the continuous growth of digitally-connected devices and tools enabling brands to connect with consumers and other devices (Internet of Things) in timely, relevant, and experiential ways, companies will have to empathize further with consumer wants, solving the challenges and issues for the digital customer at the time/location (physical location in the real world and/or virtual world) based on the customer's preference [43]. For management-level personnel charged with the goals of cost savings, reduced risk, improved operational efficiency, and increased revenue, what lies ahead is both a challenge and an opportunity. It is important to drive changes that are both externally focused (customer-facing) and internally focused (collaboration, process, technology, and so forth) to build a scalable infrastructure for the digital economy. For e-business intelligence (with elements that include reporting, querying, dashboards, and scorecards) and analytics to be institutionalized successfully, managers must create an environment that supports and encourages the use of performance data in decision making. The changing customer behavior/preferences, leads to a dynamic and volatile marketplace/marketspace. To lead effectively, it is critical to be proactive in understanding the what and the why of these changes. Technological innovations are rapidly incorporating near real-time data analysis, thereby improving decision making on dynamic performance data. However, an organization's only sustainable competitive advantage lies with how its employees apply their knowledge to business problems.

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IS LEAN THE PATH?

Indicate Submission Type: Completed Research Full Papers and Emergent Research Forum (ERF) Papers

Abstract (Required only in final camera ready version)

The Lean approach has been widely and successfully applied in the manufacturing, but it has been a challenge to transition this program into knowledge work-based operations. In our paper, we develop our research model that discuss and analyze the principles, challenges, and benefits of implementing the Lean strategy in knowledge work. Our paper answers questions about whether Lean is an applicable path to realizing the competitive business potential in knowledge work.

Keywords (Required)

KW-Knowledge Work, Lean software development (LSD), JIT-Just in time

Introduction

Lean management (sometimes called Lean) strategy is a concept that gained momentum and popularity in the 2000's. Most companies became aware of Lean given the acclaimed success that Toyota had with implementing it into their organization. Our paper examines whether Lean strategies can be used to gain competitiveness in knowledge work by examining a number of ideas such as: benefits and challenges of Lean, whether Lean can be adopted by industries that rely on knowledge work to gain a competitive advantage, and the leadership needed for successful implementation of Lean in knowledge work. Our paper helps reveal that Lean is not only geared towards manufacturing industries, but it can also be applied to various industries given that certain conditions are met. According to an article from the Harvard Business Review, the collection of ideas that are termed Lean are based on the following principles "relentless attention to detail, commitment to data-driven experimentation, and charging workers with the ongoing task of increasing efficiency and eliminating waste in their jobs" (Staats & Upton, 2011). The concepts of Lean as shown in our research model, Figure 1, can help businesses discover what customers find valuable. This knowledge then allows entities to improve and enhance their value creating processes by cutting out waste and perfecting operations, so that the service flows effectively and efficiently. (Elias, 2016).

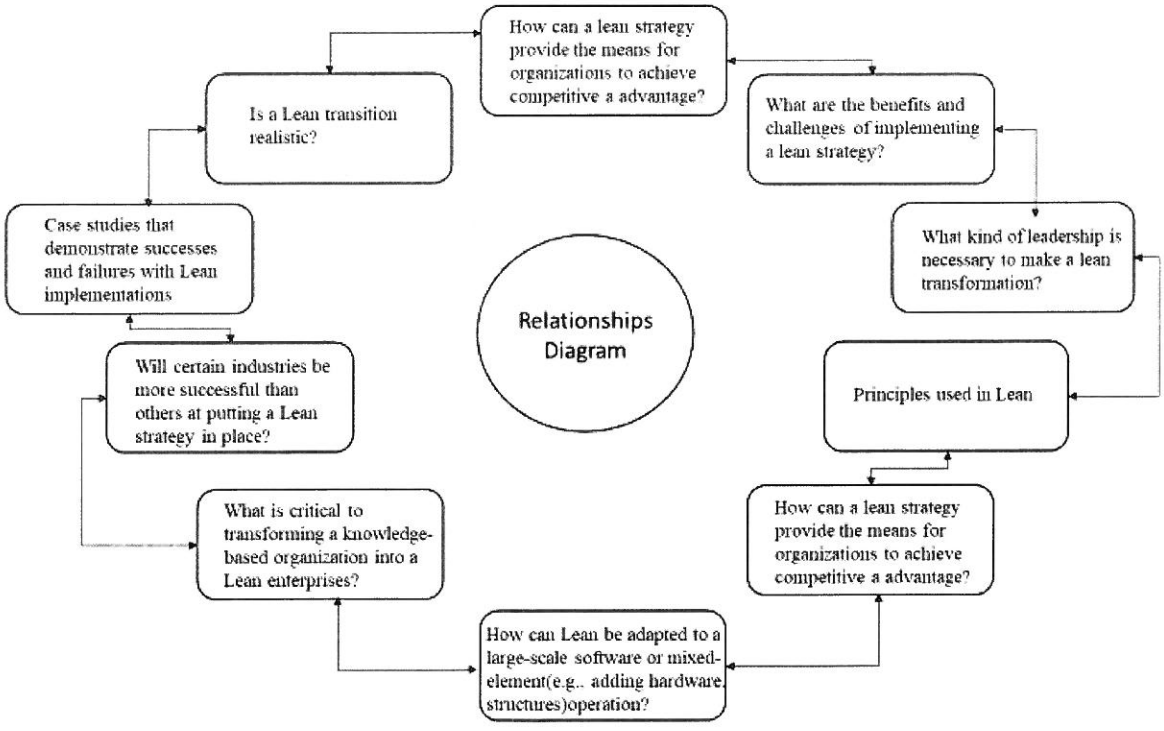

Figure 1. Relationships Diagram Model

How Can a Lean Strategy Provide the Means for Organizations to Achieve Competitive Advantage?

The efforts to apply Lean policies to knowledge work (KW) have been challenging for many companies. This is due to the belief that Lean principles cannot be applied to KW because it is not repetitive, and it is unequivocally defined. As a result, many people hold the belief that Lean is only conductive to manufacturing industries. A great example is given in an article on Lean knowledge work that gives this analogy "Consider a bank officer deciding whether to make a loan, an engineer developing a new product, and a social worker ruling on whether a child's environment is safe: In each instance the work involves expertise and judgment that depend heavily on tacit knowledge—knowledge locked inside the worker's head" (Staats & Upton, 2011). An article by Zeynep, Krogh and Nonaka also describe tacit knowledge as "knowledge that is tied to the senses, movement skills, physical experiences, intuition. (Zeynep, Krogh & Nonaka, 2008). This basically means that there is not a written process in KW which could mean that it would be difficult for a company in this industry to apply Lean concepts. However, research has revealed that jobs that require, and depend on, tacit knowledge can actually benefit from Lean. This is because most of the knowledge that is considered to be implied, can actually be expressed and documented on paper as long as a firm makes the effort to do so. "All knowledge work includes some activities that have nothing to do with applying judgment and can be streamlined by training employees to continually find and root out waste. Even when knowledge is genuinely tacit, creating systems and rules to guide workers' interactions can lead to more-effective collaboration". (Staats & Upton, 2011).

When Lean principles are applied correctly, companies can reap many benefits, those of which can lead to an advantage over competitors. A Lean strategy allows for innovation to take place in an organization, as well as- lower costs, improve work satisfaction, and increase response times. All of these benefits combined will help give a company competitive advantage over those that are not using the Lean principles. Ultimately, Lean gives a company the ability to improve and innovate faster than their competitors. When a company adopts Lean strategies, it removes complacency and forces the organization to not get too comfortable with their current successes. Rather, they are pushed to constantly come up with different strategies in order to adapt within the market. Lean policies can lead a company to be a market leader. The strategies can help a company by identifying efficiencies that allow a company to not only grow, but also to make it more attractive to investors. According to an article in the Industry Week, "Lean allows companies to better navigate the competitive life cycle as it provides time for planning so that companies can ride competitive waves rather than be thrown off course" (Boufis & Frigo, 2018).

What Are the Benefits and Challenges of Implementing a Lean Strategy?

There are many benefits to implementing a Lean strategy in a business. Many companies are adopting a Lean strategy in order to gain a competitive advantage. Although there are many benefits to putting Lean policies into effect, there are also challenges that a company will likely face during implementation, and sometimes even beyond that. For companies to be able to benefit from a Lean overhaul, they need to correctly identify and adapt the policies they wish to put into place. Otherwise, they will not reap any of the benefits that can come with implementing Lean. Both the benefits and challenges will be summarized in Figure 2 below.

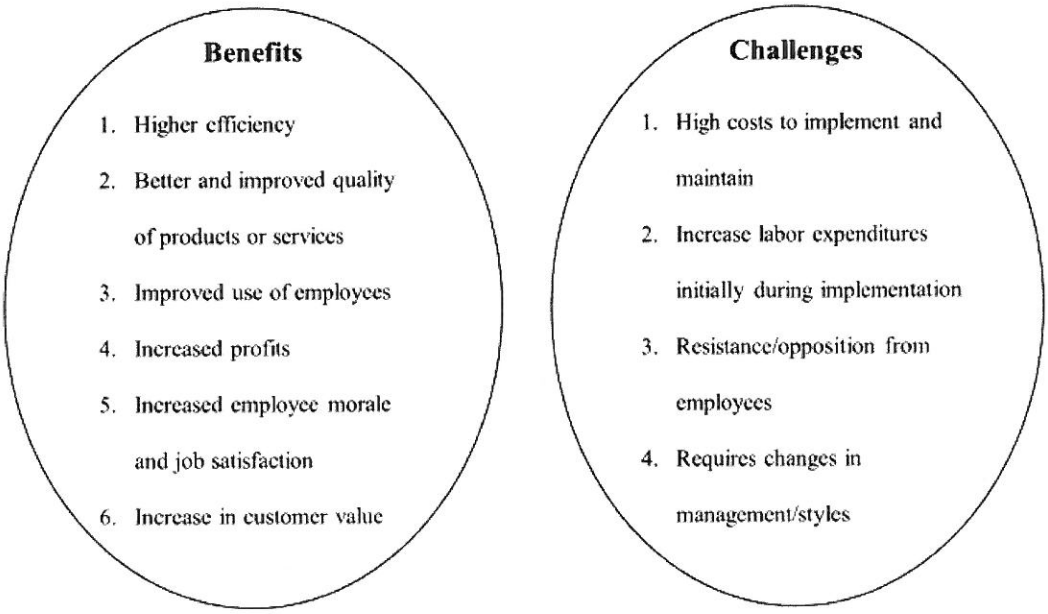

Figure 2. Benefits vs Challenges

One of the benefits of Lean is that it can lead to higher efficiency because it encourages the elimination of nonessential materials, processes, and manpower. Lean strategies remove tasks that are unnecessary and helps a company to implement a much more efficient approach. This in turn produces a direct improvement on work quality, and therefore adds value for the customer. Typically, in the area of knowledge work, there are many routine activities that do not require judgement or expertise. This can take up too much valuable time- e.g. printing documents, numerous transfers of calls etc. (Elias, 2016). However, workers that complete tasks that are not necessary do not have to be fired. Instead, they can be transferred to other departments where their work and knowledge can be better applied. As a result, there is a huge amount of unnecessary work that can eradicated from a knowledge work organization. Lean policies guide management to realize what areas that have excess waste and then can be eliminated. This eventually leads to improved efficiency (Elias, 2016). Lean tools and techniques also allow for improved customer experience and help with solutions to cut down on errors. Businesses can then become more cost effective. Ultimately, Lean can push a company towards better quality products and/or services. Lean policies can also assist in creating standardized processes that can eventually lead to improved employee morale. This spike in morale allows for a highly engaged and collaborative employee culture. It requires all individuals who are part of the organizational chain to be involved and engaged in the process by fully participating brainstorming ideas. This gives all employees an increased sense of purpose (Boufis & Frigo, 2018). This is important in knowledge work, which is usually prevalent in service-type industries. Therefore, if employee morale is high, they are more likely to be able to provide higher customer service to clients, which is ultimately beneficial to the company.

The main challenge in implementing Lean is that most companies assume that it is a one-time process that will be put in place and continue to work for many years to come. Realistically speaking, the Lean strategy requires maintenance; it is a continuous process. Companies need to be prepared to make changes regularly in order to strive for improvement. This is particularly difficult for companies that rely on knowledge work. These companies normally have a business

model that works and are rarely willing to change it. The book Journey to Lean: Making Operational Change Stick summarizes the Lean journey as follows: "The journey to Lean is not for the timid, and there are no stopping places along the way. You can't hope to reap half the benefits of Lean by being half-hearted. Making the transition is highly challenging and many fall by the wayside. You need to be completely committed before you set out," (McCullum, B. & Roggenhofer, S. 2004).

Another challenge companies may face in implementing Lean is that they will need to invest in technology and training of their staff (human knowledge). Some companies are not willing, or not financially able, to invest in. Implementing Lean policies can be very costly; it can require large capital investments in equipment, updating the production line, and proper training investments. Most of these costs must be incurred before a company can begin to enjoy the benefits of lean, which can take time to manifest.

Lean systems are knowledge intensive. To study and understand lean systems and concepts, employees need to be able to "think Lean" in all aspects. This is so they are equipped to effectively and efficiently respond to any possible changes. According to a case study on Wipro Technologies (one of the largest IT services and product Engineering companies in the world), when they decided to implement Lean, they quickly found out that even the consulting agencies had lacked relevant experience in transforming an IT company to become Lean. As a result, they had to educate themselves thoroughly about Lean processes and concepts, as well as come up with ideas to adapt those processes to software operations.

Implementing Lean can require a complete overhaul of a company's processes and when such drastic changes are made, often management and employees can be opposed to these changes. This can create tension and opposition. Some people are afraid of change and find it difficult to give up their old way of doing things. However, with proper communication and education, the worry and stress can be put at ease. Bicheno and Holweg (2009, 44) reviewed a survey conducted in 2007 on the leading one thousand Canadian manufacturing companies which showed that reverting to the old ways of doing things, and the lack of implementation knowledge were the greatest obstacles to Lean.

What Kind of Leadership is Necessary to Make a Lean Transformation?

It can be argued that leadership is one of the most essential ingredients to a successful Lean transformation. According to an article by John S. Hamalian, "research states that 46% of all improvement initiatives fail due to lack of leadership". He then goes on to mention the 6 key traits of a Lean leader which include: journey embracement, relentless pursuit of perfection, fanatical customer focus, being a champion of simplicity, living the Gemba style and being authentic, upstanding and respectful. (Hamalian, 2015).

To be successful with Lean, leaders need to be able to find out what the root cause of an issue is, instead of focusing on who is at fault or placing blame on individuals. The issues that arise should be treated as opportunities to improve on the process and not be used to place blame. Leaders also need to be open in terms of communication; this includes providing vital feedback to employees. When using Lean, performance measurement is important- employees will want their achievements noticed and praised. In the same token, the leaders should also be able to find the reasoning as to why a performance goal is not met. (Lean Solutions, n. d.)

According to an article written by Falvio Picci in the Lean Global Network Journal- the adoption of the Lean methodology in an organization calls for a number of radical changes, ranging from the way processes are run to the way people interact. As the driver of a transformation, it is a leader's responsibility to develop an ability to influence the mindsets and attitudes that will make change possible. (Picci, F, 2018)

Another article in the Industry Weekly, written by Lonnie Wilson, discusses 6 basic qualities of Lean leadership. These are as follows:

- Leaders as superior observers- Managers should be able to observe the whole process flow, from machines to people. Moreover, they need to interact with employees, so they can learn about what is working or not.
- Leaders as learners- Leaders adopting lean need to be open to learn from others and to continuously improve. Learning during Lean is an ongoing, never-ending process.
- Leaders as initiators- Leaders must be able to plan appropriately, make sure they communicate the plans, and most importantly act out the plans
- Leaders as teachers- Leaders are considered "lifelong teachers" whose main concerns is to get to the root cause of problems instead of placing blame or pointing fingers. Every issue is an opportunity to teach.
- Leaders as role models- Leaders need to be able to walk the walk. It has been reiterated that there is no substitute for this.

- Leaders as supporters- They must adopt the skill of servant leadership. They get the work done through others and they need to be humble to work well with others.

All in all, it is important to note that whatever management style is adopted during Lean, it must support the core of Lean- which is value creation.

Principles Used in Lean

Lean principles were derived from a method and strategy at Toyota to eliminate waste and inefficiency in its manufacturing operations. The process was very successful- so much so that it has transformed the world of knowledge work and management. Since then, it has been used in many manufacturing practices, as well as other industries. One such industry is healthcar, where it has been used to improve efficiency and reduce cost during patient care, as well as management of health information. It has even been implemented in smaller scale offices and laboratory organizing (Blijleven, Koelemeijer, & Jaspers, 2017). The five principles of Lean manufacturing are laid out in the book, Lean Thinking by James P. Womack and Daniel T. Jones, which can be applied to almost any industry (Figure 3) (Womack & Jones, 1997).

Value

Value can be defined as the benefit from a specific product that can be obtained. It could be measured in many ways, such as: how much the customers are willing to pay, the timeline for manufacturing and product delivery, and specific features on products or services. Understanding exactly what the customer demands, or the expectations they have, is what will determine how much cost and waste can be reduced. Finding this can help the product be delivered satisfactorily to the customers while still obtaining a profit.

Value Streams

The way to determine a value is to identify and map the value streams, which involves all the steps and activities that contribute to the values. Activities without contribution to the value of a product are considered wasteful. There are two categories of waste: one is non-value added but necessary waste, and the other is no-value and unnecessary waste (Do, 2017). The former won't create extra value but can't be eliminated because there are some limitations (such as a technical issue). This should be considered as an opportunity to improve in order to reduce the waste. The latter is considered as pure waste that should be eliminated (Do, 2017). The value stream mapping can be implemented in any step of the process in a business operation- from design, production, administration, to service. Value-stream mapping can be thought as kind of as a re-engineering process.

Flow

After the removal of waste, it is critical to make sure that the remaining steps can still run and interact smoothly. Maintaining smooth flow requires careful thinking and synchronization of each aspect in the entire operation. Breaking down Silo thinking, and cross-functional reconfiguration among departments, are possible strategies in creating Lean flow (Crawford, 2016).

Pull

Another big waste in most production systems is the inventory. The goal of the pull approach is to minimize standing inventory and in-process inventory (Do, 2017). Rather than making production based on forecast (or schedule) the pull approach allows for just-in-time delivery of products as needed. As a result, products only need to be made based on the quantity needed by customers and timed to meet their order placements. This will reduce the extra cost incurred due to stocking products in inventory that are not needed. A visualization tool like Kanban boards can help to manage each step in the flow to produce to meet customer's needs (Millard, 2016).

Perfection

The achievement of the above four Lean principles can prevent waste in business operation. However, the fifth principle in the pursuit of perfection is perhaps the most important. Lean is not a static system, and it requires constant efforts and continuous improvement to be close to perfect (Crawford, 2016). It is necessary to "think Lean," and for process improvement to be part of organizational culture. It requires every member's involvement to strive towards perfection in the implementation of a Lean system and product delivery.

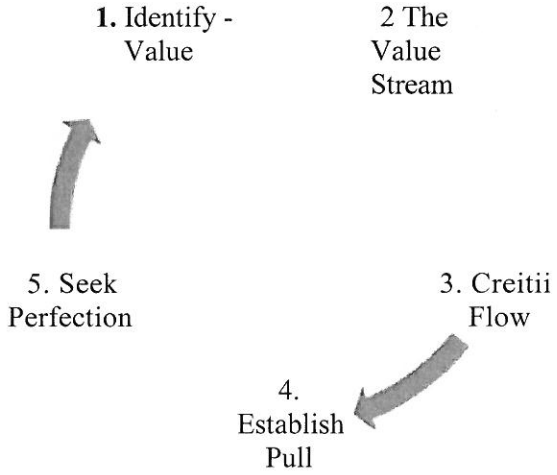

Figure 3. Principles of Lean (LEI, n.d.)

How Can Lean Be Adapted to a Large-scale Software or Mixed-element (e.g., Adding Hardware, Structures) Operation?

Lean adaption to a large-scale software operation

Every individual, or company, embarking on a Lean journey faces different challenges due to their particular set of circumstances. In large-scale software-based organizations, software constitutes a main part of the whole. The development and adaption of software, and software-intensive systems, at a large scale is the central architecture.

There are numerous software development methods existing for different reasons. The Agile development is one of the most recognized and applied conceptual framework, which includes many popular software development methodologies. Although the approach for each of the Agile methodologies is unique, they all have same set of core values and principles which refers to Agile Manifesto (Fichtner, 2012,). This emphasizes customer satisfaction as the highest priority by providing successful and frequent delivery of product. They accomplish this by applying fundamental iterations to minimize risk, and using "real-time feedback" and "face to face interaction" for effective communication. Continuous development and improvement on both projects and products are also part of their goals, however, the most important aspect is the encouragement of everyone's commitment to increase efficiency (Fichtner, 2012).

Lean software development (LSD) core principles are "1) Eliminate Waste, 2) Build Quality In, 3) Amplify learning, 4) Defer Commitment, 5) Deliver Fast, 6) Respect People, 7) Optimize the Whole" (Fichtner, 2012) (Pernstal, Feldt, & Gorschek, 2013). LSD is closely associated with the Agile software development. They share the same goal in developing software and software intensive systems, which aims to improve the activity in order to deliver high quality software faster by using fewer resources (Suomela, 2015). Although there are differences in the principles between Agile development and LSD, they overlap and complement each other. Agile method mainly focuses on activities for developing, while Lean principles can perform well in large-scale processes (Pernstal, Feldt, & Gorschek, 2013). Lean can be considered as a platform upon which Agile develops software practices.

Adaption of Lean in mix operation

It is not surprising to see successful Lean implementation in high volume and repetitive environment-based companies given its roots in manufacturing. The traditional methodology used in high volume manufacturing does not work well in high mix operations. For example, the Kanban card used in pulling schedules can be complicated in a high mix environment. This is due to variability in demands on inventory for each part that fluctuates over time. Based on the characters of a high-mix business, the Lean techniques can be successfully applied by focusing on the following: 1) changing the measurement of performance, 2) defining value streams and organizational structure in more flexible approaches by using flow path management method, utilizing alternate ways in inventory optimizing, capacity planning, and batch sizing (Invisticscorporation, 2004).

What is Critical to Transforming a Knowledge-based Organization Into a Lean Enterprise?

The Lean approach has been successfully adapted in manufacturing companies, while attempts to apply it to knowledge work can prove to be difficult. Unlike car assemblies in manufacturing, most people think that knowledge work is not repetitive and can be difficult to define. However, some knowledge can be captured and articulated in writing; and some activities can be streamlined through employees training that is focused on reducing waste. Even for the genuinely tacit knowledge, it is possible to create systems or rules in practice to improve effective collaboration. (Staats & Upton, 2011). So, it is reasonable to say that Lean approach can be applied to knowledge work in some forms to generate profits.

By extensive study on Wipro Technologies case, Bradley Staats and David M. Upton raised the six principles listed blow that can be applied in customizing Lean approaches in order to suit different knowledge-based organization (Staats & Upton, 2011).

Elimination of waste

There are many routine activities in knowledge work that are not related to judgment or expertise but can take huge amounts of resources and time. Finding the source of waste is not always easy. Instead of looking for large areas of waste, which have might have been eliminated by successful companies, encourage everyone to find small wastes that will improve overall effectiveness. Many knowledge works are unstructured and broad, so periodically reviewing the structure and content within every job can help prioritizing the tasks.

Specification of work

Clearly defining the substance of the work, and the expected outcomes, will provide significant value to the organization. By comparing the actual and expected output, an organization can figure out where the issue comes from and fix it. Knowledge work may change rapidly and can't be easily standardized, but the following four steps can be used to help specifyknowledge work: 1) Codify repeatable parts in a process, 2) Don't specify everything initially, 3) Use data to overcome resistance, 4) Check back to the work initially designated as tacit, which could be possible specified as situation change (Staats & Upton, 2011).

Standardization of communication

Some knowledge work requires teams to participate because of complexity. How to communicate effectively becomes crucial because of the involvement of multiple people. Who should be communicating needs to be defined, along with what information should be relayed and how often it should be reported. Information exchange, objectives and outputs of knowledge work are directly expressed without wasting time trying to figure out what the others want. Within the team communication, a shared understanding is required to eliminate any confusion that can be caused by cross cultural, linguistic or functional boundary (Staats & Upton, 2011). In knowledge work, some decisions are particularly arrived based on people's emotions versus facts, which could lead to waste or inefficiency. Standardizing the team's language would beneficial.

Efficiency in addressing problem

In adapting the scientific methods of Lean approach in knowledge setting, a few aspects are considered helpful. If a problem arises, whoever created the problem should be the person to fix it. It is ideal to solve the problems as soon as possible and at where they occur.

Preparation for incremental journey

Applying the Lean principles to a knowledge setting is not simple, and an organization may not get it right on the first try. It requires adjustment and continuous improvement over time. It is good to start small, then explore new ways to combine with the lessons learned, in order to find the suitable approaches.

Engagement of manger

Managers play an important support role in the long run, and they are critical in launching the process. A requirement for managers is the time they invest into the process. It is very much up to the managers to push the adaptation of the new approach in a team in most. Transformation into a Lean system requires a sustainable investment, new training and a change of culture.

Will Certain Industries be More Successful Than Others at Putting a Lean Strategy in Place?

When most people think of the Lean strategy, one brand name comes to mind- Toyota. This line of thinking helps draw the line from the Japanese auto manufacturer (who implemented the Lean Strategy over 25 years ago) to the car industry to manufacturing. This is where the Lean strategy has historically made the biggest waves. In fact, many in the car industry and other operations have copied the principles that Toyota has set in place to overhaul their company and make it into the widely successful business it is today. However, more and more other industries outside of manufacturing are starting to utilize the Lean methods. According to a Linkedln article by Mark Graban, "The core high-level Lean principles...are amazingly adaptable to different settings," (Graban, 2014). Various industries have been able to modify the Lean principles - from law firms to government agencies to healthcare. As a matter of fact, Graban formerly worked for General Motors, where they were "very clearly trying to directly copy Toyota in our attempts to close the big gaps that existed in quality and productivity measure," (Graban, 2014); but at the time the article was written, Graban was working in healthcare where he was also adhering to Lean principles. While strict Lean methods may fit better with industries like manufacturing; the strategies can be modified and molded to fit with almost any industry.

Case Studies That Demonstrate Successes and Failures With Lean Implementations

Many case studies have been done regarding the successes of Lean implementation. One such case regarding Wipro (an Indian Software company) highlights "how an organization learns through problem solving, coordination through connections and pathways, and standardization," (Staats & Upton, 2009). They were able to study how this company could adapt techniques that were traditionally made for implementation in manufacturing and use them in a way that makes sense for their industry. Software companies around the world have been able to utilize Lean strategies in a way that benefits them.

Another study that shows the impact of Lean implementation involves waste management in Brazil. The issue of waste management "is a major problem in most economically developing countries" such as Brazil (Tortorella et. Al., 2018). When introduced with Lean management theories, managers and developers in the industry were able to gain helpful information. However, the real improvements were brought about once they applied the methods and put them into practice. The use of lean management tools, especially value stream mapping, lead them to better processes and allowed them to "address improvement actions" (Tortorella et. Al., 2018).

Despite the many success stories that have come along with Lean, there can also be pitfalls. In a study done by Gorman, Hoff and Kinion, four case studies are reviewed. The companies involved in the studies were mainly interested in inventory reduction' and the failures they witnessed with their Lean implementations. The failures seen in the studies are not necessarily due to breakdowns in Lean policies, but rather in how they were put into place and a lack of focus on the whole picture. While focusing so intently on inventory reductions, these companies ended up with resulting problems- such as a drop-in customer satisfaction, delivery dates that were delayed or missed, and excessive overtime (Gorman, Hoff, & Kinion, 2009). According to the study, "If lean is not viewed strictly in terms of inventory reduction, but rather as removal of 'all waste in the process,' we suggest that the efficiency-enhancing recommendations in our case studies are indeed lean in their elimination of waste of other kinds, despite their recommendation to increase inventories," (Gorman, Hoff, & Kinion, 2009). In other words, just because a company might need to increase their inventory, does not also mean that they cannot reduce overall waste.

Is a Lean Transition Realistic?

A Lean transition is realistic, but it is not a decision that should come lightly. While companies can adapt the policies of Lean to fit their needs, it still requires a big change in the way they might have previously performed. Changes like this should be well thought out and evaluated for all possible outcomes. A program like Lean needs to be viewed as a bigger picture, so that one area is not focused on too much at the expensive of others. Implementation of Lean requires patience and full support from leadership. A company that is interested in Lean policies might need to draw out a plan for each phase and fully explain each step, as well as the overall desired outcome, to each team member. Gaining support and enthusiasm of employees could be key in making Lean implementation work.

Conclusion

In conclusion, there are many ways in which the Lean strategies can change the way a company operates for the good. A company that operates in knowledge work can take policies from Lean, which traditionally has been used in manufacturing companies, and use them to streamline their operations and eliminate unnecessary waste. There have been many articles written, and studies done, which highlight the positive ways in which Lean has transformed a company for the better. However, implementing these processes must be handled with care for a company to reap the full profits of the Lean program. When done properly, a Lean transition can have many benefits in an industry such as knowledge work.

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