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Towards Philosophical Maturity of Information Technology as a Discipline

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Abstract: Advancement in technology and the widespread use of computers in society in the early 1990s created demand for professionals in the industry to manage the infrastructure which arose from the developments. The professionals produced from computing disciplines which existed at the time and efforts to respond to the needs did not to satisfy the skills requirements of the industry. As the skills requirements became clearer towards the year 2000, representatives from some universities which had started undergraduate programs related to Information Technology to meet the demand started collaboration with ACM and IEEE-CE among other stakeholders to develop a curriculum for IT. The group created the Society for Information Technology Education (SITE) which later became a special interest group for technical education (SIGITE) to spearhead the process. Consequently, the first curriculum model was produced in 2008, which was later reviewed to produce a new one in 2017. The curriculum defined the communities of practice, research in IT, which defined the status of IT as a discipline. The curriculum has been adopted in many regions globally even though some regions just refer to it or have different arrangements for their programs. This study sought to establish the status in the development of IT towards philosophical maturity as a discipline.

Keywords: Philosophical maturity, information technology, discipline

1. INTRODUCTION

Information Technology (IT) emerged as an academic discipline in early 1990s in response to a demand for IT professionals by the industry following advancements in computing technology and a widespread use of computers in organizations (Lunt et al., 2008). This was a period of tremendous advancement in computing technologies such as the internet, networking and office systems which found a gap on availability of the right professionals to oversee the selection, creation, application, integration and management of the IT infrastructure which arose. The computing disciplines of the time did not satisfactorily respond to the new skills requirements of the industry which prompted some universities to start undergraduate programs with content related to IT to fill the gap (Ekstrom et al., 2006; Lunt et al., 2008).

The Association of Computer Machinery (ACM) uses the term Information Technology to broadly refer to all of computing, and also specifically to the discipline of IT (Lunt et al., 2008). The discipline of IT was formally defined by the curriculum review taskforce established by the joint committee of the Association of Computer Machinery (ACM) and the Institute of Electrical and Electronic Engineers - Computer Society (IEEE-CS) as "the study of systemic approaches to select, develop, apply, integrate, and administer secure computing technologies to enable users to accomplish their personal, organizational, and societal goals" (Sabin et al., 2017). An academic discipline refers to studies focusing on a limited field of knowledge which is self-imposed with a distinct boundary (Cohen & Lloyd, 2014). IT is thus concerned with the application of computing technologies and it differs from computer science which deals with processes and methodologies of programming, algorithm design and data structures while (Mony & Wabwoba, 2023).

A new discipline becomes mature when its methods and codes of operation are defined by its professional bodies to guide teaching, research and practice of its members (Lunt et al., 2008). A number of professional bodies are actively involved in the development of model curriculum, accreditation criteria and codes of practice which have defined the undergraduate program in IT. They include the ACM and IEEE-CS which in collaboration with other stakeholders developed the curriculum model and the codes of ethics, and the Accreditation Board for Engineering and Technology (ABET) that gave accreditation to the curriculum which has been adopted in many regions globally (Ekstrom & Lunt, 2009; Sabin et al., 2017; Alrumaih et al., 2018).

Maturity of the discipline is also evident in its ability to set its research agenda which makes it visible (Agresti, 2013).IT has established its journals and research conferences, as well as the departments and schools in universities offering doctoral level degrees which make it visible as a mature discipline.

A computing discipline like IT gains maturity when its intellectual and core substance of the subject matter has been defined by recognized accreditation bodies such as ACM) and IEEE – CS (Comer et al., 1989). A body of knowledge (BoK) is an organized documentation of literature about a discipline which guides members in their profession (Agresti, 2013) When the body of knowledge becomes sufficient, universities can establish departments to offer its degree programs (Denning, 2000).

Philosophy of Information Technology

Philosophy is defined as the "the personal search for truth, in any field, by rational means" (Rapaport, 2023). Just like other mature disciplines, a philosophy has been established for the Information Technology which signifies its maturity as a discipline. The philosophy of information technology is defined as attempts to rationally describe what the discipline seeks to reflect in relation to its application (Floridi, 2004). As a branch of philosophy, IT seeks to understand the impact of modern technology on society and how it has influenced

changes therein (Nyabuto & Wabwoba, 2024). The philosophy of IT, just like for other computing disciplines, is properly initiated by the effort to define that which it seeks to reflect.

Evaluation of the philosophical maturity of IT can be based on three key branches of philosophy namely metaphysics, epistemology and ethics which are fundamental for rational philosophical arguments. Metaphysics (or ontology) tries to answer questions on "what there is" which is concerned with the nature of reality (Rapaport, 2023). In IT, metaphysics could thus refer to different worldviews, objects, and social actors such as an organization, users, software, societal change towards I.T. or a subsystem (Mony & Wabwoba, 2023)

Epistemology is concerned with the nature of knowledge, how it is created, acquired and shared (Gichuki et al., 2019; Rapaport, 2023). It is all about the process of knowing the truth about something or reality in a given field. Research in IT as an applied science is based on research results from related disciplines which is applied in practice to create new knowledge. The practice of IT can lead to new research ideas original to the field to create new knowledge (Reichgelt, 2004; Sabin et al., 2017). IT research outcomes are published in specialized journals such as the ACM and IEEE-CS which recognize it as a mature discipline. Some of the other branches include logic, aesthetics, history, aesthetics and history (Gichuki et al., 2019; Rapaport, 2023).

Ethics is concerned with what is good and what ought to be done. Ethical philosophy is concerned with technologies in society and the conditions which make them valuable or harmful to users. It does not prescribe policies for dealing with unethical findings but evaluates the impact of the technologies on society against its moral values so as to create corrective policies on their use by society (Introna, 2005). Professional bodies such as ACM and IEEE-CS have developed Codes of practice which regulate the practice of IT in society.

2. THE PRACTICE OF IT

Information technology is an applied discipline concerned with the application of knowledge in different fields and its philosophy seeks to understand its impact on humanity and wellbeing, and how they relate to each other (Nyabuto & Wabwoba, 2024). Graduates of IT are prepared to engage in professional practice to meet industry needs such as production of high-quality products, solve technology related issues and promote lifelong learning as required by the sectors. Some technical associations such as Computing Technology Industry Association (CompTIA) may offer industry standard certifications to develop skills of the graduates for different sectors. Depending on the skills acquired, one of the sectors an IT graduate may join could be the infrastructure industry to practice in the management of networks, cloud implementations and projects among others. Trainees can also join the development sector to participate in Program and software development, or join the security industry to take charge in the protection of systems from attacks. Another sector they could join is the data industry where they take charge in the management of databases and analysis of stored data (Sabin et al., 2018; Information Technology (IT) Certifications & Training, n.d.). Employment statistics sought from the department of Labor in the United States towards the review of the Information Technology Curricula by ACM and IEEE-CS identifies various occupations for IT practitioners and reported a projected job growth of about 12% for the year 2024 for various IT occupations across different sector. The occupations identified which are most sought across all sectors include web development, application software development, computer systems analysis and information security analysis. Some of the other occupations of practice were network and Computer Systems Administration, Database Administration and Computer Support (Task Group on Information Technology Curricula, 2017).

To prepare students for the industry, their involvement starts by the incorporation of professional requirements of the practice in the curriculum whereby professional member associations and the industry are engaged in the development and promotion of the curriculum and codes of ethics (IEEE - IEEE Code of Ethics, n.d.; Task Group on Information Technology Curricula, 2017). The associations and the industry also provide sponsorship to groups involved in ethical and professional issues and student chapters to prepare them for professional practice, and support opportunities for lifelong learning such as conferences, publications and tutorials (Hawthorne & Quiñones, 2019).

The Professional practice which has been incorporated in the curriculum for skills development include courses relating to teamwork, aspects of IT, authentication of projects, use of professional tools and platforms, technical writing and presentation among others (Sabin et al., 2017). Clients for IT products and services have benefited from IT professional practices in the demand for quality products and services as they engage the professionals in evaluating what they receive. The practice is also beneficial to society as it guides them in understanding their expectations on what is ethically right as they engage with the professionals (Task Group on Information Technology Curricula, 2017)..

3. IT CURRICULUM

The IT skills gap in the industry became clearer towards the year 2000 which universities which were offering IT related programs to collaborate and develop a curriculum which could satisfy those needs (Denning, 2000). The universities convened the first Conference for Information Technology Curriculum (CITC-1) in December 2001 to setup a curriculum, accreditation criteria and establish the place of IT among other computing disciplines.

With the involvement of professionals from ACM, IEEE-CS and the Accreditation Board for Engineering and Technology (ABET), CITC-1 established sub-committees for the tasks and established the Society for Information Technology Education (SITE) to spearhead to process. CITC-1 also identified topic areas and four core ranked courses for IT through the Delphi method of harmonizing expert opinions which were sanctioned by Industry Advisory Board (IAB) practicing professionals of the participating institutions. It recommended that any IT program on offer should include at least one of the top four core courses namely networking, software, web system design, and databases (Ekstrom et al., 2006; Ekstrom & Lunt, 2009)

SITE became a special interest group for technical education (SIGITE) of ACM/IEEE-CS in 2003 to spearhead the process and the first sets of accreditation guidelines were approved at the fourth conference (CITC-4) held in October 2003. The guidelines were presented to ABET which was the national agency for accreditation of programs in computing, engineering, engineering technology, and applied sciences for the United States. The Education Board of ACM also provided funds to SIGITE in October 2004 which enabled

them to release the first version of the model curriculum in April 2005 for public comments (Ekstrom et al., 2006).

The final version of the model curriculum was produced in November 2008 as outlined in the Information Technology 2008 Curriculum Guidelines for Undergraduate Degree Programs in Information Technology (IT2008) report and got published by ACM saw the birth of Information Technology as a discipline (Ekstrom & Lunt, 2010; Sabin et al., 2017). The report contained the IT body of knowledge, learning outcomes, IT core, IT advanced learning outcomes, Curriculum models and course descriptions.

In 2013, ACM established a taskforce to review the curriculum model in response to advances in education and technology, so as to produce a framework and guidelines for globally acceptable and forward-looking curriculum. ACM was joined by IEEE-CE in 2015 and by 2017, they produced the new "Information Technology Curricula 2017: Guidelines for Baccalaureate Degree Programs in Information Technology" (IT2017) for global use by educators, IT professionals and practitioners (Sabin et al., 2017). IT2017 was a competency-driven curriculum which was a departure from the previous one which was user-centered.

While the IT2008 curriculum identified five core areas of study for an IT program (programming, networking, human computer interaction, databases and web systems), the new IT2017 curriculum guidelines developed a framework for defining IT competencies required of an IT graduate without naming any particular course .The competencies were categorized into essential and supplemental domains which should be drawn from the discipline itself, professional practices, a competency-based approach, and industry perspectives (Sabin et al., 2018). About 40% is drawn from the essential IT domains, 20% from the supplemental IT domains, and the remaining 40% representing IT electives.

The model curriculum by ACM and IEEE-CE is used in many regions globally while other regions such as China, United Kingdom and France make reference to it or have different curricula development arrangements. Australia uses the Bologna structure which seeks to standardize university education among European countries while Finland does not have a national curriculum but some universities follow the ACM/IEEE- CS curriculum guidelines (Sabin et al., 2017).

IT programs in Japan follow the Computing Curriculum Standard developed by the Information Processing Society of Japan with strong government regulations and some industry linkages, based on IEEE-CS and ACM computing curriculum model. India offers skill-based IT programs while the Philippines has adopted a competency-based approach. (Sabin et al., 2017).

IT emerged from other computing disciplines such as Computer Science, Computer Engineering, Information Systems, Software Engineering and other professional publications, and has maintained some level of interaction with the disciplines. It has however drawn its boundary from the disciplines which focus on knowledge by concentrating on application and competency as spelt out in the curriculum framework (Ekstrom & Lunt, 2009).

4. RESEARCH IN IT

The 2017 IT curriculum guidelines recognizes that there is a challenge in making conclusive statements in IT research because of its orientation to practice and computing environment. IT research is shaped from its programs and practice in organizations where it grew from into a discipline which could cause changes of outcome any time contrary to other disciplines which emanated from a research area. IT also operates in a computing environment with many disciplines to which it has many commonalities and differences in research which may generate different research outcomes (Sabin et al., 2017). The research agenda for IT is thus driven from its practice, content, overlaps and differences with other disciplines, and it mainly applies research findings from other computing disciplines. Earlier studies agree that IT research should work towards a theory to "provide value to users at a cost acceptable to them through the creation, selection, application, integration and administration of computing technologies" as given in its definition. Research in IT should coalesce around the creation, selection, application, integration and administration of computing technologies which relate to the application and practice of IT as it interacts with other disciplines (Reichgelt, 2004).

Research approaches in IT are related to its adoption to modernize traditional and outgoing methods of operation following advances in technology. A recent review of the fourth industrial revolution (Industry 4.0) and other technologies found that plenty of academic research was going on to demystify the concept and create systems, business models and methodologies, while the industry was also engaged in understanding the technologies, its adoption and impact on customers (Oztemel & Gursev, 2020). Further, there was also ongoing research in the industry to understand the concept of Industry 4.0, the transformations required, development of infrastructure and management models, and the impact of the technology on society. The study identified research approaches which included systems development and business modelling. This implies that research in IT is both about the technology and the management in the industry for implementation of the technologies which is interdisciplinary.

Linking of manufacturers and their clients to respond to challenges in variability in market demand is another area of IT research relating to adoption. A study on the use of digital twin technology to virtually link manufacturers with clients during production in response to challenges in variable market demands defines the role of IT in balancing production and market demand which entails production of systems, managing related infrastructure and business models to realize this need (Semeraro et al., 2021). This attracts research in the development of systems and models to implement the linkages in organizations.

Application of theories to understand and evaluate technology acceptance is another area of research in IT which deals with the adoption of technology (Granić & Marangunić, 2019). The theory of Technology Acceptance Model (TAM) was used to evaluate the adoption of different technologies in different educational domains by various users the theory was found to be useful in the assessment of technologies used in education. Besides the development and application of technologies, research in IT should also be on the adoption of the systems by users.

5. COMMUNITY OF PRACTICE

The curriculum of IT underscores the fact that its research agenda emanates from its programs, practice and environment among other computing disciplines (Sabin et al., 2017). Competence training is a collective collaboration among community of practice in IT comprising of students and program implementors in the institutions and the organizations where actual practice is done. The concept of communities of practice was originated by Etienne Wenger, an educational theorist and practitioner to describe groups of people "who engage in a process of collective learning in a shared domain of human endeavor" such as the actors in the practice of IT (Wenger, 2011).

A survey by the IT curriculum development taskforce on the essence of collaboration among the academia and the workplace found that the academia encouraged and facilitated the arrangement which gave learners real-time experience.

Just like other mature disciplines, IT has established affiliations to professional bodies and a code of ethics which regulate its practice and promote the programs.

6. DISCUSSION

The discipline of IT emerged in early 1990s to fill skills gap in the industry and has undergone two major phases of curriculum development which have seen it grow into a mature discipline. The first curriculum model was produced in 2008 (IT2008) by a task force which included university representatives, ACM and IEEE-CS among other stakeholders which identified five core areas of study (Lunt et al., 2008). The second curriculum model was development by another taskforce led by ACM and IEEE-CS over the period 2013 to 2017 which produced new competency-based curriculum guidelines (IT2017) which unlike the previous one which was user centered (Task Group on Information Technology Curricula, 2017). The new curriculum established a framework for developing a curriculum and categorized the required competencies into essential and supplemental ones. This was a futuristic approach which identified domains while the actual courses were to be identified by the university when implementing the curriculum model. This was a departure from the approach used in developing the previous curriculum model which identified core courses and therefore not flexible. This framework approach gave the curriculum flexibility to respond to changes in technology and make required changes to the competencies as may be necessary.

Research in IT emanates from the discipline itself, its practice and related disciplines which implies that it is influenced by research activities in other disciplines. As an applied discipline, IT research revolves around the creation, selection, application, integration and administration of computing technologies which raises research questions as the various tasks are performed (Reichgelt, 2004).Research in IT is also concerned with its application in the fourth industrial revolution, which links manufacturers and their clients to respond to challenges in the variable market, and also from the application of theories to understand and evaluate technology acceptance among others(Oztemel & Gursev, 2020; Granić & Marangunić, 2019). The curriculum of IT underscores the fact that its research agenda emanates from its programs, practice and environment among other computing disciplines (Sabin et al., 2017). The discipline of IT has a community of practices for which is comprised of the academia and the industry and other organizations where practice takes place. The community of practice has facilitated competence training for the graduates.

7. CONCLUSION

This paper has presented the development of IT towards philosophical maturity as a discipline in the journey which started in early 1990s. It has discussed the development stages of the discipline such as curriculum development leading to the production of the IT2008 and IT2017 curriculum model led by ACM/IEEE-CE which largely contributed towards the maturity of the discipline. The paper has also discussed research in IT and its communities of practice including the professional bodies associated with the discipline. It was evident that the curriculum guidelines by ACM/IEEE-CE are by and large used in many regions globally while some regions make reference to it or follow different arrangements.

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