A Rethink of the Nature and Value of IT Assets – Critical Realism Approach

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Abstract. In the era of fourth industrial revolution, knowledge economy and beyond, information gets increasingly prevalent and ubiquitously important. Inevitably, stakeholders' interest is increasing, which results in greater reputation risk. Do we still view IT assets in the narrowed view as we do or do we broaden our horizon? Should we not be guided by how information technology was 'coined' in the late fifties, even though the reality is that IT assets have evolved and keep evolving. More than ever before, information is now an integral part of IT assets, and IT assets must be treated and accounted for considering the critical strategic importance (of information and IT assets) to organizations. Nonetheless being ubiquitous, there is a challenge in the identification process of IT assets. There is no agreed identification metrics and common understanding on the nature, structure and mechanisms of IT assets. The impact of this challenge is that IT assets value, or benefit realization from IT assets remain underrated or risk treatments remain at risk. This research study, based on critical realism philosophy investigates the nature, structures and mechanisms of IT assets. The four domains of IT capability maturity framework was used and to an extent asset specificity, to assist with phenomena and boundaries. The study of the nature of IT assets, based on critical realism, provides better insight into dual-contrasting nature of IT assets and contributes to the discourse on assets specificity and IT assets management. The derived classification, will contribute to the areas of infonomics, information risk and IT value/diffusion.

Keywords: IT assets · Identification · Structure and mechanisms · Critical realism

1 Introduction

From time immemorial, energy is accepted to consist of potential and kinetic energies. Also, atom is seen as the smallest unit of *matter* and it consists of protons, neutrons and electron. So it seems that a number of theories and models were built on these understandings. Till date, this concept holds true. However, certain phenomena of energy and properties of *matter* cannot be explained properly with the classical theories and models of Physics. There came in quantum mechanics which allows for 'sub-atomic' level of *matter*. Yet, quantum mechanics is clouded with controversies. It took the Copenhagen convention, with its seven principles, for there to be some common understanding and a new era to begin [1]. Philosophizing about this, Bhaskar [2, p. 51]

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cautioned against fixating on 'current state' of science without re-interrogation. It is against this backdrop, this paper investigates the nature of IT assets.

Information technology (IT), which is now synonymous and used interchangeably with information and communication technology (ICT), is a well-known concept ever since the coining of the phrase by Leavitt and Whisler [3, p. 41], in the late fifties. So it seems! This aspect will be looked into much later in this paper when exploring the nature of IT assets.

1.1 Fourth Industrial Revolution, Knowledge Economy and Beyond

Although foreseen by Leavitt and Whisler back then, knowledge economy has evolved as the economy where 'pervasive importance of knowledge and other intangibles come to the fore' [4, p. 123]. In line with this, this paper adopts the Oxford Dictionary's definition of knowledge economy as 'an economy in which growth is dependent on the quantity, quality, and accessibility of the information available, rather than the means of production' [5, p. 976].

This research study sees information and IT as essential building block of the fourth industrial revolution (4IR) era, in agreement with Lee et al. [6, p. 3], view of 4IR as the horizontal expansion of IT. They then dubbed 4IR as the second information technology (IT) revolution. Therefore, the era of 4IR, knowledge economy and beyond, call for another study of the container, processor and transmitter of information – IT assets.

1.2 Organization of the Paper

The essence, drivers and objective for the research study are presented in the next section. This include the research (critical realism) philosophical approach and the methods. The next section reviews the IT capability maturity domains and nature of IT assets. This leads to the findings and discussion on the nature, structures and mechanisms of IT assets, after which the paper concludes.

2 Research Domain

> *"I have always believed that scientific research is another domain where a form of optimism is essential to success ..."*—Daniel Kahneman, Thinking, Fast and Slow.

2.1 Research Drivers

When considering risk, researchers' and practitioners' focus has always been on the possibility of threat to assets [7, p. 175]. However, from the theory of risk, assets of their own selves, have their own epistemic uncertainties [8, p. 463], especially from the viewpoint of subjectivity due to a lack of knowledge or when their fluctuating state is considered [9, pp. 4, 14].

This paper opined that epistemic uncertainty holds true to IT assets (and the containing intangible information assets). Hence, the need to 'unearth' IT assets in themselves.

2.2 Research Problem Statement

From the introduction and research driver, one can deduce that the nature of IT assets is one that is not 'distinct' and must be understudy in order to gain insight into it.

Therefore, in the fourth industrial economy, knowledge economy and beyond, there is a challenge in understanding the true nature of IT assets and improper understanding of the underlying intangible elements and information value.

2.3 Research Objective

The problem above indicates that organizations must have a firm understanding of the nature of IT assets if they are to properly identify IT assets, derive optimal benefits from IT assets and put proper controls over IT assets.

Hence, the primary objective (PO) of this research project is *to critically re-examine the structures and mechanism of IT assets (within information risk) in order to gain better insight into the nature of IT assets so as to derive a conceptual classification scheme for IT assets*.

In order to achieve on this, the following secondary research objectives are essential:

- RO1. To understudy and determine what are the inherent attributes of IT assets;
- RO2. To determine what classification exist for IT assets; and
- RO3. To develop a conceptual IT assets attribute classification scheme.

It is imperative that these objectives be met so that organizations are better able to identify and derive optimal benefits from their IT assets.

2.4 Research Philosophy and Methods

Framing this research work is critical realism as advocated by Bhaskar [10]. Of course, there are many contributors to critical realism as a research philosophy [11, p. 3].

Critical Realism. As a research philosophy, critical realism allows for critical investigation of a concept or theme or phenomena or research reality. In this instance, that is IT assets. Obviously, IT assets as a concept or research reality is not new as there are age-long beliefs, understanding, knowledge and praxis about them. Critical realism affords the prism to re-investigate and interrogate these beliefs and understanding within 4IR, knowledge economy and beyond. The critical review also allows for relations, conflicts and contradictions as well as commonality of knowledge [12–14].

Although IT assets (and information assets) are not natural social actors (as expected in interpretivism), the reality of the characteristics that IT assets possess, create the phenomena under which they must be studied. Hence, as expected in critical realism, traditional held beliefs about IT assets (and information assets) are being challenged, interrogated, allowing for ways to identify, highlight and possibly eliminate some of the sources of 'conflicts' or contradictions.

More so, critical realism is apt for investigating interdisciplinary concepts or reality such as IT assets (and information assets). This flows from critical realism's features of abstraction and 'retroduction' [10, p. 174], and critical realism's challenging

ontological differences between physical and social realities [10, pp. 190, 384]. Hence, critical realism enables the exploring of the interplay between objects (information and IT assets) and their attributes, perceptions and realities [14].

Critical realism acknowledges empirical and actual domains which are the purview of positivist and interpretivist. However, critical realism, within the real domain, rejects linearity of causality between structures and mechanisms. Just to drill in a little bit on this, IT assets carry and process different information at different times and for different purposes. The capabilities vary based on usage, the context of use and the social agency that interacts at a particular point in time. Critical realism offers a stratified ontology that is able to take into account the alienating dichotomy autonomy of organizational systems and IT assets without denying the power that various agents (management, workers, processes, capabilities …) have to change themselves, organization culture, IT capability and resultant derived benefits or accrued value of IT assets. This is where the socio-technical identity [15] in critical reality comes into play. As such, IT assets can be interrogated as technological objects having structures and mechanisms [15], instead of being viewed as mere objects lacking in forms, specificity and interactivity. Hence, critical realism is more "incisive on epistemo-ontological questions" [11, p. 2].

Multi-method. The investigation of IT assets (and information assets) to outline the dual-contrasting nature of IT assets pose a challenge following a single approach like design science or activity theory. Critical realism by its nature allows for plurality and as such has a natural affinity for plurality of methods [14, p. 4]. The methods presented in this paper are based on the DREI (describe, 'retroduce', eliminate, identify) methodology of critical realism [16, p. 797].

Identification. Internet-based research [17, p. 292] and scoping literature review [18, 19] were used to explore, identify and interrogate the nature of IT assets. This fits in with the 'identification' and 'description' phases of critical realism [13, p. 4]. Alongside with this is the use of thematic content analysis [20, pp. 1, 4, 24] to assists with 'themes' of the nature of IT assets and classification. The international standard, ISO 22274 and IT-capability maturity framework (IT-CMF) came in handy in this instance, notably themes, taxonomy and stratified ontology.

Interviews. Flowing from the themes and stratified ontology, semi-structured based interview [21, p. 318] was used to engage with identified CxO (chief information officers, chief financial officers, IT directors, chief risk officer …). The interview sessions were not just for 'data gathering' but also part of the 'retroduction' process. The attributes, structures and mechanisms of IT assets were interrogated and validated.

Iteration and Retroduction. Many at times, a concept or phenomenon is well entrenched and/or universally understood in different field of study, but with differing viewpoints. Analogy [22, p. 12], though with its own challenges, is often used to draw inference from another field to explain or engage on a concept in a field of study. For example, the principle of coherence in quantum mechanics or optical Physics can be used to engage on the challenges of coherency in ICT for development.

Alongside analogy, argumentation, from a logical reasoning approach [23, p. 403], [24], is used in iterative step as part of the 'retroduction' step of critical realism [14, p. 3], to eliminate 'false' attributes and develop the workable classification of IT assets attributes, structures and mechanisms in this paper.

2.5 Research Domain Recap

Essential to this paper is the 'breaking down', interrogation and 'bringing back' within a context and time that take place as 'retroduction' process of iterative process of data collection and analysis, towards a set of causal mechanisms within a social structure and conditions [13, p. 3]. This is the viewpoint of critical realism as used in this paper.

This research study subscribes to the (late) Roy Bhaskar's critical realism school of thought [10, 11] and approached 'retroduction' from the eyes of reductionism [21, p. 599].

Lastly, I recap with Vandenberghe's assertion, "*critical realism is not the invention of one man, Bhaskar, but his demolition of positivism is so rigorous, radical and powerful that it makes one wonder how standard accounts of science have been able to keep the best minds captive for such a long time*" [11, p. 3].

3 Nature of IT Assets

The nature of IT assets was deconstructed and identified from literature and reasoning. This section will briefly summarize the key aspects.

3.1 IT Assets Recap

As earlier explained, the concept of IT assets has evolved ever since the coining of the phrase 'information technology' in the late fifties by Leavitt and Whisler. Nonetheless, the fundamental principle remains relevant till date. Faulkner and Runde [15] cautioned against an 'object' approach, which the author of this paper strongly opined includes IT assets. They theorized, and which can be seen from a critical realism approach, that 'object' should rather be seen and engaged as 'technological objects' or rather put 'digital objects'.

The underlying principle and IT-CMF practices and domain will now be looked at.

3.2 Leavitt and Whisler Coining of Information Technology

> *"The new technology does not yet have a single established name. We shall call it information technology. It is composed of several related parts. One includes techniques for processing large amounts of information rapidly, and it is epitomized by the high-speed computer. A second part centers around the application of statistical and mathematical methods to decision-making problems; it is represented by techniques like mathematical programing, and by methodologies like operations research. A third part is in the offing, though its applications have not yet emerged very clearly; it consists of the simulation of higher-order thinking through computer programs."*—Leavitt and Whisler, 1958

Unlike then, information technology is now pervasive and ubiquitous. So it seems! However, do we really understand information technology? If we do not, possibly we do not understand IT assets as well.

Looking at Leavitt and Whisler 'coining' statement, some attributes of IT assets are inferred. These are explored below.

Processor of large amount of information (at a rapid rate) casts our mind to the evolution of big data to what is now becoming data analytics and machine learning, (although we have had statistics, data science and neural networks with us for decades). What is evident is that enormous amounts of data as information are being processed rapidly to gain competitive advantage. Of course, this is alongside higher processing computing devices where Cloud, computing infrastructures or mobiles devices are being developed in this regard.

Application of statistical and mathematical methods to decision-making problems has been at the bedrock of operation research, management information systems and e-governments. Undoubtedly, this is not new. It was apparent in the industrial age. The 1965 'abandoned big brother' project gave an indication of what to expect from decision-making, though for governance purposes [25]. The role and place of operations research, data science/analytics, management science and e-governance in 4IR, knowledge economy and beyond might just be better left to imagination.

Simulation of higher-order thinking through computer programs is finding application in far greater domains than ever before. These span medical sciences, telecommunications, and climate changes amongst many other. The place of simulation in telecommunication is increasingly seen in the development and adoption of 5G telecommunication networks. Through simulators, artificial intelligence, and data analytics, greater inferences, forecasting, verification, and assurances are being made.

One can begin to see that a narrow view of IT assets will be a denial of reality. A more embracing view and approach is needed. The overly focus on financial and risk metrics of IT assets must be broaden so as to gain a true indication of information assets value with respect to their liability, benefit realization and value attributes [26, p. 84]. This is where the dual- contrasting nature of IT assets comes into the picture. As we gain understanding of the attributes, structures and mechanism of IT assets, we can be led to gain better insight into IT capability, IT value, as well as organizational impact (of IT assets) and IT diffusion, which are major research areas within IFIP WG8.6 [27, p. 237].

3.3 IT-CMF: IT Capability Maturity Framework Review

From principle 12 of King IV [28, p. 62], organizations must ensure that technology and information support achieving on their strategic objectives. Tillquist and Rogers [29, p. 76], rightly summarize that in fixing and determining organizations value, it is difficult to separate the "value contribution of IT assets from the context in which they operate".

An approach that has assisted is IT capability, through the purposeful, strategic application of IT across an organization [30]. Whether through asset specificity or resource-based view approach [29, p. 76], [31, p. 338], information plays an important role [32].

In brief, asset specificity relates to the identification of specific (value) contribution of IT to each facets within organizational (activities and processes) boundaries [29].

IT-CMF, built on proven management practices, provides four domains which organizational activities and processes boundaries can be structured, as depicted in Fig. 1. These attributes, structures and mechanisms of IT assets (nature) can be interrogated across the domains and boundary of an organization, so as to better identify IT assets across the organization and to apportion (carrying) values for IT assets or benefits realization of IT assets.

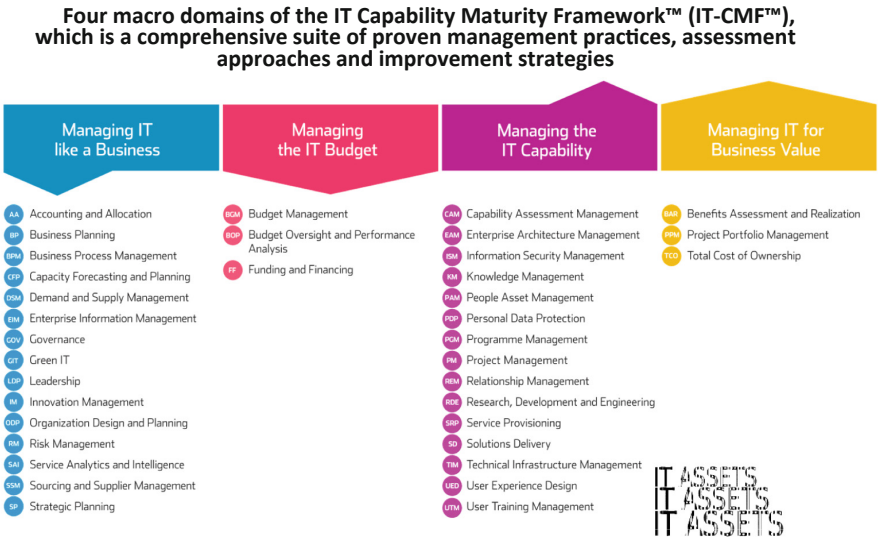

Fig. 1. The 36 critical capabilities – adapted from https://ivi.ie/it-capability-maturity-framework

In looking at the thirty-six critical capabilities of IT-CMF, due consideration was given to the IT infrastructure library – ITIL [33].

3.4 IT Capability Maturity Domains and Nature of IT Assets

Informed by the focus on service value-add and knowledge of service assets in ITIL's service assets configuration management, and the thirty-six critical capabilities of IT-CMF, as well as Leavitt and Whisler principle of IT and the exploratory scoping review, a classification system for IT assets was conceptualized. The aid used towards the conceptualization of the IT assets concept system is the ISO22274 mapping to OWL ontology available at http://tiny.cc/ITAOFIR_22274toOWL.

Through iterative refinement, the classification system was put into a graphical format that respondent can engage with. Apart from the IT concept system, respondent were encouraged to list additional elements (if any). Once respondent has 'critique' the IT assets concept system and provided their additional inputs, they are no longer at

liberty to change their mind. However, they are able to and indeed they did provide rationale for their critiques and input.

The IT assets concept system grouped elements across different domains starting with 'tangible' and 'intangible'. Some of the other groupings include 'infrastructure', 'functions', 'tangible type', 'software', 'intangible information', 'intangible type', 'reputation', and 'IT capability'.

The next section presents the findings from the engagement with the respondents who are mostly CxO.

4 Findings and Discussion

4.1 Key Findings

The key finding is presented as a heat map in Fig. 2, which shows the graphical model and the contentious domains/areas. Readers are referred to the exploratory paper [34], on intangible information assets as an integral part of IT assets.

4.2 IT Assets Deconstruction: Nature, Structures and Mechanisms

The deconstruction of IT assets into elements based on the nature, structures and mechanism discovered in this project were engaged on. Some elements or domains were heavily debated upon. Some were highly contentious. The respondents are polarized on their view about what information assets are and IT assets being tangible assets.

The main areas of engagement and contentions are the concept of IT assets as distinct tangible and intangible, infrastructure functional area of use (like ERP, CRM systems), intangible type and IT capability.

4.3 Type of IT Assets: Tangible and Intangible

A key finding is that IT assets can be classified as tangible and intangible. However, as it can be observed from the heat map, there is no consensus on what exactly are tangible and what are intangible. This has cascading effect down the line.

The statement 'tangible aspect refers to things we can touch' is one of the inclination that what can be 'touched' should be tangible and what cannot should be intangible. The key recommendation is that organizations should be left to make their own decisions on what is tangible and what is intangible. Hence, in their classification system, whether for assets management or accounting or risk, there must be flexibility for organizations to make a choice.

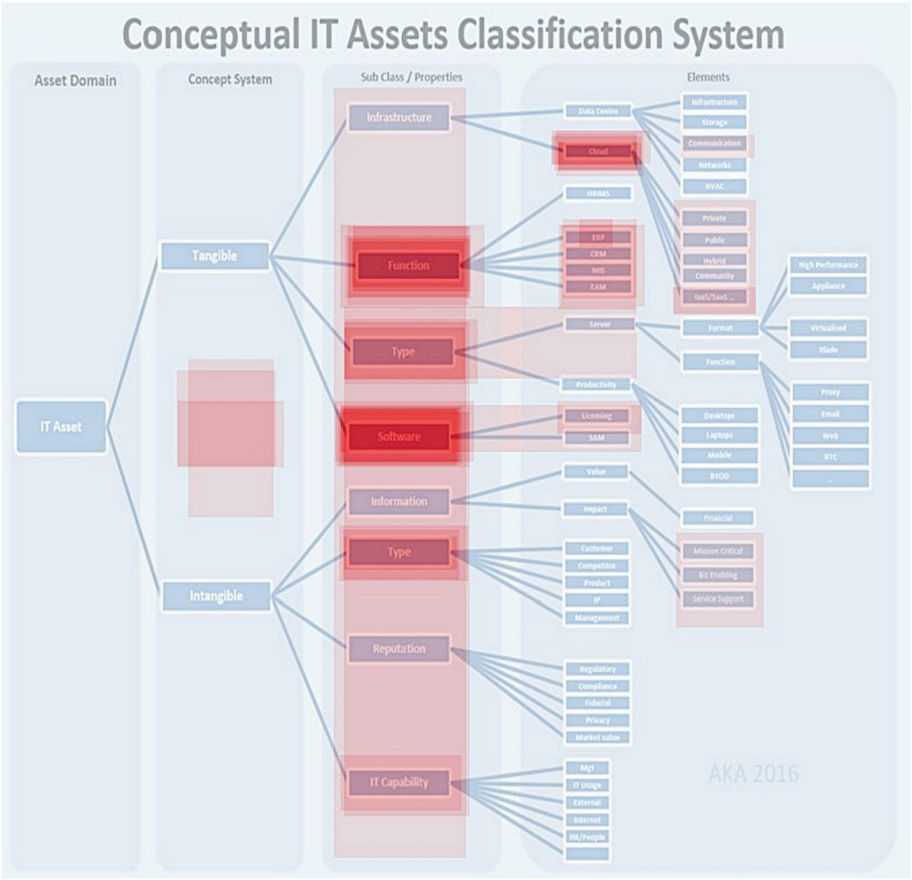

Fig. 2. Heat map representing engagement on the IT assets concept system

4.4 Type of IT Assets: Infrastructure Functional Area

Closely linked to the views on 'touch' is the concept of grouping or classifying infrastructure systems used for functional domains (line-of-business use). Whilst it is undeniable that the infrastructures are typically physical, the general view is what is termed to be the 'flip' factor, where the flip depends on how physical or function are viewed.

Systems for ERP or CRM or HRMIS or others are seen from the 'function' they provide to organizations and are considered from that functional view rather than the actual infrastructure that is in use. One suggestion is 'instead of IT function, I suggest business function'.

The other viewpoint from engagement with respondents, is that with the options of data centers, virtualization, private or public or hybrid cloud computing, infrastructure cannot simply be 'hard-defined' as physical infrastructure. This also has impact on the cost model, whether fixed cost or property, plant equipment costing approach.

Software although capable of standing as a distinct asset type should also be considered along the lines of how and where they are put to use, just like infrastructure types are considered along the line-of-business use.

4.5 Type of IT Assets: Intangible (Information) Types

The nature of information type ranging from financial to competitors information and intellectual property are classifiable as asset types. Nonetheless, how they relate to each organizations varies and must be given considerations along those lines.

4.6 Type of IT Assets: IT Capability

It is possible to group capability and impact of IT assets on an organization. The main grouping of management and strategic, IT usage, external, people are in line with the domain areas in IT-CMF. Organizations must give due considerations to the domain areas of IT-CMF, strategic intent in ITIL, and IT specificity when looking at values and benefits realization from IT assets.

4.7 Classification: Reiteration of IT Assets Structures and Mechanisms

From engagements with the CxO respondents, it is evident that the demi-regularities observed, are important in establishing the challenges faced in understanding and classifying IT asset elements. These demi-regularities have material impact on how IT assets structures, mechanisms, usage, and value would be determined, and how controls will be put in place to safeguard risk.

The demi-regularities are seen at play in the derived classification scheme for IT assets as shown in Fig. 2. The scheme has found use in an IT assets ontology for information risk [7].

4.8 Summary of Findings and Discussion

The way IT assets are treated is evidenced in how ICT investments are categorized: annual spending on hardware, software, telecommunication equipment and (internal) IT services [35, 36]. Hardware, infrastructure, telecommunication can be property, plant and equipment or fixed cost, whereas internal IT services can be fixed cost, recurring expenditure or intangibles. However, these distinct categorization no longer suffices, given the intrinsic nature, structures and mechanisms of IT assets when the multi-faceted dimensions of what IT assets consist of, composed of, context of place and use are considered. This importance of this is that IT assets can be engaged as having a carrying value, which is the financial value attribute to the IT asset and addition capability and intangible values (which are by reason of usage and the inherent attributes of IT assets. The flexibility of determining categorization as tangible and intangible is left for organizations to make.

As it was with *matter* in classical Physics, the 'hidden', non-observable, real domain of IT assets must be revisited and given due considerations in the same way *matter* was revisited and the sub-atomic nature was brought to the fore in quantum mechanics.

5 Conclusion

"Now all has been heard; here is the conclusion of the matter ..." – Ecclesiastes 12:13 NIV

The conclusion to be made in this paper stems from the starting point. Boards and directors in charge of organizations must caution against a fixed cast-in-stone view and approach to identifying, classifying, valuing, deriving benefits and managing risk of their assets, which in this instance is their IT assets.

This is done by re-interrogation based on the IT-CMF domain [37], areas and informed by their organizational strategic intent (purposeful, strategic application of IT across an organisation). This will assist in approaching IT diffusion in their organizations.

In this light, this paper addresses a very important topic: the nature, structures and mechanisms of IT assets' using critical realism philosophy approach. This is important in the identification, recognition and strategic use of IT assets.

Going forward, organizations should combine IT-CMF domain areas with the concept of asset specificity and service asset configuration management of ITIL, in approaching their IT assets, handling their IT assets and deriving benefits from their IT assets.

It is hoped that future interrogating studies will attempt to interlink reputation, information risk, accounting, IT service management, and IT diffusion. Such an approach should assist with universal definition of IT assets that will be more appropriate for the 4IR, knowledge economy and beyond. There is room to further critically examine information assets not only as intangibles [26, 34], but their common structures and mechanism with IT assets as research reality. By doing so, researchers will be re-examining the information strand of the diverse root of information technology as envisaged by Leavitt and Whisler in 1958 [3].

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