

Emerging IT and Computing Gradients in Information Sciences

P.K. Paul¹, A. Bhuimali², P.S. Aithal³, K.S. Tiwary⁴, R. Saavedra⁵ and S. Mewada⁶

¹Executive Director (MCIS), Department of CIS, Information Scientist (Offg.), Raiganj University, India

²Vice Chancellor, Raiganj University, West Bengal, India

³Vice Chancellor, Srinivas University, Karnataka, India

⁴Dean (Science & Management), Raiganj University, West Bengal, India

⁵Director & Chair, International Programs, Azteca University, México

⁶President, International Scientific Organization for the Science, Engineering and Technology, India

*Corresponding author: pkpaul.infotech@gmail.com

Received: 09 Apr., 2021

Revised: 27 May, 2021

Accepted: 13 Jun., 2021

ABSTRACT

Technology is changing and playing an important role in developing different sectors and fields and as a result, it is helping in building of Digital Society. In the fields of Computing, Computer Science is considered as oldest with the activities of Computing and Information Processing. After the development of the Computer Science another important subject has been developed, i.e., Information Technology; which is applied in nature and started for information processing and other activities using various information techniques and technologies. Information Technology takes the help of different sub-components in information collection, selection, processing, management, and delivery. Among the sub components few important are Software Technology, Networking Technology, Database Technology, Multimedia Technology, Web Technology, and so on. Further, the field of Information Technology is also changing and incorporating with other domains and fields. Information Science is older than Information Technology but mainly deals with the manual information systems and management; and after the arrival of Information Technology, it has changed its methods, scope for its activities. Emerging technologies have changed the entire arena of Information Technology. This paper discusses the emerging fields of Information Technology with reference to its components and emerging sub technologies.

Keywords: Information Technology, IT, Computing, Emerging Technologies, Information Infrastructure, Digital Society, IT Age

Information Technology is an important subject and field of study in technological progress and development. It also offers the overall development of an organization as well as an institution. Information Science and Technology is a broad and emerging field incorporating 'Information Science (IS)' and

How to cite this article: Paul, P.K., Bhuimali, A., Aithal, P.S., Tiwary, K.S., Saavedra, R. and Mewada, S. (2021). Emerging IT and Computing Gradients in Information Sciences. *IJASE*, 9(01): 01-13.

Source of Support: None; **Conflict of Interest:** None



‘Information Technology (IT)’. It is a merging domain and therefore inherits the nature and features of Information Science/ Informatics i.e., the role in societal development in a different context^{[12],[23],[34]}. Today Information Technology is required in a wide range of areas and sectors viz.—

- ❑ Education, Teaching, and Research
- ❑ Business, Commerce, and Industry
- ❑ Health, Medicine, and Clinical Systems
- ❑ Government and Administration
- ❑ Social Science and Systems
- ❑ Biological Science and Systems, etc.

The field of Information Technology is changing its shape radically with various components which are helpful in information activities and technological solutions.

Objective

The paper entitled ‘Emerging IT and Computing Gradients in Information Science’ is a short review work and kind of trend survey incorporating following objective—

- ❑ To learn about the basics of Information Technology with its meaning and basic components in a brief manner.
- ❑ To learn about the emerging technologies and components in Information Technology.
- ❑ To find out the basic differences between Information Technology with the Information Science in a brief manner.
- ❑ To find out the role of IT and Computing in Social Development.

Information Technology: Basics

Information Technology or IT is an applied science domain which is responsible for the information activities using different kinds of technologies and such components apart from traditional and most used Software Technology few important are Network Technology, Web Technology, Database Technology, Multimedia Technology^{[6],[13],[33]}. The following are basic of each component—

Network Technology

Network Technology is an important component in IT and is dedicated in designing, developing, management of network systems, and communications. Network Technology talks about many things like basics of computer networks, network management, system administration, wireless network, network security, network planning and policy, converged networks, cloud computing, routing and switching technology, etc.^{[8],[9],[32]}.

Database Technology

Database Technology is another important technology in IT and it is responsible for the planning, designing, development, management, evaluation of database management systems using different software. A

Database may be online as well as offline and may be based on text based or numeric, multimedia based. Database Technology is closely associated with DBMS, data warehousing, data mining, etc. Some of the Traditional Database Technology related activities are performed by various DBMS viz. MySQL, MS-SQL, Oracle, MS Access, IBM Tivoli Management, etc. The latest additions of Database Technology include the Big Data, Data Analytics, Data Science, etc.

Web Technology

Web Technology is dedicated and responsible in designing, developing, and management of different kinds of website and web portals; and for this various methods and different Sub Technologies fulfill its desired objective viz. Web based programming (like HTML, DHTML, XML), Scripting Language (like Java Script, VB Script), High level Web Programming (like PHP, Perl), Content Management (like wordpress, joomla, drupal), etc. However, apart from these, Web Technology also deals with Information Architecture, Information Techniques, etc.

Multimedia Technology

Multimedia Technology is another very important component of Information Technology that also involves with different kinds of designing, development and implementation of multimedia-based products and tools. Multimedia Technology is composed with various media like text, image, audio, video, image or blend of these. There are many emerging aspects in this technology viz. Animation, 3D, Visual Effects, HCI, etc.^{[1],[5]}.

Information Technology vis-à-vis Information Science

There are many similarities between Information Technology and Information Science and among these few important are mentioned herewith. Information Science is broader than IT and it consists of many other additional components for the aspect of traditional information management and fundamentals of Information Studies. Therefore, Information Science itself hold all the attributes of IT. Moreover, Information Science is older than IT and additionally, it has emerged with different nomenclature^{[14],[18],[26]}. The following table 1 depicts herewith a brief about IT and Information Science.

Table 1: Comparison between Information Technology and Information Science

	Information Technology	Information Science
Origin	Information Technology is originated with the focus on handling information using tools and technologies like database, web, networking, multimedia, software technologies, etc. It is originated after the evolution of Computer Science	Information Science is older than Information Technology and responsible for information management. However, after the birth of IT various other components became part of Information Science. Therefore, based on origin it is older than IT but now after adding IT is broader.
Aim & Agenda	The main aim of Information Technology is to manage information and technologies using traditional and latest technologies.	The main objective of Information Science is Information Solution to the society, organization and institution using manual information management tool and IT Component.

Traditional Components	Information Technology doesn't use any traditional component for managing information or information activities.	Information Science is deals with traditional components obviously using cataloging, classification, documentation and other tools.
Social Aspects	Information Technology directly not associated with any societal aspects or application concentration.	Whereas, Information Science is directly associated with societal science and society directly.
Emerging Areas	Among the emerging areas of Information Technology important are Cloud Computing, Big Data, Human Computer Interaction, Usability Engineering, etc.	Whereas, Information Science talks about the knowledge economy, information policy, health informatics, bio informatics, environmental informatics, etc.
Carrier Opportunities	With Information Technology some of the possible job opportunities are belongs to networking, software, database, multimedia and web technology, etc.	Information Science apart from the position mentioned also deals with the job opportunities in documentation, information management, IT policy, etc.
Academic Program	Common degrees of Information Technology are including BSc/BS/MSc/MS/BTech/ MTech/ PhD, etc.	Information Science whereas offered with all the degrees mentioned except BTech/ MTech which is not available.
Alternative Names	Information Technology is available with some of the similar nomenclature like Information and Communication Technology, Information Engineering, etc.	Information Science whereas also available as Informatics, Computer and Information Science, Information Systems, etc.

This way Information Technology and Information Science, both are responsible in information processing and similar activities^{[4], [11], [35]}.

Emerging Trends of IT and Computing

Information Technology components become important in healthy Information Science practice and in this regard apart from the traditional IT components many emerging technologies of sub components are playing an important role viz. Cloud Computing, Big Data, Human Computer Interaction, Usability Engineering, Internet of Things, Converged Network, Information Assurance, Cyber Security, and so on (Refer Fig. 1).

The followings are brief description of these technologies in brief manner which will help to learn regarding their role in information activities or simply Information Science practice—

Cloud Computing

Cloud computing is one of the latest emerging technology in modern Advanced Computing and Information Technology dedicated in virtualization practice from the remote place^{[10],[22],[34]}. Here internet and similar kind of technologies play an important role in delivery of the Cloud Computing such as—

- ❑ Software and Applications
- ❑ Platforms.
- ❑ Storage and database systems
- ❑ Hardware and physical infrastructure
- ❑ Contents, etc.

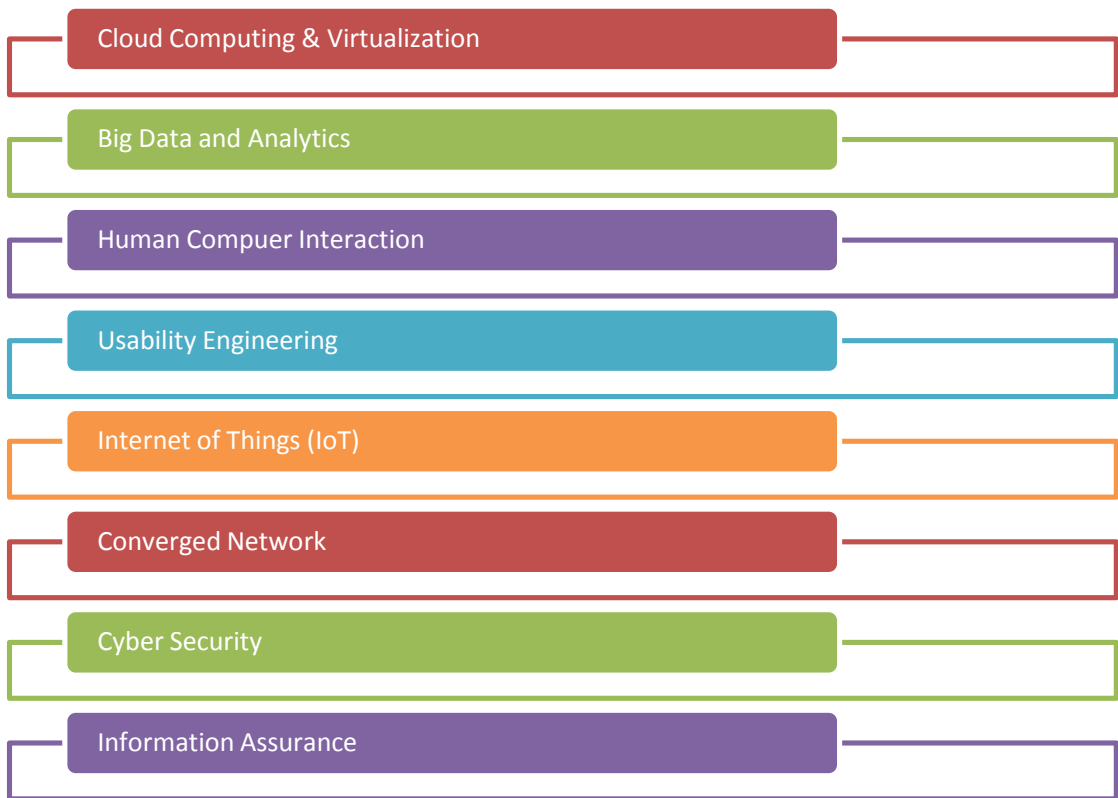


Fig. 1: Some of the emerging IT areas/ sub technologies

Cloud computing initially mainly considered as the data storage by the active management by the user and therefore also called as Data Centre. However, in recent context it is more than that and it involves with different kinds of functions, features, etc in multiple locations by the use of a centralized server. The Cloud Computing services are majorly three types viz. Public Cloud Computing, Private Cloud Computing, Hybrid Cloud Computing, etc.

Public Cloud Computing is a kind of virtualization and remote based services run by the internet based services. Therefore, public cloud computing is offered by the third party and available in multiple locations. *Private Cloud Computing* is just opposite of public cloud and it is dedicated in development of the in-house cloud-based service. It is strictly established, managed and operated from the concerned organization having higher security and mainly needed in sensitive business and organizations. Hybrid Cloud Computing, from its name we can guess that it may be offered by the combination of public & private. Hybrid Computing is useful due to its different features and characteristics like—

- ☐ Elasticity
- ☐ Scalability
- ☐ Cost Effectiveness
- ☐ Remote Based services

- ☐ Multiple Sharing and development
- ☐ Dependency, etc.

Internationally the uses of Cloud Computing are growing regardless of the types of the organizations and institutions and thus various vendors and companies have started working on cloud based solutions^{[2], [3], [25]}.

Big Data and Analytics

Big Data is the need of the hour. And Big Data is helpful in managing information proliferation since it is required for the large amount of generated data. With the help of Big Data management become possible in different formats, mediums and ways. Big Data due to its nature also known as Big Data Management. Big Data is worthy in complex data management and thus analytics techniques are being used for managing data. Big Data is applicable in various areas and sectors like Business Analytics has been results as Big Data applications in Business sectors, Health Analytics as the application of Big Data Applications in Healthcare and medical sectors, etc. Thus, Big Data is helps in building healthy and modern areas in Transportation, Governance, Education, Business, Manufacturing, etc. Big Data is considered as important tool in Information Technology for information solutions and therefore required in healthy and modern society at a large.

Data is important for everything, all kind of activities and it is required in all the sectors such as Healthcare and medicine, Government, Business and Industries, Agriculture, horticulture, Management, Education and Training, etc. Big Data applications is growing in managing large as well as complex data management using different kind of analytical tools. Therefore, it is also called as Data Analytics in certain context. The concentration of Analytics in different sectors leads to various other areas. The term Big Data application was evolved in the 1990's and gradually emerged to today's shape. Moreover, there were major changes noticeable recently worldwide. Among the major development done by the companies in this respect are include Tera Data Corporation, Seisent IMC, Google, apache, Oracle, IBM, EMC, DELL, etc. Therefore, Big Data Analytics, Data Science, etc are play important role in development of the healthy information practice and management.

Human Computer Interaction

Human Computer Interaction is abbreviated as HCI and it is considered as a process of design, development, implementation as well as evaluation of the interfaces of the electronic products and computing systems. However, Human Computer Interaction may be beyond interface designing and development. Human Computer Interaction gives importance in human utilization of various kinds of tools and technologies and naturally aspects of psychology here play an important role. It is worthy to note that gradually Human Computer Interaction is become an important field of study, and many universities internationally have started the academic programs in Human Computer Interaction. The term Human Computer Interaction was first coined in the year 1980 from the year 1983 the term became popular. In the book named 'Psychology of Human Computer Interaction' authored by the Stuart K Card and Newell, of Carnegie Mellon University the concept of Human Computer Interaction became popular. Various other emerging tools as well as technologies have become consider as important in Human Computer Interaction for its solid development regarding usable computing system. Further Human Computer Interaction is worthy and most valuable in different areas and subjects such as Computer Science, Information Science,

Information Technology. Different Human Computer Interaction tools as well as few other contributing subjects considered as important role in this regard viz.—

- ☐ Applied psychology
- ☐ Designing and Architecture
- ☐ Sociology
- ☐ Philosophical Studies
- ☐ Engineering Science
- ☐ Management
- ☐ Mechanics^{[7], [15], [37]}.

Usability Engineering & UXD

Similar to the Human Computer Interaction another important concept is Usability Engineering is another area dedicated in study, evaluation, designing, and development of various kind of interface, computers and other electronic products. Usability Engineering is useful in interface and monitors designing such as LCD, LED, websites and portal. Furthermore, it is also required in search engines and information retrieval system, smart phone ATMs and also in the Information Kiosk Interface. Thus, for the development of sophisticated and interactive information systems also Usability Engineering is very worthy. It also depends on various kind of standard and guidelines such as—

- ☐ International Standard Organization (ISO)
- ☐ National Institute of Standard and Technology (NIST)

User Experience Designing is another important area of Usability Engineering; and also called as UXD which is concentrated on various designing principles as well as methods using computer graphics and animation principles and various tools of multimedia technology. *User Centric Design* is noted as important for further process, framework, as well as guidelines. With the User Centric Designing and development service demand of the users, their needs can be studied and lastly the design process, analysis can be judged affectively. Here Feedback as well as evaluation method is also important lies on Pre testing and Post testing. *Usability Testing* is also important similar to the UXD, UCD, and Human Computer Interaction etc. for the smarter and healthy interface designing. It is also required in proper users' study on the products, services, systems. Here apart from the technology various other techniques, manual tools and procedures such as qualitative and quantitative are also being used. *Interaction Design* is also important within Usability Engineering space for the preparation of interactive documents, contents, multimedia systems, IT based systems, User interfaces, etc.

Internet of Things

Internet of Things in short known as IoT and particularly it deals with the objects as well as sensors for the internet-based activity. Furthermore, IoT is applicable in different areas and industries. Internet of Things or IoT term was first coined by Entrepreneur Kevin Ashton in the year 1990s and thereafter it is become an important tool. Internet of Things (IoT) is empowered with the built-in sensors which are able in communication; and thus, here internet and network play a leading role. In the diverse activities Internet of Things applications are important such as in automatic adjustment of heating and lighting, movement of

the cars etc. Hence, Internet of Things is required in efficient and digital society development^{[19],[21],[31]}. Here the uses of IP address considered as important in various areas such as Business, Agricultural, Education, Government, Hospital and Health Systems, Transportation, Manufacturing as well as Infrastructure, etc. Here some of the activities like Internet and network, embedded sensors, are also applicable. The following details may be considered as worthy in IoT architecture (also refer Fig. 2)—

- ❑ Internet of Things (IoT) is an advanced information collection and delivery methods that uses various internet and allied technologies.
- ❑ Internet of Things (IoT) depends on many technologies like Cloud Computing, Data Analytics, Human Centered Computing, etc.
- ❑ Internet of Things (IoT) is a kind of sensor dependent and thus it is Smart electric grids with renewable resources treated as valuable.
- ❑ Internet of Things (IoT) is also depending on machine monitoring sensors and ultimately dedicated in healthy development^{[16],[27]}.

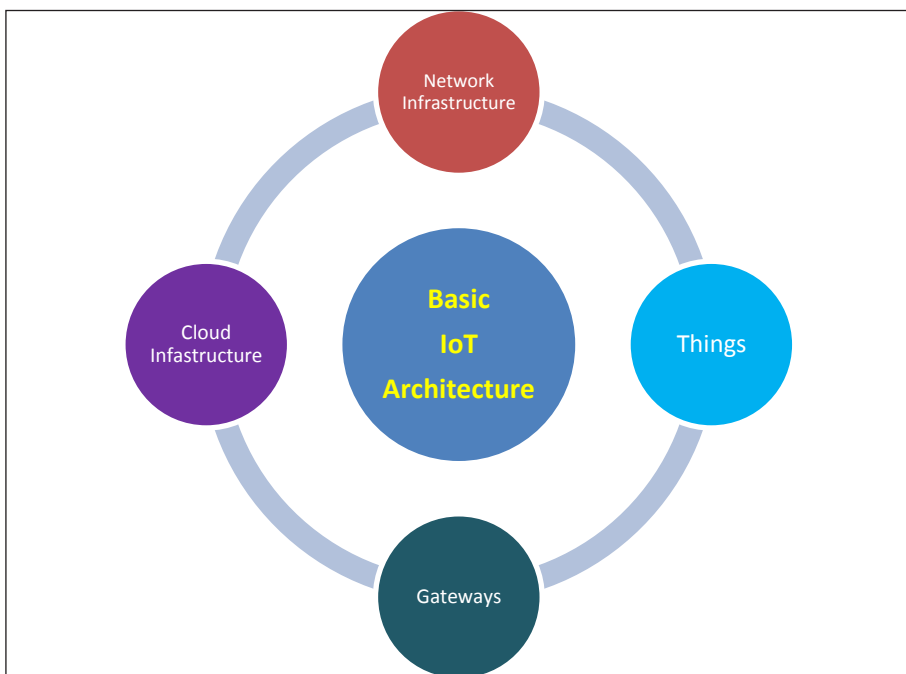


Fig. 2: The Basic IoT Architecture

Converged Networks

Computer Network is evolved long back with the communications of different types of devices like computers, servers and printers. It is helpful in sharing of the printers, files and other resources, saving time and money in the process. Converged Network is the latest in Network Technology field which is incorporated with the telephone, video and data communication in a specified single network. Network convergence basically driven by development of technology and demand and with the Computer Network

here users are able to access a wider range of services and this ultimately helps in adopting new business models, offer innovative services. “A single network with the capacity to carry a combination of data, voice and video traffic” (According to the Global Knowledge). Converged Network is considered as a next generation and advanced computer with proper voice, audio, video with the help of Internet protocol. According to the Experts Computer Network is a super network as instead of general telephone lines. Furthermore, a converged network is used and minimized cost and promotes multiple benefits. There are many benefits of the Converged Network viz.—

- ❑ Converged Network is helpful in saving cost particularly in long distance and international calls since it uses VoIP (Voice over Internet Protocol).
- ❑ Converged Network offers superb flexibility and scalability of the network structure. Therefore, with Computer Network users can use the services based on its uses.
- ❑ Simplicity is another important feature for which Computer Network is gaining rapidly throughout.

Information Assurance

Information Assurance is another emerging Information Technology area and it is also important in other allied areas such as Computing, Information Management, Information Systems, Informatics. Information Assurance is considered as important and with bigger scope of Information Security or Information Technology Security. Information Assurance is about the security, privacy of information products and tools^{[17], [28], [29]}. Further, it also deals with both technological and managerial areas in the areas of Data Privacy, Information Privacy, Information Security, Telecommunication Policies, etc. Hence Information Assurance is dedicated in principles, techniques, tools, practices in security, privacy for developing secure networked infrastructure and deals with the security policies, risk analysis. A proper Information Assurance practice, therefore, is need of the hour and required in healthy investigation skills to the IT Infrastructure, proper Risk Management Skills, proper Technology. Expert also expressed about the need of applied knowledge in Server, Web, Database and Networks, proper Communication and Leadership skills, etc. Practically Information Assurance is a broad, complex as well as interdisciplinary area that talks about digital and manual information security. Assurance is an important term for everyone and as far as Information Science is concerned Information Assurance is guarantee and pledge of information in different circumstances such as collection, organization, processing, management, and obviously dissemination. Information Assurance is important in proper designing and framing of proper and required rules, regulation, framework in the areas of privacy and security with the focus of Management, Business and Policy Studies, etc. Information Assurance is therefore can be considered as following—

- ❑ Information Assurance is a broad field which is deals with security, privacy in both technological and managerial for regarding information and content security.
- ❑ The sophisticated and healthy Information assurance can lead the healthy content and information at the right time and the right place to the right users.
- ❑ Information Assurance is needed in healthy and required traditional data management including unauthorized accessibility and illegal content transformation.
- ❑ Information Assurance is also important in healthy and proper IT Security viz. web security, network security, data security, etc.

- ❑ Therefore, Information Assurance is considered as important in proper information activities and information infrastructure development ^{[1], [34]}.

Cyber Security

Cyber security is very similar to Information Technology Security. Furthermore, it is primarily needed in the security and depending of the computers, servers, mobile devices, electronic systems, networks, and data from threats and attacks. Cyber security is also called as electronic information security. The term varies from context to context. Cyber security is broader than some of the other security areas viz. Computer Security, Cryptography, Network Security, Database Security, etc. but it is smaller than Information Assurance since it not only deals with the manual information assurance and securities but also in managerial aspects, governance of the security. Cyber security or IT Security therefore may be considered with the composition of the following—

- ❑ Network Security is deals with designing, developing and managing secure networks from attackers, malware, etc.
- ❑ Application Security is dedicated in preparing and managing software and other applications using suitable methods.
- ❑ Database Security is the designing, development and management of the proper and healthy database systems with robust security.
- ❑ Web Security may be also categorized as a Cyber security and it is needed in proper website designing, development and management with sophisticated security aspects and methods.
- ❑ Software Security is similar to application security but it is only restricted on security and privacy of software only instead of application security.

These are emerging areas of Information Technology and this is gaining rapidly throughout the world. However, depending upon the country, the emerging areas and technologies can vary.

CONCLUSION

The field of Information Technology is changing rapidly and various technologies also changing the Information Science sector radically. There are many areas which are increasing and incorporating in Information Science and Technology also like Artificial Intelligence, Robotics, etc. The emergence of IT and Computing developing and changing Information Science radically and as a result, it is also reflecting the entire arena of Information Science. Information Science is dedicated to information and technological solution with different changes and attributes and it becomes an important and diverse field of fields. And here emerging technologies playing a lead role. One of the major natures of Information Science is that it always keeps a relationship with the information fundamentals and societal aspects and this ultimately helps in managing information infrastructure at a large scale.

REFERENCES

1. Adamuthe, A.C., Salunkhe, V.D., Patil, S.H. and Thampi, G.T. 2015. Cloud Computing—A market Perspective and Research Directions. *International Journal of Information Technology and Computer Science (IJITCS)*, 7(10): 42-53.

2. Al-Mamary, Y.H., Shamsuddin, A. and Abdul Hamid, N.A. 2014. The meaning of management information systems and its role in telecommunication companies in Yemen. *American Journal of Software Engineering*, **2**(2): 22-25.
3. Arch-int, S. and Batanov, D.N. 2003. Development of industrial information systems on the Web using business components. *Computers in Industry*, **50**(2): 231-250.
4. Borko, H. 1968. Information science: what is it?. *American Documentation*, **19**(1): 3-5.
5. Brock, F.J. and Dhillon, G.S. 2001. Managerial information, the basics. *Journal of International Information Management*, **10**(2): 5.
6. Brookes, B.C. 1980. The foundations of information science. Part I. Philosophical aspects. *Journal of information science*, **2**(3-4): 125-133.
7. Buckland, M.K. 1991. Information as thing. *Journal of the American Society for information science*, **42**(5): 351-360.
8. Buckland, M. 1999. The landscape of information science: The American Society for Information Science at 62. *Journal of the American Society for Information Science*, **50**(11): 970-974.
9. Cornelius, I. 2002. Theorizing information for information science. *Annual review of information science and technology*, **36**(1): 392-425.
10. Cram, W.A., Brohman, K. and Gallupe, R.B. 2016. Information systems control: A review and framework for emerging information systems processes. *Journal of the Association for Information Systems*, **17**(4): 2.
11. Ellis, C.A. and Nutt, G.J. 1980. Office information systems and computer science. *ACM Computing Surveys (CSUR)*, **12**(1): 27-60.
12. Gillingham, P. 2011. Computer-based information systems and human service organisations: Emerging problems and future possibilities. *Australian Social Work*, **64**(3): 299-312.
13. Ghose, R. 2001. Use of information technology for community empowerment: Transforming geographic information systems into community information systems. *Transactions in GIS*, **5**(2): 141-163.
14. Holdstock, D.A. 1998. Basics of geographic information systems (GIS). *Journal of Computing in Civil Engineering*, **12**(1): 1-4.
15. Kelton, K., Fleischmann, K.R. and Wallace, W.A. 2008. Trust in digital information. *Journal of the American Society for Information Science and Technology*, **59**(3): 363-374.
16. Lee, A.S., Thomas, M. and Baskerville, R.L. 2015. Going back to basics in design science: from the information technology artifact to the information systems artifact. *Information Systems Journal*, **25**(1): 5-21.
17. Maxwell, D. and Watkins, B. 2003. Humanitarian information systems and emergencies in the Greater Horn of Africa: logical components and logical linkages. *Disasters*, **27**(1): 72-90.
18. McCune, J.C. 1994. *Information systems get back to basics*. *Management Review*, **83**(1): 54.

19. Mingers, J.C. 1995. Information and meaning: foundations for an inter-subjective account. *Information Systems Journal*, **5**(4): 285-306.
20. Nunamaker Jr, J.F., Chen, M. and Purdin, T.D. 1990. Systems development in information systems research. *Journal of Management Information Systems*, **7**(3): 89-106.
21. Paul, P.K. and Govindarajan, S. 2012. Information Scientist: Building sophisticated Technology Centric Information Infrastructure For All Round Socio-Economic Development. *International Journal of Social Sciences*, **1**(2): 209-214.
22. Paul, P.K., Sarangi, B.B., Chaterjee, D. and Chattri, R. 2012. Information Management: Emphasizing its Different Angles and View with Special Reference to Manpower Development Programme in India. *International Journal of Information Dissemination and Technology*, **2**(2): 112-116.
23. Paul, P.K., Sarangi, B.B. and Chatterjee, D. 2013. From Documentation to Information Science and Technology [IST]: Philosophical and Technological Changes-A Conceptual Study. *International Journal of Applied Sciences and Engineering*, **1**(2): 83-91.
24. Paul, P.K., Govindarajan, S., Chaterjee, D. and Bhatnagar, R. 2013. Information Systems and Information Science: Overview emphasizing comparative study. *SIT Journal of Management*, **3**(1): 336-341.
25. Paul, P.K., Dangwal, K.L. and Karn, B. 2013. Engineering Academics, Departments and Community: Emphasizing Some Educational Perspective of Information Science [IS]. *Educational Quest-An International Journal of Education and Applied Social Sciences*, **4**(2): 143-146.
26. Paul, P.K. 2013. Interactive Design: the pillar of Modern Information Systems. *Abhinav National Journal of Science and Technology*, **2**(3): 15-22.
27. Paul, P.K., Kumar, A., Poovammal, E. and Dangwal, K.L. 2014. Information Science: A Potential interdisciplinary field with Historical Perspectives and Future Potentials. *Educational Quest-An International Journal of Education and Applied Social Sciences*, **5**(3): 211-216.
28. Paul, P.K. 2014. Information Science in Indian Scenario with Reference to Possibilities of Proposed MTech (Information Science): Lets Welcome Future Programme of Indian I-School. *International Journal of Information Dissemination and Technology*, **4**(2): 173-178.
29. Paul, P.K. and Rajesh, R. 2015. MTech-information science: a new age proposed programme and its requirement with SWOT analysis in Indian educational context. *International Journal of Enterprise Network Management*, **6**(4): 286-298.
30. Paul, P.K., Ghose, M.K., Ghosh, M. and Ganguly, J. 2015. MSc-Information Science [Quantum Information Science] Specialization: Its Requirement and Proposed Model for Future I-School Dedicated to Next Generation Information-Technology-Community Interaction. *SRELS Journal of Information Management*, **52**(2): 93-99.
31. Paul, P.K., Bhuimali, A., Kumar, K., Poovammal, E. and Senthamarai, R. 2016. Information and Technology Related Educational Programmes and its Possibilities in Indian Universities. *International Journal of Applied Science and Engineering*, **4**(1): 19-27.

32. Paul, P.K., Bhuimali, A. and Tiwary, K.S. 2018. Computer & Information Science (CIS): Raiganj University into a New Research & Professional Direction. *International Journal of Information Science and Computing*, **5**(1&2): 1-16.
33. Paul, P.K. and Chatterjee, D. 2019. iSchools Promoting “Information Science and Technology(IST) Domain Towards Community, Business, and Society With Contemporary Worldwide Trend and Emerging Potentialities in India. In *Advanced Methodologies and Technologies in Artificial Intelligence, Computer Simulation, and Human-Computer Interaction* (pp. 864-878). IGI Global.
34. Robey, D. 1981. Computer information systems and organization structure. *Communications of the ACM*, **24**(10): 679-687.
35. Stivers, B.P. and Beard, L.H. 1987. Information systems: getting back to basics. *Journal of Systems Management*, **38**(3): 35.
36. White, H.D. and McCain, K.W. 1998. Visualizing a discipline: An author co-citation analysis of information science, 1972–1995. *Journal of the American society for information science*, **49**(4): 327-355.

