



# Digital Innovation & Transformation Opportunities for Researchers & Practitioners – A Structured Literature Review & Proposed Model

Raafat George Saadé – Montréal, Québec, Canada | [raafat.saade@concordia.ca](mailto:raafat.saade@concordia.ca)

Aim/Purpose	Although the latest review on digital innovation was made in 2018 (included articles up to 2017), the purpose of this study is to explore and examine opportunities for research in digital innovation and transformation for both researchers (including graduate students) and practitioners. A conceptual model is proposed.
Background	Digital innovation is omnipresent today, as it has penetrated deep into the structure and psyche of individuals, communities, organizations, institutions and governments. We find ourselves in a quagmire of opportunities risks and uncertainties, where ubiquitous technological interconnectedness form a new paradigm enabling industry to innovate and grow. All humanity is faced with these disruptive digital pressures. Yet, relatively there is little research done. Unfortunately, a coordinated effort for such a seriously important phenomenon does not exist.
Methodology	A structured literature review approach was conducted, the results of which were used for a qualitative approach, using nVivo, to extract insights and understanding.
Findings	This study identifies the extent of research done in the different areas of digital innovation and transformation and puts the results into perspective. Scholarly research is scarce, dispersed and diverse, lacking any direction or cohesion. Research on transformation is more than innovation and in both cases those that study their relationships with human or society are a handful. A conceptual model is proposed by integrating knowledge gained from the literature, the integral theory and the concept of impact assessment.
Impact on Society	This study shows that the integration of human agency digital innovation research and practice is primary. Researchers and practitioners can use the conceptual model to help them expand and extend their work.
Keywords	Digital innovation transformation, Human, Structured literature review,

\* Corresponding Author

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## AREAS OF CONTRIBUTION

Paper Category		
<input checked="" type="checkbox"/> Original Research	<input type="checkbox"/> Position Paper	<input checked="" type="checkbox"/> Comparative
<input type="checkbox"/> Case Study	<input type="checkbox"/> Technical Briefs	<input type="checkbox"/> Opinion
<input checked="" type="checkbox"/> Reviews	<input type="checkbox"/> Student Paper	<input type="checkbox"/> Innovation Ideas

Type of Digital Innovation	Industry	Discipline
<input type="checkbox"/> Radical	<input type="checkbox"/> Media	<input checked="" type="checkbox"/> Business Technology
<input checked="" type="checkbox"/> Incremental/Enhancing	<input type="checkbox"/> Telecom	<input type="checkbox"/> Human Resources
<input type="checkbox"/> Disruptive	<input type="checkbox"/> Consumer Financial Services	<input checked="" type="checkbox"/> Management
<input type="checkbox"/> Breakthrough	<input type="checkbox"/> Retail	<input type="checkbox"/> Marketing
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		<input type="checkbox"/> Digital Media
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		<input type="checkbox"/> Astronomy
		<input type="checkbox"/> Economics

Human Elements		
<input type="checkbox"/> Personality Traits	<input type="checkbox"/> Development	<input type="checkbox"/> Mental Wellbeing
<input checked="" type="checkbox"/> Behaviour	<input type="checkbox"/> Environmental	<input type="checkbox"/> Consciousness
<input checked="" type="checkbox"/> Cognition	<input checked="" type="checkbox"/> Social	<input type="checkbox"/> Physical Wellbeing

# INTRODUCTION

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## An Emerging Phenomenon

The world today is undergoing profound and fundamental changes as it settles from the industrial age into an era where products and services are all intelligently connected. These changes impact humans, animals, plants (the entire biosphere), organizations including how they do business and compete with each other, educational institutions where the cycle of curriculum maintenance is constantly getting shorter, and governments trying to make sense on their economics, budgets and policies.

Everything and everyone seem today to be experiencing some form & degree of transformation driven by digital technologies that are themselves constantly evolving and emerging at faster rates, challenging everyone's capacity for timely adaptation.

Everyone is experiencing some form of transformation due to digital innovations such as cloud computing, big data, artificial intelligence, and the Internet of Things (IoT), not to mention the phenomena of social media and mobile technologies (Sánchez, 2017). As such, and from a business perspective, every Chief Information Officer, executive, manager and entrepreneur find themselves in a quagmire of opportunities and

risks filled with uncertainties, where interconnected levels of technologies, information technologies and information systems, collectively form what is called the "3rd Platform" (3rdP) enabling industry players to innovate and grow (Gens, 2013).

This 3rdP is built on the cloud, mobile, social network, big data, artificial intelligence, and IoT technologies and systems, allowing organizations, governments, institutions, and entrepreneurs to innovate by mixing and matching underlying components and compete in the arena of digital platforms. The impact of digital innovations and platforms, due to the 3rdP space, extends beyond decision-making, operations, product development, promotion, strategy, customer relationship and into every aspect of business functions and human life.

Therefore, one can say that the 3rdP creates opportunities for innovation, which in turn, creates a response for transformation and change. To that effect, in this introduction, we will elaborate on the concepts of digital innovation and digital transformation. In the end of this introduction section, we discuss the human perspective as entrenched in 'The Digital'.

## The Digital Arena

As technology continues to impact humans in many ways, humans are not fully aware of the scope of this impact and how technology is influencing their lives, day to day and long term. The paradigms of digital innovation and transformation are weaving themselves into the fabric of mainstream politics, business, education, healthcare and life overall.

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The global business reality today is faced with a challenging and disruptive environment, all the while experiencing geo- and techno- political pressures ranging from a fast-paced emerging technology to persisting uncertainties, in practically all aspects of business and life – not more so than the COVID-19 phenomenon.

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A major shift towards a digital world is felt with an exponential increase in technological intelligence, affecting the globe at unprecedented levels. As presented in figure 1, artificial intelligence,

disruptive technologies such as blockchain, the internet of things, social media, and 5G telecommunications, are but just a few innovations pushing humans in directions that they are not aware or conscious about.

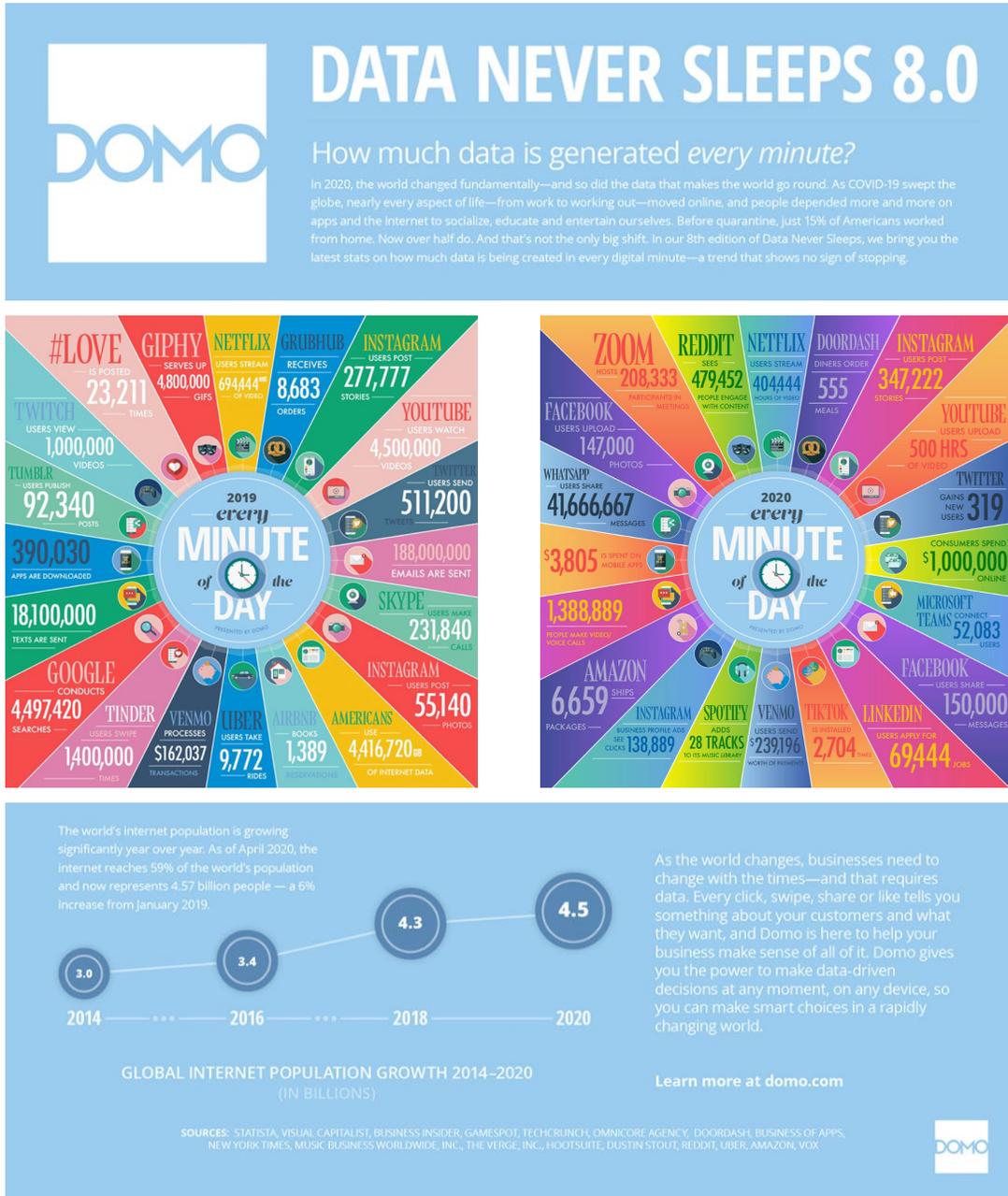


Figure 1. Digital innovations and drivers of disruption & transformation.

Figure 1 shows the extent, as well as the rate of growth, at which the various digital innovations have penetrated the global village, in terms of number of internet users of 4.5 billion in 2020 and amount of data generated every minute by users.

Do we fully understand what these numbers mean, and the multitude of the resulting outcomes? Are these numbers predictable and corresponding outcomes known or even equitable across various demographics? What effects exist today, or possibly exist, but we have not yet observed or measured? Are humans in control of the creation and evolution of those digital innovations, or vice versa? How can we manage the rate of change of technology integration into our lives? Are these technologies being pushed on humans by industry? What are the motives of the stakeholders? How are we to adapt to those technology-driven digital innovation changes? Considering the speed at which new innovations are created and the degree of intrusion into everyone's life, can we even adapt? If yes, then how is it possible to be done safely, and if not, then what are the consequences and what should we do to mitigate adverse effects? What kind of transformations do we, our organizations, our governments, and our educational institutions have to commit to, in order to adapt with our well-being in mind? These are but few questions that need to be addressed.

It is accepted today by all, that the digitalization phenomenon will continue indefinitely (for now). It seems that we are still in its early stages as we continue to see increasing momentum in recent years Nylén, D., & Holmström, J. (2015). We found it interesting to follow Bican, M. P. & Brem, A. (2020) Google searches on some key terms. Table 1 below compares their Google search numbers in May 10, 2020 and ours done in Sept. 15, 2020.

**Table 1.** Comparison of Google search terms.

Term	Google Scholar	Google (Sept. 15, 2020)	Google (Sept. 15, 2020)	Difference (%)
“Digital Transformation”	7330	42.6M	39.1M	8.95
“Digital Business Model”	562	1.16M	0.818M	41.8
“Digital Entrepreneurship”	664	456K	311K	46.6
“Digital”	649K	7.31B	7.30B	0.14

Table 1 shows that there is not only great interest in “digital *whatever*” but great momentum as we see increase in search results in the order of 45% only within 4 months. Yet when it comes to research, “digital transformation” takes the lead with over 12 times more output than “digital business model” and “digital entrepreneurship”. This tells us that there is a great interest in understanding how organizations should transform as they adapt to digital innovations.

It is worth noting here that synonymous with digital innovation is the use of industry/innovation 4.0, introducing new concepts to the already complex nature of the digital arena such as artificial intelligence, cloud computing and the Internet of Things, which add further complications to the digital conundrum because they are perceived and understood differently between different fields of study.

Having a common understanding of these terms is essential in order to have an intelligible academic discourse to build upon. In that endeavour, Bican, M. P. & Brem, A. (2020), using a multi-method approach to reviewing the current literature, they provided definitions for seven core digital-related terms within the management and economics literature and which we feel is relevant to include herein.

- Business Model: Top term encompassing all terminologies of Digital interacting the pathway to Digital Transformation of firms’ value propositions.
- Innovation: Constant discovery through new combinations and interdependent on economic viability, while opening participation for a wider access-base
- Digital Readiness: Basis as organizational necessity for implementation of anything Digital.

- Digital Technology:** Highly interconnected orchestrator of know-how-influenced innovation, enabling transformative change through speed and sustainable market activities
- Digital Business Model:** Enhanced resource optimization, characterised by intangibility, businesses' uniqueness, and core values, centering around experience, platform, and content.
- Digital Transformation:** Outcome of Digital interplay as underlying process, contingent internally (organization) and externally (cooperation), while embracing profound change and implications.

## Digital Innovation

Digital innovation literature continues to emerge appearing in both research, practice and education. Digital innovators such as Uber, Airbnb and Spotify present major firms with challenges causing potentially harming effects significant at the level of their existence. When a digital innovation is of a radical nature, it causes wide system effects to existing industries and markets, yet it seems to have a strong allure to practitioners.

In this 'digital innovator' spirit, organizations continue to experience increasing pressures to digitally adapt by integrating novel technologies and changing the way they do business. The resulting disruptions, seem to have weakened the organization as can be deduced from the surveys that many are not ready to respond to the digital trends (Kohli & Melville, 2018, Kane et al., 2015).

A lot of research has been done in relation to the adoption of information technologies, however, the digital paradigm (versus technology) has changed the playing field in terms of challenges, opportunities and impacts. There used to be a direct path between a novel technology and its consumers, especially that most consumers were not digitally native (referred to as digital immigrants). However, with today's digital native and digital innovation phenomenon driven by new underlying technologies, acceptance and adoption of digital innovations has drastically been altered. It is therefore not clear what we know in terms of impacts of these digital innovations especially that the digital arena has become significantly more complex. We are not clear what research streams exist and what practical methods have been successfully (or not) implemented. Kohli, R. & Melville, P. M. (2018) have made an attempt to bring some light in this matter where they performed a literature review and synthesis on digital innovation. They conducted a combined scientometric and systematic literature review methodologies to examine seven dimensions of an adapted theoretical framework. Their findings indicate that there is a vastly uneven coverage of research streams, diversity and diffusiveness of research. They also suggest several areas of future research. We could not find any other work that attempts to review the body of knowledge in relation to digital innovation.

*Hence, there appears to be a misalignment between demands in the marketplace and organizational capabilities to respond*

*Kohli, R. and Melville P. N., 2018*

its influence on practice. Within this IS scope, Kohli and Melville (2018) identify the main research stream and include:

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*Digital Native (DN)” was coined by Prensky 2001, to define an individual who was born or grew up immersed in digital technology, and naturally considered as digitally adept and engaged. These individuals do not find the complexity of the digital era and constant updates in the field of technology problematic.*

*Sarkar, N. et al., 2017, Dingli, A., 2016*

A precursor to digital innovation studies is research in information systems (IS) where scholars studied innovation and

- Antecedents to adoption
- Design and development
- Organizational change
- Digital innovation initiation
- Exploitation of existing IS
- The role of knowledge
- Assimilation gaps
- The role of technological framing
- Product architecture for organizing digital innovation

In their article, Nambissan et al. (2017) start by defining digital innovation as the use of digital technology during the process of innovating. Although this definition is simple, yet it does help in understanding what digital innovation is. They further elaborate that digital innovation can be used to describe the outcomes of innovation. Further into their analysis, they adopt a conceptualization of digital innovation “that is meant to be inclusive and inviting of perspectives and disciplines that may not have contributed in the past to research on innovation management”. They conceptualize

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*... digital innovation as the creation of (and consequent change in) market offerings, business processes, or models that result from the use of digital technology.*

*... in digital innovation, digital technologies and associated digitizing processes form an innate part of the new idea and/or its development, diffusion, or assimilation.*

*... digital innovation management refers to the practice, processes, and principles that underlie the effective orchestration of digital innovation*

*Nambissan et al., 2017*

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Organizations have a great need for insight and knowledge on how to manage digital innovation. Yet this is not enough because digital innovation necessitates digital transformation. They exist hand-in-hand, as the introduction of any new innovation, necessitates a change to adapt with what is newly introduced, and hence transformation. Recently, ‘digital metamorphosis’ has been associated with the adoption of innovation (Keary, 2019).

Digital transformation goes beyond the traditional notion of change and change management which entails the alignment of organizational strategy with its operations. Yet most literature still treats it as an IS paradigm. There are clear and significant distinctions between the IS and DI paradigms, and will not be discussed here as this discussion is beyond the scope of this study.

## Digital Transformation

Many researchers are making attempts to define digital transformation, but there does not seem to be a consensus. Vial (2019) defines digital transformation as

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*...a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies.*

*Vial, 2019*

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Many have reported that digital innovations lead to business disruption and transformation, particularly in their business strategies and models (loebbecke and Picot, 2015). One perspective to conceptualizing digital transformation is to consider that digital innovation implies new digital products and services whereby management and operations adjust accordingly. In this way, the new products/services enable the organization to compete by creating and delivering new value propositions and by leveraging information technologies to enhance their processes (Vial, 2019, Nambisan et al., 2017).

Another perspective can be viewed in which one considers the organization, during digital transformation, to undergo either *deep structural change* or *convergent change* (Baiyere et al., 2020). *Deep structural change* encompasses the fundamental architecture and tenets under which an organization has been built at which it manifests itself to the world. *Convergent change*, on the other hand, entails a process that does not alter the organization's structure.

Baiyere et al. (2020) conceptualize digital transformation as an organization that would become qualitatively different in both internal processes and becoming intrinsically 'digital' as part of its value proposition, offerings and identify. The implications are that of a reconfiguration of the organizational mind-set in order to adapt to its deep structural change (Vial, 2019).

Some researchers have indicated that many refer to digital transformation as "digitalization". Henriette et al. (2016) express that digital transformation is rarely defined in the literature, and any attempts to do so, simply approach it from a narrow perspective such as it being defined as a social phenomenon, a cultural evolution or creation of new business model. From this study's perspective, we can safely assume that defining digital transformation is parsed all over the literature with no convergence to any common understanding.

Literature on digital transformation seem to indicate (in its simplest form) that it suggests transformation (or change) stemming from new technologies, primarily internet technologies, analytical technologies, mobile technologies and cloud technologies. These digital technologies that appear to be the drivers for transformation may constitute one dimension of digital transformation. Another dimension is user experience (Henriette et al., 2016) where users in a transforming organization, are place at the center of the strategy, where users' expectations include fast and customized adaptation to their digitally driven needs. This is especially true due to the new digital natives.

It is evident from this section, that digital transformation is key for reasonable progress especially that many report difficulties in properly doing so. Most agree that digital transformation require deep vertical as well as broad horizontal changes in an organization entailing the entire business spectrum

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*This simultaneous attention to the generativity and deep structure change that characterise digital transformation, is akin to "changing the wheel on a moving vehicle.*

*Baiyere et al., 2020*

from technology integration and business value alignment to user satisfaction. Yet, a clear and precise understanding of what is digital transformation, does not exist and the literature is disjointed and unfocused. Digital transformation impacts processes, resources, operational methods, culture, organizational intelligence, strategy and employees, among others, yet we do not understand how. More importantly to the present study, the role of the human element (employees, customers, innovators, etc...) in the so-called digital transformation is not studied or considered, with very scarce published work.

## The Human Perspective of the Digital World

Digital innovation rose from the fast-evolving world of technology innovations such as social media, internet of things, artificial intelligence, blockchain (bitcoin) and data science. These innovations are astonishing in the way they have upset and disrupted existing and well-established paradigms, notions, and processes. This is only in the business sense, but more importantly how they have disrupted and changed humans altogether: lifestyle, behavior, and physiology. These innovations continue to accelerate at a faster pace creating a race of computers against humans (workers). If not already happened, it is expected that computers will surpass human workers redefining the paradigm of their existence. It seems to me that everyone is overtaken with keeping up with computers and no one is preparing for the aftermath. What will humans do when computers take over many if not all aspects of their lives and how will their being (ie. Computers) influence the fundamental physiology of humans.

Yet, digital innovations help organizations to continue to be competitive and to maintain their market share. Failing to continue to innovate in their strategic digital plans, results in weakening the organization loose their gains and position to emerging younger firms (Edison et al., 2013)

At this point in time, there are only questions that continue to increase with little, if any, answers. The future of digital innovations is uncertain. Many have provided all sorts of future scenarios such as Amazon making purchasing decisions on one's behalf and artificial intelligence taking over many human activities such as driving. We humans, have to re-orient our thinking, come together, discuss, lobby, and find innovative workable paradigm on how we will co-exist with computer-based intelligence. To that effect, this digital frontier is being ignored and research efforts to bring researchers and practitioners together into one single forum, must be realized.

As we have seen above, the study of digital innovation is a mixed can of worms. We observe that there are three schools of thought: those that advocate that it is good; others that oppose it; and the rest are silently observing. The phenomenon of digital innovation is not really fitting with the adoption of technology theory. The diffusion of innovation theory that includes the innovators, the early adopters, the early majority, the late majority and the laggards does not seem to apply anymore. The diffusion of innovation theory was created when technology was first introduced to people and injected into their lives. Today, people (new born) are injected into the technologies. They get born into it and grow up in it. We may even comically say that many new born are raised by technology. To that effect, we lack any theoretical foundations or even frameworks for the digital innovation paradigm.

Despite all the advances in digital innovation, the problem remains, that we still do not have a clear perspective on its progress and we seem (as individuals, organizations, societies and governments) intentionally or unconsciously oblivious to its effects (as researchers of course). In that sense, we (the entire world) seem to have already adopted not only all digital innovations in the marketplace, all new ones to come. We have submitted to the process, blind to its effects, and flowing, acceptingly, with the ebb and flow of the technological tide – A never ending rhythmical pattern of decline and re-growth.

There are some associations that deal with digital innovation and digital humanities but are very limited in their impact and are dispersed without any joint efforts or plans to strengthen the domain. Moreover, the education sector has only just started addressing or responding to the need for digital innovation and digital humanities education (McGill university and University of Ottawa). Nevertheless, some academic institutions are starting to integrate course in digital innovation into their existing curricula of management of information systems and computer science.

Having said that, Franke and Zoubir (2020) hit the nail on the head when they asked the question “How do we define what technology is for humans?”, in their article entitled,

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*“Technology for the People? Humanity as a Compass for the Digital Transformation.”*

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Is that not what technology or digital innovations should be about? In their article they suggest that technology is simply a tool that enables humans to use resources such as time and mobility. Historically, humans were innovating with a wide range of artifacts to help them utilize resources effectively to fulfill their physiological and psychological needs. We can view digital innovation and transformation from a psychological perspective. The goal of psychology is to identify and understand which factors lead to better mental well-being. In a similar fashion, should not digital innovation/transformation enable organizations and humans to identify and understand the factors (organizational and social) that lead to better human states?

There are many scenarios that can be imagined for future digital innovation states. Some scenarios can be optimistic and other pessimistic. From an optimistic perspective, one can fantasize where digital innovations can increase quality of life in general, provide universal basic income, and manage your time effectively. From a pessimistic point of view though, some scenarios can include the usual loss of jobs to artificial intelligence, cybersecurity, and digital sovereignty.

We do not have to wait for the future to see the impact of digital innovations on humans. Today we have thousands of apps available to use on mobile devices. Therefore, one would expect that smartphones loaded with apps may surely raise the standard of living, yet in one study by Twenge et al. (2018), it was shown that in the teenage group, psychological well-being decreased with increased screen time. With increased screen time, in general, every human faces cognitive challenges in information processing because of limited attention and working memory resources. As we all experience every now and then, the unconscious use of media without reflection, is a clear indication of depleting attention resources.

Ultimately, digital innovation and transformation must be actively shaped and driven, and must be human-centered (Franke & Zoubir, 2020). Today, the world is faced with one paradigm – that of driven by innovation. In this paradigm, the human state is as such: Organizations continue to digitally innovate with whatever is feasible to increase profits while humans are to adapt and avoid direct and indirect negative outcomes. This is rather discouraging as

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*Technology is developed, and its merit and potential harm are discussed ex post facto.*  
*... These possibly indicate ... a learned helplessness – i.e. a feeling of powerlessness in the face of a possible (possibly overwhelming) digital transformation.*

*Franke & Zoubir, 2020*

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To that effect, the paradigm should be driven by society which should be the motor for digital transformation. The real question that every person and business should ask is “how do we wish to live?”. This paradigm suggests the move of what is possible to the assessment of quality of human life.

Along the same thread, we need to innovate with digital innovation and transformation methods and ask the right human-centered questions. We must allow for divergent thinking and multi-disciplinarity in our approach to study it. Future research must look for net long-term human-centered utility of possible digital innovations spanning all stakeholders from fulfilling human desires to meeting government GDP goals. They are all interconnected.

## REVIEW METHODOLOGY

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### Overview

Literature review methodologies are numerous. The fact that science is, first and foremost, a collaborative and cumulative effort, makes literature reviews the more critical. This is especially the case due to the exponential increase in the body of literature, especially in the digital arena. Literature review are very important since they provide an assessment of the state of the art, and evaluation of impact, and guidance to researchers and practitioners alike. Literature reviews can be structured or not, systematic or not, and quantitative or qualitative. They also vary in purpose and provide important information on:

1. The scope of research being conducted,
2. The impact of the body of knowledge for
  - a. extending research breadth and depth,
  - b. usefulness to practitioners,
  - c. enhancement of the human state,
  - d. benefits to the world,
3. Identifying gaps in research studies,
4. Aggregated and synthesized findings,
5. The way forward through inspiration and sharing of ideas to generate new theories, frameworks and applications.

We can differentiate between two types of literature reviews, which we will label here as ‘Type A’ and ‘Type b’, where the ‘Type A’ is a section in an article that can be entitled ‘Background’, ‘Literature Review’, or any other appropriate title that aims to cluster a set of papers that were published in the same area of the article at hand. ‘Type B’ of literature review is when the entire article is dedicated to identify, collect, analyze and synthesize the body of literature in a specified area of interest. ‘Type B’ which is the typically referred to as “review article”, creates a significant starting point for all researchers of the same subject matter interest (Paré et al., 2015, Mulrow, 1987).

Although the aims of a literature review may be similar and may have similar approaches, many have proposed different steps to a literature review:

- Kitchenham et al. (2009) proposed a systematic approach to their literature review methodology. Their aim was to synthesize and analyze concepts, organize empirical findings, and identify gaps in the literature. The steps they followed are:
  - Identify sources of articles,
  - Create independent group of researchers to conduct literature review from each individual source,
  - Establish an inclusion / exclusion criterion for the selection of accepted articles,
  - Conduct a quality assessment group peer to peer,
  - Establish a final set of accepted articles and extract articles' data,
  - Conduct a quality assessment group peer to peer on the data that has been extracted,
  - Discuss and agree on final results by all group members.
- Brocke et.al (2009) proposed a generic approach that can be applied to all the fields. The approach is cyclical and entails:
  - Definition and review of scope,
  - Conceptualization of subject matter of interest,
  - Literature search,
  - Analysis and synthesis, and
  - Establishing of a research agenda.
- “The Cochrane Collaboration” is a significant and well-established literature review methodology used primarily in medicine ([www.cochrane.org](http://www.cochrane.org)). The Cochrane approach is an established evidence-based structured and systematic review process.

There is another well established literature review paradigm that is popular in many disciplines. The “Systematic Literature Review” (SLR) has similar aims as other methods in that it helps to map, assess and identify the gaps in the current body of knowledge. The way SLR differs from other methods is found in its reproducible, scientific and transparent process. Its perspective is to collect all publications that fit pre-defined inclusion criteria and uses unambiguous and systematic procedures to reduce bias during the execution of the review steps, namely identification, appraisal, synthesis, analysis, and summary. The main process of an SLR entails (Mengist, 2020):

1. Establish research questions,
2. State objectives explicitly and that can be reproduced,
3. Create appropriate search strings that would capture relevant studies,
4. Assess the quality/validity of the selected studies (such as risk of bias and confidence),
5. Systematically present the results and synthesize the extracted data, and
6. Conclude the study findings and make them available for scientific purpose and decision making (Moher et al. (2015), Del Amo, (2018)) .

Templier & Pare (2015) suggested that there is a generic process, found in most if not all approaches, to conducting a literature review. They include the following steps:

1. Research question formulation,
2. Literature search,
3. Inclusion/exclusion criteria,
4. Evaluation of studies,
5. Extracting the data,
6. Analysis of data.

## Review Method Used

The literature review approach followed in this study is in line with most approaches but can be considered closest to the SLR, since it is rather structured and systematic. The approach was devised with the nature and purpose of context in mind.

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*Compared to all other literature review methods, the main characteristic of the approach used herein, is that our goal was to evaluate the current state of the body of knowledge with the aim to identify gaps and propose research questions to be picked up by other re-searchers in the area of digital innovation and transformation in general, but more specifically as they relate to human and society effects.*

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The steps performed in this study were to ensure that the literature review is systematic, comprehensive, rigorous, and reproducible. They are:

- *Step 1: Level 1 analysis:* The literature review covered articles from peer refereed journals. This entails a first scan of the sources of the literature.
- *Step 2: Concepts identification:* Our aim is to iteratively identify scope of body of knowledge. The coding process identifies a set of concepts to be further researched.
- *Step 3: Level 2 concepts analysis:* Research for occurrence or frequency of identified concepts.
- *Step 4: Distinguish among concepts:* The 'distinguish factor' used was similarity/difference in the meaning. The concepts which sounded similar were put together and categorized as one.
- *Step 5: Develop rules for inclusion:* All the case studies were read to ensure that they meet the inclusion criteria.
- *Step 6: Read final set of articles:* Final set of articles were read.
- *Step 7: Extraction and preparation of information:* Article metrics and information contained within each article is retrieved and coded, and made ready for analysis.
- *Step 8: Analysis and synthesis:* The results analysis consisted of analyzing the articles' metrics and synthesizing the articles.

## Software Utilized

Publish or Perish (Harzing, 2007) is a desktop software program that retrieves and analyzes academic citations from user-selected various sources. The data sources used in the present literature review include Google Scholar and Microsoft Academic Search to obtain the raw citations, then analyzes these and presents the following metrics:

<i>Hirsch's h-index:</i>	A metric of an academic's impact, combining quality with quantity (Sidiropoulos et al., 2007).
<i>Esshe's g-index:</i>	Improves on the h-index by giving more weight to highly-cited articles.
<i>Zhang's e-index:</i>	Aim to differentiate between scientists with similar h-indices but different citation patterns.
<i>Contemporary h-index:</i>	Improve on the h-index by giving more weight to recent articles.
<i>Age-weighted (AWCR):</i>	The age-weighted citation rate and index measure the average number of citations relative to an entire body of work, adjusted for the age of each individual paper.

<i>Individual h-index O:</i>	This original (O) h-index answers the question “Is it possible to compare researchers with different scientific interests?” in order to reduce the effects of co-authorship.
<i>Individual h-index A:</i>	This alternative (A) h-index, developed by Publish or Perish, is much more fine-grained to more accurately account for any co-authorship effects and that it is a better approximation of the per-author impact, which is what the original h-index set out to provide (Jin et al., 2007).
<i>Multi-authored h-index:</i>	Fractional paper counts are used to account for shared authorship, then determining the multi-authored $h_m$ index based on the resulting effective rank of the papers using undiluted citation counts (Batista et al., 2006, Schreiber, 2008).
<i>AAIIBI:</i>	Average annual increase in the individual h-index developed also by Publish or Perish calculates the average annual increase individual hI and is meant as an indicator of an individual's average annual research impact, as opposed to the lifetime score by the h-index.

It is worth mentioning here (for convenience), that on their website, Publish or Perish explain that their tool is designed “...to empower individual academics to present their case for research impact to its best advantage. We would be concerned if it would be used for academic staff evaluation purposes in a mechanistic way.”

Publish or Perish makes the following suggestions for users while performing any type of citation analyses, as general rule of thumb:

- Good citation metrics are indicative of a very likely and significant impact made on the field.
- The reverse is not necessarily true, and weak citation metrics does not mean that the individual has made little or no impact on the field as this may be due to the field being small/narrow, language considerations and/or publishing in books.

## CURRENT STATE OF THE ART

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The Harzing, (2007) Publish or Perish software analytical tool was used to assess the body of research published in various areas of digital innovation and digital transformation. Figures 1, 2 and 3, and tables 1 and 2 below, outline the various publications and counts.

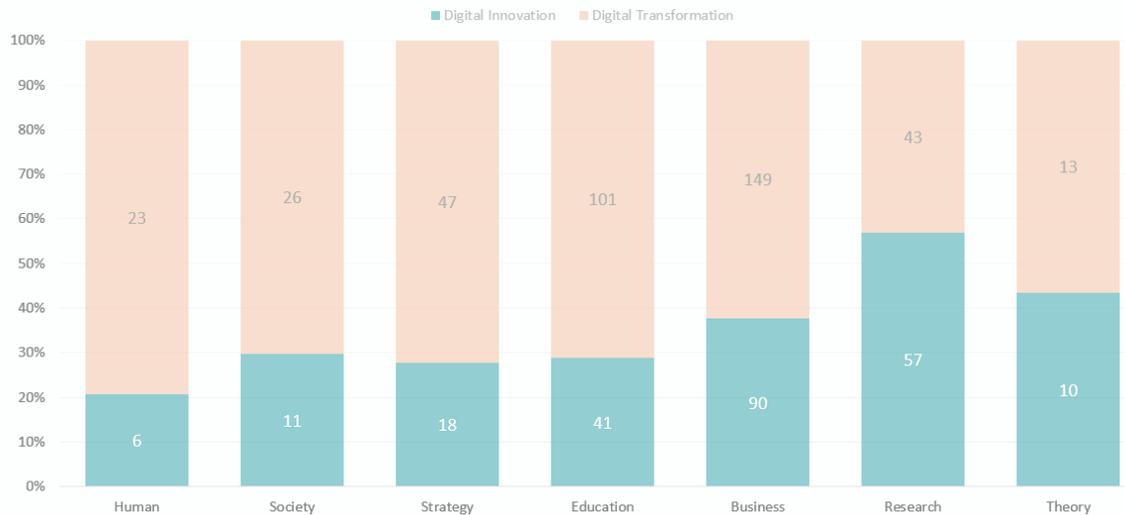
The Publish or Perish software (a desktop application and further elaborated in the following section) was utilized to retrieve and analyse academic citations key words found in their titles. As part of this software we selected Google Scholar as the search engine of choice. The analysis below presents the results on-screen and which could be selected and copied to the clipboard (for pasting into other applications) or saved in a variety of output formats. An interesting aspect of this software is that it is designed to allow academics to assess research impact of one or more article, authors or concepts.

In this study, we aim ultimately to specify the digital innovation/transformation research in the context of human/humanity and identify research gaps and opportunities in the subject area in general. Initially, we investigated the research body across a number of areas which we extracted from non-structured searches done in Google scholar, EBSCO, ProQuest and ABI/INFORM. These context areas were identified as categories under which digital innovation and transformations have been studied. These context areas are human, society, strategy, education, business, research and theory. Therefore, although one may argue the strategy can fall under the business area, yet we found many standalone works about digital innovation/transformation strategy. So, one would expect that duplicate articles may appear under strategy and business categories. This is accepted in the present study since we are looking to understand the subject matter addressed in the research first and foremost.

Our concern is the better understand which areas of interest are prominent and have attracted researcher’s attention.

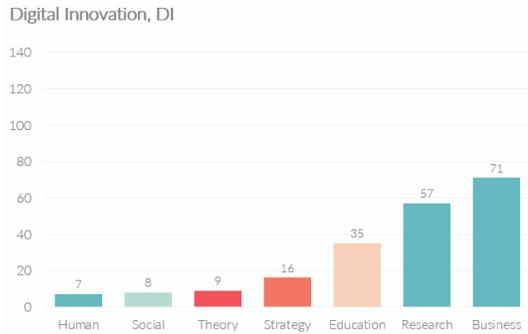
Figure 2 shows in teal that research in the area of digital innovation across all concepts is much less than in digital transformation which the exception of Research with 57 and 43 articles published in digital innovation and digital transformation respectively. We would agree that research in the area of digital innovation and transformation has not attracted some serious attention as reflected in the number of articles which total 635 articles, 37% of which are in business, and 22% in education. Therefore, close to 60% of research in digital innovation/transformation are in the areas of business and education. This is understandable since industry 4.0 is driven by digitalization while higher educational institutions need to keep up to date in teaching student’s what industry wants – a typical example yet again on industry driving the educational agenda. This is even more supported if we consider strategy category as part of business which makes the research in the areas of business and education closer to 66% (two thirds), with research in business twice the amount in education at 44% to 22% respectively.

Unfortunately, it seems that the research community is least concerned about the effects of digitalization on humans as reflected in the areas of human and society, which encompasses only approximately 3% of digital innovation and 8% in digital transformation. It is clear that research in the areas of human/humanity and society is lacking significantly.



**Figure 2.** Number of articles by concepts – innovation versus transformation.

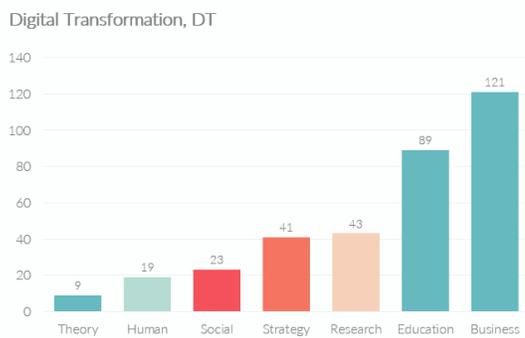
Figure 3 and 4 below depict the number of articles published in the research areas in increasing order and for digital innovation and digital transformation respectively. Human, social and theory categories are the least studied in both innovation and transformation research while education, research and business have received more attention by researchers, with business being the most popular area of study.



### Key Insights

- There is a large gap in research work on the role of DI in Human welfare, Social impact and Theory.
- Combined, these above categories constitute approximately 12% of total published work in DI.
- Unfortunately, only 3.4% of articles have studied the influence of DI on Humans.
- The role of DI on Business is the most studied but is still relatively small compared to other areas, fields and disciplines.

**Figure 3.** Digital innovation articles by concepts.

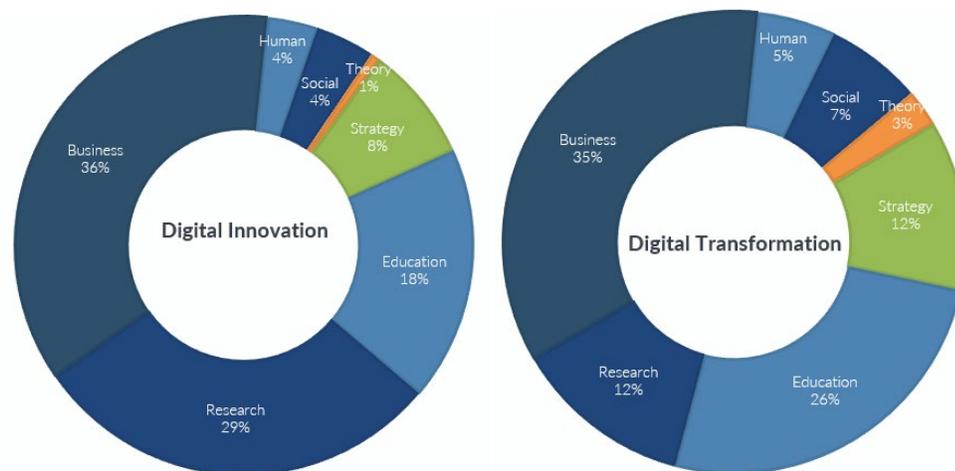


### Key Insights

- 27 out of 121 from Business category are from 2020.
- 95% of articles were published in the last 5 years.
- 73% of articles were published in the last two years.
- Theoretical work on DT is scarce.
- Research on effects of DT on Humans is relatively negligible.

**Figure 4.** Digital transformation articles by concepts.

Figure 5 presents a comparative view between digital innovation and digital transformation publication contribution within each, side by side – left is digital innovation and right is digital transformation. This visualization shows the same results as in figures 1 to 3 but also drives the point that further that in both categories research in the areas of human (including social) is scarce.



**Figure 5.** Comparison of body of knowledge within and across ‘innovation’ & ‘transformation’.

Tables 1 and 2 below list the relevant articles in digital innovation and transformation in the area of human, respectively. Table 1 shows that the most cited article (in red) had only 8 citations published in 2013 in IEEE – special issue. Similarly, table 2 shows that the most cited article is from 2014 which has 79 cites. The second most cited article drops sharply to 36 cites followed in third position with yet another sharp drop of 18 cites. These cites are not in any way significant and indicate that there does not seem to be a community of researchers working on the same problem. The research is rather dispersed.

It is also clear from table 2 that the 5 relevant articles in digital innovation and humanity dealt with an eco-system for digital lab for education, human-computer interaction, human resources management, product design and digital inclusiveness in a medical human brain project.

**Table 2.** Articles for digital innovation in the area of human – Cites, year and publisher.

Cites	Authors	Title	Year	Publisher
8	Conruyt, N	Eco-innovation for making e-services living labs as a human-centered digital eco-system for education with ICT	2013	IEEE
1	Jüngling, S. et al.	Innovation Potential for Human Computer Interaction Domains in the Digital Enterprise	2018	Springer
0	Zhao, S. et al.	Innovation-Driven Human Resource Management Practices in the Digital Era	2020	Emerald
5	Kumar B. U. et al.	Proactive ergonomics through digital human modeling and simulation for product design innovation: A case study	2013	IEEE
0	Grasenick, K & Guerrero, M	Responsible Research and Innovation & Digital Inclusiveness during Covid-19 Crisis in the Human Brain Project (HBP)	2020	Elsevier

Tables 2 and 3 also identify the outlets (publisher) where the articles have been published. They are primarily IEEE (3 articles), Emerald (3 articles), Sage (1 article), Elsevier (2 articles), and Springer (6 articles), with 4 articles in conferences. Table 2 also reveals the interest of the very few researchers in the human area subjects of:

- resources
- touch
- human work
- factors
- cyber-security
- capital
- identity
- customer relationships

**Table 3.** Articles for digital transformation in the area of human – Cites, year and publisher.

Cites	Authors	Title	Year	Publisher
0	Tursunbayeva, A et al.	“Planned Benefits” Can Be Misleading in Digital Transformation Projects: Insights From a Case Study of Human Resource Information Systems Implementation in ...	2020	Sage
12	Betchoo, K. N.	Digital Transformation and its impact on Human Resource Management: A Case Analysis of two unrelated businesses in the Mauritian public service	2016	IEEE
11	Bajer, J.	Digital transformation needs the human touch	2017	Emerald
2	Vardarlier, P	Digital transformation of human resource management: digital applications and strategic tools in HRM	2020	Springer
0	Baptista, J. et al.	Digital work and organisational transformation: Emergent digital/human work configurations in modern organisations	2020	Elsevier
36	J Kaivo-Oja, J. et al.	Futures of robotics. Human work in digital transformation	2017	Inderscience

6	Amladi, P.	HR's guide to the digital transformation: ten digital economy use cases for transforming human resources in manufacturing	2017	Emerald
1	Al-Ohali, Y. et al.	Human Factors in Digital Transformation of Education: Lessons Learned from the Future Gate at Saudi K-12	2019	Springer
6	Guryanova, V. A. et al.	Human transformation under an influence of the digital economy development	2020	Springer
0	Benter, M. & Kuhlmann, P.	Human Work Design: Modern Approaches for Designing Ergonomic and Productive Work in Times of Digital Transformation—An International Perspective	2018	Springer
0	Ali, F. et al.	Human-Technology Centric in Cyber Security Maintenance For Digital Transformation Era	2018	iopscience
0	Ereshchenko, V. M. et al.	Multimodal Training as the Strategy of Human Resources Development in Conditions for Digital Transformation	2019	shs-conferences
0	Polyanin, A. et al.	Specificity of human capital in the conditions of digital transformation of business organizations	2019	matec-conferences
79	Nagy, P. & Koles, B.	The digital transformation of human identity: Towards a conceptual model of virtual identity in virtual worlds	2014	Sage
0	Thierry, J.P.	The human resource: cornerstone of the digital transformation of the healthcare plan	2020	europemc
0	Ivanova, A. I. et al.	The transformation of human capital during the transition to a digital environment	2020	iopscience
0	Seliverstov, Y. et al.	Transformation of the Educational Environment and Formation of Human Capital in the Digital Economy	2020	dpi-proceedings
2	Belleghem, V. S.	When Digital Becomes Human: The Transformation of Customer Relationships	2016	ACM
18	Bauer, W. et al.	Working life within a hybrid world—how digital transformation and agile structures affect human functions and increase quality of work and business performance	2017	Springer

## ANALYSIS OF RESULTS

### Review of Analytical Process

In this study, we followed a systematic literature review approach (Hossain & Rehman, 2016). As mentioned earlier, the SLR approach differs from the traditional literature review in such a way that it is more rigorous, replicable by others, and transparent, as it explains in details every step of the process including the outcomes of each step.

It is worth to briefly recall the steps followed by our SLR approach in this study, with some relevant elaboration. These steps comprise of the following:

- *Step 1: Level 1 analysis:* First scan of the sources of the literature using Harzing, (2007) publish or perish software. Google scholar search engine was used by the software to obtain the raw citations.
- *Step 2: Concepts identification:* In doing multiple searches starting with ‘digital AND innovation’, in the title alone, by scanning the results’ titles we were able to identify a set of recurring concepts. Although in this step, we were interested in finding the scope of the research subject matter as it related to digital innovation, we ultimately are more interested in the body of knowledge related to human or humanity.
- *Step 3: Level 2 analysis of concepts:* After noting the concepts found in the previous step, we performed multiple searches with those concepts (e.g. ‘digital AND innovation AND Human’ to capture occurrence or frequency.
- *Step 4: Distinguish among concepts:* We applied a ‘distinguish factor’ in the analysis to identify similarity/difference in the meaning. The concepts which sounded similar were put together and categorized as one.



NVivo was used for the generation of the word cloud. The options used for display words was 100, form minimum word length of 6 (to include the word human and which is of primary interest to this study). We made many simulations by varying the three parameters to obtain the most stable results yet representative of the data set being used. It is important to perform multiple simulations with a specific aim in mind (ours namely being least variation and increased clarity) because word clouds should be used and interpreted with caveats such as words with similar meaning or singular and plurals.

The word cloud generated above clearly shows that digital innovation and transformation are the major attraction for research. This is of course expected because we only selected articles that contain these terms. To that effect, we configured the word cloud to include three concentric areas. At the center you find the red words. Surrounding the center are the words in bold, and the last outer area includes the words in grey. Our interest with the word cloud is the words (concepts) other than the three primary one, namely digital, innovation, transformation.

The figure shows that the most prominent words are human, society and project. This is also shown in table 4 below which ranks the top ten words by count. Looking at both table 3 and figure 5, and excluding digital transformation/innovation, two findings can be inferred: (1) Society and human (which can be synonymous conceptually) constitute the primary category for research and (2) every other word is less than 50% (with the exception of development which is at 44%) in occurrence (in the title). This tells us that ‘digital transformation’ is prominent with human with some focus on society. ‘Digital innovation’ is less prominent (meaning less research in the area) with some random and few articles in the areas of education and business.

**Table 4. Word ranking by Count.**

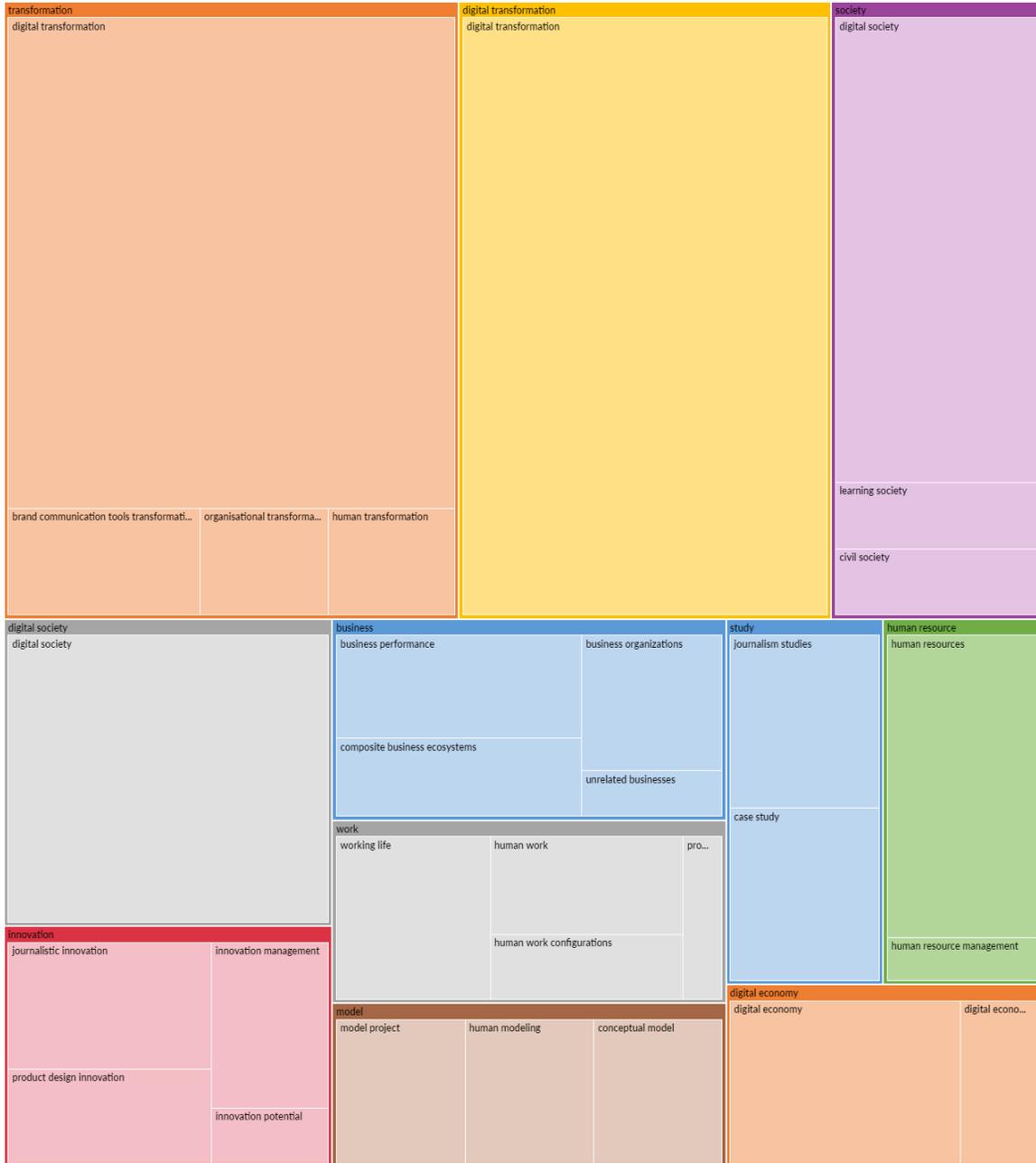
Word	Lengt	Cou <sup>v</sup>	Weighted Percentage (%)	Similar Words
digital	7	63	12.09	digital, digitally
transformation	14	43	8.25	transformation, transforming
society	7	31	5.95	society
human	5	28	5.09	human, world, worlds
innovation	10	25	4.13	design, designing, innovation, modern
development	11	14	1.70	developing, development, educating, education, educational, modern, training
project	7	11	1.73	design, designing, planned, project, projects, proposal
education	9	10	0.93	civil, educating, education, educational, teaching, training
studies	7	9	1.20	field, learned, learning, studies, study, working
business	8	8	1.54	business, businesses

It is important to note that the use of the word human can also be misleading such as in the article entitled “An innovation developing flip flop book (digital) on organ systems in human”. This article is highly specialized as it belongs to the medical category and which is not reflected as such. Although the word human is ranked at number 4, it does not represent our primary interest which is humanity. The word human is used in medical, resources management, and work, while it representing humanity is found possibly in only three studies in relation to human factors, identity and capital.

Figure 7 below presents a cluster analysis of the words in the title of the final set of articles selected for study. Cluster analysis in general help the visualization of patterns found in the data. Cluster analysis is part of the exploratory technique family of analytics which allows researchers to visualize patterns found in groups of words with similar attributes. Basically, a cluster analysis is a diagram that provides a graphical representation of relationships between similar words.



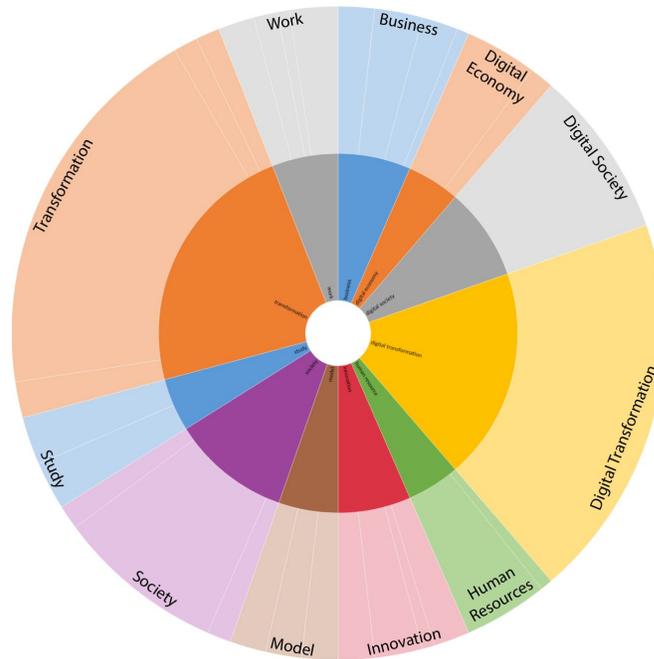
Figure 8 below presents the hierarchy chart of keywords created using NVivo. Hierarchy diagrams represent the aggregation of the qualitative data being analyzed. Every keyword (or concept in the present case) will be represented on a hierarchy chart in a parent-child relationship. The size of a parent depends on where the concept is related to children. With a hierarchy diagram, it is possible to establish levels of themes and subthemes to the data being analyzed.



**Figure 8.** Hierarchy chart of concepts – Developed using NVivo.

Based on figure 8, the displayed conceptual relationships identify the themes and subthemes for our search to organize the studies related to digital innovation and transformation within the human context. Figure 8 provides further insight to the previous diagrams as it shows relevant

clusters in the area of interest. Therefore, under the theme of transformation, digital transformation is associated with brand communication, organization and human. The first level concept or theme, society, is associated with learning and civil. Similarly, business to performance and work to human, life, and productivity.



**Figure 9.** Sunburst diagram of themes.

The sunburst diagram shown in figure 9 provides another visualization of the hierarchy of the themes and concepts found in the title of the articles under study. Considering all the analysis so far, we observe recurring themes that may group relatively in similar ways with small variations. Yet, there does not seem to be some pattern, map or model that moves us towards a framework to help researchers and practitioners in their work. At this point, we organize the information into 4 themes, each with three subthemes (still not far from the analysis but one step closer to a framework or model), as follows:

1. Human life
  - a. Individual
  - b. Society
  - c. Ecosystem
2. Working Life
  - a. Business
  - b. Government (not studied but added here)
  - c. Economy
3. Knowledge
  - a. Theory
  - b. Conceptual modelling
  - c. Design
4. Change
  - a. Development
  - b. Innovation
  - c. Transformation

In the following section, we will build on our findings and continue working towards a generalized framework that can serve as a guide for researcher to pick up new areas to study or to align/integrate with their current studies.

## CONCEPTUAL MODEL

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The analysis from the previous section identifies four themes extracted from the literature review. A natural and logical next step would be to identify the gaps in the body of knowledge, but considering that research publications in the subject area of digital innovation/transformation and humans/humanity is scarce, we feel that it would be more useful to propose a conceptual framework that may capture all relevant elements.

In order to conceptualize this model, we draw from and build on the methodology followed by international development agencies (IDA) such as the Canadian International Development Agency (CIDA) and the Integral Theory (IT). We feel that the methodology used by IDAs (and who collectively spend 100s of millions of dollars on projects around the world) has major strengths in their ultimate goals to assess impact and utilize that for future planning. At the same time, the integral theory attempts to unify human potential.

The digital paradigm has created the global village where everyone, and today increasingly everything, is connected around the world. Not only data, but information and knowledge are now global. Which means that everything we know is now available to everyone, or can be made available. The integral theory attempts to aggregate and consolidate all essential keys to human growth and evolution based on extensive cross-cultural studies, to create a comprehensive map (integral map). This map entails 5 elements: perspectives (quadrants), levels of development, lines (elements) of development (Psychograph), states, and types (masculine & feminine) (Wilber, 2005).

We propose that Wilber's (2000) integral theory can serve as a framework by which to view the various possibilities of the impact of digital innovations on humanity. Our interest in the integral theory is due to the fact that it brings together multiple theories into one approach. At the same time, it provides insights to multiple possible levels of studies and investigations for both researchers and practitioners alike, to explore. Finally, an integral approach may provide some strategy and cohesion the much-needed structure of research in digital innovation area of study.

The integral theory is comprehensive in its world view as it extends beyond systems theory, social responsibility, and corporate citizenship, and aggregates science, religion and ethics into a holistic perspective. We provide an overview of the integral theory and avoid any details because it is outside the scope of this article, and the proposed framework utilizes only one of its elements. As we develop a follow up article to an integral theory paradigm for research programs (which we plan to publish herein), we leave it up to the researchers and practitioners to further delve into the various elements of the theory for inspiration.

The integral theory model entails four quadrants named AQAL – All Quadrants All Levels. In his model, Wilber (2000) describes integral psychology

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*...as an endeavour to honor and embrace every legitimate aspect of human consciousness.*  
Wilber, K. 2000

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The AQAL presents four quadrants describing the interior and exterior of each individual and of the collective. The left side entails the subjective while the right side includes the objective, of the individual and the collective. In this model, and using the original terminology, the quadrants represent the ‘self’ as the individual first person, the ‘it’ as the individual third person, the ‘we’ as the collective second person, and the ‘its’ as the collective social system (Landrum & Gardner, 2012).

Building on the AQAL, we propose the conceptual model shown in figure 10, that can be utilized as a framework for research and practice. This model, which refer to as the Human-Digital Innovation Integral Model, HDIIM, includes four quadrant which identifies high level areas of research and practice, in terms of states and systems, namely the physical and mental states of individuals, and the ecological and social systems of the collective. Interactions occur as indicated by the arrows and which we refer as the impact chains to be discussed later. For example, the physical state can impact the social system via two pathways, through either the mental state or the ecosystem.



**Figure 10.** Proposed human digital innovation integral model [HDIIM].

Within each of the quadrants shown in figure 10, we include different intelligences which represent lines of development, which provides opportunities for research focus and practical considerations:

- Cognition,
- Morality,
- Affective, or emotions,
- Interpersonal,
- Needs (as in Maslow’s hierarchy of needs),
- Identity,
- Aesthetics, as in self-expression,
- Values

All of those lines of development are part of every quadrant and can be considered from egocentric, ethnocentric and world centric views.

Considering the body of knowledge in the quadrants of the proposed HDIIM, we performed a brief ‘allintitle’ Google search with digital innovation and transformation, and include the word that most represents the quadrant, shown after the ‘+’ sign, such as the ‘+Health’. Table 5 presents the results which further support our findings where digital innovation and transformation has been least studied in the quadrant of ‘mental state’. Nevertheless, the body of literature in the other quadrants is relatively small.

**Table 5.** Comparison of Google search terms for HDIM.

	Digital +	Innovation	Transformation	Search Results
<b>Physical State</b> <small>Body</small>	Physical State (+Health)	✓		142
			✓	89
<b>Mental State</b> <small>Mind &amp; Self</small>	Mental State (+Mental)	✓		9
			✓	3
<b>Society</b> <small>Friends, Family, Community</small>	+Society	✓		30
			✓	90
<b>Ecosystem</b> <small>Country, World, Environment</small>	+Ecosystem	✓		74
			✓	33

In addition to the lines of development or intelligences that can be used as guidelines for research and practice, we also include in our model the concept of impact assessment to represent the interactions between the quadrants. First, let us peek into the body of literature related to digital innovation and transformation and impact assessments.

Google scholar returns 430 references for ‘allintitle: impact assessment methodology’ search. Browsing through the title, we find that are some established impact assessment methodologies such as the ‘life cycle impact assessment methodology’, and a ‘delphi methodology for economic impact assessment’, yet most research work on impact assessment create or build their own specific methods. Also, most of the impact assessment work is in the environmental area. Including ‘digital innovation impact assessment’ returns two articles, one is related to nature conservation (Galán-Díaz et al., 2015) and the other is on assessment of innovation activity (Toropova et al., 2020). Replacing innovation with transformation and Google scholar returns one article that is relevant and addresses the impact of made by the digital transformation of an accounting system on a decision-making system in an enterprise (Saed, 2020). All this is indicative for great opportunity to publish in these areas.

As mentioned earlier, we propose herein as part of our conceptual model an impact assessment methodology utilized in international development projects that are not-for-profit and which many are performed by governments such as CIDA.

Generally speaking, impact assessment can be broadly described as the process of identifying anticipated and/or actual changes as a result of a development intervention, on individual, social, economic and environmental factors, and what this intervention intentionally or inadvertently may affect (Bird, 2002). While Roche (1999) provides a definition of impact assessment in an attempt to clarify its meaning, he does introduce several elements in his definition. Looking at his definition, we find 4 elements that engender impact assessment:

- Systematic analysis
- Concept of change
  - Lasting and/or significant
  - Positive or negative
  - Intended or unintended
- The target is people
- The driver is ‘action’

In order to better understand impact assessment, we need to clarify the meaning of ‘impact’ alone and ‘assessment’ alone. Impact is a noun and by definition it either describes the force or energy of a collision between two objects, or a significant or strong influence. Therefore, considering the definition of impact, we are then dealing with 3 distinct entities:

- The system
- The target
- The action between them

Based on the above impact is viewed as a two-way relationship between two objects such that one influences the other. Then, we need to understand what we mean by assessment. Assessment is a noun that is defined as ‘*a formal judgment of the value of something*’. Judgment is the act of determining and value is the quality(ies) of an accepted ideal (by an individual or a group) that renders something desirable (to that individual or group) (HEFCE, 2004, Hailey & James, 2003). To that effect, we define impact assessment in the present context as follows:

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Impact Assessment is a systematic evaluation type of study that attempts to appraise the extent of interaction of an implementation of a specific digital innovation project or digital transformation program, on desired quality(ies), outcomes, and level of success.

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These types of studies are of particular interest to practitioners as they emphasize needs assessment, holistic feedback, and change (in our context transformation). The point of governments’ spending on international projects is to make positive change, and they require data-driven assessment on how this change occurred, its extent, and for how long will it be sustained. Impact assessments usually use a variety of tools/methods such as qualitative (focus groups, interviews, surveys) and quantitative (activity data, participatory data, surveys) (Gosling & Edwards, 1995). Usually impact assessment approaches use multiple tools for triangulation of results.

Impact assessments, in general, entail the identification of units of assessment (UA) (Hailey & James, 2003), that are viewed to occur at the individual, household, organization, community, development agency, institutions and any combination, levels. Important gaps to understanding can be revealed when the focus is extended on a particular level or unit of assessment. Carrying out the analysis at different levels has the potential of revealing any inter-linkages between them (Roche, 1999). The opportunity for research and practice with the impact assessment method is the potential to explore the whole ‘impact chain’ and so investigate the linkages between inputs and activities, towards a holistic view.

## DISCUSSION

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### Findings in Perspective

The most significant outcomes from digital innovation is the successful creation of novel IT-enabled artifacts provided as products, features, functions, processes, and services. As we have seen above, despite its salience, hype, rhetoric and omnipresence, exploration of digital innovation development and outcomes have received very little scholarly attention in the literature.

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Our literature review produced a mere handful of diverse and dispersed studies, suggesting a significant opportunity for future research.

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Following the impact assessment spirit, outcomes of digital innovation appear in numerous locations and in diverse forms. Many blogs and news outlets continue to talk about it in various industry sector. In the media the hype of digital innovations in the form of blockchain, artificial intelligence and cloud computing continues to increase. Basically, every one every where is talking about digital innovation and transformation.

Given that innovation is often considered an outcome of research and development initiatives, the number of scholarly publications of digital innovation and transformation is, at this point, the most common and sensible metric to measure. Among the outcomes of digital innovation such as its effects on productivity, profitability, risk mitigation, and customer loyalty, its impact on human quality of life is paramount. Whereas internal outcomes have been the subject of measurement such as process redesign and simplification of productivity, increase in sales and customer loyalty, higher margins of profitability, error and risk mitigation such as liability insurance premium (Menon & Kohli, 2013) and market-facing metrics such as market share and consumer satisfaction, very few have explored the digital innovation outcomes impact chain from the individual to the ecosystem and the environment. Given that innovation involves novel ways of doing things, outcomes such as time-to-market, product features, and consumer reach play an important role in measuring innovation outcomes.

As evidenced by the paucity of research on digital innovation and humanity exposed by our literature review and synthesis, existing knowledge provides few insights into the process of agency. In particular, the digital innovation literature is largely silent on the role of agency in recognizing, agreeing upon, and formulating the problem or opportunity. Human agency is a critical component in how firms separate “signal” from “noise” or distinguish between fads or fashions and mindful change (Abrahamson, 1991). How is digital innovation managed if knowledge gathering during the initiation phase or in an ex-ante impact assessment, reveals contradictory results to executive intentions and beliefs, and how that impacts the decision-making power structures?

Research in organizational innovation is nebulous (Damanpour, 1992, Hage, 1999, Geiger & Cashen, 2002, De Jong & Kemp, 2003, Palmberg, 2004, Fruhling & Siau, 2007) and gives the impression that the organization as a whole speaks as one representing all its stakeholders. In reality, this is not true, and the digital innovation process is dotted with individuals’ judgements, perceptions and experience that are influenced by bias, power, culture, economic conditions, psychological state, and other forces (Acs & Audretsch, 1988). Appropriate impact assessment mechanism of stakeholder’s relevant information is essential a-priori.

There is a notion of a technological regime impacting the digital innovation paradigm that is usually embedded within the DNA of an organization. Such a technological regime is represented in the literature by the tension between a deep-rooted component-based technological

infrastructure, and a service-oriented architecture. In the process of transformation, the organization needs to evolve into some form of a digital architecture composed of three agencies, namely the physical material, digital material and human agency (Svahn et al., 2009). Only then can digital innovation be properly managed.

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*Digital innovation is a result of a dialectical process, resolving various elements of resistance, subjection, and accommodation across the three types of agency.*  
Svahn et al., 2009

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Digital innovation research lacks the study of important mechanisms for impartial agreement on what pertinent information and knowledge to capture. Human agency sensing capabilities should play an integral role that organizations should invest in. Research should look into the initiation of digital innovation since it is the most crucial point for human agency. What mechanisms should organizations develop to initiate a digital innovation? What are the external and internal condition for more effective initiation?

In parsing the complex process of digital innovation, and from an organization's point of view, Kohli & Nigel (2018) argue that organizations may be subject to the reductionist fallacy considering the 4 core activities of digital innovation (initiation, development, implementation and exploitation), rather than their texture, form, essence, or nature. Considering only the 4 core activities, important phenomena may be missed. It is important to view digital innovation from alternative framings such as emergent, complex phenomena (Janssen et al., 2015), and involving self-organization (Nan & Lu, 2015).

Kohli & Nigel (2018) developed a theoretical framework which implicitly assumes that organizations approach digital innovation in a deliberate, mindful way. Much empirical evidence supports this view. However, there is also evidence of the opposite: ad hoc approaches to digital innovation, hence the paradigm of Frugal Innovation discussed in the next section.

## List of Issues Addressed

the most important feature of digital innovation is successful generation of new IT-enabled products,

### 1. Digital disruption

(allintitle: digital disruption: 724 – all dates)

The digital transformation of organizations around the world is occurring at an increasing rate, with the goal to facilitate business innovation and improve efficiencies. It seems that if digital transformation has its own life, then its imperative is to remain insistent in the thoughts of managers. In fact, although, there has been a focus on disruption of industry in all sectors, digital transformation is also impacting every day life at the individual level as well. Transformation always causes disruption and discomfort to all stakeholders from the common person to governments. Digital disruptions are transforming the experiences of people with the co-occurrence and coexistence of a massive amount and intensely evolving digital technologies (Shrivastava, 2017).

Few business executives would argue against the disruptive nature of digital innovations and its growing disruptive influence. Yet little evidence has been presented and the magnitude of this digital disruption has not been assessed (Rauch et al., 2016). There is little insight even to the extent at which organizations and other stakeholders are reacting to this the disruptions. Executives and managers are aware of the disruption issues and they are reacting to them blind with little or no guidance to the appropriate course of action (Bughin, 2017).

In the same vein of the dot com boom during the mid-nineties, today's Silicon Valley CEOs are on a crusade to disrupt the world by changing the entire economic structure, society, every day individual's lives, work habits and patterns and consumption, at a rate that is breathtaking, to the least (Matzler et al., 2018). The internet of things, cloud computing, 5G, robotics, artificial intelligence, big data, social media, MMORPG, 3D printing are just some of the technological and digital innovations collectively conspiring to disrupt the industry in all sectors with opportunities for entirely new products and services and business models. The pressures they are putting on industry to change are fundamental and is requiring them to transform in ever shorter time. As one would expect, many still struggle with this type of transformation, are in reactive mode, and when they do, they react slowly and inappropriately.

There is much to say about the pattern of disruption over the past couple of decades. Research lacks this cluster of studies, meanwhile streaming movies innovators such as Netflix, killed Blockbuster and Amazon disrupted the entire retail industry and its supply chain.

Digital disruption can be viewed as sever systemic effect whereby some digital innovation such as Uber, Airbnb, and Spotify challenges existing dominant organizations at a fundamental and structural level (Skog et al., 2019). Digital disruption can be conceptualized as:

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*...a type of environmental turbulence induced by digital innovation that leads to the erosion of boundaries and approaches that previously served as foundations for organizing the production and capture of value.*  
Franke & Zoubir, 2020

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Literature indicate that researchers and practitioners are not clear on the meaning of digital disruption and on what it actually entails. There is some general idea about the notion of disruption which is common to any type of innovation, however, the digitization paradigm changes the entire arena in ways everyone is till trying to understand. As such, it seems that the basis for digital disruption is the lack of a convergent digital innovation discourse, which in itself triggers uncertainty on how individuals, organizations and governments should prepare and respond to digitally-induced disruptions.

Stonehouse and Konina (2020) identify today's emerging digital technologies that will disrupt managers in many sectors of the economy namely:

- Self-driving cars
- Genetic engineering
- Blockchain
- Dig data analytics
- Immersive technologies and virtual reality
- Robots

- Quantum computers
- Internet of Things and
- Artificial Intelligence

Bughin (2017) in their survey study found that two thirds of executives expressed that they lacked alignment of their strategies with digital innovations. Moreover, only one in five organization has significantly transformed its business portfolio, and even among those organizations, few only aligned it with their strategies. In this case, it seems that the notion of digital strategy is still not well understood and therefore organizations have problems in implementing it as part of their corporate strategy.

## 2. Digital innovation resistance

(allintitle: digital innovation resistance: 3; Allintitle: innovation resistance: 422)

It is clear from the Google search numbers that there is some work done on innovation resistance with 422 hits, but when we add the word digital to the term, we find only 3 references. A quick scan of the literature indicates that most of the studies published are consumer-based research.

Innovation Resistance Theory (IRT) has been used to understand the purchasing behavior of consumer. More specifically, the IRT is a theoretical framework for customer-resistance-oriented behavior (Kaur et al., 2020). In their article, they define innovation resistance as:

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*...behavior resulting from rational thinking and decision-making regarding the adoption and usage of innovation because of the possible changes brought by alterations to the existing status quo and deviations from the existing belief system.*

*Hew et al., 2017*

The importance of digital innovation resistance comes from observations that consumer resistance may be attributed as a major cause of failure of any innovation, and despite some increased interest in the subject, non-adoption and consumer resistance has received less attention as compared to subjects such as drivers for adoption success (Talwar et al., 2020).

An overview of emerging themes and key variables in consumer resistance to digital innovations research is presented schematically by Talwar et al. (2020), and we list them below for convenience:

- Theoretical underpinnings:
  - IRT
  - TAM
  - UTAUT
- Methodological perspectives
  - Cross-sectional studies
  - Scale development
  - Comment/post analysis
- Outcome variables
  - Innovation resistance

- Adoption
- Attitude
- Intention to use
- Late adoption
- Actual usage
- Barriers
  - Usage
  - Value
  - Risk
  - Tradition
  - Image
- Non-adoption
  - Opposition
  - Rejection
  - Postponement
- Socio-demographics
  - Age
  - Gender
  - Religiosity
  - Income
  - Education
- Inhibiting/Stimulating resistance
  - Innovation characteristics
  - Consumer characteristics

In their article, their structured literature review uncovered research-related patterns and the authors provided valuable insights and information for further research.

### 3. Digital innovation and industry 4.0

(allintitle: digital innovation industry: 119; allintitle: digital innovation industry 4.0: 16)

The term Industry 4.0 (or the fourth industrial revolution, FIR) is referred to as the “*inchoate transformation of production of goods and services resulting from the application of a new wave of technological innovations.*” by governments, private and public institutions, and research literature (Caruso, 2018). The primary elements are found at the intersection between production processing and information flow, found in the digital innovation space such as the IoT, cloud computing and big data, and devices that include sensors such as digital chips, that communicate with each other along the entire supply chain – this is the cyber-physical systems digital space.

The general feeling about DI and industry 4.0 is that the effects of productivity, efficiencies, opportunities and the work environment are expected to be mainly positive. However, there are concerns. Technology and digital innovation is used as pretext to transformation through restructuring processes with the promise for financial gains and cost reduction. Yet, some researchers advocate that politics, and not the digital innovations, should decide the form of that digital innovation. It is not possible for digital innovations themselves to predict consequences on individuals or organization. Three dimensions have been identified for the effects of digital innovations (Orlikovski, 1992):

- Intended or unintended
- Direct or indirect
- The degree to which a technology is reconstituted in use

In their analysis, Caruso (2018) find that the notion of digital transformation often called “digital revolution” in the context of industry 4.0, has not achieved its promises so far. He is not alone with this view as many reports, that work organizations have not become more horizontal, nor has digital innovations increased workers’ autonomy and decision-making power. The debate is centered on workers becoming more creative and only for a small portion of them who are highly skilled. In fact, and especially with COVID 19, work has become more precarious, less paid, and distinction between work time, leisure time, and family time has been blurred.

Browsing through the 16 articles on digital innovation and industry 4.0, we observe that most of them relate specifically to specific industries such as fashion, family business, energy, retailing, and food and beverages, and countries such as the EU, UAE, and Italy. Three articles had “business model” in their title. It is clear that the subject area of digital innovation and transformation and industry 4.0 present many research opportunities.

#### 4. Digital innovation readiness

(allintitle: digital innovation readiness: 13; digital transformation readiness: 22)

Surprisingly, with all the hype related to digital innovation, only 13 articles were listed in Google scholar, with a title search. The same is true with digital transformation readiness where only 22 articles were found. Yet, there is a lot of rhetoric, news, corporate reports and blogs related to this area. Why has the research community not found interest in this subject which can be very fruitful and is very much needed to provide guidance to practitioners.

In a recent study published in ‘information and management’ journal, Lokuge et al. (2019), expressed that despite the proliferation of digital technologies and the promise of digital innovation potential, approximately 90% of new ideas in organizations never convert to new products and services. They claim that this is due to their lack of readiness.

They conducted a study to develop an a-priory model for digital innovation organizational readiness, and which included the following 9 constructs:

- Resource readiness
- Cultural readiness
- Strategic readiness
- IT readiness
- Innovation valance
- Cognitive readiness
- Partnership readiness
- Global measure of organizational readiness for digital innovation
- Innovation implementation effectiveness

They then tested the model showing the results explaining 76% of the variance. Their survey included 26 items.

It seems that there has been attempts by researchers to define readiness. The variation in their definitions include the concept of state and ability to engage with a specific activity within a specific period of time.

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*Readiness is a state that is attained prior to the commencement of a specific activity in relation to psychological, behavioral, and structural preparedness of the organizations.”*

*Helfrich, et al. 2011*

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This line of research where studies undertake the challenge to identify and operationalize the constructs that are important to organizational success for digital innovation and transformation, is very important and timely. Many important issues will arise from this line of research such as ‘false starts’ which are blamed for the many innovation failures (Nylén & Holmström, 2015).

## 5. Digital humanities

(allintitle: digital humanities: 3390; digital innovation humanities: 16)

Withing the context of digital innovation, Digital Humanities (DH) have an important role to play (Tarte, 2011). Originally from a traditional area of study, as the Humanities, DH was conceived and developed by the introduction of computing following an interdisciplinary methodology, whereby the influence of the digital domain on society is investigated (Kroeze et al., 2017).

A Google scholar search for the year 2000 on digital humanities finds only 4 articles, 3 of which are related to digital libraries. Research in the area started to pick up in the years after reaching 25 articles in 2007 and over 60 in 2010. In 2015 and 2018, 340, and 477 articles were published in the area and level off at this rate to around 400 per year (give or take 20 articles). During that time, the subject matter moved from digital libraries, into the introduction of digital media in university humanities programs and then diversify today to subject matter such as:

- Feminism,
- Visualization in biographical dictionaries,
- The historical web,
- Ethics: In the context of internet research,
- Digital theology,
- Ancient Chinese,
- DH in universities across the world such as Romania,
- Network analysis,
- Digital Humanities’ Shakespeare problem – a canon problem,
- Systemic functional grammatics,
- DH in middle school, and
- Automatic text annotation system for supporting digital humanities research (digital innovation?).

In a similar vein, and for comparative purposes, we performed a Google scholar search by adding the word innovation in the title. The number of articles found for “Any time” is 16, with the following subject matter:

- Digital curation and innovation in DH,
- Language industry and multilingualism – Global networking and innovation in collaborative methods,
- Technocultural innovation,
- Temporality and innovation in DH,
- The African DH for innovation,
- Information visualization, innovation and integration,
- Innovation dynamics in digital cultures and humanities,
- The digital humanities innovation in Spanish community,
- Virtual visualization teaching innovation
- DH and IS,
- Digital innovation in publishing,
- Research innovation and institutional growth,
- Implications for innovation in the humanities, and
- DH and political innovation.

We observe that visualization remains a constant interest to researchers in DH, but the subject matter of study seems to have diversified and undergone innovation by itself, going from entities of study such as Chinese and Theology to more complex areas such technoculture and political innovation. Digital humanities are

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*...regarded as an interdisciplinary endeavor that does not only digitize traditional research in the Humanities, but also attempts to enhance and renew Humanities research by fully integrating technology with these disciplines.*

*Kroeze et al., 2017*

*... - or should be – a movement in the Humanities that aims to design, develop, promote, and use digital tools to support work – academic or not – in the various disciplines of the Humanities. It strongly encourages, benefits from, and contributes to interdisciplinary practices, including beyond the Humanities.*

*Segolen, 2011*

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Kroeze et al. (2017) continue explaining that the distinctive feature of DH is its cultivation of an area of study where the relationship between the humanities and the digital is better understood. In effect, engaging in questioning and interrogating technology in pursuit of humanities (and vice versa?). They conclude in their study that the humanities disciplines including digital humanities do not have many links to the field of information systems. In summary, the area of digital humanities has many opportunities for research and merits a structured literature review analysis, as a start.

## 6. Digital business ecosystems

(allintitle: digital platforms: 94 | 2020:8; 2019:11; 2017:3; 2016:4; 2015:1; Before 2015:58)

It is rather interesting that 58 out of 94 (around 62%) articles obtained from Google scholar search are prior to 2015. This presents great research opportunities as it is an indication for

the need to update the body of knowledge. In a recent, and timely, article by Senyou et al., (2019), a literature review and a framework for future research had been performed.

Digital Business Ecosystems (DBE), has been conceptualized from the European Union (EU) project (Whitley & Darking, 2006). Since then, Senyou et al. (2019) report that DBE has gained popularity in many disciplines, management, tourism and computer science. Considering the number of published articles, especially in the past 5 years, we do not consider that DBE has become popular. Considering that their reference list includes 73 articles, most of which do not include DBE in their title, further supports that the subject of DBE has not attracted researcher's attention.

In practice, however, a simple search will show that executives have been paying attention to the DBE paradigm as there is more rhetoric and dialogue about the notion of organizational ecosystems. There seems to be a convergence of a digital ecosystem conceptualization where emphasis is put on external shared resources, building partnerships and shared co-value products and services.

A brief overview of DBE is opportune at this point. The following are some of the attributes of digital business ecosystems:

- DBE is a cluster of business community interacting via a loosely coupled digital innovation network to co-produce products, services and value
- DBE portrays organizational interdependence with important emphasis on the centrality of digital technology/innovation
- Entails two tiers namely the digital and business ecosystems tiers
- DBE is multifaceted and can be considered as a concept, a technology or a project
- The co-created value is greater than the part created by one of the partners
- Value creation involves input and resources from all partners and can be financial, information, knowledge, etc...

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*DBE as a socio-technical environment of individuals, organizations and digital technologies with collaborative and competitive relationships to co-create value through shared digital platforms*

*Senyou et al., 2019*

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The proposed framework for DBE research by Senyou et al. (2019), aggregates all research themes, methodologies and theories used. It would have been interesting to identify the number of articles for each of the categories but looking at the numbers, their results indicate that research in DBE has been dispersed and there does not seem to be any depth in any sub-area thereof.

We can summarize their gaps for future research recommendations to be in interdependence analysis and measurement, framework and models development, platform development and management, governance, regulation and security, standardization, integration, digital infrastructure, and empirical work. We believe that there would be many more research opportunities in DBE research especially the human aspect which they only mention managers.

## 7. Digital platforms

(allintitle: digital platforms: 2110; allintitle: digital platform: 5210 – all dates)

From a functional perspective, digital platforms can be viewed as businesses that create an environment for at least two user groups to interact. For example, Facebook, Twitter, Instagram and LinkedIn are social media digital platforms, Google is a search engine digital platform, and StackOverflow is a knowledge digital platform.

Hein et al., (2019) present an excellent fundamental study on digital platform and ecosystem and propose a definition that integrates both systems. This is an important step towards better understanding digital platforms which has been investigated by scholars from various disciplines such as computer science, information technologies, economics, and management. In their article, they explain how different digital platform ecosystems vary based on value creation mechanisms, ownership and autonomy, and conclude by suggesting four research areas.

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Interestingly, scholars are starting to refer to digital platforms as an “omnipresent phenomenon” for value co-creation within an agent-driven autonomous ecosystem.

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De Reuver et al. (2018) conceptualize digital platforms (DP) by first defining non-digital platforms (NDP) and then explaining the difference between DP and NDP as well as how they differ from digital infrastructures.

Every business is built by creating what is called components or modules that represent either physical artifacts or processes, or a combination of the two. Whatever the case may be, an organization will have a number of those to independently or combined serve a user group. It is viewed that any component or module or combination that serves a purpose and a user group is referred to as a platform.

This conceptualization provides an environment where modularization by mixing and matching components creates innovativeness (Baldwin and Woodard, 2009, Henderson and Clark, 1990). Some examples include production process categories and supply-chain coordinating mechanisms. In the latter case, the platform provides a stable core and a variable periphery component that transacts between different user groups (Reuver et al., 2018).

While NDP can be represented as physical entities with clear ownership and hierarchy, DP, on the other hand, the inherent nature of information technologies necessitates the homogenization and synchronization of data, editability of content, recyclability of code, distributedness and interoperability of its components and modules, and self-referentiality (Kallinikos et al., 2013). In this case, the combination of the modules and components imply that it would be very difficult to define the owner of the platform and results in a loosely coupled hierarchy and by extension architecture.

Nevertheless, due to the pervasive penetration of digital technologies, IT-enabled digital platforms have gained significant importance. Not to confuse digital platforms with applications or software, but DP have a continuously evolving design due to very frequent changes in IT capabilities and complements and heterogenous nature (Williams and Pollock, 2008, Spagnoletti et al., 2015).

Ultimately, digital platforms include many different players/actors that need to orchestrate their relationship activities. Their main goal is to co-create value (Lusch & Nambisan, 2015). A brief Google scholar search shows that there are thousands of articles related to digital

platforms and with a little review we can see that the scholarly field is broad and diverse (Hein et al., 2019). As a result, recent scholarly publications have emphasized the need to view digital platforms in terms of digital platform ecosystems (DPE) in order to produce a fruitful body of knowledge to help theory development and guide practice for sustainable and healthy competitive advantage.

## 8. Digital innovation and OECD

(allintitle: digital innovation OECD: 4)

The Organization for Economic Co-operation and Development (OECD), recently published an article on fostering science and innovation in the digital age (OECD 2019). The OECD discusses the challenges and opportunities of assessing and accessing scientific data and publications considering that an average scientist reads about 250 articles per year and more than 26 million peer-reviewed papers exist in the biomedical science alone. They advocate that the research communities and funders revisit mandates and incentives to publish in journals with inadequate quality control. It is estimated that 28 billion USD is spent on unreplicable preclinical research (Freedman et al., 2015). Digital innovations and tools can help, such as the use of artificial intelligence for plagiarism. They identify four trends in innovation and digitalization in organizations:

- Data as the key input for innovation,
- Digitalization enables services innovation,
- Digital innovations speed innovation cycles, and
- The increasing collaboration nature of innovation.

In an effort to transform innovation in the digital age, effective policy should include the following objectives and considerations:

- Ensure the broadest possible access to data and knowledge,
- Government agencies should help coordinate and steward data-sharing agreements between firms and between firms and public research institutions,
- Government needs to be flexible and alert to change, especially due to the fast-changing pace of the digital arena,
- Governments should coordinate and synchronize information about emerging digital skills needs between businesses, trade unions, and educational institutions,
- Committing to public sector research, as government is the least contributor, in comparison with business enterprise, higher education and private non-profit,
- Foster public-private partnerships in key areas of technology development,
- Fostering diffusion of digital technologies,
- Development of technology-specific and sector-specific capabilities in government, and
- Using and optimizing digital systems to strengthen innovation policies.

## 9. Digital UN sustainable goals

(allintitle: digital united nations: 23; allintitle: digital united nations sustainable goals: 2)

The United Nations was created to encourage, foster, and harmonize cooperation, relations, and actions among member states towards the attainment of common goals (Bouchard, 2020). Moreover, digital technologies and innovations have had an impact on multilateral diplomatic interactions (Bjola et al., 2019). In chapter 5, Bouchard (2020) investigates the in-

fluence of the new digital communication environment, namely digital technologies and innovations, on the united nations, where the extent of the digital ICT's impact on processes was examined.

From the 23 articles, 13 can be rejected because they are not relevant (i.e. UN digital library), and with only 10 remaining articles published in the area of digital united nations, and with a brief scan of those articles, we can identify the general areas of publications:

- Digital signature for enhanced security,
- Digital barriers for the dissemination and implementation of the US sustainable goals,
- Scientific information challenges and opportunities,
- The right to privacy,
- Global law for digital products,
- Digital cooperation,
- Digital blue helmets for cyber peacekeeping, and
- Digital gender divide and sustainable goals.

The only article we found to discuss the United Nations sustainable goals and digital innovation is by Smith (2018), who questions how can bringing the digital gender divide accelerate the achievement of the UN sustainable development goals?

In 2010, the UN created the Millennium Development Goals (MDGs) to meet the needs of the world's poorest. One of the initiatives was the Broadband Commission for Digital Development. In 2015, the MDGs were replaced by the Sustainable Development Goals (SDGs), which included the following 17 items:

1. No poverty,
2. Zero hunger,
3. Good health and wellbeing,
4. Quality education,
5. Gender equality,
6. Clean water and sanitation,
7. Affordable and clean energy,
8. Decent work and economic growth,
9. Industry innovation and infrastructure,
10. Reduced inequalities,
11. Sustainable cities and communities,
12. Responsible consumption and production,
13. Climate action,
14. Life below water,
15. Life on land,
16. Peace, justice and strong institutions,
17. Partnerships for the goals.

In their study, Smith (2018) assess that at present 200 million fewer women are online than their male counterparts and that is having detrimental effect on the ability to achieve the UN sustainable development goals of 2030. In the same vein, researchers need to look into the UN SDGs and align, pickup or adopt (basically innovate) them with their research interests. We all need to come together and support the UN in this endeavor.

It seems to me that digital innovation, and transformation is a cross-cutting theme in the UN SDGs. Research in this area will be on the ground floor and would benefit by addressing ways in which DI and DT are an integral part of each and every item in the SDGs.

## 10. Frugal innovation

(allintitle: frugal innovation: 341)

Based on Google scholar, it seems that the first publication on frugal innovation (FI) appeared in 2005, which dealt with China's impact on environmental improvements in East Asia – technology related innovation. The next published article was in 2008, which was a study on business models-design for frugal growth. In 2010, The Economist wrote a few articles on the subject, one report was published in Business Standard, and another in Planning Commission. In 2011 the first scholarly articles appeared in the journals of Research Technology Management (Zeschky et al., 2011). In 2012 and 2013, Google scholar shows 17 and 16 articles respectively with a mild jump to 27 in each of the 2014 and 2015. In 2016, the article count went up to 47, 2017 at 40, 2018 at 52, and 2019 with a modest increase to 60.

Relatively not much research is done on frugal innovation and which seems to be a niche field within the digital innovation arena. Many have provided a definition to frugal innovation, and we include the more comprehensive one below.

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*Frugal innovation as a resource scarce solution (i.e. product, service, process, or business model) that is designed and implemented despite financial, technological, material or other resource constraints, whereby the final outcome is significantly cheaper than competitive offerings (if available) and is good enough to meet the basic needs of customers who would otherwise remain un(ders)erved.*

*Hossain et al. (2016)*

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Some examples of frugal innovations include cars, medical devices, health services, solar energy and water purifiers. (Hossain, 2017). Frugal innovation is a topic primarily focused on developing countries, understandably so, due to its nature to use as much free resources as possible. Hossain (2018) in his literature review article of frugal innovation, finds that academic literature and practices has emerged in an unorganized and convoluted fashion. Moreover, many of the relevant theories that exist today are not suitable for explaining frugal innovation (Ahuja and Chan, 2014). Research opportunities related to frugal innovation (and more specifically frugal digital innovation (FDI) entail the following:

- Theory development,
- FDI disruption,
- Sources of FDI,
- Organization FDI,
- Success factors,
- FDI asset management,
- The need for partnerships,
- Cost-benefit analysis,
- FDI project management,
- Challenges and opportunities of FDI,
- Development methods of FDI,
- Architecture and design,
- Diffusion and adoption,

- Consumer behavior,
- The promise of FDI,
- FDI in higher education,
- FDI as a strategy,
- Sustainability,
- The Frugal Entrepreneur? and
- FDI versus mainstream development methods,

Above are some examples for research in this area. Hossain (2018) presents schematically a framework of frugal innovation process that may help in identifying further research in the area and include 4 categories:

- Input,
- Success factors,
- Impeding factors, and
- Output

Ahuja & Chan (2019) assessed frugal innovation to be an emerging paradigm mainly practiced in developing countries across the continents, including but not limited to China, India, Brazil and Kenya. This is due to lack of access to resources and the need to affordability and simplicity to overcome them. As such, the focus is on the value of the products and services. The need to “innovation frugally” seems to be very advantageous because it encourages organizations to fit their business models with consumer needs in an economically, socially and culturally sensitive and sustainable way. In this perspective, frugal innovation is more human-centered.

## IMPLICATIONS

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As we set out initially to scope the state-of-the-art in digital innovation and humanity research, we found that it would be only possible if we start by broader concepts in order to obtain a better perspective of the literature as they relate to humans and humanity. We discovered that the field of digital innovation comes hand-in-hand with digital transformation and from there research splits across these two main branches, but in similar ways. All the research concepts repeat in both branches but with approximately double the interest in digital transformation. From the various concepts identified, human and society were the least studied.

For researchers, every concept on each of the innovation and transformation branches merits a state-of-the-art structured literature review with analysis and alignment to other research streams. Moreover, any combination is an opportunity for research. Digital innovation and transformation is not only occurring in organizations but, as our proposed framework shows, at the individual (physical and mental), society (including organizations and governments), and the world ecosystem. The study of any of the concepts in any of the contexts found in the proposed conceptual framework, is a relatively an empty arena waiting for insights. Some of the research themes, that today include one or two published articles are (note: innovation can be replaced with transformation in most items listed below):

- Digital innovation capacity,
- Digital innovation leadership,
- Digital human agency,
- Digital mindfulness,
- Digital innovation and internet economy,
- Digital innovation (cognitive) resistance,

- Digital innovation addiction,
- Societies of Hyper-Control,
- Digital innovation in education,
- Digital innovations for the disabled,
- Digital politics and conflict resolution,
- Digital human,
- Digital effects on ....,
- Digital innovation management,
- Digital innovation perspectives across cultures,
- Digital human augmentation (One article found. With human augmentation, we Google scholar returns 1400 results.)
- Digital transhumanism (transhumanism in Google scholar results in 675 articles, while digital transhumanism returns 4 articles.)
- The digital innovation pharmakon (my favorite), and
- Influence of digital innovations on consciousness.

The list above is not comprehensive nor complete but includes themes found in our literature review with only one or two articles published in the area. Moreover, each subject on this list merits a special issue in the literature. This domain of digital innovation and transformation requires massive amount of research and linkages to organizations creating those innovations. Studies of all types are needed and timely, from theoretical, empirical, case studies, reviews of digital innovations, technical notes, observations, etc....

The practitioner is the ultimate benefactor of the outcomes from digital innovation and transformation scholarly studies. This domain needs to be aligned similar to the engineering field where applied and theoretical research work hand in hand. Academic theory is utilized by engineers to create applied customized solutions. Similarly, research in digital innovation and practice should create an applied paradigm where practitioners can use the theory to create appropriate and 'good' digital innovations. The practitioner, should in the spirit of collaboration share data and information with researchers and provide them support in order to make sense of their innovations activities and serve the public well. For example, practitioners would benefit from the following:

- Dimensions of digital innovations and transformation,
- Factors of success,
- Case studies of failures and successes (especially in the case of organizational digital transformation which are mostly failures),
- The human element
  - Consumers
  - Management
  - Teams
- Cognitive aspects of digital innovations such as
  - Flow
  - Engagement
  - Dissonance
- Impacts of digital economy
  - Internet of things
  - Cloud computing
  - Artificial intelligence
  - Blockchain
  - Big data analytics

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What we are advocating is that a new paradigm between researchers and practitioners need to be forged. Government funding for academic research in the digital innovation arena does not work, and is out of synch.

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The ongoing old paradigm of government funding for academic research does not work for the following reasons:

- First, researchers need to be very narrow in focus to have better chances in getting their grants approved. Narrow research is limiting to industry in the present context.
- Second, the mechanism of government funding is very slow to produce useful results for industry. By the time any research results are published, organizations would have already moved to better and more refined innovations.
- Third, many researchers do not have industry experience and are disconnected with the real world yet their research is published by rehashing content in the literature in the form of various combination. These researchers cannot conceive of applied usable research for industry.
- Fourth, academic research is motivated for the purpose of tenure and not for impact to organizations and society. Also, tenure considerations do not consider industry connections, neither does administration support and encourage that.
- Fifth, the academic culture does not foster an environment for researchers-industry collaboration.
- Sixth, industry does not make enough effort to connect to the researcher directly but rather go through administration, which due to bureaucracy and inefficient processes, discourages both researchers and industry to get involved.
- Seventh, once tenure is obtained, interest in research drops dramatically for most. There are no effective motivational mechanisms for researchers to continue with a strong research plan nor to connect with industry.
- Eighth, industry does not understand how to take advantage of your researchers nor do they know how to guide researchers to do applied research. So, there is clearly a communication gap for knowledge creation opportunities.

Considering the above, we advocate that a partnership between industry and academic researchers is necessary. Because this subject is outside the scope of the article, we briefly highlight some of the most important elements of this digital innovation partnerships sphere (DIPS):

- In the same vein as engineering labs, create industry-based research labs (Lab for Applied Digital Innovation Research - LADIR) as independent entities outside the organization and the academic structure.
- Engage academic researchers and match them to key personnel from different areas or the organization such as marketing, finance, supply chain, etc...
- Similar to structured literature review, establish a structured process for the identification of key areas for research, perform collaborative peer evaluation of proposed ideas, sort and rank and get feedback from various stakeholders, and establish plan for a specific time horizon of interest.
- Researchers are supported for their research work in terms of equipment, material, students, and scholarly travels, and organization can benefit from the research outcomes and do what they do best which is 'monetizing'. Researchers gain access to data, support for publications and dissemination, and bonuses at end of year based on the monetization of the research results via new revenues or cost savings to the organizations. It is worth nothing that many

organizations around the world do that with their employees, but they have not captured the untapped potential in academic researchers.

## CONCLUSION

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This paper is part of the inaugural set of articles for the “Journal of Digital Innovation for Humanity – JDIH”. We acknowledge that the literature review herein, is lengthy. Nevertheless, it should not be tiresome to read. It is intended to be comprehensive, such that as many aspects of digital innovation are covered, which can be used to inspire researchers to pick up studies, align their current research, integrate or extend/expand their research, in this arena of digital innovation and transformation. We attempt in this paper to supply researchers with an arsenal of ideas and concepts, pointing to the different directions of research and applied opportunities to be had.

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*Conditions of modern life could be driving changes in the makeup of our genes. Our bodies and our brains may not be the same as those of our descendants.”*

*Scientific American ‘What May Become of Homo Sapiens*

*<https://www.scientificamerican.com/article/what-may-become-of-homo-sapiens/>*

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While some believe that humans have not evolved much since prehistoric times, others believe (and studies confirm) that the pace of human evolution is increasing with the advent of cities. Are humans still evolving? What will happen to humans in the next few decades as they adapt to environmental and social changes, and with new digital innovations surprises? Are you hopeful or dystopian? Giant brain or not, it seems that human evolution lies not within its genes but within technology and digital innovation, as humans shall augment their brains and bodies with silicon and steel.

It seems that humans were primarily created to evolve. History is dotted with evolutionary milestones making clear distinctions in the human tapestry. With each new set of important developments (regardless of it being social, political, or technological) a new era is created with a new scene for new forms of thinking and organization. Even knowledge itself is reconfigured, combined and transformed, into new understanding, in the course of these developments (Stiegler, 2019).

It is important for us as humans to understand all aspects of our development in order to better make judgement for the quality of our lives. To that effect, appropriate research is primordial. As such, our primary concern is the effect of digital innovation on humans, or humanity, whichever makes sense to you. Therefore, we set out, as we launch this journal (JDIH), into exploration to map what has been studied. We found that the concept of digital is very popular and continues to be a famous buzz word. Any other concept attached to the digital concept gains popularity by association. However, we found that certain trends loose momentum very fast. In the world of blogs and news and reports, the digital rhetoric is abundant, overwhelming and not sure if saturated yet, especially that the dialogue in the community at large continues to gain momentum. Nevertheless, when we look at scholarly research, using Google scholar, the number are relatively small. For example, using the term ‘digital business model’, we have 818 hits in Google, whereas in Google scholar the number of hits is only 562 articles (0.069%).

Narrowing down the area of interest to digital innovation and transformation, we find ourselves working with a couple of hundred articles spread across areas of society, human strategy, education, business, research and theory. This can hardly be considered a strong body of literature in any

area. Since the ultimate focus and hence message of this journal (JDIH) is about the relationship between digital innovation and humanity, we find that the research, and the articles, are rare and handful (17 articles). Granted that there are more publications in digital transformation and humans and combined we can total them to 59 articles, and that includes with the keywords, ‘human’ and ‘society’ as well. This is still relatively very small number.

We perform a qualitative analysis on the literature review data obtained and identify areas of research that have been addressed so far. They span over 11 subjects with a handful of studies in each. With this in mind, it is clear that each and every subject area identified is still fertile grounds for further research, including any combinations of these areas. As well as many areas can be identified with new subject matter to study. To that effect, we proposed a research development model based on the integral theory and identifying 4 interconnected states where digital innovation and humanity research can be done, namely the physical, mental, social, and ecosystem states. We hope that with this so far, we provide researchers with the background information on digital innovation/transformation and humanity and provide some structure by which they can follow for their research.

It is worthwhile noting (and maybe philosophically speaking), that the problem with current trends and patterns in emerging digital innovations is that they create a psychological and behavioral gap that gives rise to an absolute emptiness of thought.

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*In its ultimate purpose, digital innovations must foster new forms of thought, yet instead, they replace them with behavioral & psychological forms of automation, addiction, and neurosis. Could it even be possible that digital innovations could create a society of obedience, subservience, and observance?*

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These negative outcomes disrupt (maybe convolutes) the transmission of various knowledge forms of life to younger generations, via explicit (digital information chunks) to tacit (absorbing and assimilating the information) knowledge processing, and vice versa. It is best elaborated by Reader (2019) on her review of Bernard Stiegler’s book:

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*There is a rupture as a result of the failure of this new era to communicate the values and practices of previous times to the next generation. Instead, what they are given is simply the latest smart phones, apps, and digital devices through which they increasingly mediate and negotiate their relationship with the world and each other.*  
*Reader, 2019*

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It is common that various types of patterns of thought and behavior emerge from affective dynamics between individuals and their respective relations. These patterns effectively arise from interaction with family, friends, colleagues, bosses, and mentors, who play an indispensable role in forging dreams, goals, objectives and common horizons (Stiegler, 2019). Could this be, as Reader (2019) put it, as “the hollowing out of civil society seen as a result of the impact of a globalized culture mediated through digital technology.” Deleuze and Guattari (2009) introduce the concept of “societies of hyper-control”.

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The effect of a Society of Hyper-Control has a lot to do with the intensity, speed & volume of information (with no quality control) sharing, & that is mediated and controlled by digital technologies and innovations, required for social and individual development.

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Our concern (we all should!) for establishing and guiding future generations in this increasingly digital world, can be considered as the digital innovation pharmakon, which can be poison/venom or cure/remedy.

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*The danger of an algorithmically dominated economy and culture is that it operates at speeds far in advance of normal human thought processes and thus pre-empts the possibility of reflexive or critical responses: the digital pharmakon – which, through the speed at which it functions, makes it possible for calculation to destroy the improbable, that is desire, affection, attachment, identification, singularity, individuation and the feeling of existing physically and thus collectively, which are the conditions of any neganthropy - .... is also the bearer of a new epoch of psychic and collective individuation.*

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As mentioned earlier multiple times, this study presents the findings on the body of knowledge related to digital innovation and transformation system as an integral part of the human ecology. We wish to conclude by address a little further the notion of agency in our particular context.

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Agency is viewed by social science as the capacity of humans for independent thought and act through free choice. This statement is loaded with complex ideas of independent thought, action and free choice. We cannot stress enough though, that this statement reveals the crux of digital innovation rooted in consciousness.

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No digital innovation can be considered adequate without the inclusion of human agency attributes in its conception, birth, growth and death. This is where we feel that most of the research should focus on, and ultimately the point of this lengthy article. Regarding agency, Google scholar search (allintitle: digital innovation agency) results in only 4 articles, three of which are in conferences. Of most relevance to our own message attempt herein, Van Den Berg & Verster (2020), present a pilot project where students propose social, digital innovations for complex problems within marginalized communities in Cape Town, South Africa, with the goal of developing community-agency-sensitive digital innovation. Human agency attributes such as empathy and storytelling were emphasized at the design level of the digital innovation. An inspiring example, of an integral digital innovation.

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## AUTHOR'S BIOGRAPHY

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**Dr. Raafat George Saadé** is a professor at Concordia University. He was awarded the Canadian National Research Council fellowship at McGill University. Dr. Saade has published over 115 research articles many of which in top tier journals such as Fuel, Intl. Journal of Numerical Methods in Heat & Fluid Flow, Information & Management, Decision Sciences, Decision Support Systems, Computers in Human Behavior, IEEE, Journal of Organizational Change Management, and Expert Systems with Applications. His work has been cited over 3552 times and has an h-index of 22. He is multidisciplinary and interested in the fusion of theories through divergent thinking, and their operationalization to solve all types of problems. His current research interests are in digital innovation and its impact on humans, digital economy and organizational transformation, change management, and elearning.