

## A Survey on Big Data Analytics (BDA) Implementation and Practices in Medical Libraries of Punjab

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**Received:** March 18, 2023 **Accepted:** August 01, 2023 **Published:** September 17, 2023

**Abstract:** The purpose of this study is to evaluate the perception of medical librarians, their capabilities, and the organizational infrastructure of medical institute and teaching hospital libraries of the Punjab for the convincing implementation of Big Data Analytics (BDA). Among the major objectives of this study were to determine the perceived ease of use, perceived usefulness, behavioral intentions, BDA skills of librarians, current practices, and actual use of BDA in these medical libraries. Survey method was employed to collect data from 156 medical librarians. Collected data was analyzed through SEM-PLS. Results of the study revealed that all the hypotheses were significantly supported (except-H2 and H5). The study showed a positive impact of perceived ease of use on perceived usefulness. Similarly, PU has a significant positive impact on BI, skills and current practices. Furthermore, there is a significant positive relationship between BI and Skills, and between current practices and Performance / actual use.

**Keywords:** Big Data Analytics; BDA Implementation; Current Practice; Healthcare; Medical Institute libraries.

### 1. Introduction

The impact of Information Communication Technology (ICT) and digital emergence has led to the development of huge numbers of digital objects around the world [1]. There is an information flood and explosion in this digital era, as it is rightly reported that, due to the advancement in the internet, mobile technology, sensors and cloud computing data is being produced at an exponential rate [2]. Big data has been extensively discussed in various fields of life for the last two decades [3]. The term "Big Data" is defined as "high-volume, high-velocity, and/or high variety information assets that require innovative and cost-effective methods of information processing in order to facilitate decision making and automation processes" [4]. It is reported that the word "Big Data" was coined by Michael Cox and David Ellsworth at an IEEE conference in 1997 [5]. BD can be conceptualized in three ways: volume, velocity, and variety [6].

Several authors have pointed out that library data and big data are interconnected, for example increasing library materials/items contribute to big data [7]. The importance of BDA in library operations is also acknowledged by many library professionals [8]. By doing so, Ambigavathi and Sridharan [9] stated that BDA is bringing significant changes in the easy way to transform data into valuable insights. Primary responsibility of library professionals is to analyze the existing data of libraries for achieving and fulfilling the institutional strategic goals [10]. Herland [11], has suggested that new technologies should be applied to the health sector to reduce the gap between patients and doctors. By implementing modern technology in the health sector, patients will get proper treatment at minimal cost [12-14]. By medical libraries in province Punjab, we mean libraries located in medical institutions and teaching hospitals. Moreover, all the participated medical institutions are affiliated with the concerned Medical Universities and recognized by the Pakistan Medical Commission (PMC). There are 156 medical institutes and attached teaching hospitals

in Punjab [15]. Medical library users are life savers. They need the latest, accurate and relevant materials for the fulfillment of their daily information needs. With the help of BDA, medical librarians can provide information to the healthcare users according to their requirements in a very organized form [16]. Similarly, Islam, Liu [12], argued that it can also serve as a tool for providing information to health practitioners, educators, students, researchers, and paramedical staff in a more effective way. The major focus of this study is to determine the level of understandability, usability, and applicability of BDA in Punjab medical libraries. Efforts have also been made to identify the current practices, required skills, and capabilities of medical librarians of these institutions.

## 2. Research Objectives

The current study has the following research objectives:

- 1) To determine the degree to which medical librarians perceive the ease in the use of BDA in medical libraries of Punjab.
- 2) To know the perception of medical librarians about the usefulness of BDA to improve their job performance.
- 3) To know the Behavioral Intention (BI) of medical librarians of these institutions.
- 4) To determine the skills of these library professionals towards applying for BDA.
- 5) To explore the current practices of Big Data Analytics in these Medical Institutes.
- 6) To evaluate the performance of medical librarians.

In medical library, BDA is an effective tool used to manage past and present data for easy access and use. Using this study, we aim to determine the level of awareness, current skills, and capabilities of medical librarians at these institutions. Its findings will be a valuable resource for medical librarians, healthcare researchers, high ups of health departments, and policy makers associated with the medical field in Punjab, Pakistan. The implementation of these findings will help improve the existing situation of medical libraries. By providing the latest and required information to medical stakeholders, we can prevent diseases, thereby supporting the establishment of a healthy and prosperous Punjab.

## 3. Literature Review

According to pioneering studies, the concept of "Big Data" is not new; however, its definition is constantly changing due to the needs of the time. Once it was quoted that there are almost as many definitions of Big Data as the number of people you ask [17]. Various scientists have defined BD in various ways; Big Data (BD) can be defined as the collection of items whose size, velocity, kind, and complexity necessitate the adoption and discovery of new software and hardware setup in order to effectively analyze, store, and visualize the data [18]. Digital data in all formats and sizes, is growing at an astounding rate. The National Security Agency (NSA), reported that the internet is processing 1,826 Petabytes of data daily [19]. Xianju and Shufeng [20], BDA is a technology that processes vast amounts of data to meet some objectives, and it provides tremendous support for decision making, future predictions, and planning. According to Zhong, Huang [21], on a global scale, various social media applications such as Instagram, Twitter, Facebook, and Whatsapp generate 10-18 terabytes of data.

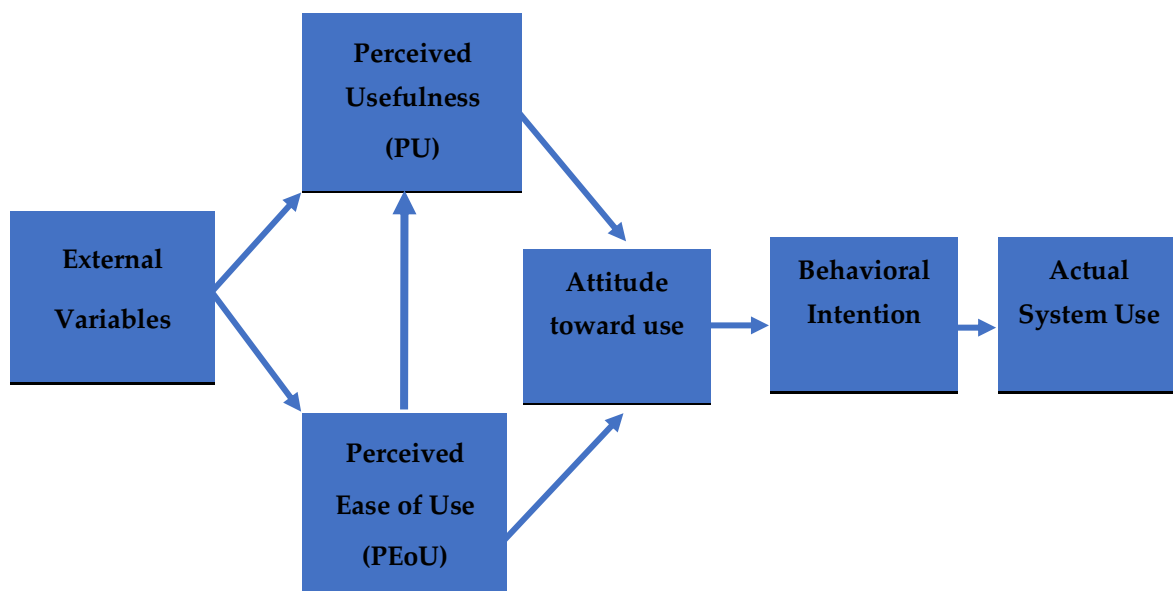
BDA refers to the technologies and techniques applied to search for, store, transmit, analyze, and visualize a massive amount of unstructured and structured data [22]. [23], has characterized BDA as a "holistic practice that comprises data collection, analysis, use, and its interpretation for a number of functional divisions for the purpose of achieving actionable insights, generating business value, and forming viable advantages". Currently, there are few examples of using Big Data Analytics in various businesses, firm performance and administration progression [24, 25]. Because of the differences between traditional data and big data, institutions and organizations have encountered numerous problems and challenges in BD management. In order to achieve maximum benefits and utilize this information, the organization will need to develop new algorithms and architecture for handling large amounts of data [26].

## 4. Theoretical Framework of the Study

Theoretical framework is the development of existing theory from previous relevant literature which have already been used, tested, and published by other researchers [27, 28].

[29] Swanson and Chermack [30], rightly said that “The theoretical framework is a tool that can support or backing a model / theory of a research work”.

The TAM is considered a theoretical framework for the current study which is widely used in elucidating a person’s perception about the acceptance of a modern information system [31, 32]. Many researchers have developed various theories and models to explain users’ perceptions about the acceptance of modern technology in their work - stations. Among these are; the Theory of Reasoned Action (TRA) by [33], the TAM by [34], Combined TAM & TPB by [35], the theory of Planned Behavior, Model of PC Utilization (MPCU) by [36], the Social Cognitive Theory, the Motivational Model by [37], the Information System Success Model, the innovation diffusion theory and the Unified Theory of Technology Acceptance and Use of Technology (UTAUT) etc. Technology Acceptance Model (TAM), information system (IS) theory denotes user’s approval and make use of modern technology [38]. Shahbaz, Gao [39], reported that main constructs of the TAM and Task-technology models enormously contributed to the enrichment of Behavioral Intentions to utilize the BDA in the health system. TAM adopts the Reasoned Action Model developed by Ajzen [33]. The extended form of TAM is the Unified Theory of Acceptance and Use of Technology (UTAUT). TAM indicates the adopter’s perception of the IT system’s usefulness and ease of use to decide the user’s approach about the adoption of a modern technology [34].



**Figure 1.** Technology Acceptance Model (TAM)

TAM is based on two main external factors, namely Perceived usefulness (PU) and Perceived Ease of Use (PEoU). PU denotes the future possibility that an organization's performance and outcomes can be improved by implementing a specific information system. The second factor of TAM is PEoU, which indicates that the adopter of an information system believes that it will not require any additional effort to run [40]. Perceived usefulness (PU) has direct relationship with intentions and attitudes, similarly, PEoU has impact on PU [41]. Keeping in view the importance and a unique role among the technology acceptance models, the study in hand will be based on TAM which is given in Figure 1. TAM has its roots in Theory of Reasoned Action (TRA) [42]. It indicates that an individual’s adoption of a particular technology depends on his belief on the following two variables i.e. PU and PEoU. As Davis [37], articulated that, Technology Acceptable Model (TAM) is precisely meant to elucidate technology adopted behavior. Keeping in view the original TAM as given in Figure 1. It assumes that a person’s acceptance of an information system is directly subject to his or her intention, which is later subjected to Attitude towards actual Use.

## 5. Conceptual Framework

Based on the reviewed literature and study of different theories and models about the technology acceptance model, the researcher has developed the following conceptual model and hypotheses.

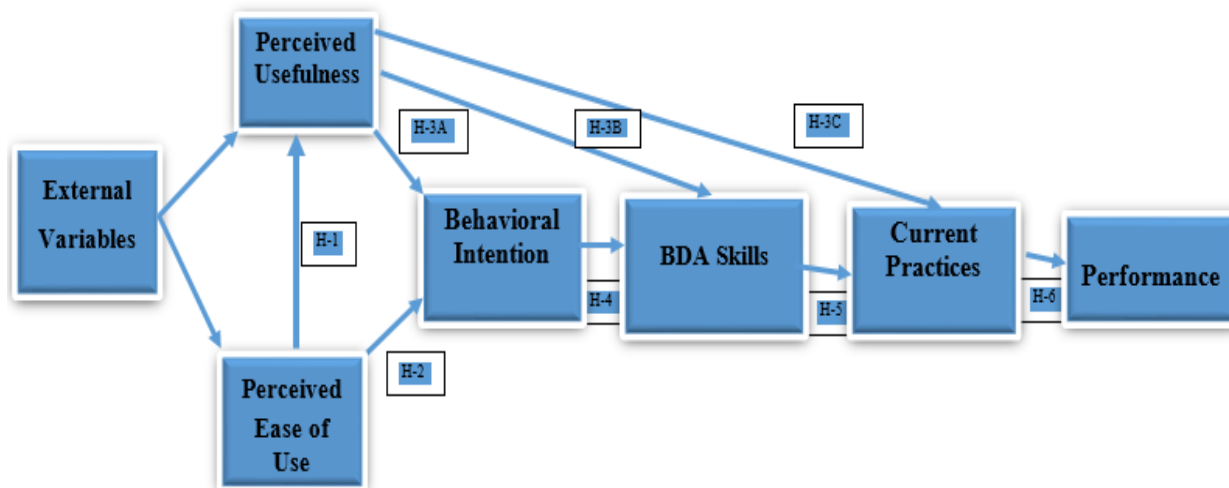


Figure 2. Conceptual Model proposed by author

#### I. Perceived Ease of Use (PEoU).

Different researchers have defined ease of use as the degree to which an individual considers that the application of a particular information system will be free of exertion [34]. Organizational performance can be enhanced with the help of easy and effortless processes [43]. Davis [34], has also defined the Perceived Ease of Use as “the degree of ease involved when using an information system.” Likewise, Soon, Lee [44] explained that ease in utilizing the new technology would pave the ways for users to accept the same. Using an information system free of effort will increase the organizational performance [45, 46]. Shin and Bohlin [47] Described that BDA possibly produce benefits for various types of organizations, consisting of cutting costs, managing and controlling risk factors & facilitating the process of informed decisions.

H1: There is a positive relationship of perceived ease of use and perceived usefulness.

H2: There is a positive impact of Perceived Ease of Use (PEoU) on Behavioral Intention (BI).

#### II. Perceived Usefulness (PU):

PU is one of the external factors of TAM. PU is the extent to which a person considers that utilizing modern technology would enhance his job performance [37, 48]. Wu, Li [49], stated that PU is a basic motivator and the most frequently used variable for technology adoption. Similarly, PU can be explained that whether a person considers that by utilizing the modern system his job performance will be enhanced [45]. According to the reviewed literature, there is a positive significant impacts of PU on BI, BDA skills, and current practices. [50], [38], [51]. Similarly, the PU influences the skills and work experience in an accounting virtual learning environment [52]. Based on the reviewed literature the following hypotheses were developed;

H3A: There is a significant positive impact of PU on BI.

H3B: PU has a positive impact on BDA Skills

H3C: There is a positive relationship between PU and Current Practices of BDA.

#### III. Behavioral Intention (BI):

Behavioral Intention (BI) means the level to which a person has developed conscious plans to perform or not to perform some specified future behavior [53]. Esteves and Curto [54], explained that BI intends to attain some definite future behavior. The reviewed literature has produced evidences of a positive relationship between PU with BI which has been found and measured in different fields [51],[50].

H4: There is a positive relationship between BI and BDA skills.

#### IV. BDA Skills of Medical Librarians

Capabilities and skills are two main components for achieving the goals of perceived usefulness (PU) [55]. Ullah and Anwar [56], rightly reported that skills and awareness of modern technology are now essential for library professionals to provide required information to their users in minimal time. Ahmad, JianMing [1], articulated that there is a strong correlation between the competencies of library professionals and the required skills for applying BDA in these academic library centers.

H5: There is a positive relationship between BDA skills and current practices of BDA in medical libraries.

## V. Current Practices of BDA in Libraries

Islam, Ahmad [10], described that the concept of BDA is a supportive tool for upgrading libraries and its infrastructure to deliver better services to library centers and community patrons. The identification of current practices of BDA in the medical institute libraries is necessary to achieve the determinant of perceived usefulness. A positive impact of BDA skills on current practices was found in some studies [57]. Therefore, it is hypothesized that:

H6: There is a strong relationship of current practices and performance/actual use.

## 6. Materials and Methods

For this study, the researchers used mono method i.e. quantitative survey. The list of the medical institutes and attached teaching hospital was acquired from official site of Pakistan Medical Commission (PMC) ([www.pmdc.gov.pk](http://www.pmdc.gov.pk)). The data collection tool was developed based on the current literature in the same area. Respondents of the study were medical librarians of these registered medical institutes and attached teaching hospitals of Punjab province. Prior permission was obtained from the respondents. The data was collected through structured questionnaire from the medical librarians of the Province Punjab, Pakistan (N=156). Out of total 156, 145 responses were received. The collected data was analyzed through SEM-PLS for measurement model and testing hypotheses.

## 7. Results

### I. Measurement model (Convergent Validity and Discriminant Validity)

Table 1 presents the results of measurement model. Which includes cross loading of the items of each construct, weight of each item, Cronbach's Alpha value, Composite Reliability (CR), and Average Variance Extracted (AVE) of the determinants of model. Test results of the measurement model indicated that the tool was statistically meeting their critical values therefore, it is a valid & reliable one. Consequently, it can be used to collect data from the study's targeted Population [58]. Figure 3 shows the measurement model of the study.

### II. Structural model and Testing of Hypotheses:

Non parametric bootstrapping method was applied for path coefficients in structural model as shown in Table 2. "P" and "T" values were examined during the analysis. It was observed that perceived ease of use has significant effect on perceived usefulness as p-value is  $0.00 < 0.05$  at 95% significant level and T-value is  $4.782 > 1.96$  (H1 supported). Perceived ease of use did not impact behavioral intention as p-values is  $0.246 > 0.05$  at 95% significant level and T-Value is  $1.160 < 1.96$  (H2 not supported). Similarly, perceived usefulness has a positive impact on behavioral intention as P-value is  $0.00 < 0.05$  at 95% significant level and T-value is  $18.862 > 1.96$  (H3A Supported). Perceived usefulness has strong relationship with skills as p-value is  $0.000 < 0.05$  at 95% significant level and T-Value is  $4.072 < 1.96$  (H3B supported). Furthermore, there is positive relationship between perceived usefulness and current practices as p-value is  $0.00 < 0.05$  at 95% significant level and T-value is  $4.341 > 1.96$  (H3C Supported). As far as H4 is concerned, there is positive impact of behavioral intention on skills as p-value  $0.00 < 0.05$  at 95% significant level and T-value is  $4.622 > 1.96$  (H4 Supported). In case of H5, there is no positive impact of BDA skills on current practices as p-value is  $0.097 > 0.05$  at 95% significant level and T-value is  $1.662 > 1.96$  (H5 not supported). Finally, current practices positively impacts the performances as p-value is  $0.00 < 0.05$  at 95% significant level and T-value is  $11.922 > 1.96$  (H6 supported) [59] as shown in Figure 4.

### III. The R – Square Value

In Table 3, the R-square values give the predictive power of dependent variables and shows the percent (%) of variance explained by a particular variable or variables. The R-square values were perceived usefulness (0.184), behavioral intention (0.715), skills (0.689), current practices (0.472), and performance (0.483). The behavioral intention can be explained to 71 % and current practices 47% by the variable considered. Furthermore, the R-square values of perceived usefulness, performance and skills can be respectively explained as (18 %), (48 %) and (68%).

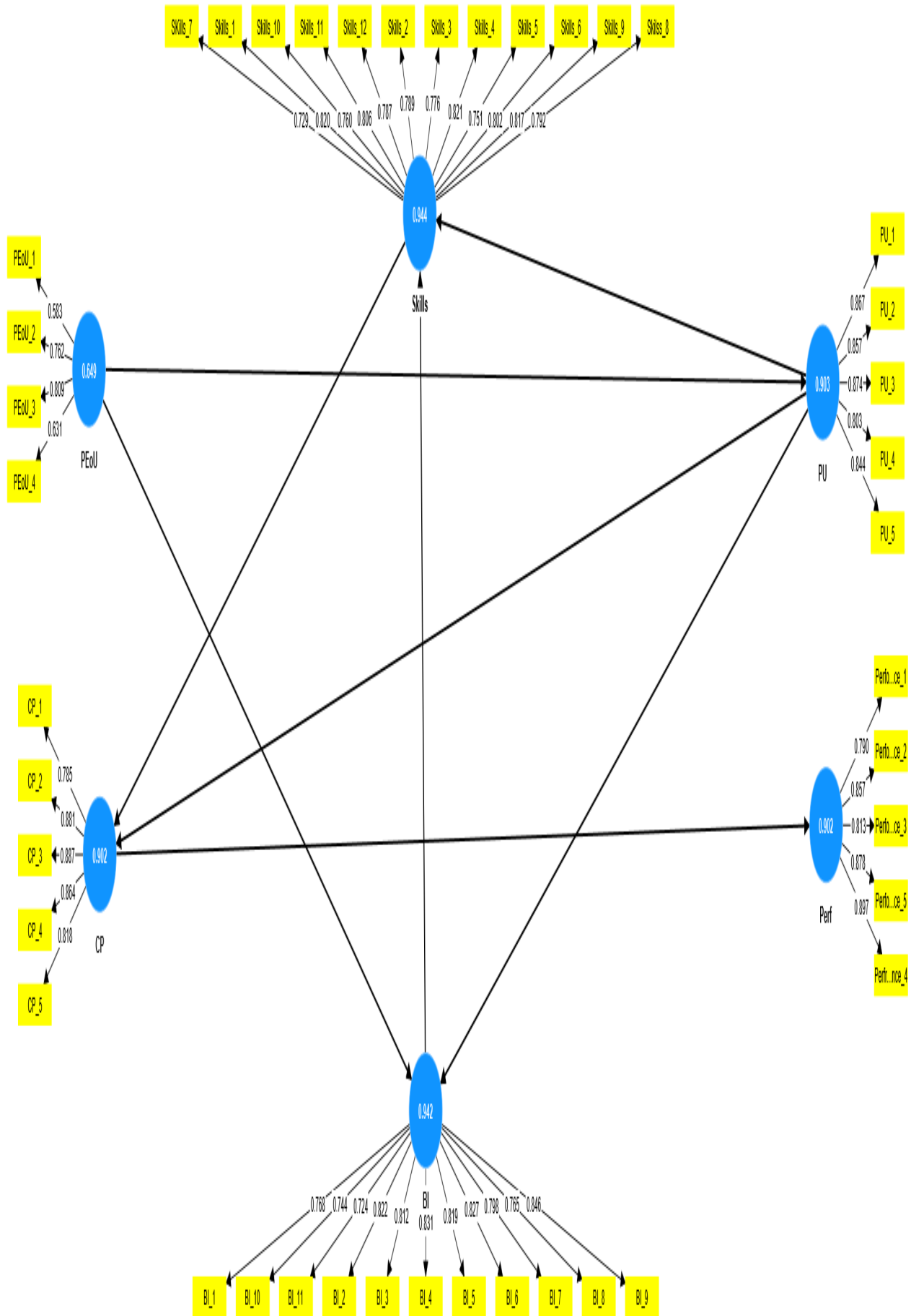


Figure 3. Measurement Model

Table 1. Measurement Model

Constructs	Items	Loadings	Weights	C. Alpha	CR	AVE
Perceived Ease of Use (PEoU)	PEoU_1	0.583	0.322	0.649	0.793	0.493
	PEoU_2	0.762	0.308			
	PEoU_3	0.809	0.438			
	PEoU_4	0.631	0.355			
Perceived Usefulness (PU)	PU_1	0.867	0.236	0.903	0.928	0.722
	PU_2	0.857	0.231			
	PU_3	0.874	0.251			
	PU_4	0.803	0.216			
	PU_5	0.844	0.242			
Behavioral Intention (BI)	BI_1	0.768	0.104	0.942	0.950	0.635
	BI_2	0.822	0.119			
	BI_3	0.812	0.128			
	BI_4	0.831	0.118			
	BI_5	0.819	0.118			
	BI_6	0.827	0.114			
	BI_7	0.798	0.114			
	BI_8	0.765	0.109			
	BI_9	0.846	0.120			
	BI_10	0.744	0.109			
	BI_11	0.724	0.100			
Skills	Skills_1	0.820	0.106	0.944	0.952	0.621
	Skills_2	0.789	0.110			
	Skills_3	0.776	0.114			
	Skills_4	0.821	0.104			
	Skills_5	0.751	0.107			
	Skills_6	0.802	0.114			
	Skills_7	0.729	0.104			
	Skills_8	0.792	0.102			
	Skills_9	0.817	0.108			
	Skills_10	0.760	0.099			
	Skills_11	0.806	0.099			
	Skills_12	0.787	0.102			
Current Practices (CP)	CP_1	0.785	0.219	0.902	0.927	0.719
	CP_2	0.881	0.267			
	CP_3	0.887	0.237			
	CP_4	0.864	0.234			
	CP_5	0.818	0.220			

	Performance_1	0.790	0.218			
	Performance_2	0.857	0.231			
Performance/ Actual Use	Performance_3	0.813	0.212	0.902	0.927	0.719
	Performance_4	0.878	0.249			
	Performance_5	0.897	0.267			

Note: BI= Behavioral Intention, CP= Current Practices, PEOU= Perceived Ease of Use, PU= Perceived Usefulness, Performance= performance/ Actual Use, Skill= BDA skills.

**Table 2.** Path Coefficient for Direct Effect

Hypotheses	Paths	T values	P values	Results
H1	PEoU -> PU	4.782	0.000	Significant
H2	PEoU -> BI	1.160	0.246	In-Significant
H3A	PU -> BI	18.862	0.000	Significant
H3B	PU -> Skills	4.072	0.000	Significant
H3C	PU -> CP	4.341	0.000	Significant
H4	BI -> Skills	4.622	0.000	Significant
H5	Skills -> CP	1.662	0.097	In-Significant
H6	CP-> Perform.	11.922	0.000	Significant

Note: BI= Behavioral Intention, CP= Current Practices, PEOU= Perceived Ease of Use, PU= Perceived Usefulness, Performance= performance/ Actual Use, Skill= BDA skills. Threshold values. \*\*p < 0.05, \*T > 1.96

**Table 3.** R- Square Values

Constructs	R Square	R Square Adjusted
PU	0.184	0.315
BI	0.715	0.697
Skills	0.689	0.675
CP	0.472	0.494
Performance	0.483	0.522

Note: BI= Behavioral Intention, CP= Current Practices, PEOU= Perceived Ease of Use, PU= Perceived Usefulness, Performance= performance/ Actual Use, Skill= BDA skills



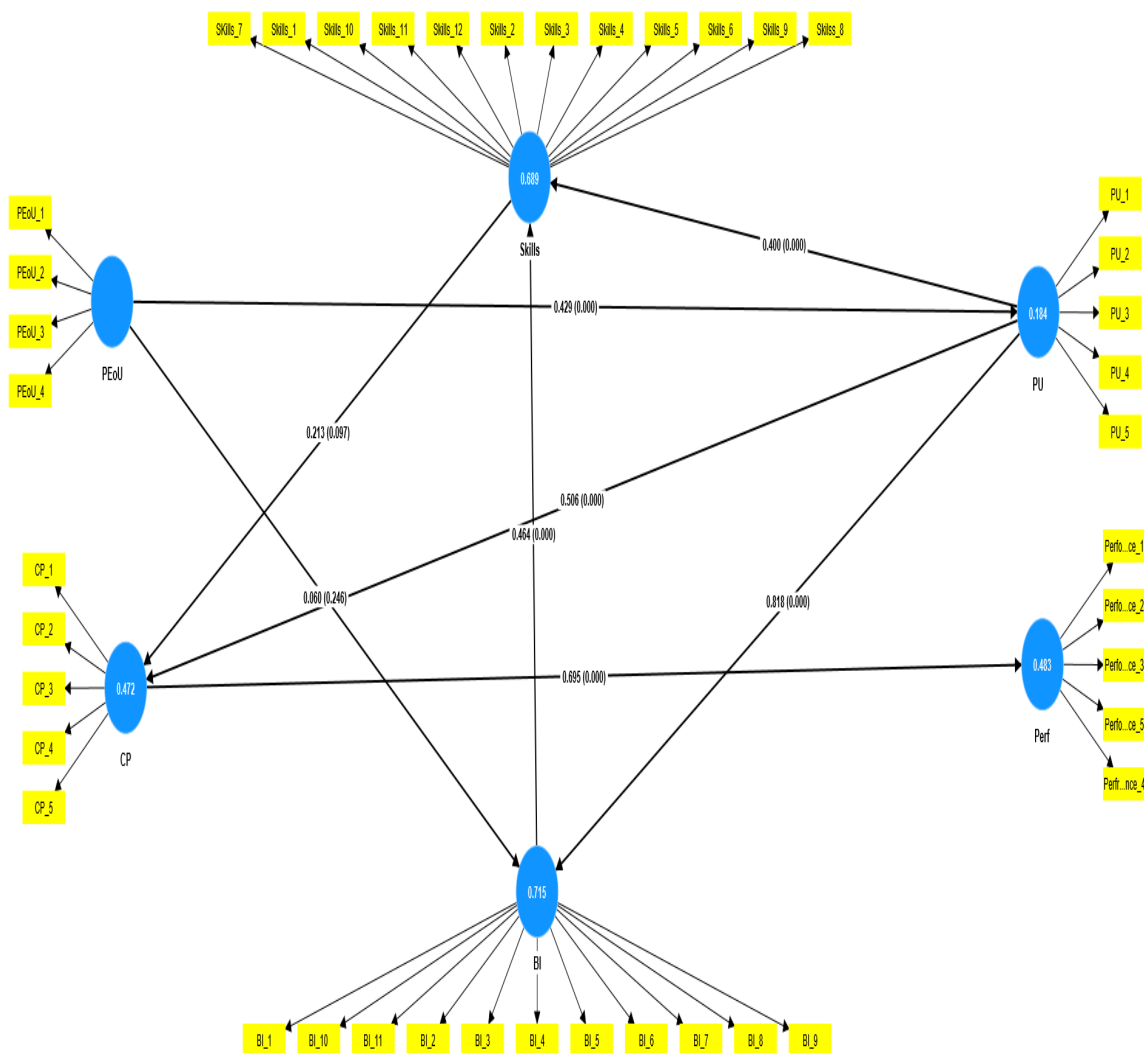


Figure 4. Structural Model

## 8. Discussions

The Importance of Big Data analytics implementation in healthcare units and in medical institute's libraries are increasing day by day [9]. As compare to the role of the past librarians, the current library professionals have many challenges to face. Now they are working in digital era, they are supposed to act like data scientist, data curators, and digital service provider [1]. The study in hand deals with an emergent phenomenon, and fills a research gap in the sphere of implementation and practices of modern technology in shape of BDA in the area of medical institutes and teaching hospitals of the province Punjab. This research will contribute a lot to bring awareness and provide a guide line to medical librarians and policy makers to implement this technology in their concerned medical libraries. Furthermore, the current study has provided a complete authentic model for the purpose to examine the intentions of the people in various fields about the adoption of BDA technology. More generally, this study contributes a lot to the existing studies in the area of BDA implementation and practices. This study has alluded the current situation of the implementation and practice of BDA in medical libraries and also pointed out the loop holes and hurdles in the smooth application of BDA.

In this research, the researchers first tested the data collection tool through the Structural Equation Modeling (SEM) measurement model using Smart – PLS – 04 [60]. The result showed an excellent validity and reliability of the instrument. Both the convergent and discriminant validity were tested and proved excellent. Table 1. provides the values of the validity and reliability of the tool, which meet the required criterion in all aspects [61]. The results showed that most of the medical librarians performed BDA practices but in a disorganized form. Core reasons for these jumble practices were lack of knowledge and skills, non-availability of the modern equipment, administrative issues and few other reasons. There were total 6 main

latent variables, namely, PEOU, PU, BI, Skills, Current Practices and Performance /Actual Use. Table 2 shows all the measured / latent variables of the study in hand. TAM was used as base for the current study [46]. The same was modified and add some new variables to the model with the help of literature in the field of BDA as given in Figure.2.

The researchers also went through the structure model of the SEM to examine the impact and relationship of few variables on others, which detail is given in Table. 2. For the said purpose, 8 hypotheses were developed and tested. The result showed that there is positive Impact of PEOU on PU. Which has a similar result of the study conducted by Nnaji, Okpala [62] on adoption of modern technology. It indicated that medical librarians perceived that use of BDA is an easy task and will be helpful to enhance the standard of work at their libraries. The policy makers of health department and administration of these medical institutes must encourage these medical librarians and extend all the facilities in this regard. PEOU has less impact on the BI as P-value of the said hypothesis does not meet the required criterion [63] as shown in Table 2. It indicates that the perception of medical library practitioners about the ease of use does not affect their behavioral intention towards the implementation of BDA in these medical libraries. Result of the study conducted on adoption of Wearable Sensing Devices (WSDs) is adverse to the current study where the PEOU has significantly positive effect on BI [62].

Furthermore, the structure model also indicated that PU has positive impact on BI as its P and T values meets the threshold values. In similar studies conducted by [34], [38] and [64], the same result were observed in the adoption and implementation of modern technology. These medical institutes and teaching hospitals should sensitize their medical librarians regarding the benefits of these modern technologies to ensure that they will adopt this modern information system. Similarly, PU influenced the skills of these medical library professionals as proved by structural model of SEM by meeting the required criterion. This demonstrated that PU and BDA skills are correlated and skills of medical library practitioner is strong predictors for the adoption of BDA in these medical institutes. The same relationship was reported in yet another study where the PU has influenced both the skills and work experience too [52]. PU has significantly positive relationship with CP. The P and T values ( $P=0.000$ ,  $T=4.341$ ) of the structural model showed the result which met the required criterion. In yet another study, conducted on PU, PEOU, and User Acceptance of IT has the same result [34]. Moreover, it indicates that the current practices are performing its vital role to compel these medical librarians to adopt this new information technology. In the same vein, The BI has a strong positive impact on skills ( $P=0.000$ ,  $T=4.622$ ). The result indicated that the BI is a strong predictor of BDA skills as compare to PU. It is obvious from the analysis that the behavioral intention of adoption of BDA in these institutes has strong correlation with the BDA skills of these medical library practitioners. The same impact can be found in yet another study where a strong positive impact of BI on skills has found [65].

The analysis also showed that BDA Skills have less impact on current practices (CP) ( $P=0.097$ ,  $T=1.662$ ). It can be elaborated that the BDA skills of these medical librarians is not a good predictor for the implementation and practices of BDA in these information centers. Findings of the current study are in adverse with a study conducted by Richards [57] where a positive impact of skills on current practices was found. The study in hand also propagated that there is a strong positive impact of current practices on performance/ actual use. According to the coefficient analysis with  $P=0.000$  and  $T=11.922$  as given in table 2, the current practice (CP) is a strong predictor for the actual use of modern information system. The administration of these medical institutes should concentrate on the current practices of BDA and provide facilities to improve the standard of these practices as they will pave the ways for the smooth implementation of BDA technology in these institutes and teaching hospitals' libraries.

## 9. Conclusion

The significance of BDA has been recognized in many fields of life including commerce, enterprises, business, government agencies, healthcare units, libraries and information centers [22]. Based on reviewed literature and analysis of the collected data, it is obvious that the implementation and practices of BDA in medical and teaching hospital libraries are the need of the time. The health department and administration of medical institutes and teaching hospitals should play their vital role to provide all kinds of infrastructure, training of BDA technologies and eradicate all the barriers faced by the library practitioners of these institutions for the smooth implementation of this new information technology. BDA practices in these

medical institutions can enhance the usefulness of the library services which will result in the provision of best services to the life savers and other library users [5]. The application of Structural Equation Modeling (SEM) and Hypothesis testing proved that there is a favorable environment in the libraries of medical institutes and attached teaching hospitals of Punjab for the implementation and practices of BDA technologies. Furthermore, the behavioral intention of the library professionals of these libraries toward the adoption of this information system is also very much positive. To put in a nut shell, the support and assistance of upper management and administration of these institutions is indispensable for the execution of this emerging information system in these medical libraries.

**References**

1. Ahmad, K., Z. JianMing, and M. Rafi, Librarian's perspective for the implementation of big data analytics in libraries on the bases of lean-startup model. *Digital Library Perspectives*, 2019.
2. Giannakis, M., K. Spanaki, and R. Dubey, A cloud-based supply chain management system: effects on supply chain responsiveness. *Journal of Enterprise Information Management*, 2019.
3. Djafri, L., D.A. Bensaber, and R. Adjoudj, Big Data analytics for prediction: parallel processing of the big learning base with the possibility of improving the final result of the prediction. *Information Discovery and Delivery*, 2018.
4. Zhang, L., et al., Big data and medical research in China. *bmj*, 2018. 360.
5. Wang, Y., L. Kung, and T.A. Byrd, Big data analytics: Understanding its capabilities and potential benefits for healthcare organizations. *Technological Forecasting and Social Change*, 2018. 126: p. 3-13.
6. Gandomi, A. and M. Haider, Beyond the hype: Big data concepts, methods, and analytics. *International journal of information management*, 2015. 35(2): p. 137-144.
7. Teets, M. and M. Goldner, Libraries' role in curating and exposing big data. *Future Internet*, 2013. 5(3): p. 429-438.
8. Zhan, Y. and K.H. Tan, An analytic infrastructure for harvesting big data to enhance supply chain performance. *European Journal of Operational Research*, 2020. 281(3): p. 559-574.
9. Ambigavathi, M. and D. Sridharan. Big Data Analytics in Healthcare. in *2018 Tenth International Conference on Advanced Computing (ICoAC)*. 2018. IEEE.
10. Islam, A.A., et al., Performance-based evaluation of academic libraries in the big data era. *Journal of Information Science*, 2020: p. 0165551520918516.
11. Herland, M., Big Data Analytics and Engineering for Medicare Fraud Detection. 2019, Florida Atlantic University, Boca Raton, USA.
12. Islam, M.S., et al. A Case Study of HealthCare Platform using Big Data Analytics and Machine Learning. in *Proceedings of the 2019 3rd High Performance Computing and Cluster Technologies Conference*. 2019.
13. Ngan, O.M. and A.M. Kelmenson, Using big data tools to analyze digital footprint in the COVID-19 pandemic: Some public health ethics considerations. *Asia Pacific Journal of Public Health*, 2021. 33(1): p. 129-130.
14. Yang, S.-D. and H.-S. Park, Analysis of the Rate of Confirmed COVID-19 Cases in Seoul and Factors Affecting It Using Big Data Analysis. *Asia Pacific Journal of Public Health*, 2022. 34(8): p. 824-831.
15. PMDC, Pakistan Medical and Dental Council. 2019.
16. El-Seoud, S.A., et al., Big Data and Cloud Computing: Trends and Challenges. *International Journal of Interactive Mobile Technologies*, 2017. 11(2).
17. Ward, J.S. and A. Barker, Undefined by data: a survey of big data definitions. *arXiv preprint arXiv:1309.5821*, 2013.
18. Liu, Y., et al., Collaborative matrix factorization mechanism for group recommendation in big data-based library systems. *Library Hi Tech*, 2018.
19. Agency., N.S., National Security Agency. 2013.
20. Xianju, F. and W. Shufeng, Storage and management of massive data in cloud computing. *Computer Measurement & Control*, 2014. 7(1): p. 79-82.
21. Zhong, R.Y., et al., A big data approach for logistics trajectory discovery from RFID-enabled production data. *International Journal of Production Economics*, 2015. 165: p. 260-272.
22. Erevelles, S., N. Fukawa, and L. Swayne, Big Data consumer analytics and the transformation of marketing. *Journal of business research*, 2016. 69(2): p. 897-904.
23. Akter, S., et al., Analytics-based decision-making for service systems: A qualitative study and agenda for future research. *International Journal of Information Management*, 2019. 48: p. 85-95.
24. Dubey, R., et al., Can big data and predictive analytics improve social and environmental sustainability? *Technological Forecasting and Social Change*, 2019. 144: p. 534-545.
25. Müller, O., M. Fay, and J. Vom Brocke, The effect of big data and analytics on firm performance: An econometric analysis considering industry characteristics. *Journal of Management Information Systems*, 2018. 35(2): p. 488-509.
26. Sivarajah, U., et al., Critical analysis of Big Data challenges and analytical methods. *Journal of Business Research*, 2017. 70: p. 263-286.
27. Kivunja, C., Distinguishing between theory, theoretical framework, and conceptual framework: A systematic review of lessons from the field. *International Journal of Higher Education*, 2018. 7(6): p. 44-53.
28. Gajdzik, B., S. Grabowska, and S. Saniuk, A theoretical framework for Industry 4.0 and its implementation with selected practical schedules. *Energies*, 2021. 14(4): p. 940.
29. Kushwaha, A.K., A.K. Kar, and Y.K. Dwivedi, Applications of big data in emerging management disciplines: A literature review using text mining. *International Journal of Information Management Data Insights*, 2021. 1(2): p. 100017.
30. Swanson, R.A. and T.J. Chermack, *Theory building in applied disciplines*. 2013: Berrett-Koehler Publishers.
31. Weerasinghe, S., *Technology Acceptance Model in the Domains of LIS and Education: A Review of Selected Literature*. *Library Philosophy & Practice*, 2017.
32. Martín-García, A.V., R. Redolat, and S. Pinazo-Hernandis, Factors Influencing Intention to Technological Use in Older Adults. The TAM Model Application. *Research on Aging*, 2022. 44(7-8): p. 573-588.

33. Fishbein, M. and I. Ajzen, Belief, attitude, intention, and behavior: An introduction to theory and research. 1977.
34. Davis, F.D., Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, 1989: p. 319-340.
35. Taylor, S. and P. Todd, Decomposition and crossover effects in the theory of planned behavior: A study of consumer adoption intentions. *International journal of research in marketing*, 1995. 12(2): p. 137-155.
36. Thompson, R.L., C.A. Higgins, and J.M. Howell, Personal computing: Toward a conceptual model of utilization. *MIS quarterly*, 1991: p. 125-143.
37. Davis, F.D., User acceptance of information technology: system characteristics, user perceptions and behavioral impacts. *International journal of man-machine studies*, 1993. 38(3): p. 475-487.
38. Soon, K., C. Lee, and P. Boursier, A study of the determinants affecting adoption of big data using integrated technology acceptance model (TAM) and diffusion of innovation (DOI) in Malaysia. *International journal of applied business and economic research*, 2016. 14(1): p. 17-47.
39. Shahbaz, M., et al., Investigating the adoption of big data analytics in healthcare: the moderating role of resistance to change. *Journal of Big Data*, 2019. 6(1): p. 6.
40. Tang, D. and L. Chen. A review of the evolution of research on information Technology Acceptance Model. in 2011 International Conference on Business Management and Electronic Information. 2011. IEEE.
41. Zhong, H. and J. Xiao. Apply technology acceptance model with big data analytics and unity game engine. in 2015 6th IEEE International Conference on Software Engineering and Service Science (ICSESS). 2015. IEEE.
42. Ajzen, I. and T.J. Madden, Prediction of goal-directed behavior: Attitudes, intentions, and perceived behavioral control. *Journal of experimental social psychology*, 1986. 22(5): p. 453-474.
43. Brock, V. and H.U. Khan, Big data analytics: does organizational factor matters impact technology acceptance? *Journal of Big Data*, 2017. 4(1): p. 1-28.
44. Soon, K.W.K., C.A. Lee, and P. Boursier, A study of the determinants affecting adoption of big data using integrated technology acceptance model (TAM) and diffusion of innovation (DOI) in Malaysia. *International journal of applied business and economic research*, 2016. 14(1): p. 17-47.
45. Brock, V. and H.U. Khan, Big data analytics: does organizational factor matters impact technology acceptance? *Journal of Big Data*, 2017. 4(1): p. 21.
46. Venkatesh, V. and F.D. Davis, A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management science*, 2000. 46(2): p. 186-204.
47. Shin, D.-H. and E. Bohlin, Demystifying big data: Anatomy of big data developmental process. *Telecommunications Policy* 40: 837-854. *Telecommunications Policy*, 2020. 44.
48. Al-Gahtani, S., The applicability of TAM outside North America: An empirical test in the United Kingdom. *Information Resources Management Journal (IRMJ)*, 2001. 14(3): p. 37-46.
49. Wu, J., et al., Adoption of big data and analytics in mobile healthcare market: An economic perspective. *Electronic Commerce Research and Applications*, 2017. 22: p. 24-41.
50. Ambak, K., et al., Driver intention to use electric cars using technology acceptance model. *Age*, 2006. 3(9.7): p. 1.4.
51. Wu, B. and X. Chen, Continuance intention to use MOOCs: Integrating the technology acceptance model (TAM) and task technology fit (TTF) model. *Computers in Human Behavior*, 2017. 67: p. 221-232.
52. Herrador-Alcaide, T.C. and M. Hernández-Solís, Numerical-Technological Skills and Work Experience in the Perceived Usefulness in an Accounting Virtual Learning Environment. *Turkish Online Journal of Educational Technology-TOJET*, 2017. 16(3): p. 116-131.
53. Budu, K.W.A., M. Yinping, and K.K. Mireku, Investigating the effect of behavioral intention on e-learning systems usage: Empirical study on tertiary education institutions in Ghana. *Mediterranean Journal of Social Sciences*, 2018. 9(3): p. 201-201.
54. Esteves, J. and J. Curto. A risk and benefits behavioral model to assess intentions to adopt big data. in Proceedings of the 10th International Conference on Intellectual Capital, Knowledge Management and Organisational Learning: ICICKM 2013. 2013.
55. Pipitwanichakarn, T. and N. Wongtada, Leveraging the technology acceptance model for mobile commerce adoption under distinct stages of adoption: a case of micro businesses. *Asia Pacific Journal of Marketing and Logistics*, 2019.
56. Ullah, M. and M.A. Anwar, Developing competencies for medical librarians in Pakistan. *Health Information & Libraries Journal*, 2013. 30(1): p. 59-71.
57. Richards, G., *Big Data and Analytics Applications in Government: Current Practices and Future Opportunities*. 2017: CRC Press.
58. Hair Jr, J.F., et al., Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *European business review*, 2014.
59. Mueller, R.O. and G.R. Hancock, Structural equation modeling, in *The reviewer's guide to quantitative methods in the social sciences*. 2018, Routledge. p. 445-456.
60. Ahmad, S., N.N.A. Zulkurnain, and F.I. Khairushalimi, Assessing the validity and reliability of a measurement model in Structural Equation Modeling (SEM). *Journal of Advances in Mathematics and Computer Science*, 2016: p. 1-8.
61. Fornell, C. and D.F. Larcker, Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research*, 1981. 18(1): p. 39-50.

62. Nnaji, C., I. Okpala, and I. Awolusi, Wearable sensing devices: Potential impact & current use for incident prevention. *Professional Safety*, 2020. 65(04): p. 16-24.
63. Anna, N.E.V. and E.F. Mannan, Big data adoption in academic libraries: a literature review. *Library Hi Tech News*, 2020. 37(4): p. 1-5.
64. Cheng, E.W., Choosing between the theory of planned behavior (TPB) and the technology acceptance model (TAM). *Educational Technology Research and Development*, 2019. 67(1): p. 21-37.
65. Adetoro, J.A., et al. Learning on the move: The behavioural intentions of nigerian students with disabilities. in *ICEL 2017- Proceedings of the 12th International Conference on e-Learning*. 2017. Academic Conferences and publishing limited