Analysis of Software Industry: Natural Language Processing Approach

Rameesa K.[1] & K. T. Veeramanju[2]

[1]Research Scholar, Institute of Computer Science and Information Science, Srinivas University, Mangalore–575001,Karnataka,India,Orcidid:0000-0003-0971-1661;

[2]Research Professor, Institute of Computer Science and Information Science, Srinivas University, Mangalore–575001,Karnataka,India,Orcidid:0000-0002-7869-3914;

Abstract

Background/Purpose: Natural language processing is an artificial intelligence subfield, through which human can communicate with computers in their own language either it is written, spoken or even drawn carelessly. Nowadays its effect is too much in our daily lives and world. The software industry refers to the redistribution of software among the software producers and software customers. A very less percentage of the overall computer programming activity is the software industry. NLP enables computers to interact with humans by using human language. Natural Language Processing also allows computers to scan text, hear speech, and interpret it. NLP relies on a variety of fields, including computational linguistics and computer science, to bridge the gap between human and computer communication. For the smooth communication between computers and humans NLP technique automates language recognition and generation. **Problem:** In this report, I analyse how Natural language processing techniques influences the software industry. **Design/Methodology/Approach:** The pertinent material and details for this case study on Natural Language Processing were collected from several research works published in various peer-reviewed magazines, conferences, and websites related to Information Technology. Further information have supplied by white papers. A theoretical concept can be developed based on model building and the model analysis can be done using ABCD listing framework. **Findings/Results:** The Natural language processing has a great role in software industry. **Conclusion:** The study of this paper focus on the relevance and importance of Natural language processing the present era of software industry. **Paper Type:** Research Analysis based on the case study

Keywords: Natural language processing, industry of software, software engineering, ABCD analysis, transform learning, Natural language interface, Graphical user interface, semantic analysis, Chabot, Software development life cycle.

1. Introduction:

The origins of the software industry is in the late 1960s. The tech sector has developed into a global economic powerhouse, employing over four million people in the United States alone. In 2012, the revenue generated over $640 billion. The different areas of Software products' usage are in commercial, social, governmental, and entertainment activities all around the world. In our life the importance of software are increasing day by day. When software fails, the battery runs down, motorised transit is affected, phone and network communications fail, and financial transactions may be suspended, all of which have a significant impact on industrial and economic operations. The commercial processes of software development, maintenance, and publication are critical components of a software corporation. The software industry describes the exchange of computer programming activity of both a software-producing company and a business or private software user. The main segments of the software industry are services for programming, business of software products, and Software that has been shrink wrapped. These three areas developed as technical opportunities multiplied and the potential for a thriving corporate environment increased.

2. Focus of the research:

- To examine the importance and application of the natural language processing in software industries.
- Examine the function and significance of natural language processing techniques with the industry of software.
- To assess the natural language processing affects in software industries and the difficulties it presents.
- To study the nature of the software industry

3. Strategy:

The study's foundation is the information gathered from both primary and secondary sources, as stated below:

- The supplemental collection methods are gathered by consulting a little text books on the subject of sentiment analysis, articles, websites, and literature reviews pertaining to the software industries and natural language processing concepts, as well as the financial and operational information of software industries

4. Literaturereview:

A review of literature is a key step in the research process. It portrays the understanding of what is known about a particular situation, phenomenon, or problem and to identify the knowledge gaps that exist [26].

There are new models for natural language processing which produce applicable software and accurately robotize a variety of programming activities. The chemistry community has yet to be affected by these tools. This type of artificial intelligence has the potential to revolutionise the study of chemistry and chemical engineering. The developments that led to this point, look at chemistry applications, and offer our opinion on how this might drastically change research and instruction [2]. There is a complex system which is multi-dimensional, called as Cyber Physical System(CPS)[3] which ties the real world and cyber world in order to processing a big amount of heterogeneous data. The main activities included in the CPS are Natural Language Inference (NLI) [3] tasks. It is based on the text from different sources. There is a new model introduced to find out the connection between text and language data which is from different sources. The name of the new model is Siamese network structure. Its main usage is to implement Natural Language Inference tasks and arrangement of a detailed evaluation of semantics.

The software engineering field is experiencing the same technological improvements that were brought about by the combination of NLP and AI techniques, according to the literature and research groups. The NLP-SEA [4] contribute to the development and expansion of knowledge in this area. NLP-SEA denotes Software Engineering Automation in Natural Language perspective. It provides a chance for the researchers and practitioners in academics and industry to experience the different technologies.

Manual Graphical User Interface (GUI) testing entails utilising the software's GUI to input data and using the software's outputs—one of which is the GUI—to assess if the software is valid. GUI testing is infamous for taking a long time because it puts a user in the loop. In reality, it is done by inexperienced, cheap testers towards the end of the software development life cycle to keep expenses down. Because of its historical limited purpose of identifying lingering software flaws, GUI testing has lost some of its significance. Due to the looping nature of human, testing of graphical user interface seems to have the capability to deliver outputs than failures and can be used as inputs to various subsequent processes, such as analysis of security. For example, the GUI tester introduced a model during testing which informs the tester implicitly about the software designer's goal [5]. This model is a remark of GUI testing, and its consistency can be applied for assurance activities of software quality like assessment of security [5].

A common goal for natural language processing is bug reporting (NLP).The artefacts like snippets of code, log of outputs, and stack of traces are frequently included in problem reports. These artefacts must be eliminated because they not only add noise to the bug reports but frequently pose. To distinguish text into natural language and artefacts, there is a machine learning-based strategy is available in Python [6]. It demonstrate that GitHub used for automate training set construction and bug report creation using pre-processing approach[6].

During the early phases of software development, many stakeholders are participating. Software checking are frequently used in business to find and correct issues with requirements and design artefacts, preventing the error from spreading to next stages. Across different stakeholders, requirements written in natural language (NL)[7] are different. There is various techniques for Natural Language Processing using semantic analysis (SA) and mining methods from graph theory to Natural Language requirements to create inter-related requirements (IRRs)[7]. Furthermore, this approach assists requirements engineers on before or after inspection[7].

Preliminary inspection and the use of IRRs aid in the removal of duplicate and unnecessary errors within linked requirements. It assists engineers in analyzing the effects of change in one requirement or other related requirements during post-inspection[7]. Natural Language Processing and semantic analysis methodologies can create a graph of inter-related requirements on a given requirements document which may be utilised to aid various judgements during and after the inspections[7].

The written documents are codes of ethics, which is intended to influence both internal and external stakeholders, as well as transmit different perspectives on what is right and wrong[8].Natural Language Processing can be used as a technique for measuring ethical standards. Quantitative computational models have a number of benefits, including explicitness, established assumptions, and repeatability.

Numerous requirements engineering (RE) processes are automated in association with natural language processing (NLP). The majority of suggested methods are starting with different NLP procedures that linguistic information from needs statements, and then transform them into representations of simple-to-process. These are applying as inputs for rule-based approaches or machine learning techniques at a later stage. Consequently, requirements representations are crucial in defining the precision of various methods[9].

Visualising the underlying processes and idea into programmes is a significant portion of software development. Converting ideas into code is one of programming's most challenging tasks, especially when working with new libraries' APIs. Machine learning techniques for generating and retrieving codes from natural language queries have proliferated recently. On the retrieval correctness or the overlap of generated code with developer-written code and it is shockingly unknown how these methods actually affect developer workflow. This showed difficulties and constraints in the status of code creation and code retrieval at the moment; results were inconsistent in terms of how they affect the workflow of developer including effectiveness of time, correctness of code, and quality of code. Developers' subjective satisfaction with the IDE[10] developer management tools was high and they identified a number of specific areas for improvement[10].

NLP has expanded its operations in countless areas like machine translation, email spam detection, information extraction, summarization, medical, and question answering etc[23].A ChatBot is an automated communication system. It can reply to the queries of users by analysing them using NLP and assists them in different way it can[24]. The Natural Language Processing (NLP) techniques are applied on Twitter messages using supervised learning to achieve real-time automated event detection in smart cities [25].

5. Industryoverview:

The industry of software encompasses organisations to create, maintain, and publish software using various business models, mostly "license/maintenance based" or "Cloud based". The industry includes the services like training, documentation, consultancy, and data recovery. The software and computer services industry spends more than 11% of its net sales on Research & Development[11]. In 2021, the global software products market is predicted to be worth $968.25 billion, with an annual growth rate (CAGR) of 4%.[11].Microsoft, Apple, Google, and IBM are examples of significant organizations.

Table 1: Annual Net Income in Fiscal Year 2022

Company	Net Income
Microsoft	$ 198 Billion
Apple	$99.8 Billion
Google	$72.9 Billion
IBM	$60.533 Billion

From Table 1, can conclude that Microsoft has the highest and IBM has the comparatively less annual net income in fiscal year 2022.

Table 2: Number of Employees in 2021-2022

Company	Number of Employees
Microsoft	221000
Apple	154000
Google	139995
IBM	270000

From Table 2, can conclude that IBM has the highest and Google has the comparatively less number of employees in 2021-2022.

In every industry, companies face competitions. Many businesses utilise their access to cutting-edge technology or ongoing innovation to draw clients and employees. It will be necessary to meet this criterion to compete in the business software sector in terms of employee and customer satisfaction[1].The main competitors in software industry are Microsoft, Google, Apple, IBM etc.

Microsoft

Microsoft is an American based multinational tech operation company by Bill Gates and Paul Allen in 1975 and went public in 1986. Different products are productivity software including Excel, word, outlook, PowerPoint, edge web browser and Internet Explorer and Microsoft Windows. it is the second most valuable company the globe with the market capitalisation of 2 trillion dollars.

Google

One of the strongest and famous competitor to Microsoft. it a provides plate G Suite platform including Gmail Google Drive docs. the largest Market share in terms of search engine's has owned by Google.

Apple

Microsoft competes apple in the mobile OS market business solution and hardware. It is one of the most known brands in the tech industry. it offers Mac, iPad, iPhone and pod.

Ibm

The International Business Machines(IBM)[16], frequently known as Big Blue[16], is a well known multinational company situated at Armonk, New York. It's operations are spread around 175 countries[17][18].

It focuses on computer hardware, middleware, and software as well as hosting and consulting services spanning from mainframe computers to nanotechnology. It is the world's largest industrial research organisation with 19 research facilities in a dozen countries. It has the record for most annual U.S. patents generated by a business for 29 years in a row[19][20].

6. ABCD analysis:

Using the ABCD analysis paradigm, several factors influencing the issues in a specific industry and its important aspects of every factor can be found[12].These influencing elements are categorized as advantages, benefits, restrictions, and downsides of selected major topics.[12]. Aithal, P. S. et al. (2015) [21] established the ABCD[21] evaluation to determine the model/strategy/concept/system for businesses and measures its efficacy in generating value for stakeholders. The ABCD analysis framework is a business model evaluation tool that takes into account all parameters of a business[27]. This analysis framework is also used for the analysis of the Black Ocean strategy concept[27]. For an organization the advantages, benefits, constraints, and disadvantages of the black ocean strategy on organizational issues, administrative issues, employee issues, business issues, external environmental issues, and operational issues have been identified and analyzed by studying various affecting factors and their constituent critical elements [28-31].

6.1 Advantages of nlp in software industry:

NLP has many advantages in software industry as follows.

6.1.1. Better analysis of data -

The computer has to difficult to process the unstructured data like documents, emails, and findings of study etc. The technology of Natural Language Processing can be analyse and assess large amounts of text-based information. It can perform repeated tasks like surveys of gathering or forms of processing more accurately.

NLP can be extremely useful in the recruitment process. Instead of evaluating hundreds of resumes based on desired attributes, companies can apply Natural Language Processing applications to screen resumes.When it comes to hiring the best candidates, companies that employ NLP have an advantage. T ranking of where to focus on hiring efforts. To improve the effectiveness of recruiting procedures NLP activities includes some deep learning models.

6.1.2. Streamlined process

Using NLP algorithm chat bot can be trained to find certain clauses from many papers without the help of Manpower. the main users of this kind of chat bot are either legal or accounting professionals. It can be reduced the amount of time for searching certain provisions.

Employees are mainly using this kind of chat bots for searching in different sources. it provides faster response time and delivering results very shortly. and also automatic the discussions.

6.1.3. ***Improvement in customer experience***

Customer interactions and question answering can be improved through the artificial intelligence. To understand the behaviour of customers, the hospitality of industry conducts surveys and evaluation with the help of artificial intelligence. The significance of this survey are to analyse the customers experience and to know that how they are rate it. for finding the aspects in a phrase structure that reflects the emotions can be identified through the sentiment analysis algorithms.

The important techniques behind the nlpchatbots are machine learning approaches data science syntactic analysis, computer science etc.

Through the chatbot, the customer experience a fast response for their queries and no need to wait for a long time.

6.1.4. Empowerment in employees

The technology can return a more comprehensive data set because it processes real-time big data from numerous sources. The nlp technology makes the real world more productive. With the help of the chatbots the employees can respond to the client very quickly or to complete the assigned activities more efficiently. The employees are obtained the freedom for working Independently. It provides the satisfaction and engagement of employees.

6.1.5. Reduction in costs

Increased productivity points to an efficient operation including response time to client requests, consuming customer data and many other usecases. With an NLP solution, a company can reduce the number of personnel needed to respond to client inquiries from six to two. Enterprise AI can process data more quickly and provide more relevant insights, resulting in better customer experiences.

6.1.6. Realizing benefits

Organizations must assess their culture in order to reap the benefits of NLP. Both the people and processes, are continuously changing. To overcome these changes, company has to introduce new technologies like artificial

intelligence, machine learning. To be successful, NLP requires large amounts of data to process. Before embarking on an NLP project, businesses must examine the resources required to supply the essential data.

Organizations can adopt the benefits of the artificial intelligence once the foundation is in place. Customer and employee experiences improve, resulting in a larger customer base.

6.2 Benefits of NLP in software industry:

Natural language processing (NLP) is one of the important area in artificial intelligence and machine learning. Trends and developments of the discipline have emerged as a result of NLP's quick growth. Some of the trends of NLP are as follows:

6.2.1. Transfer learning

A model is trained for one task and then repurposed for a related one in a machine learning technique called transfer learning. Creating a model from an already existing one is better than developing and training a new model because it is expensive, time-consuming, and requires a big amount of data. As a result, businesses may do NLP tasks more quickly and with less labelled data. Transfer learning is now used in NLP applications like intent classification, sentiment analysis, and named entity identification after first becoming popular in the field of computer vision.

6.2.2. Fake news and cyberbullying detection

Saving time and effort, NLP has emerged as a crucial technique for identifying and halting the spread of false information. Detecting cyberbullying is another way NLP is used to have positive influence. Classifiers are being created to identify the use of abusive, insulting, and hateful words on social media.

6.2.3. Software development Life cycle with NLP

The development of a software consists of different phases that leads to a successful product. NLP can be used at any stage of the Software Development Life Cycle[13].

6.2.4. Software engineering in NLP

Despite its evolution, software engineering has numerous standard methods, tools, and approaches that can be used in the development of NLP software[14]. Natural Language Processing (NLP) techniques are assisting software programmers in retrieving information from massive amounts of unstructured data[15].

6.2.5 Job market and NLP

With the progress of NLP the job market presented Labor Market Intelligence (LMI)[22]. LMI means algorithms in Artificial Intelligence and frameworks are using to analyse data connected to job market for decision making and supporting policy.

6.3 Constraints: NLP in software industry:

NLP is a strong technology. Its has multiple benefits. It has some limitations and drawbacks with Natural Language Processing:

6.3.1. Contextual words and phrases, as well as homonyms

Mainly in English, the same words and phrases are used for distinct meanings depending on the context of statements. In this context, the words have the same pronounciation but completely different meanings. These kind of words are called as homonyms. Handling the homonyms in NLP are difficult in question answering and speech to text applications.

6.3.2. Synonyms

Synonyms may provide challenges similar to comprehensive knowledge as we use many different terms to convey the same notion. Different people are using the different words for the same meaning according to the degree of complexity like little or small or minute. It is mainly depends upon the lexicon of the people.

6.3.3. Irony and sarcasm

Irony means the opposition word of its usual meaning. Sarcasm means it he word using to insult others. For machine learning models it is very difficult to present Irony and sarcasm. Models can be trained using indicators, but it' is a difficult procedure.

6.3.4. Ambiguity

In NLP, ambiguity means the sentences and phrases that have two or more different meanings. When a word is used as a verb, noun, or adjective then Lexical ambiguity occurs.

6.3.4.1 Semantic ambiguity:

how a sentence is interpreted in context. As an example: I used my binoculars to spot the boy in the beach. It has two meanings like I saw a boy through my binoculars in the beach or the binoculars was carried by the boy.

6.3.4.2 Syntactic ambiguity:

It causes the misunderstanding of meaning in the preceding statement. The phrase "with my binoculars" could refer to either the verb "saw" or the noun "boy." For humans also, it is very tough to decipher the sentence without the context of surrounding text. To solve this problem, POS (part of speech) tagging is available in NLP.

6.3.5.Errors in text and speech

Misspelled or overused terms may impede text analysis. Nowadays many autocorrect and grammatical softwares are available. It can handle frequent errors in a document. But the softwares can not understand the purpose of text. It is difficult to understand the mispronunciations, various accents, stutters, and other characteristics of spoken language for a machine. To overcome these problems various methods are developed according to the usage of users.

6.3.6. Colloquialisms and slang

The curious challenges for NLP is representing informal words, expressions, idioms, and cultural slang. Because colloquialisms, as formal language, may have no "dictionary definition," and these idioms may even have various meanings in different geographic places. Furthermore, cultural slang is always evolving and increasing, thus new words appear on a daily basis. This is where training and continually updating custom models can be useful, however it frequently necessitates a large amount of data.

6.3.7. Domain-specific language

Different firms and industries are using various jargon. For example, an NLP application in healthcare sector is not same as in the legal documents sector. There are already a lot of analysis tools that have been trained for certain disciplines, but extremely narrow companies may need to design or train their own models.

6.3.8. Low-resource languages

AI machine learning NLP solutions are focused on the most commonly using languages. Each of these techniques are doing the translation very accurately. Some of the languages are using only for the communication.

Technology can not access these kind of languages. have primarily been developed for the most common and extensively used languages.

To find the universal similarities between languages multilingual transformers and multilingual sentence embeddings are applying. Google's BERT "Bidirectional Encoder Representations from Transformers" is an example for multilingual transformers.

6.3.9. Lack of research and development

For the proper working of techniques machine learning requires a lot of data. It means billions of pieces of training data. NLP models become more smarter based on their trained data. Having said that, data (and human language!) are becoming increasingly abundant, as are new machine learning approaches and custom algorithms To improve on the challenges listed above, more study and new methodologies will be required.

As a result of Artificial neural networks and deep learning, the NLP approaches, algorithms, and models are working as human mind.

SaaS text analysis solutions, such as MonkeyLearn, enable customers to train their own machine learning NLP models, frequently in just a few clicks, alleviating many of the above-mentioned NLP processing restrictions. The benifits of NLP in a production field is doing customercare operations, customers' feedback about the product and impression of product in social media.

6.3.10. Wrap Up

While Natural Language Processing has limits, it nonetheless provides enormous and far-reaching benefits to any organisation. And, with new techniques and technology emerging on a daily basis, many of these restrictions will be knocked down in the next years.

NLP machine learning can be used to evaluate enormous quantities of text in real time, yielding previously unreachable insights.

6.4 Disadvantages: NLP in software industry:

1. The NLP system lacks a user interface to allow users to communicate with the system.
2. If a new model is developed without a pre-trained model. It will take a long time to obtain good performance.
3. If a NLP technique is designed for a particular and unique goal, then its is unable to apply in another field.
4. NLP techniques are unable to offer the proper answers for the confusing questions.
5. It is not completely reliable and dependable.
6. There is a chance to return the incorrect results.

7. Conclusion:

Natural language processing is now all about us, assisting firms in automating operations, improving customer service, and lowering operating expenses. Furthermore, NLP systems are becoming easier to create and deploy.NLP is all around us, enhancing our lives in various ways.The enhanced speed and precision available with today's hardware, as well as the shift from statistical machine learning methods to the usage of neural networks and deep learning, have changed the area of NLP in recent years. These new ideas make it possible to create automated systems that interact with people more naturally than ever before. And organisations are capitalising on the potential by embedding NLP into a wide range of procedures, both customer-facing and internal.

References:

1. Harris, R. (2022) *Software industry competition predictions*, *App Developer Magazine*. Available at: appdevelopermagazine.com
2. Hocky, G. M., & White, A. D. (2022). Natural language processing models that automate programming will transform chemistry research and teaching. *Digital discovery*, *1*(2), 79-83
3. Ni, P., Li, Y., Li, G., & Chang, V. (2021). A hybrid siamese neural network for natural language inference in cyber-physical systems.*ACM Transactions on Internet Technology (TOIT)*,*21*(2), 1-25
4. Anwar, S., Rauf, A., Ramzan, M., Razzak, I., &Saadatmad, M. (2022). NLP-SEA 2021 Workshop Summary. *ACM SIGSOFT Software Engineering Notes*, *47*(2), 15-16
5. Kowalczyk, E., &Memon, A. (2015, November). Extending manual gui testing beyond defects by building mental models of software behavior. In *2015 30th IEEE/ACM International Conference on Automated Software Engineering Workshop (ASEW)*(pp. 35-41). IEEE
6. Hirsch, T., & Hofer, B. (2021, November). Identifying non-natural language artifacts in bug reports. In *2021 36th IEEE/ACM International Conference on Automated Software Engineering Workshops (ASEW)*(pp. 191-197)
7. Singh, M. (2022). Using Natural Language Processing and Graph Mining to Explore Inter-Related Requirements in Software Artefacts.*ACM SIGSOFT Software Engineering Notes*,*44*(1), 37-42
8. Glass, Z., & Cahn, E. S. (2022). Codes of Ethics: Extending Classification Techniques with Natural Language Processing.*The Journal of Values-Based Leadership*,*15*(1), 11
9. Sonbol, R., Rebdawi, G., &Ghneim, N. (2022). The use of nlp-based text representation techniques to support requirement engineering tasks: A systematic mapping review. *IEEE Access*
10. Xu, F. F., Vasilescu, B., &Neubig, G. (2022). In-ide code generation from natural language: Promise and challenges.*ACM Transactions on Software Engineering and Methodology (TOSEM)*,*31*(2), 1-47
11. Aithal, P. S., Industry Analysis – the First Step in Business Management Scholarly Research (June 17, 2017). *International Journal of Case Studies in Business, IT and Education (IJCSBE)*, 1(1), 1-13
12. Yalla, P., & Sharma, N. (2015). Integrating natural language processing and software engineering.*International Journal of Software Engineering and Its Applications*, *9*(11), 127-136
13. Yang, Y., Ronchieri, E., &Canaparo, M. (2022). Natural Language Processing Application on Commit Messages: a case study on HEP software. *Applied Sciences*, *12*(21), 10773
14. Reshma, P. S., Aithal, P. S., & Acharya, S. (2015). An empirical study on Working from Home: A popular e-business model. *International Journal of Advance and Innovative Research*, *2*(2)
15. Varelas, G., Lagios, D., Ntouroukis, S., Zervas, P., Parsons, K., &Tzimas, G. (2022, June). Employing natural language processing techniques for online job vacancies classification. In *Artificial Intelligence Applications and Innovations. AIAI 2022 IFIP WG 12.5 International Workshops: MHDW 2022, 5G-PINE 2022, AIBMG 2022, ML@ HC 2022, and AIBEI 2022, Hersonissos, Crete, Greece, June 17–20, 2022, Proceedings* (pp. 333-344). Cham: Springer International Publishing
16. Khurana, D., Koli, A., Khatter, K., & Singh, S. (2022). Natural language processing: State of the art, current trends and challenges. *Multimedia tools and applications*, 1-32
17. Regin, R., Rajest, S. S., &Shynu, T. (2022). An Automated Conversation System Using Natural Language Processing (NLP) Chatbot in Python. *Central Asian Journal of Medical and Natural Science*, *3*(4), 314-336
18. Hodorog, A., Petri, I., &Rezgui, Y. (2022). Machine learning and Natural Language Processing of social media data for event detection in smart cities. *Sustainable Cities and Society*, *85*, 104026
19. Kumari, P., &Aithal, P. S. (2022). Stress Coping Mechanisms: A Quantitative ABCD Analysis. *International Journal of Case Studies in Business, IT, and Education (IJCSBE)*, 6(2), 268-291
20. Raj, K., &Aithal, P. S. (2022). Assessing the Attractiveness & Feasibility of doing Business in the BoP Market–A Mixed Method Approach using ABCD Analysis Technique. *International Journal of Case Studies in Business, IT, and Education (IJCSBE)*, 6(2), 117-145
21. Aithal, P. S., Shailashree, V. T., & Kumar, P. M. (2016). Application of ABCD Analysis Framework on Private University System in India. *International Journal of Management Sciences and Business Research*, 5(4), 159-170
22. Aithal, P. S., Shailashree, V. T., & Suresh Kumar, P. M., (2016). The Study of New National Institutional Ranking System using ABCD Framework. *International Journal of Current Research and Modern Education (IJCRME)*, 1(1), 389 – 402

23. Aithal, P. S., & Kumar, P. M. (2016). Analysis of Choice Based Credit System in Higher Education. *International Journal of Engineering Research and Modern Education (IJERME)*, 1(1), 278-284
24. Aithal, P. S. (2016). Study on ABCD Analysis Technique for Business Models, Business Strategies, Operating Concepts & Business Systems. *International Journal in Management and Social Science*, 4(1), 98-115
25. Aithal, P. S., &Aithal, S. (2019). A new attitude-behaviour (AB) theory for organizational leadership. *International Journal of Management, Technology, and Social Sciences (IJMTS*),(2019), 4(1), 83-97