ADEQUATE RESPONSE FRAMEWORK TO 5G/IOT TECHNOLOGIES DISRUPTION FOR INCUMBENTS

by

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Dedication

To my wife, without whose support I would not have progressed any further, and my daughter who already believes me to be the man I am trying to be.

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ABSTRACT

ADEQUATE RESPONSE FRAMEWORK TO 5G/IOT TECHNOLOGIES DISRUPTION FOR INCUMBENTS

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The advent of 5G/IoT technologies is being hailed as the premise of building the next industrial revolution and is being termed as Industry 4.0 which will impact the incumbents in unprecedented ways. The potential of Internet of Things (IoT) along with the converging technologies like cloud computing and 5G is being forecasted as a disruption wave that will spur innovation and can change the boundaries of industries.

While the incumbents are bracing for this change, lot of uncertainty remains with regards to the prevalence of competitive business models, adoption of cloud services and engagement of the Ecosystem. The goal of this research is to enable organizations to position themselves well to provide adequate response to the 5G/IoT disruption wave. The research proposes analysis and synthesis of quantitative and qualitative data of existing theory, empirical data collected from 5G/IoT Ecosystem participants,

manufacturers, researchers, and consultants, along with testing the framework in case study conducted in real life setting of such incumbents.

The research proposed to achieve this by explaining the causal relationship of three variables: the prevalence of competitive business models, adoption of cloud services to proliferate IoT offerings and engagement of the Ecosystem – that examine the research title – “Adequate Response Framework to 5G/IoT technologies disruption for incumbents”.

The outcome of the research is an Adequate Response Framework that will help the incumbents to leverage 5G/IoT/Cloud technology convergence. It consists of an Innovation model that helps incumbents understand the key changes that are needed for each Influential Force and Research Dimension. Another aspect of this framework is the inclusion of a Decision Model that consists of core tenets and guidelines that helps incumbent understand how to realign the Influential forces to ensure that they leverage the technology advancements. Research has also developed a quad-classification model for incumbents to assess their maturity in terms of innovativeness in face of 5G/IoT technologies wave.

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CHAPTER I:
INTRODUCTION

1.1 Introduction

One of the prevalent technologies that are impacting the incumbents is Internet of Things (IoT), which can be defined as a network of uniquely, identifiable physical objects that acquire capabilities to sense, communicate and interact with themselves, with their external environment or both (Gartner, 2021). Connection information and physical machinery rely on how effective and fast connectivity are achieved for a new paradigm in Industry revolution being termed as Industry 4.0 (Koh, Orzes and Jia, 2019). Industrial IoT (IIoT) software platforms connect to and manage smart devices and infrastructure in industrial and manufacturing environments to integrate operational data and control into business processes as noted by Forrester Research (Miller and Pelino, 2018). IoT has been hailed to provide elastic infrastructure and ever-increasing services that provide the required environment to proliferate the IoT technology (Karpinski, 2021a). The emergence of cloud computing will further enhance the value proposition and ease adoption of IoT wave and that majority incumbents have identified cloud as the preferred consumption model for IoT Deployment (Karpinski, 2021b).

In the same breadth, it is important to recognize the inference regarding 5G that if incumbent businesses delay 5G adoption, the resulting gaps will inevitably attract new entrants and start-ups, unleashing the kind of sudden disruptions that have unsettled mature industries including entertainment (iTunes and Netflix), transportation (Uber and Lyft) and manufacturing (3D printing) (Abbosh and Downes, 2019) .

The collective impact of 5G, Cloud and IoT can so be studied broadly by examining impacts on the business model and the decision-making capability of the incumbents in terms of technology management. This research seeks to explore what the incumbents can do better to take advantage of 5G/IoT technologies.

The objective of this research is to explore and build Adequate Response Framework that incumbents can utilize to build an adequate response to 5G/IoT technologies wave.

1.2 Research Problem

Current methodologies limit themselves as advisory literature with the following constraints:

- Technical domain is focused on technology innovations not on building engagement with Ecosystem and methodology to foster innovative ideas within the organization as intrapreneurial ventures.
- Management domain focus on general intrapreneurial advisory, strategy, methodology and frameworks but are not tailored to deal with specific nuances of 5G/IoT technologies disruption.

There is no clear literature available that explains the Influential Forces that are shaping the innovation for the incumbents to counter 5G/IoT technologies challenge and turn it to their advantage. Following is the research question:

"Adequate response framework to 5G/IoT technologies disruption for incumbents"

The linguistic model is based on seminal works (Revilla, Zavala-Rojas and Saris, 2016; Saris and Gallhofer, 2020) on formulation of the right question which helped build the linguistic model leading to an appropriate design of the research question.

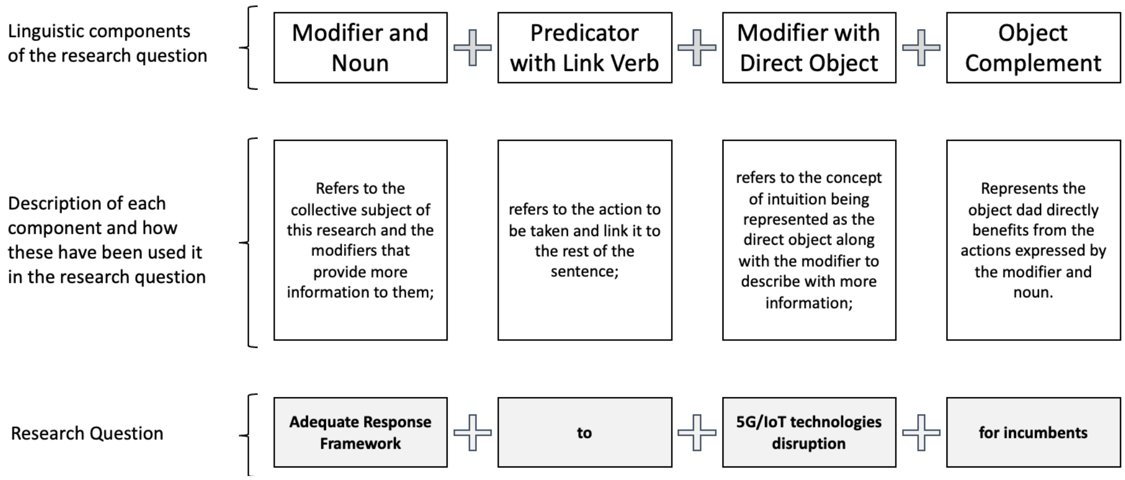


Figure 1 Linguistic Model for Research title (Revilla, Zavala-Rojas and Saris, 2016)

The model is depicted in Figure 1 Linguistic Model for Research title (Revilla, Zavala-Rojas and Saris, 2016) and explained in following four parts:

- Part 1: "Adequate Response Framework" is a Modifier Noun – this has helped define the research title in an interpretive manner - interpret how a group makes sense of shared experiences and attributes meaning to various phenomena (Alharahsheh and Pius, 2020).
- Part 2: "to" is Predicator with Link Verb – this links the subject with the rest of the sentence.
- Part 3: "5G/IoT technologies disruption" is the Direct Object referring to the Concept of Intuition. A concept of Intuition, or concepts are more or less immediately perceived by the sensory organs (or their extensions) without recourse to a deductively formulated theory (Saris and Gallhofer, 2014). Here, 5G/IoT is the direct object of enquiry which is invoking the incumbents to provide an adequate response. It is further explained with more information by using the modifier – "disruption".

- Part 4: “for incumbents” is the Object Complement - entity, that benefits from the action expressed by the predicator and the direct object (Saris and Gallhofer, 2014).

This study will evaluate the above research title from the relationship of three key dimensions that concern the incumbents:

- Dimension 1: Prevalence of the competitive business models
- Dimension 2: Adoption of cloud-based services to proliferate IoT offerings
- Dimension 3: Engagement of the Ecosystem.

1.3 Purpose of Research

The key aspiration of this research is to build Adequate Response Framework that will help the Low Innovative Incumbent Organizations garner an adequate response to the 5G/IoT technologies wave. We achieve this by examining the research title – “Adequate Response Framework to 5G/IoT technologies disruption for incumbents”

The advent of the 5G/IoT is bringing the next wave of changes that can pose existential risk to some organizations that do not have a clearly defined strategy to create viable extensions to their current products and services. These approaches have not been very successful as they see a genuine lack of Adequate Response Framework in the academic world. Such a framework would work as a guiderail to assess, analyze, and guide them through the process of adaption. And, on the other end of the spectrum, we find the academic and management led literature as more generic to be tailored to 5G/IoT disruption change. This is where there is severe loss of faculty – this research would to address this gap as 5G/IoT is an unprecedented turn of events.

This research strives to build Adequate Response Framework that will help the incumbents in the following ways:

- Identify different clusters of organizations with respect to their ability (maturity) to innovate with 5G/IoT technologies.
- Identify key Influential Forces that help build an adequate response to the 5G/IoT technologies wave.
- Identify the Influential Forces interrelationships with respect to the ability to provide adequate response to 5G/IoT disruption.
- Establishes how the Influential Forces interdependencies differ across organizations.
- Guidelines for Low Innovative Incumbent Organization to leverage Influential Forces in realigning their decision-making process to provide an adequate response to 5G/IoT technologies disruption.
- Evaluate the impact of the Business Models, Cloud Adoption, and the Engagement of Ecosystem on the adoption of 5G/IoT technologies by the incumbents.

This research strives to provide an indigenous framework that will be of value to the industry and become the base for evaluating further academic possibilities. It is a sincere attempt to spur further interest on how the convergence of technology and industry and be studied in the science of value creation.

1.4 Significance of the Study

This research aims at providing a comprehensive approach to assess Influential Forces key to the decision-making process in formulating an adequate response to 5G/ IoT Technology disruption. It provides the following value to the academia.

- Identify a quad-form classification for incumbents with respect to their ability to innovate in the presence of 5G/IoT technologies.
- Identify key Influential Forces that help build an adequate response to the 5G/IoT technologies wave.

- Identify the Influential Forces interrelationships with respect to the organization's ability to innovate.
- How the Influential Forces interdependencies differ across the incumbent organizations.
- Guidelines for Low Innovative Incumbent Organization to leverage Influential Forces in realigning their decision-making process to provide an adequate response to 5G/IoT technologies disruption.

1.5 Research Purpose and Questions

As explained earlier, researcher has chosen to research on the following question:

"Adequate Response Framework to 5G/IoT technologies disruption for incumbents"

This study will evaluate the above research title from the relationship of three key drivers as dimensions that concern the incumbents:

- Dimension 1: Prevalence of the Competitive Business Models
- Dimension 2: Adoption of Cloud-Based Services to proliferate IoT offerings
- Dimension 3: Engagement of the Ecosystem.

The first dimension – 'Prevalence of Competitive Business Models' - explains the following part of the research question:

- Prevalence of Competitive Business Models ensures a higher propensity to stimulate a more adequate response by the incumbents.
- Examining the conjecture that the advent of 5G/IoT technologies creates an unprecedented opportunity to build new business models for the incumbents else they are likely to lose significant business value.

This dimension has been suggested as further research work on how industrial IoT business models are changing the key drivers in the now and infers that adoption of IoT leads to profit optimization related to production value chain (Deogratius, 2018).

The following research gaps inferred from the literature review support the research question:

1. Prevalence of competitive business models ensures a higher propensity to stimulate a more adequate response by the incumbents.
2. Adequate response to any 5G/IoT technologies disruption wave would translate to identifying new innovative business models and retiring some of the old business models.
3. Examining the conjecture that the advent of 5G/IoT technologies creates an unprecedented opportunity to build new business models for the incumbents else they are likely to lose significant business value.

This research will examine the dimension: ‘Prevalence of Competitive Business Models’ – for its influence on adequate response that incumbents can provide in wake of the 5G/IoT technologies disruption wave.

The second dimension – “Adoption Of Cloud-Based Services to proliferate IoT Offering” – has been suggested as further research work by Saldivar *et al.*(2015) stating that a methodology that integrates Cyber-Physical Systems, Cloud Computing and Real-Time Analysis is key to achieving innovation and a high productivity, because the system at the end becomes self-aware and self-predictive among other properties that are suitable for future.

Following research gaps inferred from the literature review support the research question:

1. Adoption of cloud-based services is an essential element to garner an adequate response by the incumbents and failing which can lead to their failure in Industry 4.0 requirement like Servitization of products.
2. Adoption of cloud services is a key differentiator in the era of 5G/IoT technologies disruptions being experienced in the industry.
3. Adoption of cloud services is thus an essential part of transformation that adopts Servitization models.

This research will thus examine this dimension for its relationship with adequate response that incumbents can provide in wake of the 5G/IoT disruption wave.

This dimension – ‘Adoption of Cloud-Based Services to proliferate IoT offerings’ - explains the following part of the research question:

1. Adoption of cloud-based services is an essential element to garner an adequate response by the incumbents.
2. Adoption of cloud services is an essential part of Servitization transformation.

The third dimension – “Engagement of the Ecosystem” – has been cited as further research work concluding that for getting better insights into the potential differences might reveal how successful alliances and partnerships are formed and what the critical success factors to these alliances and partnerships might be (Thiagarajan, 2016). In addition, case studies of successful organizations in different roles will prove to be a valuable source of best practices for successful industrial adoption (Thiagarajan, 2016).

Following research gaps inferred from the literature review support the research question:

1. No adequate research provides a comprehensive understanding of impact of engagement in Ecosystem as an essential response for the incumbents in the wake of 5G/IoT disruption.

2. Deeper level of engagement with Ecosystem is essential to achieve Servitization.
3. Incumbents need to adapt to flexible organizations that build meaningful innovations in 5G/IoT essentially due to a scalable and sustainable Ecosystem.

This dimension explains the following part of the research question:

1. Impact of engagement in Ecosystem as an essential response for the incumbents in the wake of 5G/IoT disruption.
2. Deeper level of engagement with Ecosystem is essential to achieve Servitization that provides the adequate 5G/IoT platform services.
3. Scalable and sustainable Ecosystem is essential for Incumbents to build meaningful innovations in 5G/IoT.

With these additions, this research is in a unique position to guide the industry on how to convert a plausible threat into a remarkable opportunity.

Chapter II:

REVIEW OF LITERATURE

2.1 Theoretical Framework

The objective of this research endeavor is to build Adequate Response Framework that the incumbents can utilize to build an adequate response to the surge of 5G/IoT technologies wave. To achieve this objective, the research title is as follows:

"Adequate Response Framework to 5G/IoT technologies disruption for incumbents"

A detailed literature review was undertaken to identify the research gaps and directions for future research. Conducted the literature review and then classified chosen works to form the base for identifying the research elements. Literature review involved evaluation of 974 different published research articles thereby classifying 225 of those chosen articles for 22 years period from 2000 to 2022.

The rest of the chapter is organized as per the three dimensions identified to explain the research question. Each dimension is explained in following parts:

- "Introduction" – Explains the key concepts and sets the initial context
- "Main Context" – Undertakes key conjectures that build the inquiry for research and explains why the given dimension is important to explain the research
- "Summary" – Explains the main issues and the research gaps found in the literature review

2.2 Dimension 1: Prevalence of Competitive Business Models

The first dimension - Prevalence of Competitive Business Models - is reflective of the fact that there is business value that can be unlocked as the industry is at the cusp of an inflection point (Sirkin, Zinser and Rose, 2015).

2.2.1 Introduction

The research aims to how Prevalence of Business Models aids in providing adequate response by the incumbents to the 5G/IoT technologies disruption.

It is observed that the low adaptability rate among manufacturers poses an inability to consider long term benefits of 5G/IoT technologies (TechVision Group of Frost & Sullivan, 2020). This supports the proposition that 5G/IoT technologies are being considered as a global megatrend. It is also observed that 67% of global mobility decision makers in the manufacturing sector agree that IoT enables new types of business models while the adoption of these business models remains unusual low with only 22% incumbents have prioritized the revision in the models (Miller, Pelino, Voce, Belissent, *et al.*, 2019).

With help of published works (Miller, Pelino, Voce, Belissent, *et al.*, 2019; TechVision Group of Frost & Sullivan, 2020) it is reasonable to argue that incumbents stand to gain considerably by innovating with new business models. Private equity will buy a manufacturer, flip its business model, and float it for profit as the public organizations struggle to rapidly shift their business models from products to services because of their perceived impact on the finances (O'Donnell *et al.*, 2021). With this evidence, it is inferred that the abundance of business models in industry today is indicative of the fact that this abundance is primarily driven from the advent of the 5G/IoT technologies wave.

On the other hand, the inability to adopt with technologies in time poses a significant threat to the incumbents. The findings support the conjecture that globally, digital disruption is shaving 30% of incumbent revenue growth and 25% of growth in Earnings Before Interest and Taxes (EBIT) (Bughin and Zeebroeck, 2017). The authors further support the proposition with the finding that digital disruption hurts slower-growing organizations the most; the bottom 25% of organizations in terms of growth are experiencing three times greater reduction in annual revenue at the hands of digital disruption than the top quartile (Bughin and Zeebroeck, 2017).

Thus, we can infer that inability to innovative with new business models poses a significant risk to the incumbents.

2.2.2 Main Context

A logical examination of the following statement is essential – 'Is 5G/IoT technologies wave consequentially strong to be considered as new frontiers of growth that can create new business models?' To understand this conjecture, magnitude of this wave of disruption has to be understood.

IoT endpoints in industrial environments expected to double by 2025 growing at 24% CAGR (Castanon-Martinez, Zwakman and Kawasaki, 2021). Further support is from the findings of Karpinskauthor (2021b) that the top reasons for deploying 5G in support of IoT are: high network availability/resiliency; greater network speed/bandwidth; and support for massive numbers of IoT endpoints. Emerging IoT solutions provide vendors and services firms with opportunities to implement new client service delivery innovation options, reduce costs of ongoing service delivery to their clients, and increase margins based on driving better measurable outcomes (Miller, Pelino, Voce, Belissent, *et al.*, 2019).

This confirms that the wave of 5G/IoT technologies is a significant trend that is changing the industry model in any unprecedented way. A key aspect of this trend is "Servitization" - the innovative requirements of designing the physical internet infrastructure creates a potential competitive landscape for Service-Oriented Business to enrich value added services supported by Digital Technologies (Tran-Dang and Kim, 2021). Servitization is further explained - as modern corporations are increasingly offering fuller market packages or "bundles" of customer-focused combinations of goods, services, support, self-service and knowledge where services are beginning to dominate and this movement is termed the "Servitization" of business (Kryvinska *et al.*, 2014). These findings support the conjecture that 5G/IoT technologies are new frontiers of growth. 5G/IoT technologies are leading this change from forefront pushing the incumbents towards adopting Servitization.

A change of trajectory in the wake of 5G/IoT technologies disruption wave can be very challenging for the incumbents. Business leaders are grappling to understand 5G/IoT technologies and its disruptive potential with 75% incumbents stating that they need help in imagining use cases (Abbosh and Downes, 2019). It has also been suggested as further research work for investigating Business Model as an entire system contributing to a more comprehensive understanding of changes in the context of the Industrial IoT (Deogratius, 2018). This is the pivotal context in identifying and studying "Prevalence of competitive business models" as the first research dimension.

2.2.3 Summary

The key issues of this research dimension are as follows:

1. Prevalence of competitive business models ensures that the incumbent will have high propensity to an adequate response; this would translate to identifying new innovative business models and retiring some of the old business models.
2. Examining the conjecture that the advent of 5G/IoT technologies creates an unprecedented opportunity to build new business models.

The following research gaps have been identified from the literature review that support the research question:

1. Prevalence of competitive business models ensures a higher propensity to stimulate a more adequate response by the incumbents.
2. Adequate response to any 5G/IoT technologies wave would translate to identifying new innovative business models and retiring some of the old business models.
3. Advent of 5G/IoT technologies creates an unprecedented opportunity to build new business models for the incumbents barring which they are likely to lose significant business value.

The research will examine that "prevalence of competitive business models" relates with ability to provide adequate response by incumbents for 5G/IoT technologies disruption wave.

2.3 Dimension 2: Adoption of Cloud-Based Services to proliferate IoT Offerings

The second dimension – 'adoption of cloud-based services to proliferate IoT offerings'- explains the imperative of how IoT technologies led revolution embarks on adoption of cloud-based services by the incumbents.

2.3.1 Introduction

Cloud computing provides huge, virtualized computing resources as on-demand services to users, which makes it very attractive for many industrial application domains (Mubeen *et al.*, 2018). The convergence of IoT technologies and Cloud computing has been seen as a symbiotic success and referred to as Cloud of Things where they call out several advantages like power processing, storage capacity, scalability, rapid elasticity, ease of use, cost effectiveness and less technical know-how (Idrissi, Elbeqqali and Riffi, 2019). Similarly, the 5G technology enhances the role of the IoT by integrating its functionality within a virtualized network infrastructure, possibly controlled by a Software-Defined Networking (SDN) approach, and the cloud (Borsatti *et al.*, 2020).

To conclude, evaluating cloud as an enabler for 5G and IoT technologies, this research aims to understand the relationship between adoption of cloud-based services and proliferation of IoT offerings.

2.3.2 Main Context

Let us consider the conjecture – "The rise in Cloud Computing eases adoption of IoT based offerings".

The practical possibilities of IoT come to the fore by leveraging the vast storage and computational capabilities of cloud datacenters to employ big data analytics on the distributed sensor data (Bloom *et al.*, 2018). Symbiotically, the industry expects their compute requirements to grow by an average of 49% in the next two years as a direct result of IoT projects and the most significant sources of additional IoT compute capacity will be public cloud compute (Karpinski, 2021b).

Convergence and dependence between IoT and cloud is supported by findings that their commonality is viewed as a novel paradigm between two very different technologies which support each other toward a common goal in a coordinated fashion to attain a mutual objective and profit maximization (Barril, Ruyter and Tan, 2016) . IoT systems must be supported by additional technologies, in particular the Cloud Computing and Big Data systems (Benkhelifa *et al.*, 2014). There is a very strong support in distributed computing standpoint - Edge computing is defined as the vast space or intermediary between the data collecting endpoints and the core that supports all key business decision support systems(Crook, 2020). Edge computing allows the things to maintain their activities while disconnected, and then send data to the cloud when the connection resumes (Crook, 2020).

These findings lead to infer that IoT technologies proliferation is dependent on the rise in adoption of cloud computing paradigm. This is also supported as an observation that integration of IoT, centralized cloud computing and cloud based distributed computing models can provide pervasive and accessible services that have significant implications for applications in the global Physical Internet network (Tran-Dang and Kim, 2021). Additional support is found in findings that telecommunications and media organizations have migrated about 25% of their production workload to Public Cloud and will reach 30% in forthcoming years to market IoT and streaming services (Sfondrini, Motta and Longo, 2018). Consider the findings that 5G is a key driver for IoT adoption because of the Service Based Architecture together with Softwarization and Virtualization which provides the agility enabling an organization to respond to customer needs quickly (Mademann, 2018). The concurrent development of the IoT, Cloud Computing, 5G has flourished in recent years and has become a new infrastructure of modern society (Chen *et al.*, 2021). This is observed as a part of a larger trend that has captured the manufacturing industry which can be explained as Product-Service-System and Servitization - the product and services merge to a product-service-system that provides its unique value solely in their combination (Kryvinska *et al.*, 2014).

These above findings lend support to the conjecture that IoT proliferation depends on a strong leverage of cloud computing model. This is summed up very effectively as follows - IoT services can only be achieved if they are attributed with ubiquitous accessibility , reliability, performance, efficiency and scalability which are essentially provided by cloud computing (Biswas and Giaffreda, 2014).

2.3.3 Summary

This research will explain that the proliferation of IoT is a necessary and essential step towards Servitization. The main issue is to evaluate the following

- Adoption of cloud-based services leads to an adequate response from the incumbents in a way that it enables them to proliferate IoT offerings.
- Examining the conjecture that adoption of cloud services is essential to building IoT based Servitization models.
- Proliferation of IoT is a necessary and definite step towards Servitization.

The following research gaps have been identified in the literature review that support of the research question:

- Adoption of cloud-based services is an essential element to garner an adequate response by the incumbents, failing which can lead to a failure in Industry 4.0 requirement like Servitization of products.
- Adoption of cloud services is a key differentiator in the era of 5G/IoT technologies disruptions.
- Adoption of cloud services is an essential part of Servitization led transformation.

The research will examine the dimension: Adoption of cloud-based services to proliferate IoT Offerings – for its relationship with adequate response that incumbents can provide in wake of the 5G/IoT disruption wave.

2.4 Dimension 3: Engagement of the Ecosystem

The third dimension – Engagement of Ecosystem – is based on the conjecture that to compete in the ever-changing market and to satisfy customers changing demands, the incumbents cannot work in isolation and will depend on engagement with their Ecosystem.

2.4.1 Introduction

Incumbents face difficulty and uncertainty in the current marketplace; this is confirmed in the finding of Miaoudakis et al. (2020) that the IoT landscape is very fragmented and for overcoming this fragmentation it is essential to fully leverage the change in business value that the cocreation and continuous innovation of IoT services brings. The disposition is fully qualified in the findings that in today's dynamic market, customized products are more and more demanded, while still requiring to be released under tight conditions that only mass production is able to satisfy (Trullas-Ledesma and Ribas-Xirgo, 2009).

The incumbents' need to extend a larger cooperation along with its complementary service organizations within the ecosystem. They play a significant role in by playing their part of a digital Ecosystem. Digital Ecosystem as distributed adaptive open sociotechnical systems, with properties of self- organization, scalability and sustainability, inspired by natural ecosystems, and are emerging as a novel approach to the catalysis of sustainable regional development driven by SMEs (Briscoe and Marinos, 2009). Digital Ecosystems aim to help local economic actors become active players in globalization and enabling them to interact and create value networks at the global level (Briscoe and Marinos, 2009). The competency of engaging with a collaborative and sustainable Ecosystem is essential for incumbents. There is another strong position in research work that application-centric IoT development as a key enabler for building complex but at the same time maintainable IoT ecosystems (Willocx *et al.*, 2018).

It is inferred that such capabilities are difficult for the incumbents to acquire on their own which drives the need to leverage the Ecosystem. Engagement with Ecosystem is then essential to form an adequate response by the incumbents. This is validated by the findings that the ability react to flexible and on demand both on business and technical environment changes is a new competitive differentiator with strategic importance (Hoyer and Stanoevska-Slabeva, 2009).

The above-mentioned discussion helped in choosing the third dimension – 'Engagement of the Ecosystem' – and its relationship with the adequate response that incumbents should provide in the wake of the disruption wave of 5G/IoT.

2.4.2 Main Context

The choice of this dimension leads to evaluate a conjecture that incumbents need to adapt to Servitization that is scalable and built on a sustainable Ecosystem to stay relevant in the marketplace. This conjecture is confirmed rom the following argument on digital Ecosystem - digital ecosystems aim to support network-based economies reliant on next-generation technologies with the automatic combining of available and applicable services in a scalable architecture, to meet business user requests for applications that facilitate business processes (Briscoe and Marinos, 2009).

The rigid (and hierarchical) organization should be replaced by a network of autonomous and distributed entities, operating according to specific or local objectives but with a global coordination between them (Trullas-Ledesma and Ribas-Xirgo, 2009). Such changes to the business models invariable will lead to a disruption in the value chain. (Hoyer and Stanoevska-Slabeva, 2009). Researcher finds that general trends for value creation in business are that value is found near the customer and derives from product modularity and orchestration, that is the composition of single product modules into composite products that can offer valuable outcomes for the customer (Fragidis, Tarabanis and Koumpis, 2007). This is concurrent with the finding - envisioning business ecosystems as evolutionary environment that provide customizable and adaptive e-service provisioning and management capabilities for SME (Cheah, 2007).

It is thus inferred that incumbents must aid their business models to work towards Servitization.

What then is the overall objective of a sustainable Ecosystem that enables the incumbents to adapt Servitization? The ideal goal of Ecosystem should deliver a scalable new vision of collective value and comprehensive action across an entire operating environment, a master solution framework, not only for a range of customers, but the partners within it (Willocx et al., 2018). Similarly, ecosystems create a self-generating market which is ultimately about building a collaborative business model framed by a shared vision of opportunity (Singer, 2009). Incumbent are forced to evolve and adapt to a new reality of collaborative business model. To understand what is the essential paradigm shift for the incumbent, referrence to the findings that developments of IoT platforms involves an entire Ecosystem of stakeholders covering the whole value chain of the IoT that together coordinate and deliver the functionalities and the services required by the various supported IoT applications (Nedeltcheva and Shoikova, 2017).

The research wants to explain the premise that incumbents need to build deeper level of engagement with the Ecosystem to successfully achieve Servitization in the wake of the disruption of 5G/IoT technologies wave.

The main issue is to evaluate as follows:

- The incumbents cannot work in isolation to provide for service demands from the customer.
- Being a part of the digital Ecosystem is an essential part of the business strategy to provide an adequate response to 5G/IoT technologies disruption.
- The incumbents are struggling to provide an adequate Servitization strategy.
- Incumbents must rely on effective and sustainable Ecosystem to provide meaningful innovations in the value to customer.

2.4.3 Summary

The following research gaps have been identified from the literature review that support of the research:

- No adequate research provides a comprehensive understanding of impact of engagement in Ecosystem as an essential response for the incumbents in the wake of 5G/IoT technologies disruption.
- Deeper level of engagement with Ecosystem is essential to achieve Servitization.
- Incumbents need to adapt to flexible organizations that build meaningful innovations in 5G/IoT essentially due to a scalable and sustainable Ecosystem.

2.5 Conclusion

The literature review has helped in identify the gaps in current theories but also support the theory as follows:

- The abundance of business models in industry today is indicative of the fact that this abundance is primarily driven from the advent of the 5G/IoT technologies wave.
- 5G/IoT technologies are pushing the incumbents to adopting Servitization.

- The rise in cloud computing is a mega trend and is converging with the wave of 5G/IoT technologies disruption.
- Incumbents need to leverage Ecosystem to build meaningful innovations in IoT offerings.
- Incumbents must alter their business models to achieve successful Servitization.

The key research gaps found in the literature review are as follows:

- Does prevalence of competitive business models ensure a higher propensity to stimulate a more adequate response by the incumbents?
- Examining the conjecture that the advent of 5G/IoT creates an unprecedented opportunity to build new business models for the incumbents else they are likely to lose significant business value?
- Is adoption of cloud-based services an essential element to garner an adequate response by the incumbents and failing which can lead to a failure in Industry 4.0 requirement like Servitization of products?
- Is adoption of cloud services a key differentiator in the era of 5G/IoT technologies disruptions being experienced in the industry?
- Is deeper level of engagement with Ecosystem is essential to achieve Servitization?

The key objective of this research is to examine the research title – "Adequate Response Framework to 5G/IoT technologies disruption for incumbents"

CHAPTER III:

METHODOLOGY

3.1 Overview of the Research Problem

Researcher has chosen to research on the following:

"Adequate Response Framework to 5G/IoT technologies disruption for incumbents"

The advent of 5G/IoT technologies wave is an unprecedented opportunity for the traditional players. Castanon-Martinez, Zwakman and Kawasakauthor (2021) observe that the number of IoT endpoints is expected to nearly double, increasing from 86.7 million in 2020 to 152 million by 2025, an overall global CAGR of 12%. The eventuality of 5G/IoT technologies coming together transforms this disruption from a product-based disruption to a platform-based disruption. As Sampere (2016) observes that product-based disruptions have a strong "within the industry" effect; being a serious threat that can even lead to replacing the incumbent; but platform-based disruptions have effects not only inside the industry but also well beyond industry boundaries; incumbents that are used to dealing with product-based competition often don't know how to react to a platform that competes at an Ecosystem level.

All in all, it cannot be seen as everything is gloom and doom. This research has undertaken a comprehensive analysis of what can the incumbents do in terms of competitive business model, adoption of cloud and widening and engaging with larger Ecosystem so that they can proliferate their product line extensions with IoT led new service capabilities.

3.2 Operationalization of Theoretical Constructs

To develop the right research strategy, the research onion is used, the diagram used to depict the issues underlying the choice of data collection techniques and analysis procedure (Saunders, Lewis and Thornhill, 2007).

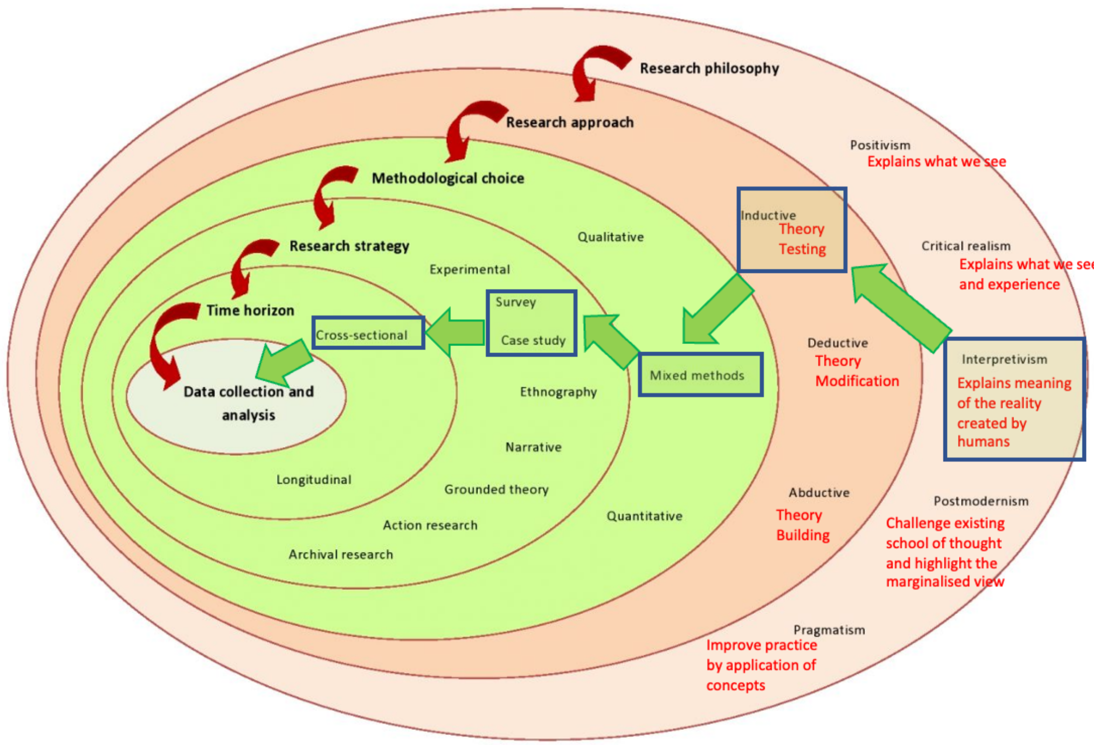


Figure 2 Research Onion (Saunders, Lewis and Thornhill, 2007)

To use the research onion as depicted in Figure 2 Research Onion (Saunders, Lewis and Thornhill, 2007) effectively, one must be aware about the own research philosophy. The predicament is supported in the academic writings pertaining to "Research Reflexivity"- the process of exploring and understanding your own research philosophy requires you to hone the skill of reflexivity, that is to question your own thinking and actions, and learn to examine your own beliefs with the same scrutiny as you would apply to the beliefs of others (Haynes, 2012). To improve the research reflexivity, one needs to gain better understanding of the major research philosophies. This chapter is used to explain outline the philosophy and justify it in relation to the alternatives that could have been adopted.

3.2.1 Ontology and Axiology

This research takes a "pluralist approach" which suggests that each research philosophy and paradigm contribute something unique and valuable to business and management research, representing a different and distinctive 'way of seeing' organizational realities (Morgan, 2011). This comes from the understanding that one tends to carry over figments of knowledge of what we understand from one part of life and cope with the unknown. This is putting to good use the tools of 'what one knows' to understand and deal with the 'unknown'.

Ontology is usually classified as realist and relativist. Realist ontology assumes that reality exists independent of observer's perceptions and operates according to immutable natural laws that often take cause/effect form, whereas relativist ontology assumes that there exist multiple, socially constructed realities ungoverned by natural laws (Lincoln, Lynham and Guba, 2011). This research is undertaken with "Relativist Ontology" as the reality being created by social entities, like the incumbent organizations, the subject matter.

The next consideration for research philosophy is "Axiology"**.** Saunders *et al.* (2007) highlighted that one of the key axiological choices that you will face as a researcher is the extent to which you wish to view the impact of your own values and beliefs on your research as a positive thing. As Heron (1996) argues to demonstrate your axiological skill by being able to articulate your values as a basis for making judgements about what research you are conducting and how you go about doing it. Thus, using the axiological assumptions helped understand extent to which one wishes to view the impact of the own values and beliefs on your research as a positive thing. This research finds that the research objective lends itself to multiple realities and the researcher is certainly a part of the subject matter that is being researched. Hence, research lends to "Normative values" - Normative research differs from an informative investigation "because the target is not only to gather information but also to point out in which aspects the object of study can be improved" (McKee, 2012). As the research associates not only identifying the current theories on technology management, but it aims to build Adequate Response Framework that will help Low Innovative Incumbent Organizations to overcome the challenges and improve their sequential decision-making process, the axiology lend itself ideally to "Proportional Axiology". Proportional axiology deals with the transactional knowledge as being an instrument valuable as a mean to social emancipation which as an end in itself is intrinsically valuable (Lincoln, Lynham and Guba, 2011).

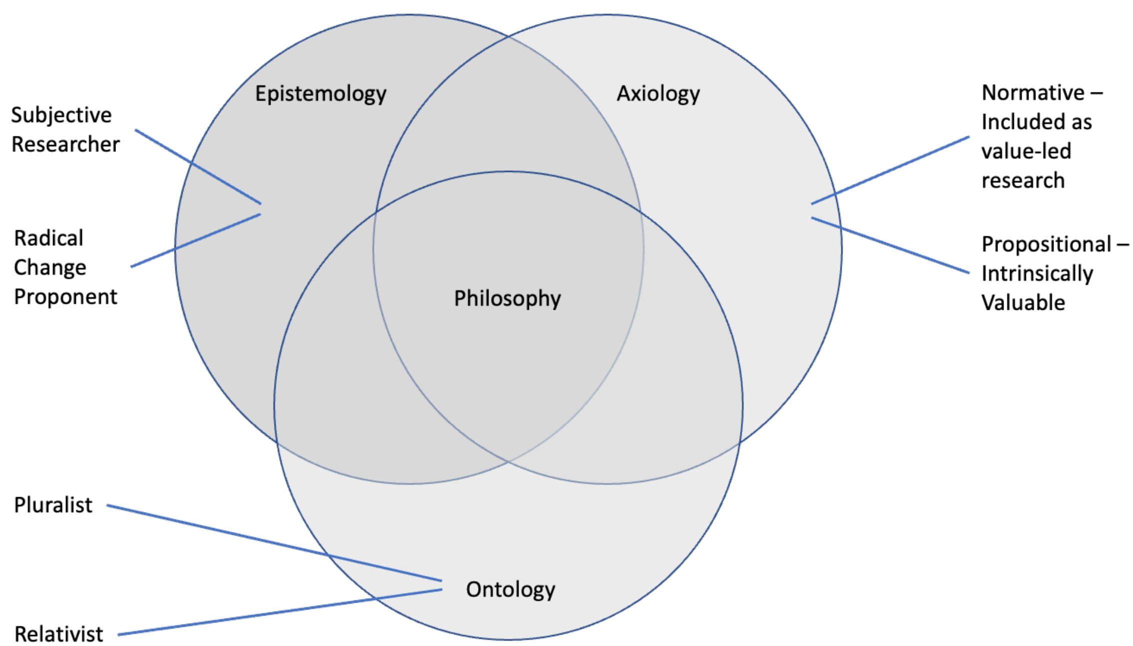


Figure 3 Philosophical paradigm - Epistemology, Axiology and Ontology

The research philosophy is depicted in Figure 3 Philosophical paradigm - Epistemology, Axiology and Ontology.

3.2.2 Epistemology

This brings us into the domain of "Epistemology" that emphasizes on the nature and origins of knowing and the construction of knowledge (Maykut and Morehouse, 2002). Epistemology refers to assumptions about knowledge, what constitutes acceptable, valid and legitimate knowledge, and how we can communicate knowledge to others (Saunders, Lewis and Thornhill, 2007; Morgan, 2011; Rashid *et al.*, 2019). These epistemological choices influence how the subsequent research findings are likely to be considered objective and generalizable. This research has found many scholarly literature (Morgan, 2011; Dieronitou, 2014; Kammerl *et al.*, 2014) support the following point of view - The "crossing over" that underlies metaphor as ontological—a primal cognitive process that, in part, defines the very nature as human beings and this ontological process results in metaphors as images or words that are used to evoke and capture meaning (Morgan, 2011).

Between the two epistemological extremes of subjectivism and objectivism, author identifies as a "Subjectivist Researcher", playing the role to seek different realities of the incumbents. Author interprets these realities to be able to respond in a meaningful way. In this subjectivist view, the adequate response by the incumbents is constructed through the social interactions between incumbents and research dimensions. The Influential Forces of the environment are being continually revised because of this interaction. author concurs on "Critical Subjectivity"; it means that author don't have to throw away the living knowledge in the search for objectivity, but am able to build on it and develop it (Heron, 1996).

To build the research paradigm author utilize what Burrell and Morgan (2017) refer to extremes as 'sociology of regulation' (for short, regulation) and 'sociology of radical change' (simply, radical change). author views the research as "Radical Change Research" to approach incumbents' problems from the enquiry of overturning the existing sequential decision-making process creating a new framework to help them build an adequate response to 5G/IoT technologies wave. The research will also attempt to expose the problems and weaknesses, as well as the damaging effects, of existing decision-making process of incumbents. As the opinion aligns with the radical change research, framework will have the following characteristics:

- Framework will advocate the radical change instead of find supporting evidence for the status quo methods.
- Framework would not subscribe to advocate the order in current paradigm instead will process the conflicts.
- Framework would be free to question the dominion of existing method of decision making.
- Instead of observing the actual it seeks to see the potential in the given adversity.

3.2.3 Research Paradigm

This research has considered the works (Saunders, Lewis and Thornhill, 2007; Lincoln, Lynham and Guba, 2011; Morgan, 2011; Burrell and Morgan, 2017; Rashid *et al.*, 2019) to build the research philosophy. Organized as follows, is the research framework in Table 1 Paradigmatic position for the research framework.

- "The Paradigm position": These are the inquiry elements which impact the philosophy position that researcher takes for formulating the research framework.

- “Guidance”: This refers to the practical positions on the spectrum of postmodern paradigms - paradigmatic strands of research will find that echoes of many streams of thought come together (Lincoln, Lynham and Guba, 2011).
- “Attribution”: The values that researcher has ascribed and refers to the philosophical position the research takes on the different paradigms.

Table 1 Paradigmatic position for the research framework

Paradigm positions	**Guidance**	**Attribution by the research framework**
Research paradigm	• Constructivism • Interpretivism	Interpretivism - action on research results as a meaningful and important outcome of inquiry processes.
Ontology	Relativism – Local and specific constructed realities	Knowledge is created by developing alternative interpretations of reality to help understand the subject better.
Epistemology	• Transaction • Subjective • Created findings	Subjective – assimilates through the intuitive understanding combined with reasoning.
Methodology	Typically, inductive. Small samples, in-depth investigations, qualitative methods	Case studies and Content Analysis

Paradigm positions	Guidance	Attribution by the research framework
	of analysis, but a range of data can be interpreted	
Research Goal	• Understanding • Reconstruction	New theory formulation and to describe situation holistically from the perspective of the participants
Nature Of Knowledge	Individual reconstruction coalescing around consensus	• Nominal / decided by convention. • Simple theories and concepts • What a respondent narrates - her stories, perception, and interpretations • New understanding or a worldview either expressed by a respondent • Opinions. • Written, spoken and visual accounts. • Attributed meanings from entities and context. • Specifics.

Paradigm positions	Guidance	Attribution by the research framework
Knowledge Accumulation	• Informed and sophisticated reconstructions • Vicarious explanations	Using the understanding of the worldview to understand and assimilate an alternative reality that helps build a better worldview.
Values	Included - Formative	• Values of the respondents and the role as a researcher is an important aspect • Value bound research • Author sees self as a part of what is being researched • Subjectivity is the essence of research • Researcher reflexive, the assumptions perceptions and conceptual understanding effects various decisions in the research process.
Ethics	• Intrinsic • Process tilt towards revelation	• Intrinsic - Transactional knowledge as being an instrument valuable as a mean to social emancipation which as an end in itself

Paradigm positions	Guidance	Attribution by the research framework
		is intrinsically valuable (Lincoln, Lynham and Guba, 2011).
Hegemony	Seeking recognition and input	Building a framework for adequate response specifically to leverage the 5G/IoT.
Control	Shared between inquirer and participants	• Shared for most parts of the research between observer and the participants • Participants construct the most important Research Elements while the part remains to build a quantitative realization on the top of this analysis to derive the Influential Forces. • Constructive reality formulation where author play a role of facilitator / enhancer for the Adequate Response Framework • Participants to take an increasingly active role in nominating questions of interest for any inquiry and in designing outlets for findings to be shared more widely within and outside the community.

Paradigm positions	Guidance	Attribution by the research framework
Relation-ship to foundation of truth and knowledge	Antifoundational - Anti-foundational is the term used to denote a refusal to adopt any permanent, un-varying (or "foundational") standards by which truth can be universally known (Lincoln, Lynham and Guba, 2011).	• Proponent of the radical change and finds support - the process can create multiple forms of perspective-based knowledge that is always context based, in the sense that it is a direct product of the mode of engage-ment embedded in the perspective and ob-jectives that the would-be knower brings to the phenomenon of study (Morgan, 2011). • Author sides with Bohr (1958) that view that the opposite of a profound truth can be another profound truth, hence, the view of knowledge and research is essentially plu-ralistic and open to multiple approaches to overcome the oversimplification of narrow views. • There are no final and ultimate criteria upon which all theories can be tested, only those that we can agree upon at a certain time and under certain conditions.

Paradigm positions	Guidance	Attribution by the research framework
		• Foundational criteria are discovered; non-foundational criteria are negotiated

3.2.4 Research Philosophy – Interpretivism

Research philosophy denotes that the methods of the research which adopt the position that people's knowledge of reality is a social construction by human actors, and so it distinctively rules out the methods of natural science (Chowdhury, 2014). It can be argued that value of own preconceptions is reflected in the research work throughout the process of enquiry. Author has experienced that the interactions with the participants influence each other's perceptions. Interpretivism is different from positivism as it aims to include richness in the insights gathered rather than attempting to provide a definite and universal laws that can be generalized and applicable to everyone regardless of some key variables and factors (Saunders, Lewis and Thornhill, 2007).

Interpretivism is the adequate research management philosophy because the problem at hand requires a more complex, rich socially constructed interpretation which is built on in-depth analysis and insights that one gains from interactions with the participants. Clearly, one is not expecting that an adequate response to the wake of 5G/IoT technologies disruption can be a universal law, but instead it is an interpretation of multiple realities. The argument lends itself into the favor of Interpretivism because what this research finds as a valuable framework, as knowledge, is through narrative stories, perceptions, and interpretations of the participants.

It is “Value Lead Research” where researcher plays a significant part in identifying what is being researched. Subjectivity thus is of primary essence and is key for contribution to knowledge.

Research would work through an “Inductive Method” with two extreme organizations which are incumbents in terms of the technology’s disruption wave- and carry in-depth investigation to distill a range of datasets that can be interpretted.

3.2.5 Research Approach – Inductive

The motivation for the research is clearly theory building rather than testing. This research has established in the purpose of the research that there is a clear gap of finding a concrete theory that would help incumbents with this problem at hand. As theory testing and theory building are two contrasting approaches alluding to deductive or inductive approaches - opted for “Inductive Research Approach”**.** This helps in theory development because the conclusions of this research are derived logically from interpretations, patterns of data that has been collected during the research.

The approach is provided in Table 2 Induction – Reason to Research Method as guided by epitomic published work on research methods (Saunders, Lewis and Thornhill, 2007).

Table 2 Induction – Reason to Research Method

Paradigm positions	Guidance	Attribution by the research framework
Logic	Known premises are used to generate untested conclusions.	Known theories from the published work and established examples of incumbents who have adopted to the 5G/IoT technologies disruption provided the known premises. But the inadequacy of research to create an Adequate Response Framework that Low Innovative Incumbent Organizations could utilize is lacking. This research utilizes "Inductive Approaches" to build Adequate Response Framework which would be considered as a body of knowledge that will be contributed to both academic and professional world.
Generalizability	Generalizing from the specific to the general.	The findings can be generalized only to the contextual setting of this research. This covers the incumbents that are affected by the 5G/IoT technologies disruption wave.
Use of data	Data collection is used to explore a phenomenon, identify themes and	Data is collected at different levels across the cross section of the research.

Paradigm positions	Guidance	Attribution by the research framework
	patterns, and create a conceptual framework.	Initial “Research Elements” are identified through critical literature review of published work relating to the research question. By conducting a survey across selected participants, a broader understanding of these Research Elements is built to the contextual setting of this research. Themes and patterns are identified to distil the “Influential Forces”. A “Qualitative Case Study” is carried across two contrasting organizations to build interrelationships and knowledge patterns that build Adequate Response Framework. The Low Innovative Incumbent Organizations can use framework to build an adequate response to the technology disruption wave.
Theory	Theory generation and building	This research supports the theory generation. It builds on the predecessors published literature work to fill the literature gaps identified during the literature review.

3.2.6 Methodical Choice – Mixed Methods

In essence, this philosophical and research paradigm is concerned with the uniqueness of a particular situation, contributing to the underlying pursuit of contextual depth (Myers and Avison, 2002). However, while Interpretive Research is recognized for its value in providing contextual depth, results are often criticized in terms of validity, reliability and generalizability (Eisenhardt, 1989; Perry, 1998). So, to avoid this philosophically driven criticism, a different proposition to combine Quantitative And Qualitative Methods, sometimes termed as "Triangulation", in researching the social world is suggested (Silverman, 2015).

A "Mixed-Method" Study is one in which the researcher incorporates both qualitative and quantitative methods of data collection and analysis in a single study; this type of a study enables one to understand complex phenomena qualitatively as well as to explain the phenomena through numbers, charts, and basic statistical analyses (Creswell, 1999). Following benefits in employing Mixed Method as the methodical choice for research as identified in work of Byrne and Humble (2006) as follows:

- Because social phenomena are so complex, different kinds of methods are needed to best understand these complexities.
- It enables to answer confirmatory and exploratory questions at the same time, and as a result be able to construct and confirm theory in the same study.
- It aids in providing explanations for seemingly contradictory results that emerge from using different methods.

Published works (Byrne and Humble, 2006; Cameron, 2009; Chowdhury, 2014; Silverman, 2015) have served as guiderails to distill the methodological choice. These are provided in the Table 3 Methodological choice.

Table 3 Methodological choice

Paradigm positions	**Guidance**	**Attribution by the research framework**
Reliability	As all methods of data collection have limitations, the use of multiple methods can neutralize or cancel out some of the disadvantages of certain methods.	Reliability would have been generally low had the consideration would be employing only survey method – to investigate the Research Elements. Combining the case study method allowed triangulation of data and has thus increase the reliability of overall results.
Complexity	Social phenomena are so complex, different kinds of methods are needed to best understand these complexities	Identifying the Influential Forces has been a complexity in the research. This research considered expert opinion to validate the interpretation of the survey results. This helped in understanding the key Research Elements ensuring that the Influential Forces identified have preserved the diversity. Expert opinions form the basis of contextualizing the Influential Forces.

Paradigm positions	Guidance	Attribution by the research framework
		Qualitative case studies that research undertook for two different incumbent organizations (differing in terms of their innovativeness) helped construct the Adequate Response Framework. This framework accentuates the inter relationships between these Influential Forces with more dexterity.
Exploratory questions for theory building	It enables one to answer confirmatory and exploratory questions at the same time, and as a result one can construct and confirm theory in the same study	Explorative methods are aimed at studying multiple features and exploration of possible developments, while normative methods aim to shape the desirable/undesirable features and build the pathways or chain of events for reaching it (Melnikovas, 2018). The process to develop the Adequate Response Framework drew research into the exploratory dimensions. Survey concludingly formulated the basis for defining the Research Elements while the exploratory case studies helped to formulate the interdependencies within these elements.

Paradigm positions	Guidance	Attribution by the research framework
Explanation to contradictory results	It can provide explanations for seemingly contradictory results that emerge from using different methods.	What looked as the most Influential Forces from the results of the survey, any expert opinion over the interpretation of these results followed by exploratory case study across 2 incumbent organizations contradicted these results add multiple dimensions. These discrepancies indeed formulated the body of work and ratified the interdependencies between the Influential Forces.

3.2.7 Research Strategy – Survey followed by Case Study

To explain the Research Strategy, one must understand typology. Typologies are the study or systematic classification of types that have characteristics or traits in common and form part of models and theories (Cameron, 2009).

The following works (Byrne and Humble, 2006; Cameron, 2009; Melnikovas, 2018) has helped develop the Typology choices as explained in Table 4 Typology choice:

Table 4 Typology choice

Paradigm positions	Guidance	Attribution by the research framework
Sequential Form	One type of data provides a basis for collection of another type of data.	The Research Element data collected over the survey has been validated by the expert opinion and further used for theory building by qualitative case study.
Triangulation	Different methods are used to assess the same phenomenon toward convergence and increased validity	The survey method and expert opinion were both employed to ensure that we increase the validity of identified Research Elements. By employing both the methods, it has been possible to identify the outliers and build Influential Forces.
Explanatory	Sequential design in which the Quantitative is followed by Qualitative analysis.	This research has used the multi-strand design as explained in the Figure 4 Sequential Mixed Model Design and Figure 5 Sequential Mixed Model Design – Meta Inference Confirmatory.

The **Mixed Model Design** allows for the research questions for the second strand (phase) of research to emerge from the inferences of the first strand (phase) (Tashakkori and Teddlie, 2003).

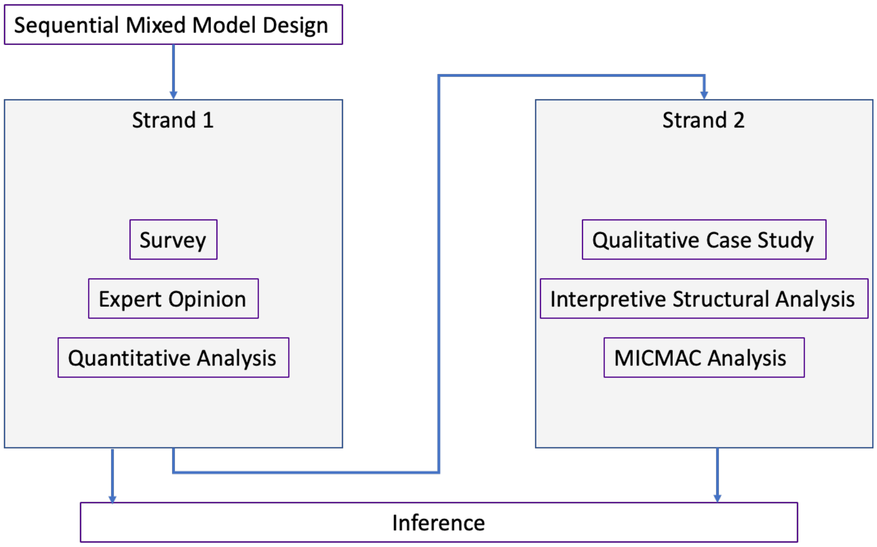


Figure 4 Sequential Mixed Model Design (Tashakkori and Teddlie, 2003)

As depicted in Figure 4 Sequential Mixed Model Design, the first strand (phase) (Tashakkori and Teddlie, 2003) the first strand is exploratory and data collection, analysis and inferences are quantitative approach. The resulting final meta-inferences are made as either confirmatory or disconformity of the inferences made at the end of the two strands (phases) (Tashakkori and Teddlie, 2003). In mixed methods, research inferences are obtained from each strand of a mixed method study and are distinguished from meta-inferences which are obtained by integrating the initial inferences (Tashakkori and Teddlie, 2003).

The adopted research design is shown in Figure 5 Sequential Mixed Model Design – Meta Inference Confirmatory

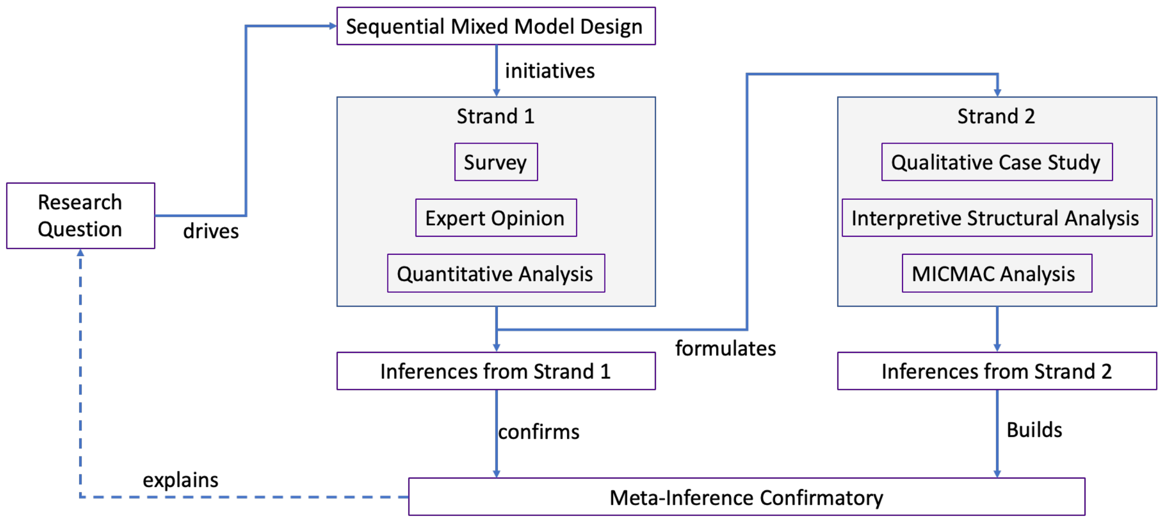


Figure 5 Sequential Mixed Model Design – Meta Inference Confirmatory

3.2.8 Time Horizon – Cross-sectional

The "Time Horizon" opted for conducting the study has been "Cross-Sectional" i.e., analysis of the sequential decision-making phenomena in a particular period, in the case it is currently or in the current time epoch.

The qualitative study in the research helps to formulate and explain the Adequate Response Framework. This serves as a foundation of the decision-making process of the incumbents to manage the 5G/IoT technologies wave disruption. Getting new insights is not about quantitative hypothesis testing but to exploring the actual world from which an understanding can be gained. There are other works that supported similar methodology constructs - qualitative research approach aims at finding various aspects that are involved in determining the overall representation of the current reality (Deogratius, 2018). "Exploratory Study" aligns with the research goal to explore new theory adequately. Several researchers agree that Exploratory Study approach practically always unhides novel insights in a topic of research (Maykut and Morehouse, 2002; Dieronitou, 2014; Silverman, 2015; Corlett and Mavin, 2018; Gackstatter and Lemaire, 2019).

3.3 Research Purpose and Questions

Researcher has chosen to research on the following question:

"Adequate Response Framework to 5G/IoT technologies disruption for incumbents"

This study will evaluate the above research title from the relationship of three dimensions that concern the incumbents, and it is depicted in the Figure 6 Research Purpose.

- Dimension 1: Prevalence of the competitive business models
- Dimension 2: Adoption of cloud-based services to proliferate IoT offerings
- Dimension 3: Engagement of the Ecosystem.

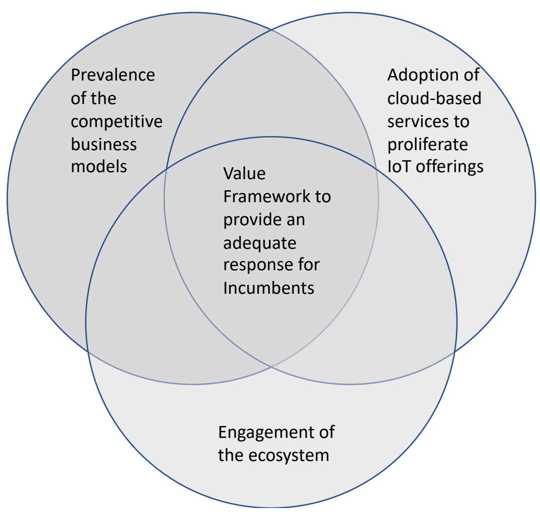


Figure 6 Research Purpose

3.3.1 What constitutes knowledge

Presented below is the research paradigm position in the subjective-objective bi-dimensionality to construct "what would be perceived as knowledge":

- New theory formulation and to describe situation holistically from the perspective of the participants.
- Nominal / decided by convention.
- Simple theories and concepts.
- What a respondent narrates - her stories, perception, and interpretations
- New understanding or a worldview either expressed by a respondent
- There are no final and ultimate criteria upon which all theories can be tested, only those that we can agree upon at a certain time and under certain conditions.
- Foundational criteria are discovered; nonfoundational criteria are negotiated.
- Written, spoken and visual accounts.
- Attributed meanings from entities and context.
- Specifics.
- Refusal to adopt any permanent, unvarying standards by which truth can be universally known agreements.
- Researcher Reflexive, the assumptions perceptions and conceptual understanding effects various decisions in the research process.

3.3.2 Key outcomes

The key aspiration of this research is to explain the research title using the research dimensions: ‘the prevalence of competitive business models’, ‘adoption of cloud services to proliferate IoT offerings ‘and ‘engagement of the ecosystem’.

This research strives to build Adequate Response Framework that will help the incumbents in the following ways:

- Impact of the business models, cloud adoption and the engagement of Ecosystem on the adoption of 5G/IoT technologies by the incumbent players.

- Identify different clusters of organizations with respect to their ability to innovate in the presence of 5G/IoT technologies.
- Identify key Influential Forces that help build an adequate response to the 5G/IoT technologies wave.
- Identify the Influential Forces interrelationships with respect to the ability to innovate.
- Establishes how the Influential Forces interdependencies are different for different organizations.
- Guidelines for Low Innovative Incumbent Organization to leverage Influential Forces in readjusting their decision-making process to provide an adequate response to 5G/IoT technologies disruption.

3.4 Research Design

This research has been conducted in the following phases which are elaborated in rest of the chapter:

- Phase 1: Discover Research Elements through literature review
- Phase 2: Conduct survey to discover the Influential Forces that drive these elements
- Phase 3: Conduct data analysis to build the Adequate Response Framework
- Phase 4: Test framework through qualitative case study
- Phase 5: Finalize Adequate Response Framework.

The Table 5 Research Design explains each phase with its key objective and important activities. These phases overlapped with each other and worked in parallel.

Table 5 Research Design

Phase	Thematic	Objective	Key Activities
Prelim	Research proposal development	To build the research concept, conduct a literature review to find the research gaps and present along with the methodology in research proposal	• Concept paper – Build the preliminary research and its validity • Literature review – Study the existing art to validate the research gap • Methodology development – understand the research ontology and propose the methodology to conduct the research.
1	Discover Research Elements through literature review	Classify the literature and identify the key Research Elements that relate and explain the research question	• Literature Review publications classification • Identify and build a set of Research Elements form the meta values of the selected literature • Optimize into reference set and describe the elements • Tabulate with reference literature citations.

Phase	Thematic	Objective	Key Activities
2	Data Collection: Conduct survey to build correlations between these elements	Collect empirical data from a survey for the reference set.	• Design the questionnaire • Conduct the survey • Validate the data for its completeness and quality
3	Conduct data analysis to define the Adequate Response Framework	Perform data analysis to build the Adequate Response Framework diagraph	• Principle Component Analysis – identify the underlying driver elements • Cronbach Alpha – check reliability of research • Confirmatory Factor Analysis – understand latent constructs validity • Reliability Analysis - Homogeneity, Completeness and V-Measure – Extent to which the research reflects the theoretical latent construct

Phase	Thematic	Objective	Key Activities
			• Index generation – To quantify the responses in terms of the research variables. • Cluster Analysis – to find distinct clusters in terms of the research title within the incumbents
4	Test framework through case study	Build the relationships among elements to see the implementation in action	• Case study design – To work with 2 incumbents that belong to different clusters and check the framework validity with real life execution. • Interpretive Structural Modelling (ISM) – Establish directional relationship between the Research Elements. • MICMAC analysis – Explain the driver power and Dependence Power of the model.

Phase	Thematic	Objective	Key Activities
			• Revise the Adequate Response Framework with the findings from the MICMAC Analysis and the case study.
5	Present the final findings	Explain the relationships, practical findings of fitting the model in 2 case studies.	• Thesis completion – Document and explain the findings and further work in the thesis

3.5 Instrumentation

In Phase 2, author designed the survey questionnaire. A questionnaire is designed to gather empirical data for the finite set of the Research Elements (Rezac, 2020). Built the survey and employed them to collect empirical data regarding the importance and Driving Power of these Research Elements.

But surveys are also bound with many problems, most of them that affect the validity of the research findings are the trust that the respondents place on the survey-based outcome. Developed the operationalization framework to designing the questionnaire for it to be effective in collecting the relevant data.

3.5.1 Operationalization Framework for Survey

Operationalization is turning the abstract concepts into survey questions. This research has used the Postulation-Intuition-Inquiry model (Saris and Gallhofer, 2014) to build the operationalization

"Postulation": Postulates are concepts that are less obvious and thus their meanings are not readily available. An approach to measuring a given concept with a direct question presupposes that the meaning of that concept is obvious to everyone, and that people share a common interpretation of it. This is a good strategy to adopt if the concept we are dealing with is not complex and directly observable, while the concepts author wanted clarity on deals with larger and complex concepts. These are referred to as Constructs that will require explicit definition to impart the meaning of the concept in the right sense (Költringer, 1995).

The postulates have been thus defined for the Research Elements accurately because they are the core tenets to build postulates as constructs for the research.

A postulate is then defined through various other aspects which are called as Formative Indicators (Saris and Gallhofer, 2014). This is depicted in Figure 7 Postulates and Indicators (Saris and Gallhofer, 2014, p. 21).

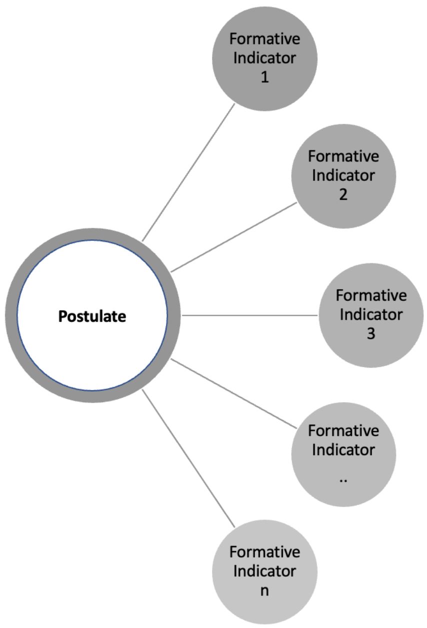


Figure 7 Postulates and Indicators (Saris and Gallhofer, 2014, p. 21)

"Intuition": When designing the questionnaire, many decisions had to be made to be sure that author address the postulate adequately. This research has chosen the model in which the Postulates are represented by the set of Research Element using decision model framework as suggested by Saris and Gallhofer (2014b, p. 7,8) the chosen model and it is depicted in Figure 8 Developing Enquiry from Postulates using Intuitions (Saris and Gallhofer, 2014, p. 7,8).

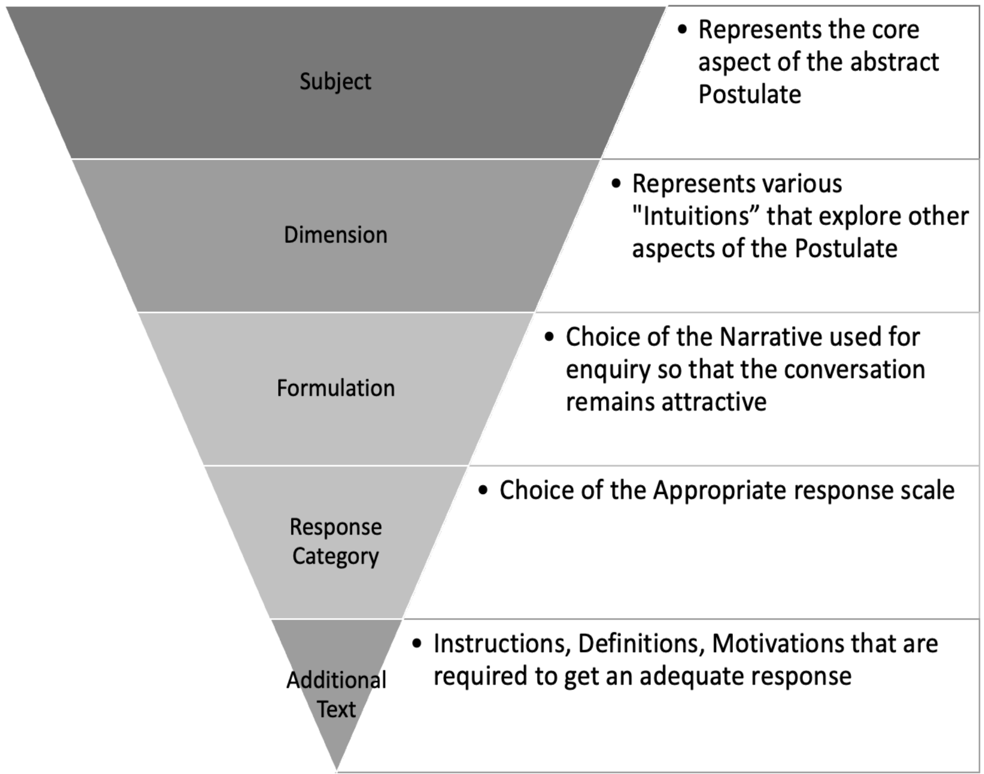


Figure 8 Developing Enquiry from Postulates using Intuitions (Saris and Gallhofer, 2014, p. 7,8)

To build the enquiry is to successfully formulate a request for an answer. This research has used the linguistic structure of the sentence as shown in Figure 9 Developing Enquiry from Postulates using Intuitions to build the questions of the questionnaire. The linguistic model helped frame the questions so that one can direct the respondents a query which provides gainful insights on their perception for the Influential Forces.

Thus, by changing the Enquiry Clause and the Subject Complement one can build all the request for answer questions regarding the Influential Forces which represent the Research Elements.

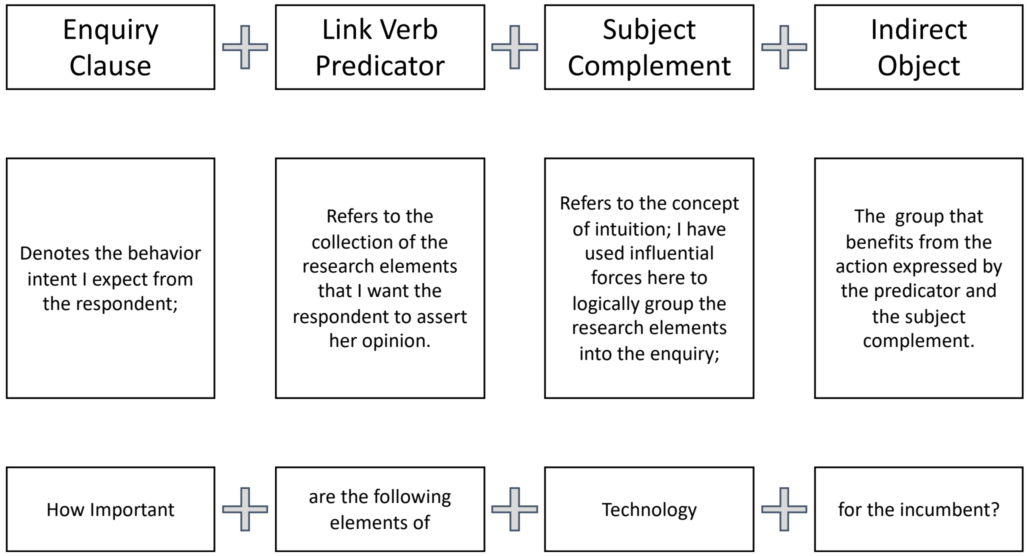


Figure 9 Developing Enquiry from Postulates using Intuitions (Saris and Gallhofer, 2014b)

3.6 Population and Sample

A cross-sectional survey has been carried out across incumbents impacted by the 5G/IoT disruption wave. This questionnaire has been sent to 500 participants representing manufacturers, system providers, IoT consultants, Strategy Consultants, System Integrators, and practitioners from IoT Ecosystem. received a response rate of 40% therefore achieving a 200 respondents sample size.

Testing the validity of the framework and improving it from conditioning in real-life situations has been done through case studies. The case study has been conducted for two organizations and the data has been collected through structured interviews and focused discussions around the driving force of the Research Elements.

3.7 Participant Selection

All participants are either currently developing IoT solutions or expect to do so within the next 12-18 months. The primary data that has been collected from key consultants, researchers, business leaders and technology subject-matter-experts in field of 5G/IoT.

The strategy for sampling implemented was such that the selector had no influence on the sample and therefore the author cannot influence the results. The selection strategy has been thus random sampling.

3.8 Data Collection Procedures

Research articles published in the last 22 years starting from 2000 to 2022 have been selected for the present review. The criteria for the selection of the candidates have been to explore all the articles related to Adequate Response Framework in the wake of new technology advent. Thus, new technology response, adoption, 5G/IoT, technologies response framework among others and their combinations were used as keywords for the articles across several databases including Internet searches Google Scholar, IEEE, science direct and O'Reilly amongst others. Researcher would read the abstracts of these papers and decide whether to include the given article on the premise that it relates significantly with the research title or it's a light dimension has been made.

A total of 794 research articles were identified and it has been very helpful to go through citations and references in these articles to find the related articles and art of work. A guiding principle employed within this literature review has been about capturing in essence the spirit of innovation that organizations kindle and sustain, as it manifests itself into this adequate response. An innovation is the implementation of a new or significantly changed product or process that includes production or delivery, organization, or marketing processes (Gault, 2016). Also, this impacts the capability of an organization to be innovative, which is captured in ‘innovativeness’. ‘Innovativeness’ is the capacity of a new innovation to influence the firm's existing marketing resources, technological resources, skills, knowledge, capabilities, or strategy (Garcia *et al.*, 2002).

These guiding principles helped as guiderail in selecting the relevant literature and formulating the research title and its dimensions.

3.8.1 Research Element Frequency Matrix

In phase 1, author conducted the literature review to identify key Research Elements that address limited spectrum of constructs in relation to the research question. A review of theories, as suggested by Randolph (2009), can help establish what theories already exist, the relationships between them, and to what degree the existing theories have been investigated. A theoretical review is appropriate if the dissertation aims to advance a new theory (Cooper, 1988). In terms of the research rationale, a theoretical review can help establish a lack of theories or reveal that the current theories are insufficient, helping to justify that a new theory should be put forth (Cooper, 1988; Garcia *et al.*, 2002; Randolph, 2009). Utilized the literature review to conduct a theoretical review and documented the findings with aid of a matrix.

"Research Element Fulfillment Matrix" has helped identify the key elements that represent the central theme of this research and how often have they been cited in the selected research works. author derived the Matrix using Cooper's Taxonomy for Literature Review which discusses that the methodology offers goals of sizing up new substantial developments in the field, synthesizing knowledge from different lines of research and inferring generalizations from a set of studies (Cooper, 1988). This is shown in Table 6 Literature Review Guide on Cooper's Taxonomy.

Table 6 Literature Review Guide on Cooper's Taxonomy

Paradigm positions	Guidance	Attribution by the research framework
Character-istic – Fo-cus	• Research outcomes • Research methods • Theories • Practices or applications	Theories – The research aims to build a new theory on adequate response to 5G/IoT tech-nologies wave for the incumbents that dif-ferentiates from any previous theory on technology management and decision mak-ing.
Goal	• Integration • Criticism • Identification of central issues	"Identification of central issues"-the goal for the literature review is to identify specific gaps in existing theories that are inade-quately addressed. This has culminated into a need for Adequate Response Framework that incumbents can utilize to manage and leverage 5G/ IoT technologies wave.
Perspec-tive	• Neutral representation • Espousal of position	"Espousal of Position" – Researcher played a more active role in the editorial process by accumulating and synthesizing the literature to identify and define the Research Ele-ments.

Paradigm positions	Guidance	Attribution by the research framework
Coverage	• Exhaustive • Exhaustive with selective citation • Representative • Central or pivotal	"Central or Pivotal" - Selected materials that investigate decision-making process for technology, evaluate how the process will be impacted by 5G/IoT technologies. The focus has been to introduce an Adequate Response Framework for the incumbents.
Organization	• Historical • Conceptual • Methodological	"Conceptual" – Literature that are exploring similar topics are grouped together to understand the cohesiveness and distinguish them to identify the key thematic – Research Elements.

This approach allowed to focus on selecting the right articles - Literature review involved classification of 225 research articles published during the 22 years period from 2000 to 2022. The following key words, among others, to build the base for the literature review were used.

- Response*
- Edge*
- IoT
- 5G*
- Business Model
- *Ecosystem*

- Cloud*
- Indus*4. *
- CP*
- Cyber-Physical System [. and among others].

In the search strings above, the Asterix (*) represents wildcard characters. The search has been done on subject terms, which are representative for a specific While the essential concept that construct the meaning of these Research Elements were taken sacrosanct from the referenced text, however, any similar elements which would concede the same meaning as that of this Research Element, such elements were combined to represent a single element. For example, words like “machine intelligence”, “intelligence”, “edge intelligence” and “machine intelligence” would all mean converge into a Research Element “machine intelligence”.

In reviewing the selected articles, it was observed that the response to 5G/IoT technologies to build an Adequate Response Framework channeled wide spectrum of elements which can be utilized as a finite set to conduct the empirical research. Research Element Frequency Tabulation will help club some of the synonymous concepts together and present the entire set with its referenced literature (Vinayak, 2013). Thus, the Elements were identified and recorded in Table 12 Research Elements from Literature Review.

3.8.2 Survey

The intent of the questionnaire has been to collect empirical data and so a two-part questionnaire has been used in this research. The first part introduced the context and collected the basic background information about the respondent and the representative industry and how respondent is affiliated with the sequential design decision-making process for forming an adequate response to technology innovation. The second part of the questionnaire has been to measure on a 5-point Likert scale (1- Not Important 2- Less Important 3- Important 4- More Important 5- Most Important), asking the respondent to rate each Research Element construct individually. This part presented 69 items that were generated from the literature review and identified as Research Elements.

To examine the content validity of the Research Elements being qualified under this questionnaire, it has been sent to 3 top consultants and 2 Academy experts who have published relevant articles or have rich experience in driving such innovation frameworks for technology adoption. The feedback collected from these experts has been incorporated in the questionnaire and it has been only this final questionnaire that has been prepared and sent along with its covering letter to all the respondents.

3.8.3 Case Study

In phase 4, author conducted case studies for two organizations that belong to different clusters that have been identified in phase 3. This research has then used qualitative data from the case studies to help explain the directional relationship between Influential Forces using Interpretive Structural Modeling (ISM). Where, using quantitative techniques Gathered ample observations for the research, with qualitative data on the other hand, it has helped test the framework in real life setting and thus providing more insights to increase the reliability of the findings.

Employed interviews observations in field visits, workshops, and archival sources to collect data for the case studies.

"Interviews" were held with the participants who are key proponents of the sequence of decision-making carried out at a strategic level as well as tactical levels for the case study organizations. It was found useful to maintain graphs about the information being collected which could be coupled with the narrative. A guiding principle that held a well-defined focus has been to become intimately familiar with the case as a standalone entity. This process allows the unique patterns of each case to emerge before investigators push to generalize patterns across cases (Eisenhardt, 1989). Understanding influence on the decision-making process and coupling them with the narratives also help accelerate the understanding in terms of cross case comparisons.

"Field visits" meant being a part of regular team meetings as an observer and capturing in the notes qualitative data that will help formulate the theory. Maintained field notes, as a running commentary of the observations as per the case study protocol. These notes captured the impressions as they occur such that observer has been reacting to them instead of processing to find what seems relevant and important This was very progressive during the research as it helps compare across the cases, build hunches about inter relationships and validate some of these during the informal observations.

"Workshops" with cross functional team to validate the findings of the research. Work started with a detailed planning for the workshop which meant to scope out the part of research and set its objective, essentially be very clear on what this workshop should achieve.

The workshop had been initiated with an introduction and briefing done jointly alongwith the case study sponsor. Setting the context and explained the objective, presenters would always have an introductory text available for all the participants to go through what the research title is and what is the objective of the overall research. This helped bring the focus across the participants and bring up to speed any new participants poor join the discourse.

Workshop was conducted with the guidance to foster creativity and collaboration so that it maximizes the participation and help reduce the biases within the team. As the participants started understanding the personal gain as well as organizational gain that is possible through the Adequate Response Framework that research has produced, a broader engagement was observed

Presenters would end the workshop with a debrief and clearly outline the next steps and thank the participants for their impartial and open participation to formulate this research framework.

“Archives” to discussions and some of the presentations that were provided by consultants helped understand the relationships between the Influential Forces and what sequence of decision-making has been adopted by the organization.

3.9 Data Analysis

“Principal Component Analysis (PCA)”: a statistical technique that allows us to understand if there is any underlying element that drives the other elements as represented in the empirical data set, doing this with the minimal loss of information (Vinayak, 2013). PCA captures the attributes that contain the greatest amount of variability in the dataset - It does this by transforming the existing variables into a set of principal components or new variables (Kotu and Deshpande, Nov 2018).

“Horn’s parallel analysis (PA)” is an empirical method to decide how many components in a principal component analysis (PCA) drive the variance observed in a data set (Dinno, 2010).

“Screeplot”: Screeplot is used to define the optimal number of clusters that will dissect the population into distinct clusters. Screeplot involves examining the graph of the eigenvalues and looking for the natural bend or break point in the data where the curve flattens out (Dinno, 2010). The number of datapoints above the “break” (i.e., not including the point at which the break occurs) is usually the number of factors to retain, although it can be unclear if there are data points clustered together near the bend (Costello and Osborne, 2005).

“KMeans++ Cluster Analysis”: It may be desirable to dissect the observations into relatively homogeneous groups, as observations within the same group may be sufficiently similar to be treated identically for the purpose of some further analysis, whereas this would be impossible for the whole heterogeneous data set (Jolliffe, 2002, p. 210). Cluster analysis classifies data into a sequence of groupings so that objects of each group are more alike among themselves than they are to objects found in other groups (Levine and Stephan, 2015). Research has employed KMeans++ algorithm to cluster the observations into homogenous groups.

“Confirmatory Factor Analysis (CFA)”: is appropriately used when the analyst has some knowledge of the underlying latent variable structure (Byrne, 2012). Since the elements are all derived from the extensive literature review, CFA has been found apt for this data analysis. CFA is concerned with the extent to which the observed variables are generated by the underlying latent constructs, and thus the strength of the regression paths from the factors to the observed variables (the factor loadings) is of primary interest (Byrne, 2012). Validity of research has been tested by validating construct validity, convergent validity and discriminant validity (Byrne, 2012).

“Homogeneity, Completeness and the V-measure”: Homogeneity is defined where each cluster contains only members of a single class and completeness where all members of a given class are assigned to the same cluster (Pauletic, Prskalo and Bakaric, 2019). V-measure measures how successfully the criteria of homogeneity and completeness have been satisfied - It measures how successful a clustering algorithm is at satisfying the homogeneity and completeness criteria by providing a "Validity" value (Ball *et al.*, 2011). Research has calculated the three metrics to ensure that findings of the cluster analysis are reliable.

"Interpretive Structural Modeling (ISM)": With the reliability and validity of the Influential Forces been established in Phase 3, Phase 4 developed and validated the relationships between the Influential Forces. Research has achieved this by using Interpretive Structural Modeling (ISM). ISM is described as learning process that enables individuals or groups to develop a map of the complex relationships between many elements involved in a complex situation (Amrina and Yusof, 2012). The goal of ISM is to develop a structural model describing the relationships among the elements of a complex system based on a meaningful contextual relation that is assumed transitive (Venkatesan, 1984). Further, ISM also refers to a kind of graph theory of the systematic application in such a way that theoretical, conceptual, and computational leverage is exploited to efficiently construct a digraph, or network representation, of the complex pattern of a contextual relationship among a set of elements (Sun *et al.*, 2010). Research utilized Interpretive Structural Modeling (ISM) to define the dependencies within these Influential Forces as a diagraph. The modeling was carried out separately for the both case study organizations.

"Case Study": Case study is a strategy for doing research that involves an empirical investigation of a particular contemporary phenomenon within its context using multiple sources of evidence (Runeson *et al.*, 2012). An interpretive case study attempts to understand phenomena through the participants' interpretation of their context

(Runeson *et al.*, 2012). The use of ISM enabled to compare two models (Two organizations that belong to extreme clusters) as to how value can be proliferated by these organizations. Built constructs to attribute to the differences in the separately created Diagraph. Research used case study to validate the differences found in these two ISM models. This helped explain and interpret the difference in response by the incumbents to the 5G/IoT disruption wave.

"MICMAC (Impact Matrix Cross-Reference Multiplication Applied to a Classification) Analysis": Which factors should be focused first in order to get a solution is identified by looking at the (Impact Matrix Cross-Reference Multiplication Applied to a Classification) MICMAC analysis (Karadayi-Usta, 2020). This analysis helps divide the core factors set into Autonomous, Dependent, Relay and Independent variables thus helping us explain the conceptual reality of the founded elemental set to a better extent (Vinayak, 2013). The purpose of MICMAC analysis is to arrange the factors with respect to their Driving Power and dependence into four clusters - Autonomous, Dependent, Relay, and Independent factors (Ertas, 2018). In the final phase of the research, Research has employed MICMAC analysis to build guidelines that low Incumbent Innovative Organizations could use to realign their decision-making process based on the leverage of the Influential Forces. This research aims to explain various Driving Power and Dependence Powers of the Adequate Response Framework that will help the incumbent in terms of the research dimensions and Influential Forces.

3.10 Case Study Design

3.10.1 Objectives

The results from the quantitative analysis establish the Influential Forces that explain the research dimensions. But it does not explain the relationship between these forces and how these relationships can be used to explain the difference between an adequate response and an inadequate response. The following objectives have helped focus the research effort and the outcomes in designing an adequate case study:

"Qualitative Methodology" is used to derive relationships, study, and interpret them into a repeatable framework. Business situations incite creative and innovative responses from the managers, leading to ensuring sustainability amidst volatile market forces (Kulkarni and Pachpande, 2011). The case study is a research strategy which focuses on understanding the dynamics present within single settings (Eisenhardt, 1989). Case study is a strategy for doing research that involves an empirical investigation of a particular contemporary phenomenon within its context using multiple sources of evidence (Robson, 2002). Research has used case studies that have been conducted on Low Innovative Incumbent Organization and Highly Innovative Incumbent Organization, in parallel, to formulate the Adequate Response Framework.

"Exploratory Research": Case study strategy has been originally used primarily for exploratory purposes (Flyvbjerg, 2006). Research is utilizing this strategy for explaining how to best build Adequate Response Framework to manage 5G/IoT technologies wave disruption.

"Interpretive": An interpretive case study attempts to understand phenomena through the participants' interpretation of their context (Runeson *et al.*, 2012). As called out in 3.2.2, the perspective of this research is value bound and pluralist – thus research seeks the reality through the interpretations of the participants of case study.

"Realism": Case studies are, by definition, conducted in real-world settings, and thus have a high degree of realism, mostly at the expense of the level of control (Flyvbjerg, 2006; Runeson *et al.*, 2012; Rashid *et al.*, 2019). This helps generalize the research findings for the population of the organizations that are incumbents to 5G/IoT technologies wave.

"Replication": The replications increase the validity of the research findings. The aim of replication is not to increase accuracy (i.e., the development of an ever-more accurate representation of some external reality), rather, replication in interpretive research aims at gaining increasingly more in-depth understanding of the phenomena investigated (i.e., building richness of phenomenological experience) (Riedl, 2007). This research has argued for theoretical replication in this research as the objective is to build a new theory – proposing Adequate Response Framework – for managing 5G/IoT technologies wave disruption.

"Inductive Enquiry": In inductive research, the researcher first observes with an open mind, identifies patterns in the observations, sets up tentative hypotheses, and finally relates them to existing theory or develops new theory (Eisenhardt, 1989; Cameron, 2009; Runeson *et al.*, 2012). Research has opted for Inductive Enquiry as depicted in Figure 10 Inductive Enquiry Objective as the process is formulating a new theory of technology management in the realm of 5G/IoT technologies wave.

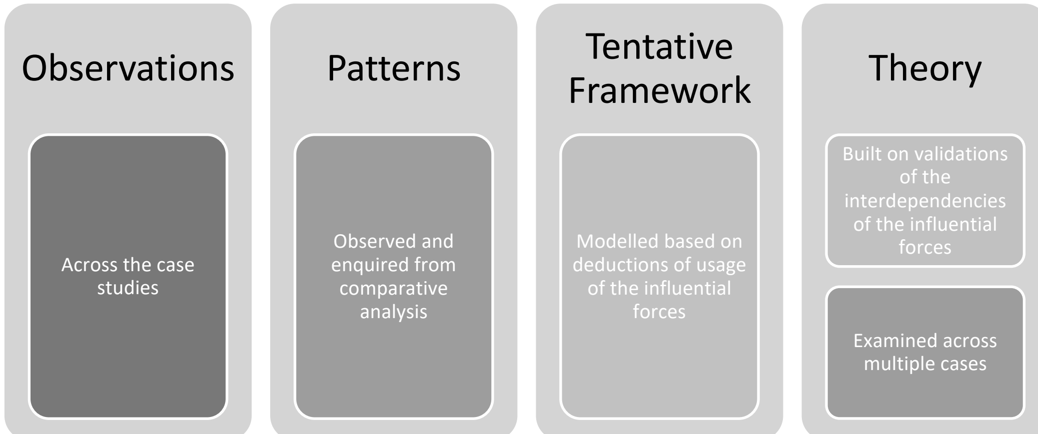


Figure 10 Inductive Enquiry Objective

In accordance with Yin (2003), Research has considered conducting qualitative research through case study as per the following reasons provided in Table 7 Considerations for Case Study (Yin, 2003):

Table 7 Considerations for Case Study (Yin, 2003)

Paradigm positions	**Guidance**	**Attribution by the research framework**
Behavior	Cannot manipulate the behavior of those involved in the study;	Yes, the case study is carried out in industrial setting where the participants behavior cannot be manipulated.
Contextual Setting	Cover contextual conditions because researcher believe the conditions are relevant to the phenomenon under study;	Yes, contextual setting is of current decision-making process for technology management. The participants were not discussing generic decision-making framework, but rather explaining and evaluating their own organizations decision-making framework as it is used

Paradigm positions	Guidance	Attribution by the research framework
		today. This contextual setting is further elaborated in Figure 12 Context and Unit of Analysis
Boundary	Boundaries are not clear between the phenomenon and context;	Yes, the phenomenon for this research endeavor is the advance of the 5G/IoT technologies wave, while the context is the incumbents managing the response to this wave. Hence, the boundary is not clear between the phenomenon and context.

3.10.2 Boundaries of the case

The bounded context of case is essential as one of the common pitfalls associated with case study is that there is a tendency for researchers to attempt to answer a question that is too broad or a topic that has too many objectives for one study (Baxter and Jack, 2015). Based on these recommendations clear boundaries of the case study have been developed to remain reasonable in scope of research as explained in Table 8 Boundaries of the case study.

Table 8 Boundaries of the case study

Paradigm positions	Guidance	Attribution by the research framework
Time	The time epoch the case study ascribes.	The time horizon for the study has been cross-sectional i.e., Analysis of the sequential decision-making phenomena during the period when conducting the case study - in the current time epoch.
Activity	Describes the activities that will be covered during the case study	Research will be investigating how the Influential Forces impact the technology management decision-making process of the incumbents in wake of 5G/IoT technologies wave.
Definition	Concise definition of Unit of Analysis.	This study evaluates the research - "Adequate response framework to 5G/IoT technologies disruption for incumbents"
Context	Establish when and where this case study will be conducted and who will participate in it.	The context is different organizations that are impacted by the 5G/IoT technologies wave. Research has identified 2 incumbent organizations that vastly differ in terms of their innovativeness regarding the decision-making process for new technology management.

Paradigm positions	Guidance	Attribution by the research framework
		The participants of the case study are the key personnel from these organizations that influence decision-making process regarding technology advancements. The case study will be conducted on the premises of the 2 organizations; given the restrictions of Covid-19, the actual physical movements on this premise has been as per best effort basis. The participants, however, have also adopted remote working ways of working and thus as a complementary approach, research interviews and workshops are being conducted on online meeting rooms in a collaborative manner.

3.10.3 Case Study Design Decision

The problem of single cases is limitations in generalizability and several information-processing biases (Eisenhardt, 1989). One way to respond to these biases is by applying a multi-case approach (Leonard-Barton, 1990). Multiple cases, augment external validity and help guard against observer biases; moreover, multi-case sampling adds confidence to findings (Miles and Huberman, 1994). By looking at a range of similar and contrasting cases, one can understand a single-case finding, grounding it by specifying how and where and, if possible, why it behaves as it does (Miles and Huberman, 1994). The case study design as a single case study is a misfit for the research because of the following reasons:

- This research undertaking does not represent a critical case to test the well formulated theory.
- The current research endeavor does not address only an extreme case or a unique case – representing situations that might be specific to a given certain disorder.
- The current research endeavor is not being opted to be a representative or a typical case-the objective is certainly beyond capturing the circumstances and conditions of everyday or commonplace situations.
- Research is not opting for revelatory case - this is when one have an opportunity to observe and analyze a phenomenon that has been previously inaccessible to investigation.
- The current case study is not a longitudinal case- studying the same case at different points in time such that the theory of interest would likely assert in how conditions have changed overtime and the desired time intervals to be selected would reflect the presume stages at which these changes should reveal themselves.

Given this difference for motivation of the single case study, research has opted for Multiple Case Study methodology. This research has chosen two cases, which allows for comparison and contrast between the cases. Following are the advantages that have been observed while pursuing multiple case study design:

- The evidence from multiple cases is often considered more compelling, and the overall study is there for regarded as being more robust (Dul and Hak, 2007).

- It offered more flexibility-each case served a specific purpose within the overall scope of the enquiry.
- Replication, not sampling logic, is considered for multiple cases and here the replication logic is analogous to that used in multiple experiments (Yin, 2003; Dul and Hak, 2007; Baxter and Jack, 2010).

Yin (2003) categorizes case studies as "Explanatory, Exploratory, or Descriptive" and Stake (1995) identifies case studies as "Intrinsic, Instrumental, or Collective". The Table 9 Case Study Design Considerations explains how researcher has taken the published work into consideration to design the Case Study.

Table 9 Case Study Design Considerations

Paradigm positions	Guidance	Attribution by the research framework
Research Strategy (Yin, 2003)	• Explanatory • Exploratory • Descriptive • Multiple Case Studies	"Multiple Case Studies" - to build Adequate Response Framework which would form the basis of the adequate response that incum-bents will use for 5G/IoT technologies wave, this research has chosen 2 organiza-tions that are very diverse in their innovation and technology management process.
Case Study Type	• Intrinsic • Instrumental	"Collective" – Collecting data across two different cases to validate the phenomenon

Paradigm positions	Guidance	Attribution by the research framework
(Stake, 1995)	• Collective	of decision-making for technology management.

A “Multiple Case Study” allows to explore differences within and between cases. The goal is to replicate findings across cases. Because comparisons will be drawn, it is imperative that the cases are chosen carefully so that the researcher can predict similar results across cases, or predict contrasting results based on a theory (Yin, 2003).

“Collective Case Study”, researcher move further away from any one case, studying more cases together as inquiries into the phenomenon or population at hand. In advance of the case study, researchers do not know whether the individual cases will manifest common characteristics (Stake, 1995). Their selection is based on the premise that understanding each individual case will increase knowledge about a larger group of cases - whether case study researchers seek out what is particular about a case or what is common across cases, “the result is likely to be unique” (Stufflebeam, Coryn and L., 2014).

3.10.4 Conceptual Model of Case Study

Some defining published works on case study research design (Stake, 1995; Yin, 2003) have advocated building Conceptual Model that serves several purposes (Miles and Huberman, 1994) as listed below:

- Identifying who will and will not be included in the study;
- Describing what relationships may be present based on logic, theory and/or experience; and
- Providing the opportunity to gather general constructs into intellectual "bins".

The Conceptual Model serves as an anchor for the study and is referred at the stage of data interpretation (Baxter and Jack, 2015). The Conceptual Model helps in the process of understanding change as it draws on a phenomenon at the vertical and horizontal level of analysis and the interconnections between those levels throughout the time (Pettigrew, 1990). Author present in Figure 11 Conceptual Model of Case Study that will help ascertain various elements that case study will address:

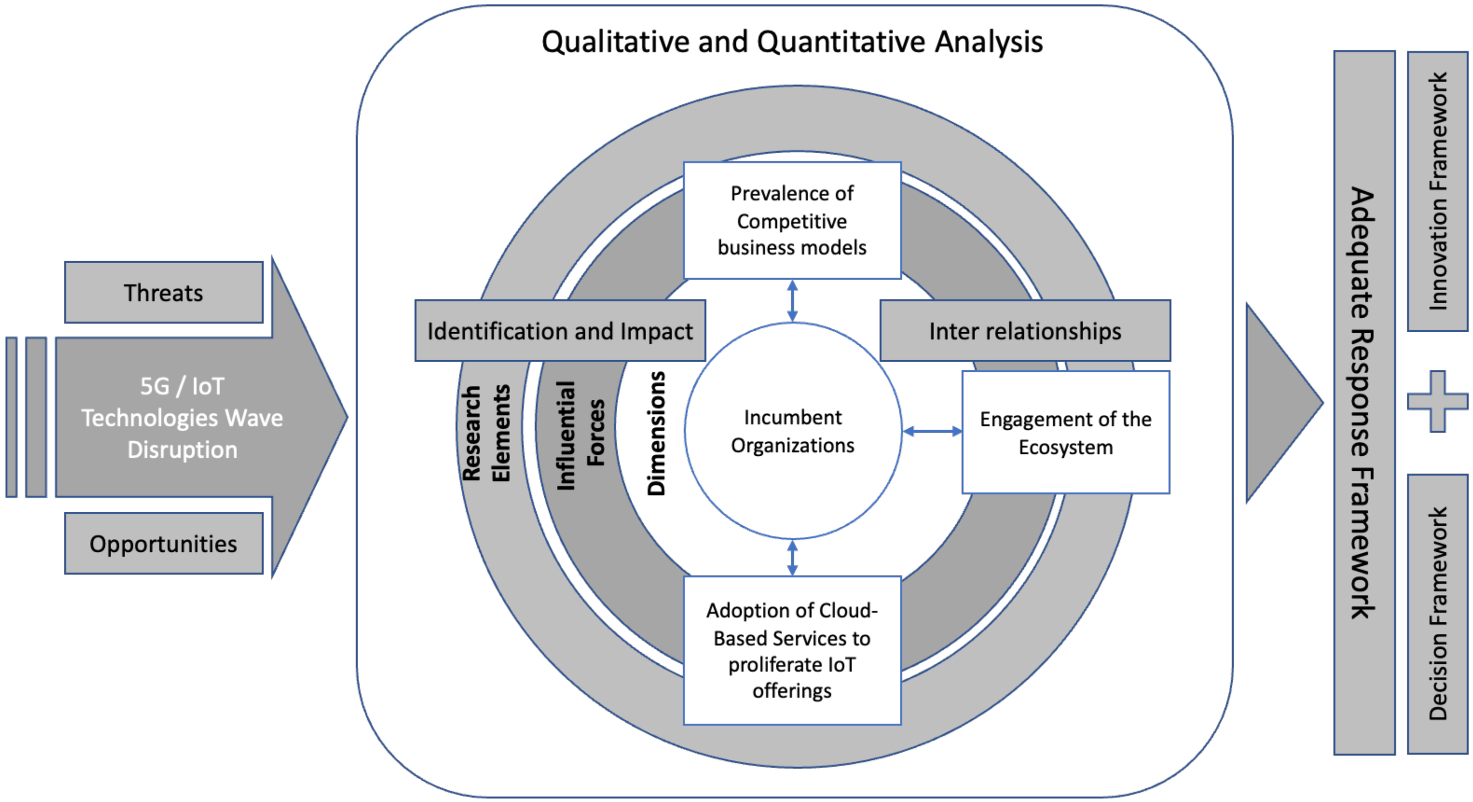
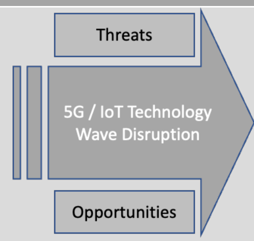
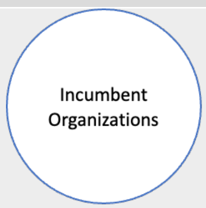
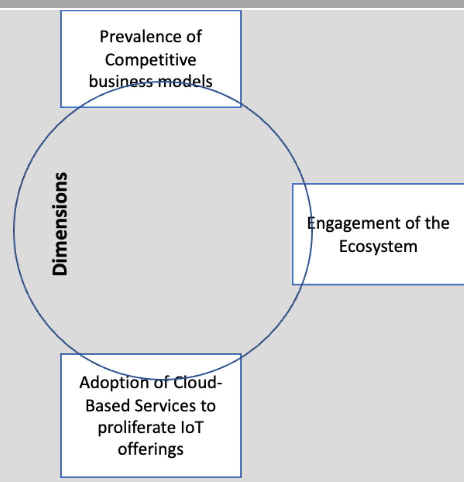
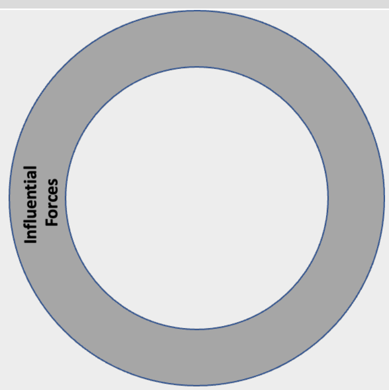


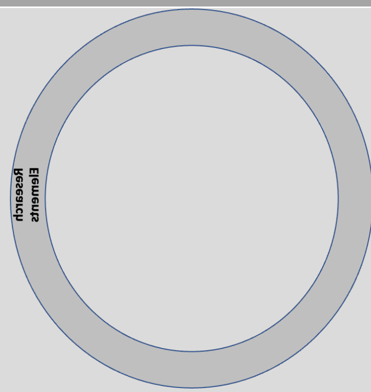
Figure 11 Conceptual Model of Case Study

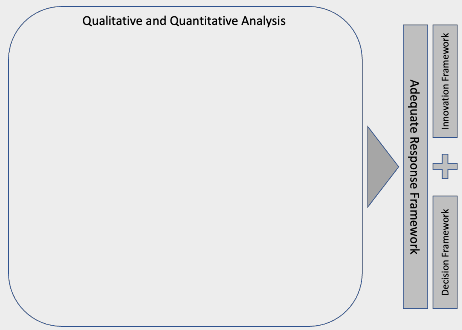
Key elements of the conceptual model are explained in the table below:

Table 10 Case Study Conceptual Model Components

Component Name	**Component Visual Depiction in the Model**	**Explanation**
Technologies wave Disruption		Represents the 5G/IoT technologies wave disruption, and assessment of the opportunities and threats, that incumbents would face in terms of technology management.
Incumbent Organization		Represents incumbent organizations that face an unprecedented threat (or opportunity) due to 5G/IoT technologies wave disruption.

Component Name	Component Visual Depiction in the Model	Explanation
Dimensions		Represents the three dimensions that will be assessed so that this research can provide an adequate response to the technologies wave.
Influential Forces		Represents the Influential Forces that influence technology management decision process that incumbent organizations use to formulate a response to the 5G/IoT technologies wave.

Component Name	**Component Visual Depiction in the Model**	**Explanation**
Research Elements		Represents several Research Elements that have been utilized for prior technologies wave management theories and the aspects incumbent organizations feel are most relevant in terms of formulating an adequate response to the 5G/IoT technologies wave threat.
Identification and Impact	Identification and Impact	Represents objective of the research to identify the key Research Elements as well as Influential Forces along with the impact they have in terms of decision-making for technology management by the incumbent organizations.
Inter-relationships	Inter relationships	Represents the inter relationships between the Influential Forces to build an Adequate Response Framework for the incumbent organizations.

Component Name	Component Visual Depiction in the Model	Explanation
Adequate Response Framework		Represents the objective of this research. Formulating an adequate response would mean building a consistent Adequate Response Framework that provide the Decision Framework and Innovation Framework for the incumbent organizations to properly manage the 5G/IoT technologies wave.

3.10.5 Context and Unit of Analysis

The Unit of Analysis is related to the fundamental problem of defining what the "case" is (Yin, 2003). Information about each relevant individual would be collected and several such event processes or entities as cases might be included to formulate a multi case study (Yin, 2003).

Unit of analysis is what the case study really analyses, and research had multiple choices. Used the research purpose and research title as guiderails to develop the right unit of analysis. Presented with two choices and these are depicted in the Figure 12 Context and Unit of Analysis below:

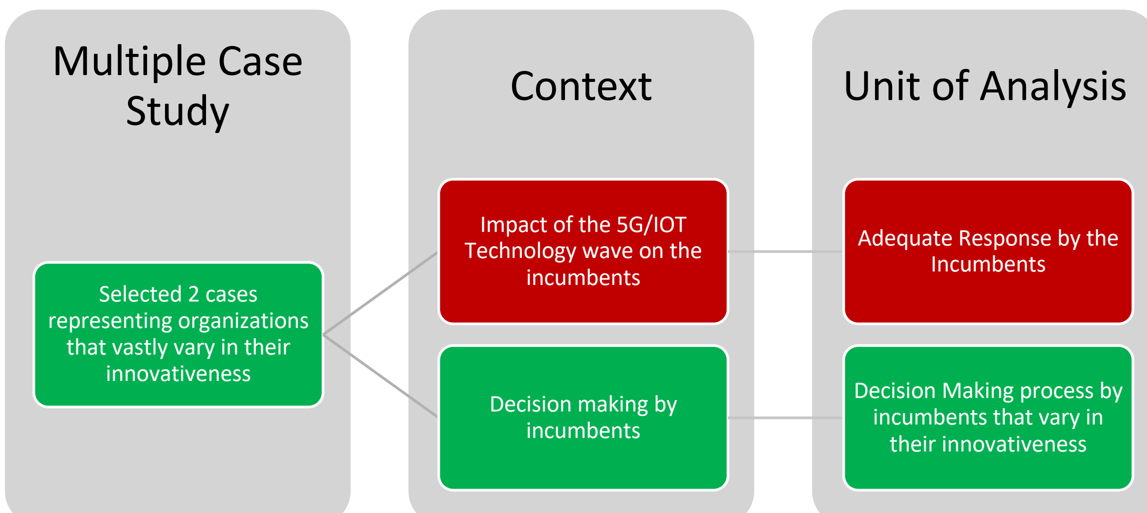


Figure 12 Context and Unit of Analysis

The "Context of Case Study" and "Unit of Analysis" are chosen as follows:

- Context of Case Study: Decision-making by incumbents
- Unit of Analysis: Decision-making process by incumbents (that vary in their innovativeness)

Research opted the "Green" path for following considerations:

- Research is keen to understand the decision-making process by the incumbents and how it varies for the organizations having different maturities of innovativeness.
- This Unit of Analysis will lead to building Adequate Response Framework that can help Low Innovative Incumbent Organizations manage the 5G/IoT technologies wave better.

The reason not to choose “Adequate Response by the Incumbents” as the Unit of Analysis is because it is not adequately discriminating the key body of interest – “decision-making process” and “difference of innovativeness of the Incumbents”.

3.10.6 Reliability Design

Four tests have been commonly used to establish the quality of any empirical Social Research, such as, case study (Yin, 2003), defined as below:

- “Construct validity”: Establishing correct operational measures for the concept being studied
- “Internal validity”: Establishing a causal relationship whereby certain conditions are shown to lead it to other conditions as distinguished from the spurious relationships
- “External validity”: Establishing the domain to which study is findings can be generalized
- “Reliability”: Demonstrating that the operations of for a study can be repeated with the same results.

The following ground rules as a guideline to the data collection analysis of the data from the multiple case studies as a part of the case study protocol.

1) Ensured that all the evidences that had been collected across both the cases were adequately cosnidered.

2) Ensured that the interpretations account for the evidences that have been collected exhaustively.
3) Be flexible, to the point very curious and encouraging, when observer has had someone else offer an alternative explanation to the findings. Some of this has been captured as part of future studies that can be done as the way forward as these are great points but remained outside the realm of the research undertaking.
4) Ensured to be stuck to the most significant aspects of the case study, leveraging the analytical skills and avoiding any unnecessary detours for lesser issues.
5) Captured the ontological, axiological and epistemological constructs of the research methodology.

Table 11 Case Study Reliability Design represents Case Study Reliability Design considerations accordingly.

Table 11 Case Study Reliability Design

Test	**Guidance**	**Attribution by the research framework**
External Validity	Use replication logic	Each individual case study undertaken has been considered as a whole study in which convergent evidence were sort regarding the facts in the conclusions for the case. If such cases conclusions are then considered to be information so that it can be replicated to other case (Yin, 2003).
Construct Validity	• Use multiple sources of evidence.	To increase the construct validity, research has specified accurately the "change" that is being

Test	Guidance	Attribution by the research framework
	• Established chain of evidence. • Have key informants review draft case study report	studied, i.e., 5G/IoT technologies disruption waves impact on the incumbents. During the case, participants were encouraged to undertake the sequential decision-making process as a "chain of events" that is observed to manage a technology advancement impacting the organization. This has helped invalidating 5G/IoT technologies wave being perceived as an isolated event. The final case study has been reviewed by the key informant from both the organizations.
Reliability	• Use case study protocol	• Employed the "case study protocol" as suggested by Yin (2003), which works as an instrument that could employ and tweak to the individual context of the two case studies. • This protocol guided in carrying out the data collection and help maintain the focus on the case study. • Building this protocol helped identify the audience for the case even before formally

Test	Guidance	Attribution by the research framework
		conducting the case study which help be more effective during the field study.
Internal Validity	• Do pattern matching • Do explanation building • Address rival explanations • Use logic models	• Research employed "pattern matching" across the Research Elements which helped to classify them into Influential Forces. These Influential Forces were then aligned using the same technique to the research dimensions. • Research has used **"**explanation building technique" in the following manner: To "explain" the phenomenon of an inadequate response, the process would have to be to stipulate to presumed set of causal links between the Influential Forces. Research has utilized "Interpretive Structural Modelling" technique to validate this causality and reflect on the insights which are a part of Adequate Response Framework. As Research has undertaken multiple case study, one goal is to build a general explanation that fits each of the individual cases even though the cases will vary in their details (Yin, 2003).

Test	Guidance	Attribution by the research framework
		• Research has used “Organization Level Logic Model”, and output from the Interpretive Structural Modelling is a “Directed Dia-graph”, a visual flow chart of how Influential Forces sequentially interplay to build the re-sponse framework. By visually building these diagraphs for two contrasting organizations in terms of their innovativeness Research has been able to develop an “Adequate Response Model” of why the successful organization differed significantly from another organiza-tion that has been struggling in its innovative answer to the technologies wave threat. This adequate response model is elaborated in the Section 5.4.

3.10.7 Case Study Protocol

The research design is used to establish the Case Study Protocol. This protocol covers the data collection procedures along with the data collection plan. This research worked with an outline of the case study report which would help me understand how the incumbent organization utilize Influential Forces in their decision-making process. The objective of the case study endeavor has been to ensure that “to understand and analyze the interdependencies of these Influential Forces within the context of the incumbent organization". It was decided to capture all the evidence during the field trips, online meetings, and the workshop sessions to validate the understanding that has been constructing in parallel for both the cases. Thus, the protocol has been helpful in leveraging the same plan across both the organizations to the maximum extent possible and capture any detours research took to collect and analyze more evidence. Research defined a set of case study questions that focused on managing innovativeness within the organization gathering information about the following:

- Explain the Overview for all interactions,
- Capture and understand current practice of managing innovation,
- Focus on understanding the importance ascribed to each Influential Force,
- Collect evidence for collaboration around Influential Forces,
- Capture and observe Decision-making Process for technology management,
- Understand their readiness assessment process for 5G/IoT technologies,
- Ongoing perception about utilizing technology advancements in current product and service lines,
- Interactions and Management Model used for ecosystem,
- Cloudification process and its apparent challenges,
- How the practices are aligned in terms of skilling the manpower and resources,
- What were the key initiatives and roadmap projects, products, and services,
- Any other prevalent point of view created with 5G/IoT based technology interventions.

3.10.8 Case Selection

Whereas quantitative sampling concerns itself with representativeness, qualitative sampling seeks information richness and selects the cases purposefully rather than randomly (Miller and Crabtree, 1992). Contextualism is about revealing the temporal interconnectedness thus catching the reality in flight - antecedent conditions shape the present and the emerging future (Pettigrew, 1990).

Selecting the case study is as important as the theory building motivation of the case study itself. If the phenomena to be observed have to be contained within a single or relatively small number of cases then choose cases where the progress is transparently observable (Pettigrew, 1990). Case study analysis focuses on a small number of cases that are expected to provide insight into a causal relationship across a larger population of cases (Gerring, 2006a). Research followed the following framework to select the case study target organizations:

- Ensured that case selection has been not based on random rather selector specifically choose organizations that would help extend the theory to a broader range of organizations.
- Selecting cases from different categories allowed the findings to be replicated within those categories.
- The selection of diverse cases has the additional advantage of introducing variation on the key variables of interest (Gerring, 2006a).
- Focused working with large corporations which help constrain variations due to size among the participants.
- In order to be a case of something broader than itself, the chosen case must be representative (in some respects) of a larger population. Otherwise – if it is purely idiosyncratic ("unique") – it is uninformative about anything other than itself (Gerring, 2006a).
- Focused on specific markets so that environmental variations can be controlled.

The research endeavor has been also not without constraints when it comes to recruitment of the case candidates, here are the constraints being referred to hard considerations for recruitment.

- “Access” – The case had to have access to their sequential decision-making process, interaction and intent of such an inquisition from the top management and ideally a organization where there is access to such resources.
- “Geographical Proximity” – Given the Covid-19 travel restrictions, it loomed larger uncertainty about what can one achieve fully offline. Hence, a hard constraint that atleast one case should be of geographical proximity so that when conditions become favorable, will seize the opportunity to resume the field work physically at the campus of the organization.
- “Congeniality” - The case study subject organizations should be congenial to the fact that this research is engaged with them at the early stages of research.

Referring to the seminal work of Gerring (2006b, p. 97) on case study selection as “Diverse Case Study Method” guiding primary objective the achievement of maximum variance along relevant dimensions; it is ideal to choose case from extreme values that motivated to recruit the case study candidates. The diverse case study became the obvious choice for the following reasons:

While similarity is always of interest, identification of diversity became readily accessible in this methodology.

- A causal relationship is affected not only by combinations of factors but also by their “sequencing”, then the technique allows to incorporate temporal elements (Gerring, 2006a).

- Encompassing “a full range of variation” is likely to enhance the representativeness of the sample of cases chosen (Gerring, 2006a)
- The selection of “diverse cases” has the additional advantage of introducing variation on the key variables of interest (Gerring, 2006a).

Hence, it was decided to recruit two cases under the “Diverse Case Study Methodology” guidance that represents extreme ends of the spectrum to represent full variation of the inquiry spectrum.

3.10.9 Case Recruitment

It was essential for the success of case studies to have a clear focus when engaging with the participating organizations. This research collected specific kind of data symmetrically across the both case studies. What helped in the case study design is that the specifics were known that is, a priori specification elaborated as “context and unit of analysis” in Section 3.10.5 and Conceptual Model of Case study in Section 3.10.4. This clarity and prework helped with case recruitments.

a) Case 1: High Innovative Incumbents Organization (HIIO)

A candidate from Energy and Utility organization formed the subject for Case 1. The incumbent owns the high-voltage electricity transmission network in England and Wales and is responsible for ensuring electricity is transported safely and efficiently from where it’s produced to where it’s needed. This organization has Electricity System Operator is a legally separate business, balancing supply, and demand to ensure homes and businesses in Great Britain. They aspire to leverage IoT data to ensure that their infrastructure is functioning properly, quickly detect shifts in demand, and meet their customers’ energy requirements with the utmost cost-efficiency.

To scope out the innovative process pertaining to the research, engagement had been worked with the organization's senior management to define which part of the innovative product line can be affiliated with to conduct the case study. The department of "New Product and Innovation", which aligns with regulated business of the organization has been identified. They have new capability of utilizing 5G/IoT based technologies which fully aligned with the research objective. Following is the objective identified by this department which was tracked and observed during the research process.

This organization has a wild field span of several transmission lines that end at boundaries of interconnect with other distribution organizations. These endpoints are called as service off-take points and are key in tracking, monitoring, and ensuring the service contracts that the energy and utility organization had with the other distribution organizations. The data that is collected from these endpoints via IoT sensors that can work on several telecommunication technologies. 5G is a new technology which is being rolled out across the country and would directly impact this process. The organization is keen on being ahead of the curve and utilizing this technology innovation to its best advantage.

They envisaged service off-take points as control points that would capture the data supporting service contracts. This data is extremely critical from regulatory point of view, ensuring that emission-based calculations can be carried out accurately. Data is also valued to significantly improve operational efficiency of off-take service process.

Given that this has been a regulatory construct the organization decided that it has been best to engage a Domain Expert Data Processor so that the risk can be transferred, and it reduces the chances of misappropriation or miscalculation. A Data Processesor, according to GDPR, Article 5, Clause 8, is defined as the natural or legal person, public authority, agency or other body which processes personal data on behalf of the controller (Calder, 2017). The organization is aware that the data would be ingested from various sources, and they have struggled for long to manage the inconsistencies of the definition within this disparate data. This data is time sensitive and subject to availability, thus any miss in the data or non-alignment in its latency could pose significant risks. Data Security is also a key driver while deciding any allied innovations and extensions.

Organization acknowledged IoT data processing as an industry classified problem and found an opportunity of providing process of data ingestion, pattern recognition and its analysis to be provided as a service. This would be seen as a major value addition for all the players across the ecosystem. Further, if real time processing could be achieved an automated response and alerting mechanisms which would become core construct of a Central Intelligence and Incidence Processing System would be a very strong capability augmentation to existing service portfolio of this organization. There were many advantages such as operational efficiency, increased social responsibility, providing a value-added service to other operators, making the entire Ecosystem more collaborative and agile and finally being able to catch these imbalances early can lead to better supply demand balances which has been the primary objective, also being called out in the corporate strategy. So, to achieve the above objectives the organization had put together a new “Product Innovation Department” that is building its capabilities to better utilize innovation as a response strategy in the advent of 5G/IoT technologies.

b) Case 2: Low Innovative Incumbent Organization (LIIO)

Organization is a candidate from the LIIO group that formed the subject of the Case 2. This organization is evolved into the Modular Cleanroom, Equipment and HVAC Systems manufacturing concern. The vision of the organization is to provide energy efficient design solutions, equipment, prompt services relating to operation, maintenance at affordable cost. Organization participates and guides the clients through the project like concept design, basic and detailed engineering, construction management, validation and to commissioning. The organization is actively participating in New Product Development projects by providing the design & prototype support activities to their clients that are located globally.

To scope out the adequate response process pertaining to the research, engagment was defined with the organization's senior management. We jointly agreed parts of their service and product portfolio the research can be affiliated to conduct the case study. The department of "Product Extensions of Clean Room Technology" pertaining to their flagship products related to Cleanroom Technologies has been identified for the case study. This department builds new capabilities for utilizing 5G/IoT based technologies which fully aligned with the research or objective. Following is the objective identified by this department which was tracked and observed during the research process.

Organization has a unique ability to offer complete concept to commissioning services and undertakes turnkey project management for clean room product and service line. They specialize in offering the components and equipment becoming one stop shop regarding clean room. These clean rooms are commissioned for Biotech, Pharmaceuticals, Electronics, Laboratories, Semiconducting Units and Hospitals. They have retained their competitive edge in the market by the unique design that includes partitioning and subcomponent-based ceiling systems that meet the technical requirements of high specifications regarding controlled environments. Natural growth has come organically from their mainstay business of Heating Ventilating Air Conditioning (HVAC) industry.

Recently, cleanroom-tech has gone through crucial technology upgrades worldwide and as it belongs to a widespread Ecosystem. These upgrades have cascaded to component providers and service providers within the Ecosystem. Organization has identified this as an important driver and has at multiple times tried retrofitting the technology upgrades with their mastered engineering design process. As their assembly line pulls several components from several vendors into a single unit, it is essential for them to start supporting the new technologies that the Ecosystem is advancing.

The advent of 5G/IoT has accelerated this technology upgrade and there are considerable threats that organization feels from its competitors who are building new high technology systems around these enabling technologies. Some of their important clients have already demanded such upgrades to be made to their ongoing projects. The clients have demanded that their provisioned systems must be upgraded to take advantage of Alerting Mechanisms, Data Patterns that can be developed with data from IoT based sensor driven systems. Clients have expressed this as a major shortcoming stinting them of crucial capabilities. Organization recognizes this shortcoming in their capabilities. They have created a new department which would retrofit their existing product and service lines with sensors that can be enabled to leverage technology advancements like 5G and IoT. This department has been called as “Technology Extension Department”. The research scope and objective align with this technology department and thus, the senior management allowed access to their department and its resources in terms of teams, projects that are undertaken and some of their consultant reports. They agreed to conduct workshops to make the observations and provide inputs to the Adequate Response Framework.

During the engagement with this department, there was an important discussion with the CTO of the organization who manages the technology extensions, who mentioned that it is utmost priority for her department to identify 5G/IoT enabled sensors that can add value to their engineering design process. She envisages that the abilities organization would garner from such technology interventions will allow them access, adopt, and build next generation assembled products based on vendors who provide components with such capabilities. The key drivers for them are leveraging telemetry data that would be available from sensors which can be turned it into actionable insights. It would provide additional capabilities in terms of preventive maintenance. She envisages that once such data can be redacted and aggregated onto the cloud, they would be able to create pattern recognition models so that then entire client portfolio can benefit from these machine learnings. It would create the essential alerting mechanism that some of their key clients have already demanded.

It is essential to understand there are significant challenges this department faces today as they do not have adequate skills to garner such technology interventions. There is a cultural shift required in the engineering design process and there is a very strong inhibition felt in the team which has successfully rendered new products on the assembly line that have been widely adopted so far in their existing client portfolio. Some of the other departments do not agree that the loss of some of the customers and their inability to add new customers is because of the organization not in waiting enough to keep up with the market trends. It is also essential to know that, while industry 4.0 which is based on industrial IoT knowledge has become a mainstay in the region, this organization has very small footprint in terms of product and services portfolio to offer in this segment and are losing on a very strong and white footed opportunity.

Having recognized the above opportunities and challenges, Managing Director of this organization has personally mandated Technology Extension Department to be a part of their strategic discussions that the organization takes on a quarter-to-quarter basis.

3.11 Research Design Limitations

"Self-reporting Bias" - All the measures used in the study are self-reported by chosen respondents from each firm. Research has assumed that these respondents possessed high degree of relevant knowledge, but the nature of the study makes it difficult to rule out the possibility of a bias from self-reporting of the different samples. Investigation may mistakenly assume that all kinds of documents- including proposals of projects or programs - are containers of the unmitigated truth. Research has taken care of this bias by acknowledging that documentation research has received is limited. Research has acknowledged that every document is written with some other specific purpose and some other specific audience rather than the case study datapoint.

"Investigator Bias" - Case study work is particularly prone to problems of Investigator Bias because so much rides on the researcher's selection of one case (or a few cases); even if the investigator is unbiased, the sample may still be biased simply by virtue of "random" error (which may be understood as measurement error, error in the data-generation process, or an underlying causal feature of the universe) (Gerring, 2006a). To mitigate the bias, researcher consciously identified the possibility of bias and mindfully approaching the investigation with the specific intention to avoid it as suggested by Sepler (2017, pp. 12–1 to 12–13). This research looked at inferences as only clues that would help direct further inquisitive enquiries of the investigation rather than label in them is definite if findings as inferences could be also false positives of the cases. Treated the participants as informants rather than respondents as they provide with insights into the matter at hand and suggest sources of corroboratory or contrary evidence.

"Snapshot View": There is a possibility that the situation may provide differing results if another timeframe had been chosen; this research would argue against this eventuality it is in the current time epoch which coincides with the chosen time horizon of the case studies and explained in Section, that the world is seeing maximum investments and thus, the maximum impact of this technologies wave. Consider the findings from the McKinsey Report (Grijpink, Ménard and Vucevic, 2019) that in an analysis of one European country, where all three operators followed a conservative approach to 5G investment, the report predicted that total cost of ownership for RAN would increase significantly in the period from 2020 through 2025, compared to the expected 2018 level; for instance, in a scenario that assumes 25 percent annual data growth, TCO would rise by about 60 percent.

"Shift in Enquiry": A problem with holistic design of a case is that the entire nature of the case study may shift, unbeknownst to the researcher, during study i.e. The initial study questions may have reflected one orientation but as the case study proceeds a different orientation the emerge and the evidence begins to address different research title (Yin, 2003). As per the case study protocol, a vigil was maintained to avoid such unsuspected slippage.

3.12 Conclusion

This chapter reviewed the research methodology and research design that has been used for the research endeavor. By using the "Research Onion" made famous by the works of Saunders, Lewis and Thornhill (2007) researchestablished that the most suitable methodology would be Interpretivism as the Research Philosophy.

This is based on the Research Reflexivity to adopt "Pluralist" approach. Researcher perceives this research with "Relativist Ontology" and, since the research objective lends itself to multiple realities and researcher is certainly a part of the subject matter that is being researched, leaned to “Normative Values”. “Proportional Axiology” that deals with the transactional knowledge as being instrument valuable as means to social emancipation which as an end in itself is intrinsically valuable (Lincoln, Lynham and Guba, 2011) is best suited as the Axiological choice.

Reviewed the research paradigms as suggested by Burrell and Morgan (2017) and established the research as “Radical Change” research that approaches problems from the enquiry of overturning the existing sequential decision-making process thus not subscribing to advocate the current order. The support for Interpretivism as an adequate Research Management Philosophy is because the problem at hand requires a more complex, highly socially constructed interpretation which is built on in-depth analysis and insights that research would gain from the interactions of the participants. Thus, it is “Value Led Research” where researcher play a significant part in identifying what is being researched; subjectivity is the of primary essence and it is the key to the contribution to knowledge from this research.

Research has used “Inductive Research” approach that is focused on “Theory Testing” rather than authority testing. Adopting “Inductive Research” approach for theory development is appropriate because the conclusions of this research are derived logically from interpretations patterns of data that has been collected during the research.

Research has employed “Mixed Methods Approach” as the choice in terms of research methodology. The research strategy is to employ survey that would establish the desired corpus of Research Elements from which onne can build the framework of Influential Forces. Research also employed case study as a research strategy to build and validate the Adequate Response Framework- the objective of the research - that can be used by Low Innovative Incumbent Organizations to formulate an adequate response to 5G/IoT technologies wave in terms of technology.

Developed the research design in 5 phases: “Discovery of Research Elements through Literature Review”, “Conduct Survey to define the Influential Forces”, “Conduct Data Analysis to build the Adequate Response Framework”, “Qualitative Case Study to test Framework” and “Finalize the Adequate Response Framework for an adequate response”.

Research employed Cooper's taxonomy for Literature Review (Cooper, 1988) by focusing on published articles that made the criteria. The focus has been scoped to “past theories”, having the goal of “identification of central issues” with the perspective of “espousal of position” and coverage being “central or pivotal”.

Research operationalized the framework for survey by the process of “Postulation” that helped define various aspects of the research through formative indicators. Research built the inquiry model using the linguistic structure based on Intuitions (Saris and Gallhofer, 2014b, p. 7,8). This helped to formulate the survey questions that would have the maximum impact in terms of giving clarity and collecting data.

The “Data Analysis” is designed using the following methodology: Principal Component Analysis to identify the key Influential Forces, Horn’s Parallel Analysis and Screeplot to validate the number of components to be retained in the PCA, Cluster Analysis to formulate the homogenous groups and then Homogeneity, Completeness, and the V-measure to test the validity of research.

The Quantitative Methodology has been followed by a Qualitative Methodology by conducting an “Exploratory Research”. The design of the case study methodology has been “Multiple Case Studies” that were “Collective” in their type. Formulated a

“Conceptual Model” that defined the “Context” and finalize the “Unit of Analysis” as the “Decision-making process by the incumbents that vary in their innovativeness”. Established the Reliability Design as suggested in published works (Yin, 2003) by developing the “Case Study Protocol”. Designed 2 interpretive case studies in vastly different incumbent organizations.

The “Interpretive Structural Modeling (ISM)” has been utilized to develop a map of the complex relationships between Influential Forces – a “Diagraph”. This would be validated during the Exploratory Case Study and the “Adequate Response Framework” will be developed using the “MICMAC (Impact Matrix Cross-Reference Multiplication Applied to a Classification) Analysis”.

The incumbents can use the Adequate Response Framework that comprises of Response Framework and Decision Framework to understand what the risks in their current decision-making process are. This framework will be helpful for them to mitigate these risks and develop an adequate response to the 5G/IoT technologies wave

CHAPTER IV:

RESULTS

4.1 Data Collection Protocol

This research aims to investigate "How can the incumbents provide an adequate response to the 5G / IoT disruption wave?"

Research employed the following principles for data collection:

- Always giving importance to multiple, and no single source of evidence.
- Aggregating all the information and evidence.
- Maintaining a clear log of what has been collected and when. Building this further into a representation such that one can isolate evidence against a sequence of events leading to the collection of that data point.
- Looked at inferences as only clues that would help direct further inquisitive enquiries of the investigation rather than label in them is definite if findings as inferences could be also false positives of the case.
- In the case protocol, specific time was allotted to go through books regarding fieldwork and case designs as well as finding across industry to draw better referential context for the case.
- Trained oneself to be a keen observer and validate in the epistemology that the documentary evidence which I'm collecting is reflective of communications among other parties who are collaborating to achieve some other objectives.
- While dealing with archival documents, researcher has been conscious and skeptical about the age of these documents since it might not represent the reality during the cross section of this case study

- While conducting the interviews, referred to the guidelines by Warren (2002) to follow the own line of inquiry as reflected by the case protocol and be sure to ask the questions in an unbiased manner so that they essentially serve the needs of enquiry.
- Treats the participants as informants rather than respondents as they provide with insights into the matter at hand and suggest sources of corroboratory or contrary evidence.
- While playing a role in the Participatory Observation Methodology , made sure that one can perceive the reality from the viewpoint of someone from inside the case rather than being an external participant-such change in the perspective has helped produce an accurate portrayal of the case study phenomenon.
- Should use multiple sources of inquiry rather than rely on isolated use of a single source. Thus, employing a hybrid strategy that leverages multiple sources seem more relevant in the case study method.
- Utilized the Converging line of inquiry (Yin, 2003, p. 97), which facilitated the process of Triangulation.
- Taken every attempt to ensure "chain of evidence" the time able to move from one part of the case study process to another ensuring let there are clear cross references to the methodological procedures and to the resulting evidences (Yin, 2003, p. 105).

The data is collected accordingly in the following forms:

- "Literature review" – examination of relevant literature to provide the initially known Research Elements

- “Primary data collection” – Employed a questionnaire to collect the relevance of the Research Elements in formulating a response for the incumbents. This helped identify the key “Influential Forces” that represent the Research Elements.
- “Primary data collection through case study” – Identified two organizations that represent the incumbents – one that is successful in employing a response that is adequately managing the 5G/IoT disruption wave and another which has seen obvious struggle in its endeavor respectively.
    - “Documentation”-These comprised of the progress reports an internal record that the teams had kept as minutes of meetings the primary use of this documentation what's to assure that one can augment evidence and corroborate them across the other findings across the case study for the observations when contradictory rather than symmetrical observations are found.
    - “Archival Records” - These included the organizational records like the organizational charts, roaster including the names of various stakeholders and concluded projects deliverables which helps understand how the organization handles new technology enhancements.
    - “Interviews” - These are open ended in nature where interviewer would ask the key informants about the facts of a matter as well as their opinions about a given sequence in a process or events, interviewer would encourage them to propose their own insights into these certain occurrences which would help form the basis of the further inquiry.
    - “Direct observation”-Referenced within this research, “site” is the case study organizations workplace as an opportunity for direct observations.

These observations help collect evidence for the causal observations as it happened.

- "Participant- Observations" - A segment in the workshop lend an opportunity to participate in a role play of the case studies situation in terms of sequential decision-making and under and movie please how this process interacts with the Influential Forces, as depicted in the conceptual model of the case study.

4.1 Process of Extracting Research Elements

Reviewed the selected 225 articles that addressed wide variety of constructs and all the elements or constructs of adequate response are identified. In total, 69 elements or constructs are identified and listed in Table 12 Research Elements from Literature Review.

Table 12 Research Elements from Literature Review

Research Element	Literature Reference	References
Automated Control	(TechVision Group of Frost & Sullivan, 2020), (Saxena *et al.*, 2020)	2
Device Management	(Willocx et al., 2018), (Saxena et al., 2020)	2
Business Innovation	(TechVision Group of Frost & Sullivan, 2020), (Murphy-Hoye, 2016)	2

Research Element	Literature Reference	References
Context-Aware Services	(Willocx et al., 2018), (Murphy-Hoye, 2016)	2
Decentralized Organization	(Fragidis et al., 2007), (Hoyer and Stanoevska-Slabeva, 2009)	2
Digital Twin	(TechVision Group of Frost & Sullivan, 2020), (Tran-Dang and Kim, 2021)	2
Diversity	(Nedeltcheva and Shoikova, 2017), (Murphy-Hoye, 2016)	2
Manufacturing Service Ecosystem	(O’Donnell et al., 2021),(Kirsch and Hurwitz, 2015)	2
Graceful Failures	(Briscoe and Marinos, 2009), (Sastry, 2015)	2
Horizontal Business Model	(Nedeltcheva and Shoikova, 2017), (Kirsch and Hurwitz, 2015)	2
Marketplace	(Singer, 2009), (Murphy-Hoye, 2016)	2
Move Fast	(Bughin and Zeebroeck, 2017), (O’Donnell et al., 2021)	2

Research Element	Literature Reference	References
New Skills	(O’Donnell et al., 2021), (Sfondrini et al., 2018)	2
Ontological Model	(Cheah, 2007), (Trullas-Ledesma and Ribas-Xirgo, 2009)	2
Product Extensions	(Trullas-Ledesma and Ribas-Xirgo, 2009), (Murphy-Hoye, 2016)	2
Reconfigurability	(Willocx et al., 2018), (Kirsch and Hurwitz, 2015)	2
Service Control	(Willocx et al., 2018), (Kirsch and Hurwitz, 2015)	2
Servitization	(Cheah, 2007), (Fragidis et al., 2007)	2
Vertical Business Model	(Nedeltcheva and Shoikova, 2017), (Kirsch and Hurwitz, 2015)	2
Artificial Intelligence	(Tran-Dang and Kim, 2021), (O’Donnell et al., 2021), (Kirsch and Hurwitz, 2015)	3
Evolution Roadmap	(Nedeltcheva and Shoikova, 2017), (Cheah, 2007), (Fragidis et al., 2007)	3

Research Element	Literature Reference	References
Imitation	(Bughin and Zeebroeck, 2017), (O'Donnell et al., 2021), (Sfondrini et al., 2018)	3
Open Source	(Hoyer and Stanoevska-Slabeva, 2009), (O'Donnell et al., 2021), (Sfondrini et al., 2018)	3
Process Automation	(TechVision Group of Frost & Sullivan, 2020), (Cheah, 2007), (Fragidis et al., 2007)	3
Separation Of Concerns	(Willocx et al., 2018), (TechVision Group of Frost & Sullivan, 2020), (Tran-Dang and Kim, 2021)	3
Cyber-Physical Systems	(Tran-Dang and Kim, 2021), (Sastry, 2015), (Saxena, Patra and Bharti, 2020)	3
Fragmented	(Miaoudakis et al. ,2020), (Sastry, 2015), (Saxena et al., 2020)	3
Industry 4.0	(Kryvinska et al., 2014), (Tran-Dang and Kim, 2021), (Saxena et al., 2020)	3
Self-Generating Market	(Singer, 2009), (Sastry, 2015), (Saxena et al., 2020)	3

Research Element	Literature Reference	References
Big Data Analytics	(Karpinski, 2021b), (Miaoudakis et al. ,2020), (Tran-Dang and Kim, 2021)	3
Business Partnership	(Barril et al., 2016), (Biswas and Gi-affreda, 2014), (Singer, 2009)	3
Cloud Adoption	(Karpinski, 2021b), (O'Donnell et al., 2021), (Sirkin et al., 2015)	3
Cloud Models	(Nedeltcheva and Shoikova, 2017), (Barril et al., 2016), (Sfondrini et al., 2018)	3
Cost Competitiveness	(Miaoudakis et al. ,2020), (Sirkin et al., 2015), (Kirsch and Hurwitz, 2015)	3
Customer Experience	(Fragidis et al., 2007), (Karpinski, 2021b), (O'Donnell et al., 2021)	3
Decoupling	(Fragidis et al., 2007), (Willocx et al., 2018), (Murphy-Hoye, 2016)	3
Edge Computing	((Karpinski, 2021b), (Karpinski, 2021b), (Nedeltcheva and Shoikova, 2017)	3
Hybrid Cloud	(Barril et al., 2016), (Sfondrini et al., 2018), (Kirsch and Hurwitz, 2015)	3

Research Element	Literature Reference	References
Interoperability	(Miaoudakis et al. ,2020), (Kirsch and Hurwitz, 2015), (Sastry, 2015)	3
New Customer Segments	(Bughin and Zeebroeck, 2017), (Hoyer and Stanoevska-Slabeva, 2009), (Kryvin-ska et al., 2014)	3
Productivity	(Nedeltcheva and Shoikova, 2017), (Sirkin et al., 2015), (TechVision Group of Frost & Sullivan, 2020)	3
Product-Service-Systems (PSS)	(Kryvinska et al., 2014), (Miaoudakis et al. ,2020), (Nedeltcheva and Shoikova, 2017), (Agarwal *et al.*, 2021)	3
Self-Organizing System	(Singer, 2009), (Murphy-Hoye, 2016), (Sastry, 2015)	3
Standardization	(Barril et al., 2016), (Trullas-Ledesma and Ribas-Xirgo, 2009), (Willocx et al., 2018)	3
Value Networks	(Briscoe and Marinos, 2009), (Fragidis et al., 2007), (Murphy-Hoye, 2016)	3

Research Element	Literature Reference	References
Workload Management	(Karpinski, 2021b), (Saxena et al., 2020), (Cheah, 2007), (Trullas-Ledesma and Ribas-Xirgo, 2009)	4
Transformation Roadmap	(Tran-Dang and Kim, 2021), (Sastry, 2015), (O'Donnell et al., 2021), (Sfon-drini et al., 2018)	4
Cloud Computing	(Biswas and Giaffreda, 2014), (Briscoe and Marinos, 2009), (Nedeltcheva and Shoikova, 2017), (Sastry, 2015)	4
Data Communication	(Benkhelifa et al., 2014), (Nedeltcheva and Shoikova, 2017), (Tran-Dang and Kim, 2021), (Kirsch and Hurwitz, 2015)	4
Engineering Partnership	(Kryvinska et al., 2014), (Miaoudakis et al. ,2020), (Singer, 2009), (Kirsch and Hurwitz, 2015)	4
Flexible Manufacturing Systems	(Nedeltcheva and Shoikova, 2017), (Sirkin et al., 2015), (TechVision Group of Frost & Sullivan, 2020), (Trullas-Ledesma and Ribas-Xirgo, 2009)	4

Research Element	Literature Reference	References
Metered Services	(Kryvinska et al., 2014), (Tran-Dang and Kim, 2021), (Hoyer and Stanoevska-Slabeva, 2009), (Sastry, 2015)	4
Regulators	(Sfondrini et al., 2018), (Singer, 2009), (Sirkin et al., 2015), (TechVision Group of Frost & Sullivan, 2020)	4
Security	(Miaoudakis et al. ,2020), (Nedeltcheva and Shoikova, 2017), (Sfondrini et al., 2018), (TechVision Group of Frost & Sullivan, 2020)	4
Service Orchestration	(Miaoudakis et al. ,2020), (Nedeltcheva and Shoikova, 2017), (Trullas-Ledesma and Ribas-Xirgo, 2009), (Murphy-Hoye, 2016)	4
Supply Chain Management	(Miaoudakis et al. ,2020), (Sirkin et al., 2015), (TechVision Group of Frost & Sullivan, 2020), (Tran-Dang and Kim, 2021)	4
Value Enhancement	(Kryvinska et al., 2014), (Miller et al., 2019), (O'Donnell et al., 2021), (TechVision Group of Frost & Sullivan, 2020)	4

Research Element	Literature Reference	References
Governance	(Willocx et al., 2018), (Sastry, 2015), (Tran-Dang and Kim, 2021), (Sastry, 2015), (Saxena et al., 2020)	5
Sustainability	(Benkhelifa et al., 2014), (Briscoe and Marinos, 2009), (Miaoudakis et al. ,2020), (Tran-Dang and Kim, 2021), (Willocx et al., 2018)	5
Value Chain	(Bughin and Zeebroeck, 2017), (Hoyer and Stanoevska-Slabeva, 2009), (Kryvin-ska et al., 2014), (Nedeltcheva and Shoikova, 2017), (Singer, 2009)	5
As-A-Service Model	(Benkhelifa et al., 2014), (Briscoe and Marinos, 2009), (Hoyer and Stanoevska-Slabeva, 2009), (Mademann, 2018), (Mur-phy-Hoye, 2016), (Sastry, 2015)	6
Cloud Adoption	((Karpinski, 2021b), (Barril et al., 2016), (Benkhelifa et al., 2014), (Bloom et al., 2018), (Sfondrini et al., 2018), (Tran-Dang and Kim, 2021)	6
Connected Products	(Abbosh and Downes, 2019), (Hoyer and Stanoevska-Slabeva, 2009), (Miller et al.,	6

Research Element	Literature Reference	References
	2019), (O'Donnell et al., 2021), (Trullas-Ledesma and Ribas-Xirgo, 2009), (Murphy-Hoye, 2016)	
5G	((Karpinski, 2021b), (Abbosh and Downes, 2019), (Castanon-Martinez et al., 2021), (Karpinski, 2021b), (Mademann, 2018), (Miaoudakis et al. ,2020), (Sfondrini et al., 2018), (TechVision Group of Frost & Sullivan, 2020), (Tran-Dang and Kim, 2021)	9
Industrial IoT	(Biswas and Giaffreda, 2014), (Bloom et al., 2018), (Castanon-Martinez et al., 2021), (Deogratius, 2018), (Kryvinska et al., 2014), (Miller et al., 2019), (O'Donnell et al., 2021), (TechVision Group of Frost & Sullivan, 2020), (Tran-Dang and Kim, 2021)	9
Business Model	(Abbosh and Downes, 2019), (Bughin and Zeebroeck, 2017), (Cheah, 2007), (Deogratius, 2018), (Hoyer and Stanoevska-Slabeva, 2009), (Kryvinska et al., 2014), (Miller et al., 2019), (Nedeltcheva and	12

Research Element	Literature Reference	References
	Shoikova, 2017), (O’Donnell et al., 2021), (TechVision Group of Frost & Sullivan, 2020), (Tran-Dang and Kim, 2021), (Saxena and Bharti, 2021)	
Scalable Architecture	(Barril et al., 2016), (Bloom et al., 2018), (Briscoe and Marinos, 2009), (Castanon-Martinez et al., 2021), (Cheah, 2007), (Fragidis et al., 2007), (Hoyer and Stanoevska-Slabeva, 2009), (Miaoudakis et al. ,2020), (Nedeltcheva and Shoikova, 2017), (Singer, 2009), (Tran-Dang and Kim, 2021), (Saxena et al., 2020)	12

4.2 Research Elements

Research Elements that have been identified form the aggregate set for this enquiry. This is consistent with the Conceptual Model elaborated in the Section 3.10.4. The elaborate definitions of these Research Elements can be found in the Appendix D.

4.3 Design of Questionnaire

A questionnaire is used to collect empirical data regarding the Research Elements. The objective has been to gain an understanding on the applicability of these Research

Elements from a sizeable sample drawn from the population of the incumbent organizations. A multipart questionnaire has been used in this research.

The first part of the Questionnaire collects background information about industry and how the respondents are affiliated in providing an insight to 5G/IoT technologies wave.

The next part of the questionnaire designed to capture the relevance of the Research Elements as identified and validated in the previous step. These Research Elements were measured for their relevance on a Likert scale as follows:

1. Not Important
2. Less Important
3. Important
4. More Important
5. Most Important

The Research Elements were grouped together with their corresponding postulates, for making the questionnaire legible and easy to work with.

To examine the Content Validity of the questionnaire items, it has been sent to an Industry Practitioners who have patents in 5G and IoT technologies and are revered as Subject Matter Experts. Questionnaire has been also sent it to a senior architect having rich experience in driving the innovation. The feedback provided by the experts has been incorporated in the questionnaire and final version of questionnaire has been prepared along with the covering letter attached in the Appendix A.

Using the framework as explained in 3.5.1, postulates have been designed. As an example, the following postulate "Driver" – as an abstract concept – which can be realized through multiple formative indicators as shown in Figure 13 Driver as a Postulate with its set of Formative Indicators.

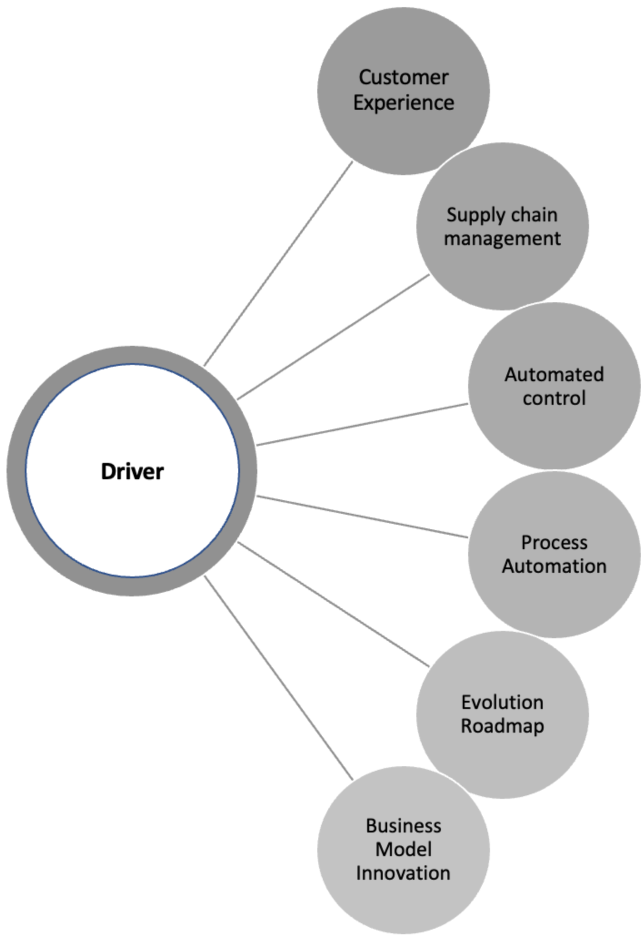


Figure 13 Driver as a Postulate with its set of Formative Indicators

"Intuition": When designing the questionnaire, many decisions must be made to be sure that these address the postulate adequately. This research has developed the model in which the Postulates are represented by the set of Research Elements.

The following framework helped formulate the mapping of the Research Elements as Indicators to define the Postulates. An example of the adoption is given in Figure 14 Defining "Driver" postulate as concept of Intuitions:

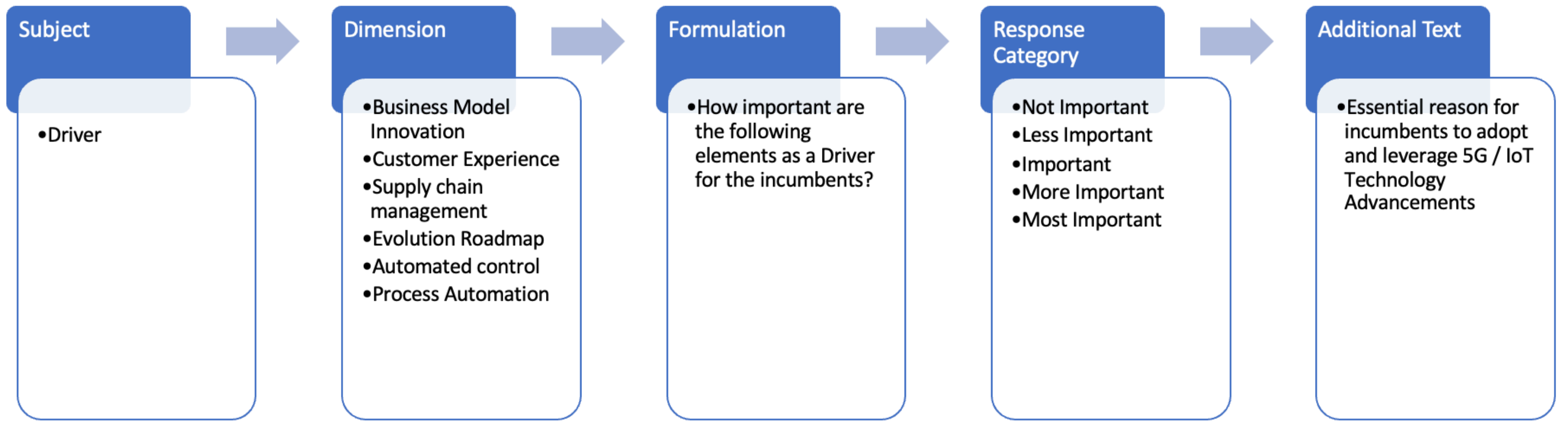


Figure 14 Defining "Driver" postulate as concept of Intuitions

The following 11 Postulates as shown in Figure 15 Postulates with their Research Elements, have been defined along with their corresponding set of Research. These Postulates have been the foundation to build and understanding of the importance of the identified Research Elements. The objective is to find the most relevant Research Elements to build the Adequate Response Framework that the incumbents can use to develop the adequate response to technologies wave.

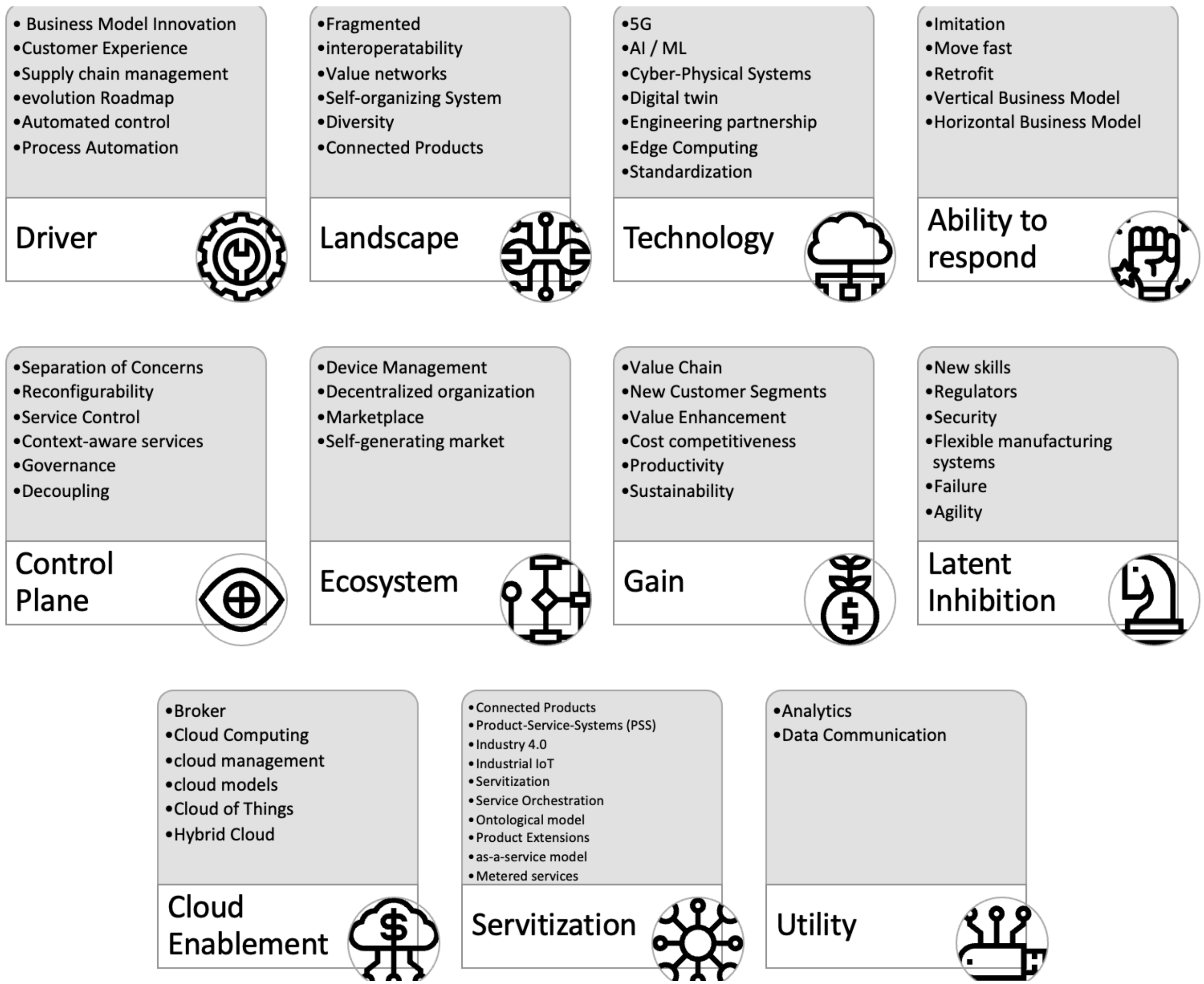


Figure 15 Postulates with their Research Elements

4.4 Industry and Data Collection

The target for the data collection have been the incumbents across industries that have been impacted by the 5G/IoT technologies wave. They come from diverse industries like the Energy and Utility, HVAC (Heating, Ventilation and Air Conditioning), Telecommunications, Financial Services, Automobiles, Healthcare, Manufacturing, Logistics, and IT consulting services. Research undertook a cross-sectional study using survey research from respondents of these industries.

An online method using SurveyMonkey, a survey software & questionnaire tool which enables to create own surveys quickly and easily has been used. The thesis assessed requirements, evaluate demand, and analyze impacts, which is why this study used a survey research design (Muafueshiangha, 2016). Online surveys are adopted as an alternative to traditional models of data collection because they are efficient in terms of cost and time to gain knowledge about the behaviors, thoughts, opinions, and feelings of people or groups (Oliveira and Paula, 2021). Questionnaire has been posted on SurveyMonkey and the link sent to the selected respondent's organizations email ID's.

A total of 201 completed responses have been received representing a rate of 38.2%.

Table 13 Responses on Survey

Industry	No of responses received	Sample Size	Response Rate
Energy and Utility	30	73	**41.1%**
HVAC (Heating, Ventilation and Air Conditioning)	5	24	**20.8%**
Telecommunications	35	61	**57.4%**
Banking, Insurance and Financial Services	45	103	**43.7%**
Automobiles	5	33	**15.2%**

Industry	No of responses received	Sample Size	Response Rate
Healthcare and Pharmaceuticals	5	24	**20.8%**
Manufacturing	16	59	**27.1%**
Shipping and Logistics	5	23	**21.7%**
Information Technology Consulting	55	126	**43.7%**
Overall Response	**201**	**526**	**38.2%**

4.5 Data Analysis

The figure below shows the Data Analysis Methodology followed for the analysis of respondents' data collected through the survey in sequence.

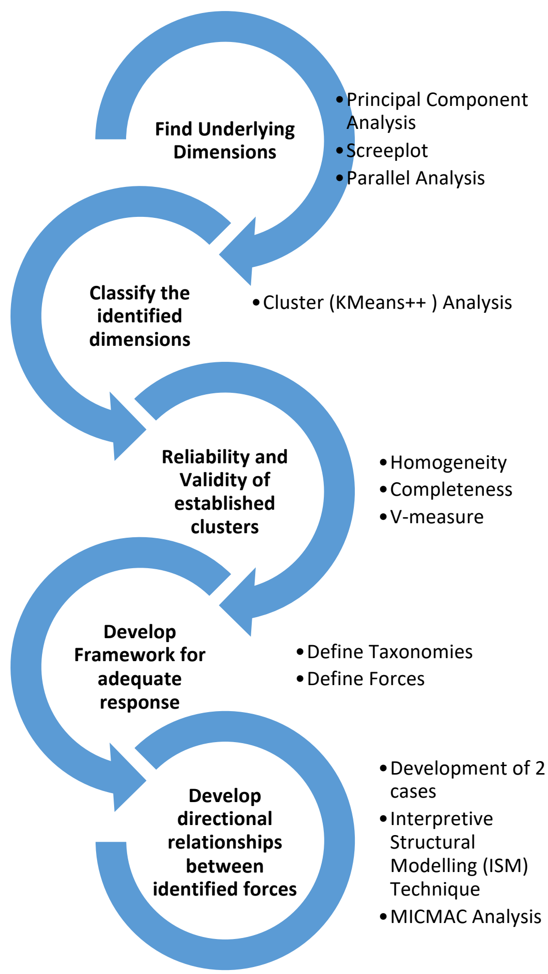


Figure 16 Data Analysis Methodology

4.5.1 Find Underlying Dimensions

a) Principal Component Analysis

To understand the underlying dimensions that ascribe adequate response of the incumbents to the wave of 5G/IoT, Principal Component Analysis (PCA) has been carried out on all the Research Elements. To be sure when the number of factors coming into play in a phenomenological complex is too large, scientific method in most cases fails us (Einstein, 1940). The basic strategy of PCA is to reduce the data dimension by projecting the correlated variables onto a smaller set of new variables that are uncorrelated and retain most of the original variance (Lou, Tuo and Wang, 2017). Thus, the original variables with very low weighting factors in their principal components are effectively removed from the dataset (Kotu and Deshpande, 2018). Large sample size tended to produce more accurate solutions subject to item/variable ratio is the best method for standardizing sample size (Jolliffe, 2002).

On the other hand, it is reported that about 14.7% of studies that they had reviewed used less than 2:1 as subject to item/variable ratio and only 10% of these studies produced correct results (Costello and Osborne, 2005). The present study subject to variable ratio is 2.91:1 and thus favorable to implement Principal Component Analysis. In Varimax Rotation that factors should be formed with a few large loadings and as many near zero loadings as possible, normally achieved by an iterative maximization of a quadratic function of the factor loadings (Charles and Fyfe, 2000). The principal Component Analysis carried out on the respondent’s data gives us 35 components that have an explained variance of 71%.

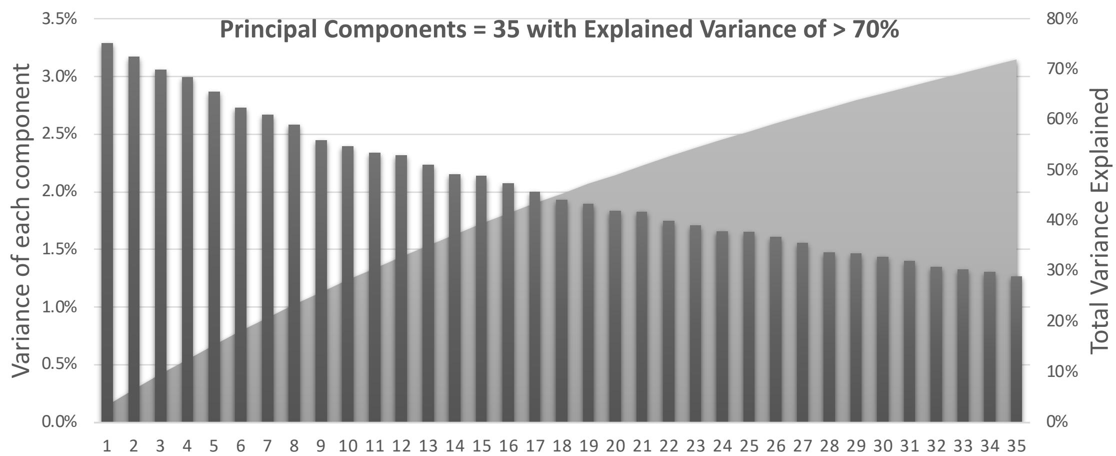


Figure 17 Principal Component Analysis of Research Elements

Components = 35.

Total Explained Variance = 0.71877 ~ 71.8%

b) Parallel Analysis

Horn's parallel analysis (PA) is an empirical method to decide how many components in a PCA or factors in a Common Factor Analysis (CFA) drive the variance observed in a data set (Dinno, 2010). Ferris and Horn (1998) argued that because of sampling error in the computation of latent roots, some components from uncorrelated variables in the true population could have eigenvalues over one. Consequently, it has been proposed the PA method, which takes into account the proportion of variance resulting from sampling error (Dinno, 2010). The PA method is implemented by generating many data matrices from random data. Each matrix is generated in parallel with the real data meaning that matrices with the same number of cases and variables are created. Factors are retained in the real data as long as they are greater than the mean eigenvalue generated from the random data matrices (Dinno, 2010).

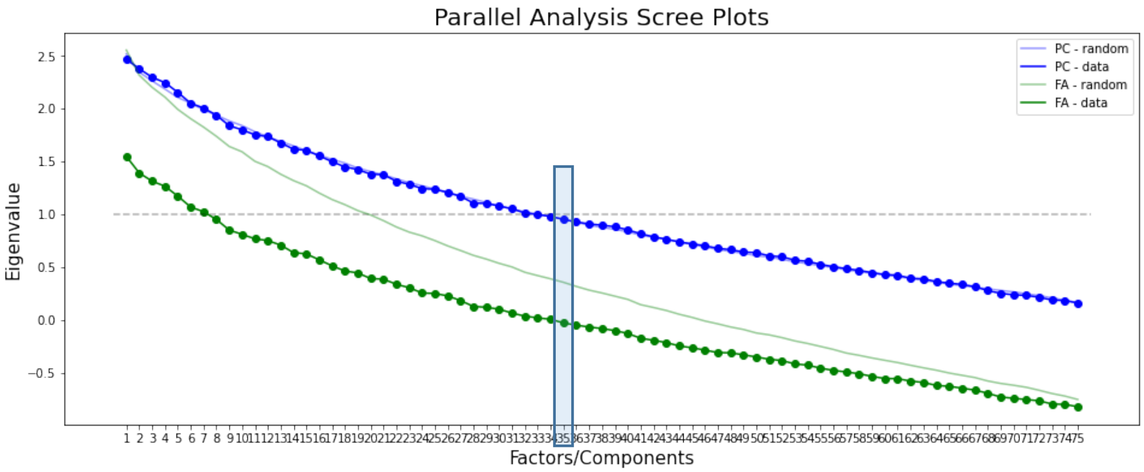


Figure 18 Scree Plot: Research Elements

The plot above further validates the premise that 35 components identified in the Principal Component Analysis are adequate number of components to carry out further analysis.

c) Screeplot

Kaiser Rule states that any Principle Component with variance less than 1 contains less information than one of the original variables and so is not worth retaining (Kaiser, 1991). Costello and Osborne (2005) recommends Screeplot as the best technique - the Scree Test involves examining the graph of the eigenvalues and looking for the natural bend or break point in the data where the curve flattens out.

The number of datapoints above the “break” (i.e., not including the point at which the break occurs) is usually the number of factors to retain, although it can be unclear if there are data points clustered together near the bend (Costello and Osborne, 2005). This research thus used Screeplot to define the optimal number of clusters that will dissect the population into distinct clusters.

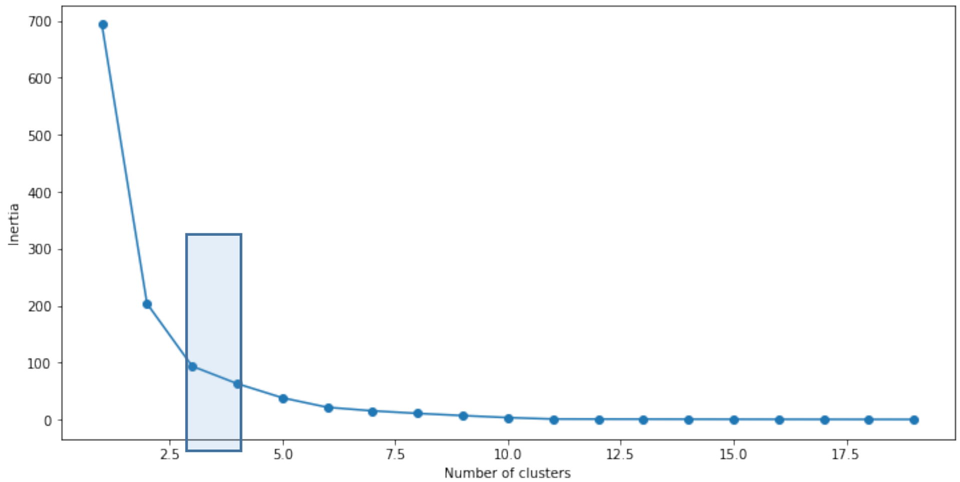


Figure 19 Scree Plot: Respondent Clusters

From the Screeplot it is evident that the respondents can be fully represented through 3~4 clusters. Employed the cluster analysis and later checked the homogeneity, completeness, and V-measure to validate the number of clusters.

4.5.2 Classify the Identified Dimensions

"KMeans++ Cluster Analysis": It may be desirable to dissect the observations into relatively homogeneous groups, as observations within the same group may be sufficiently similar to be treated identically for the purpose of some further analysis, whereas this would be impossible for the whole heterogeneous data set (Jolliffe, 2002, p. 210). Research employed KMeans++ algorithm that aims to cluster the observations into K distinct clusters, where observations belong to the clusters with the nearest mean. The goal is to minimize the sum of all intra-cluster distances (Yin *et al.*, 2019). The motive for KMeans++ is dimensional reduction in such a manner that we preserve the information of the categorical elements. Kmeans method is a better way to divide because it automatically classifies the samples according to the sample features (Lu *et al.*, 2018).

Using the Cluster analysis to explain over 70% of variation, we get the following plot in Figure 20 Cluster Analysis on Identified Dimensions.

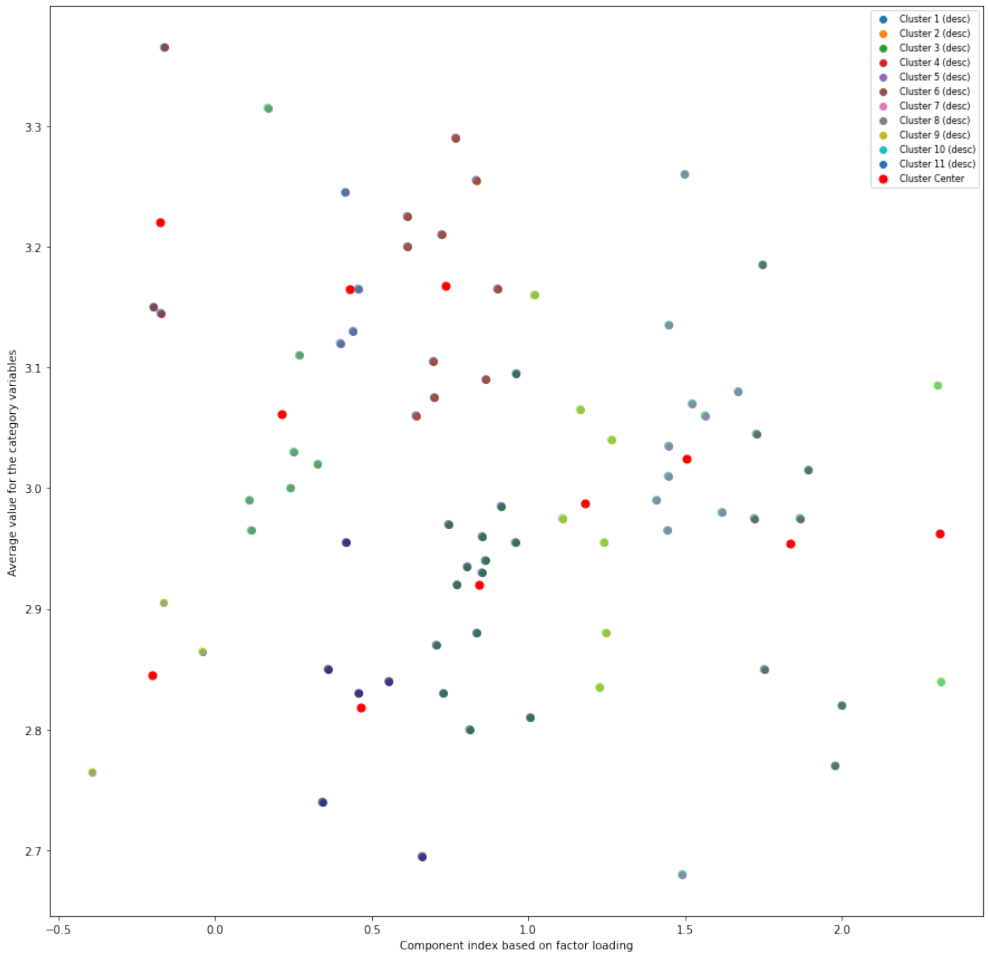


Figure 20 Cluster Analysis on Identified Dimensions

Similarly, worked in parallel to get a better understanding of the respondent's data as plotted in Figure 21 Cluster Analysis on Respondents.

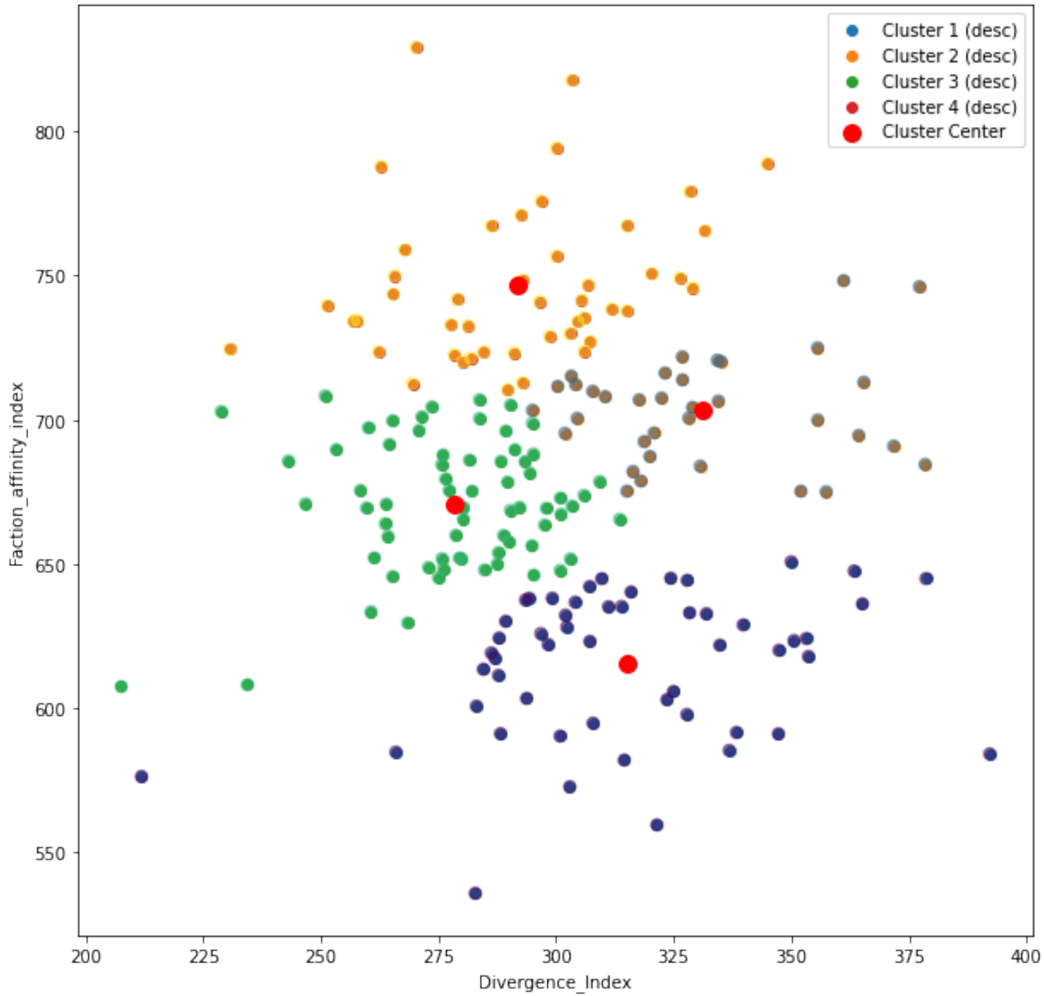


Figure 21 Cluster Analysis on Respondents

From the cluster plot of the respondent's, it is evident that there appear 4 clusters that represent the incumbents. Developed the following taxonomy to explain these clusters:

- Highly Innovative Incumbents
- Moderately Innovative Incumbents
- Low Innovative Incumbents
- Laggards

4.5.3 Reliability and Validity of established clusters

“Homogeneity” is defined where each cluster contains only members of a single class and “Completeness” where all members of a given class are assigned to the same cluster (Pauletic, Prskalo and Bakaric, 2019). “V-measure” measures how successfully the criteria of homogeneity and completeness have been satisfied - It measures how successful a clustering algorithm is at satisfying the homogeneity and completeness criteria by providing a “validity” value (Ball *et al.*, 2011). Homogeneity, Completeness and V-Measure are plotted in the following Figure 22 Homogeneity, Completeness and V. Measure Plots for Dimensions.

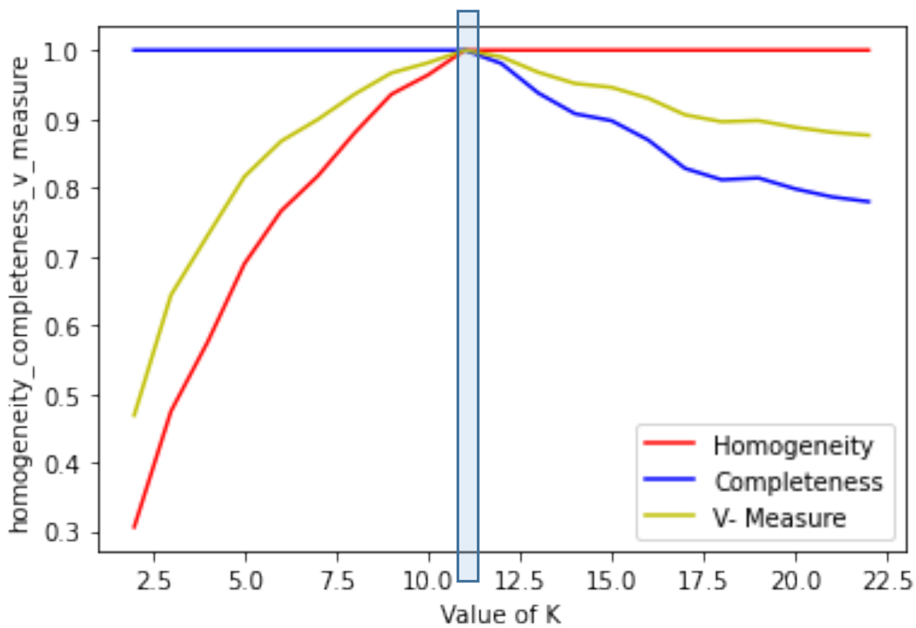


Figure 22 Homogeneity, Completeness and V. Measure Plots for Dimensions

As it is evident from the findings that after plotting the Homogeneity, Completeness and the V-measure, value of K as 11 proves to be the most optimal numbers of clusters to represent the Principal Components.

Similarly, when plotting for the respondents' dataset we validate that 4 clusters will be the most optimal way to represent the entire population of the respondents in the Figure 23 Homogeneity, Completeness and V. Measure Plots for Respondents.

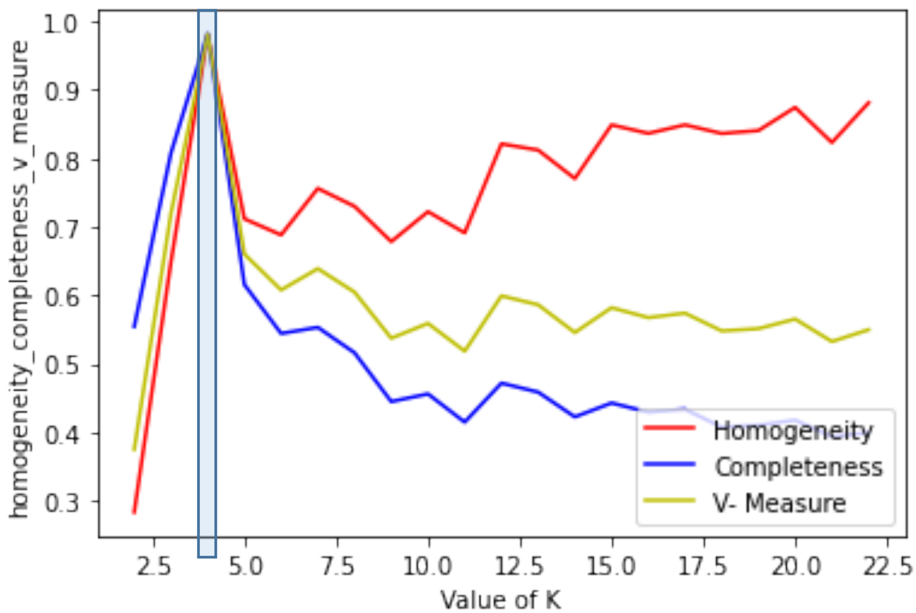


Figure 23 Homogeneity, Completeness and V. Measure Plots for Respondents

Cluster analysis that has been carried out on the respondent data to dissect the respondent population into distinct clusters we received the optimal number of clusters as 4 clusters. This has been confirmed by carrying out the homogeneity completeness and V- measure plots in section 4.5.3.

4.6 Framework for Adequate Response

The Framework for the Adequate Response has been discussed in Conceptual Model explained in Section 3.10.4. This relies on a well conducted case study; This research has envisioned it as a 4-step process as depicted in Figure 24 Case Study Method.

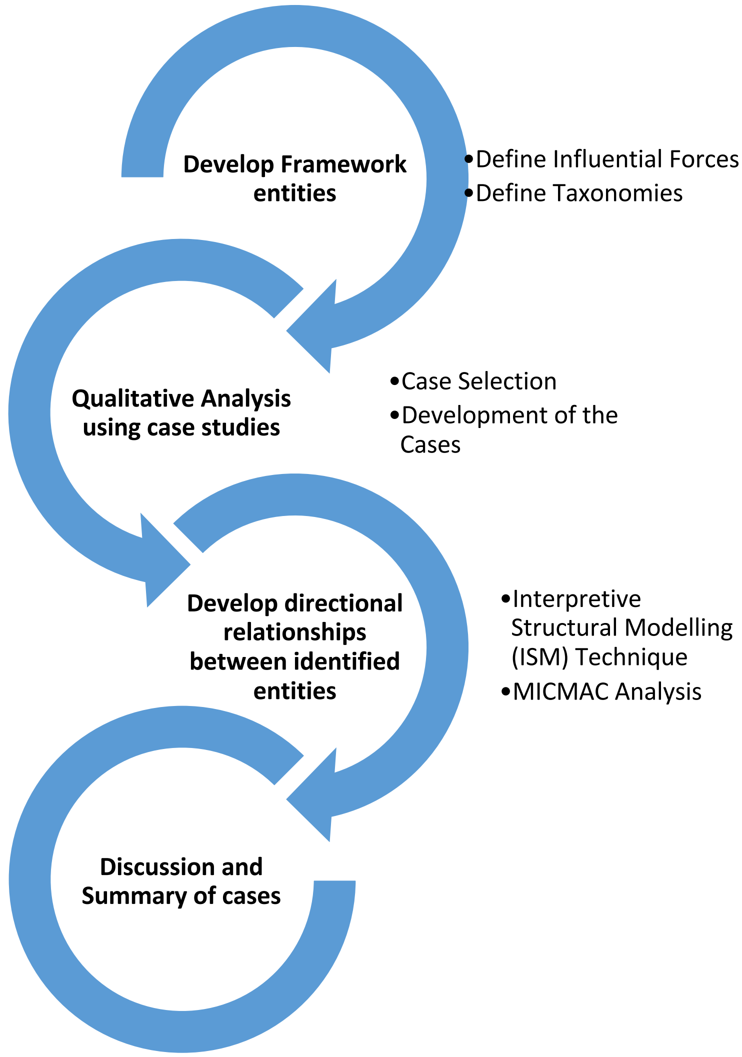


Figure 24 Case Study Method

4.6.1 Define Influential Forces

The principal forces that have been identified are the constitutive entities of defining the Adequate Response Framework. It is imperative to understand what these forces latently describe, because it is worth noting that 11 components have explain 70% variance in the entire dataset.

The first step provides a Knowledge Model of the application domain where all the terms, attributes, elements and relations of the domain must be identified, thus a syntactical and semantical model for the environment is obtained (Trullas-Ledesma and Ribas-Xirgo, 2009). This research refer to this derivation of taxonomy as “Develop Framework Entities”.

This is done in following 2 parts

a) Define the identified Principal Component

Defined the principal component clearly as a taxonomical knowledge element that will become a framework entity. The criterion is to retain those first components with adjusted Eigenvalues greater than one (technically, all components following the first component with an adjusted eigenvalue less than one were rejected; the adjustment to subsequent components often increases their eigenvalues, sometimes above the value of one) (Dinno, 2010). These components are the essential Influential Forces that represent the decision-making process of the incumbents.

b) Dimension aligned

This analysis ensures that any entity that is being formed as a building block for the Response Framework, is aligned with the Research Question. This research finds the primary alignment of these entities across the following dimensions: “Prevalence of the Competitive Business Models”, “Adoption of Cloud-Based Services to proliferate IoT offerings” or “Engagement of the Ecosystem”.

4.6.2 Define Taxonomies

The Response Forces Taxonomies present an opportunity to align them with the research dimensions. These are depicted as in the Figure 25 Mindmap to align Influential Forces with Research Dimensions. This research has used mind maps to ascertain the alignment of the response force (categorical) variables with the research variables. Mind-mapping represents the visualization of the thinking process; mind-mapping allows the radiation or expansion of a core problem or an issue, thus building connections between different concepts and ideas (Mustika, Cheng and Chan, 2021).

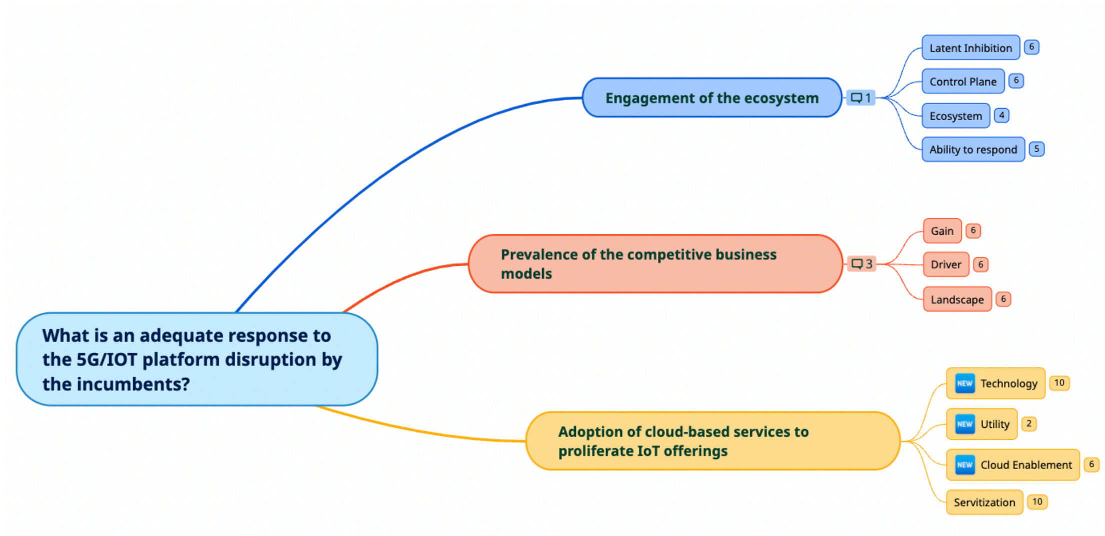


Figure 25 Mindmap to align Influential Forces with Research Dimensions

Interpreting the above depiction from right to left, the 11 "Influential forces" have alignment to the 3 research that comprehensively address the research title of this research. Following is the taxonomy definition for the Framework Entities: Following is the explanation of all the Influential Forces with their alignment to their respective Research Dimension as follows:

Dimension 1 aligned: Prevalence of the Competitive Business Models

- "Gain" – This Influential Force explains the competitive business models in terms of value chain, value enhancement and new interventions such as deriving new customer segments. The elements of cost competitiveness and productivity enhancement are also explain in this category. A lot of literature explained sustainability as an important element while defining competitive business models.

- "Driver" - Customer experience, digital transformation, automation in terms of control and processes and increased effectiveness of the supply chain have been identified as key drivers.
- "Landscape" - The prevalence of competitive business models depends on some key dimensions of landscape such as the level of fragmentation, effect of digital evolution, diversity and ability to create self organising systems across the breath of landscape are explained by this Influential Force.
- "Servitization" - Servitization has been identified as a major impact variable as it explores the realm of connected products Product service systems, service orientation that the incumbents are experiencing. Industry 4.0 and industrial IoT are leading edge of this change. Strategies such as product extensions, building ontological models of services and creating new "as-a-service" models are also covered under this category.

Dimension 2 aligned: Adoption of Cloud-Based Services to proliferate IoT offerings

- "Cloud" - Cloud relates to the ability to leverage on the cloud computing paradigm encompassing different models of engagement and hybrid architectures that combines and unifies public cloud and private cloud services from multiple cloud vendors to create a single, flexible, cost-optimal IT infrastructure (Hurwitz and Kirsch, 2019).
- "Technology" – Technology refers to the advent of the new age technology spearheaded by 5G and IoT. These have been envisaged as the most important tenets to build Cyber Physical Systems and leverage AI/ML that formulates the cognitive aspect of these connected systems.

- "Utility" - Utility of cloud based systems depends on the effectiveness of the data plane, communication that is proliferated due to the common knowledge about the data and effective analytics that presents actionable insights.
- "Control" - Control plane captures the ease of adoption for new features are that are enabled by cloud-based services. It requires ability to build reconfigurable connected product systems and clearly managing separation of concerns. Control plane also refers to the ability to have strong governance across the Ecosystem and governance models that spans life cycle of these connected products.

Dimension 3 aligned: Engagement of the Ecosystem.

- "Ecosystem" - Ecosystem help build new capabilities and help with the undertaking of extending the connected product experience onto new devices. This Research Element refers to an ability to fully functionalised and leverage marketplaces required for such capabilities.
- "Inhibition" - This Research Element captures the inhibitions in engaging with the Ecosystem to build extendable experiences on the connected products such as inability to build the new set of skills, security and data privacy concerns and the ability to build a culture of graceful failures so that new experiences options can be built in a agile way.
- "Response" - This Research Element captures different responses that the incumbent ascertain as the most adequate-ability to move fast with the interventions, build strategically allayer that fosters Business Innovation, assess and retrofit extensions to the existing product line and ability to scale the business models horizontally.

The above Influential Force alignment is depicted in Figure 26 Influential Forces Dimensional Alignment as follows:

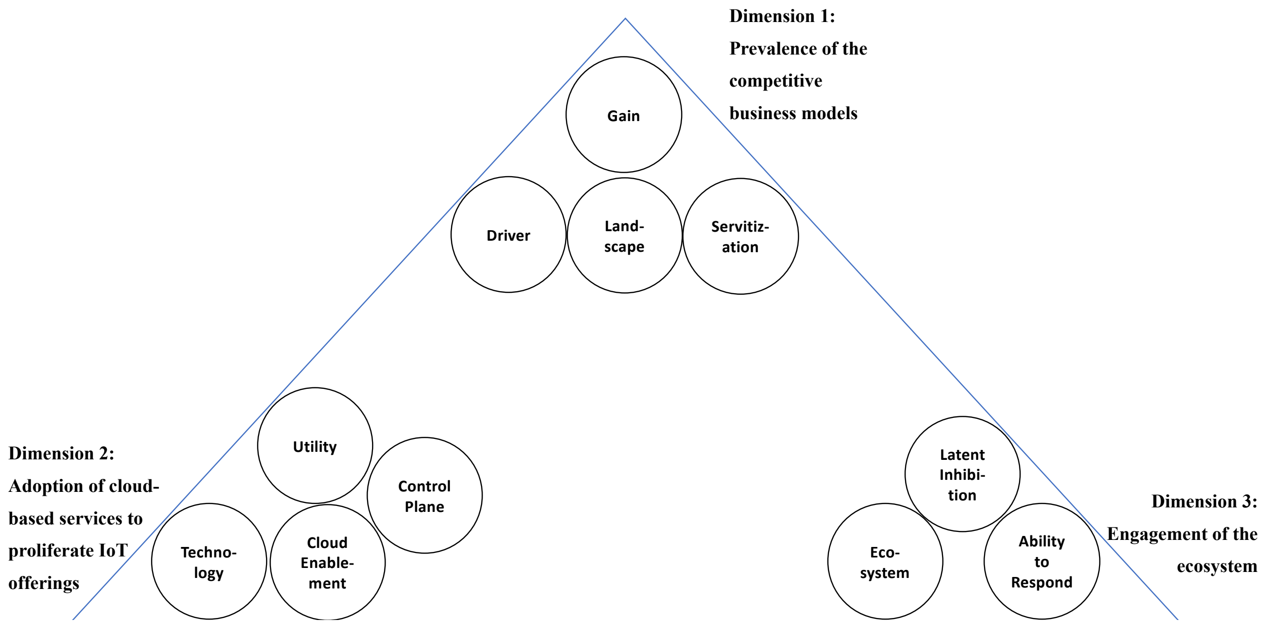


Figure 26 Influential Forces Dimensional Alignment

4.7 Qualitative Analysis using Case Study

4.7.1 Decision Framework

We had identified in the section 4.5.2 the quad-classification for the incumbents based on their innovative practice today as a measure of the preparedness of an adequate response for 5G/ IoT technologies wave.

Innovation is used as the premise for building the Decision Framework. Creating conditions for the implementation of modern innovative strategies allows corporations to receive innovative ideas, to improve the innovation process, and to make their products and services competitive (Yuliya, 2018). This research has used the reference of seminal work that defines innovation adequately- interpreted as technical changes through the concept of creative destruction, where, capitalism manifested itself through destroying outdated, obsolete structures and finding new forms (Schumpeter and Backhaus, 2003).

Concept of Innovation is described then as a Technological Innovation and a process that leads to its commercialization (Mansfield *et al.*, 1971).

The concept of Bounded Rationality, applies to situations in which all actors and participants have access to the same amount of incomplete information and it applies to most cases in general in which some have more information than others (Ormerod, 2007). Much economic theory however has barely begun to grapple with the even most interesting and widespread situation in which agents not only lack access to complete information but also lack the cognitive ability to arrive at the best decision; in most real-world situations it is simply not possible to maximize, to find the optimal choice (Ormerod, 2007). In a social and economic context there is a certain amount of fuzziness involved but again but, the answer seems fairly clear - the ability of an economic agent such as an incumbent firm to prosper it's fitness to survive can be affected by decisions which are consciously taken up by that agent (Ormerod, 2007).

This research agrees with the following facet - Innovation is a common denominator for successful organizations that have succeeded by creating advantages over their competitors; they have used new knowledge and technology to create or to improve their products and services, as well as to create these products and services (Yuliya, 2018). The key to successful disruptive innovation is to undermine the core of the organization's activities, rather than the periphery, the disruptive as a rule, technological innovation leads to a rethinking of business models, a new cycle of development and growth of the organization (Yuliya, 2018).

The Decision Framework is presented here can help LIIO improve their innovativeness capabilities. It is built on 5 important pillars that follows sequentially in order of maximum thrust that is required to transform and sustain from a Low Innovative Incumbent Organization into a highly innovative company.

- “Objective” refers to the revised strategic objectives that will help improve the innovativeness and overcome any impedance to provide an adequate response to the 5G/IoT technologies wave. It lays down guiderails for aligning new strategic objectives as drivers actively seeking “ Cloud First” thinking across the engineering process. Revised objectives enhance the organizations’ strategic relationships in the Ecosystem thus forging a leadership positioning.
- “Engagement” refers to a cultural shift of working actively and seeking symbiotic relationships within the Ecosystem. It overturns the current mindset of perceiving Ecosystem as a risk. Such risk crystallizes into building a heterogeneous mix of devices leading to added complexity in design and overall management.
- “Risks And Rewards” refers to the start and the end points of the sequential decision framework. These guidelines help Low Innovative Incumbent Organizations to realign their strategy to find rewards in developing adaptive business networks that fuse servicing capabilities and Servitization models. These rewards extend organizational boundaries and converting the Servitization models into sustainable advantage.
- “Plausible Control” refers to the ability of decentralizing and collaborating across the Ecosystem. This overturns the current philosophy of arresting control that gives the Low Innovative Incumbent Organizations an false illusion of formidable defense for their existing product and services capabilities in the marketplace.
- “Cloud and Landscape” provides guidelines in adequately adopting the Cloud Computing paradigm that creates sustainable, profitable collaborations and cooperation across the participants of the Ecosystem. These guidelines help Low Innovative Incompetent Organizations decouple their dependencies on isolated parts of the Ecosystem. It helps the LIIO open their Engineering Process so that they can

adopt technology advancements which drive new utilities for existing product and service lines with a better degree of ease.

- "Enabling technology" help Low Innovative Incumbent Organizations reimagine 5G/IoT technologies as a driving force. These guidelines nurture Federated Architecture bringing forth several new opportunities in terms of Artificial Intelligence and Machine Learning. These guidelines help embrace the idea of open innovation helping organizations avoid vendor lock-in and foster standardization of their revised and improved product and services.

The above-mentioned tenets are used to build a Classification Model for the organization. These core tenets are utilized to build the different capabilities of innovation that the incumbents exhibit, as follows:

- High Impact
- Medium Impact
- Low Impact
- Non-existent

The Innovation gradient is studied across the core tenets and shows how the different categories of the organizations differ against each other. These are depicted as Maturity Assessment on the Radar chart in Figure 27 Innovation Maturity Assessment.

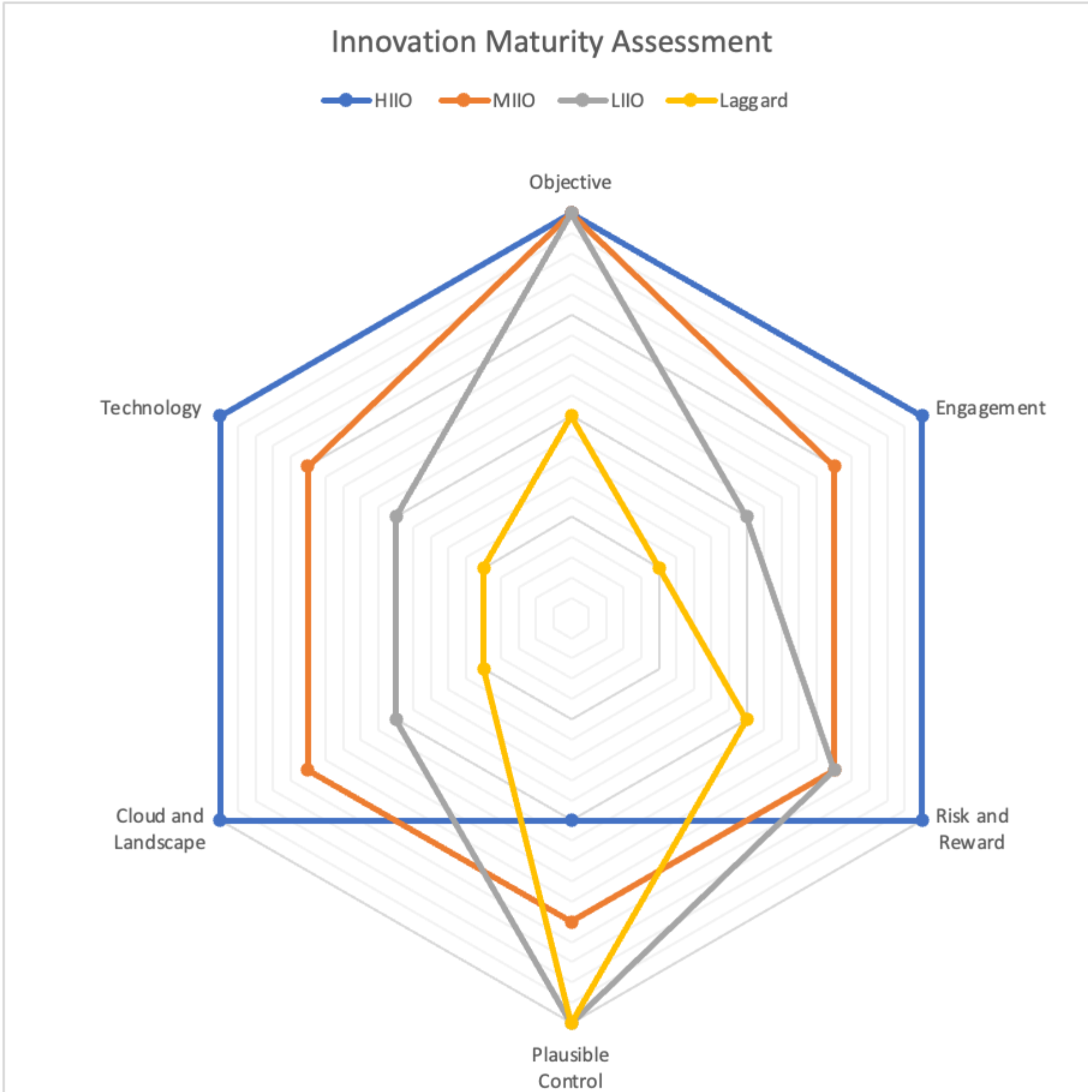


Figure 27 Innovation Maturity Assessment

The values of these assessments are shown in the Table 14 Innovation Maturity Assessment:

Table 14 Innovation Maturity Assessment

Core Tenets	**HIIO**	**MIIO**	**LIIO**	**Laggard**
Objective	High	High	High	Low

Core Tenets	HIIO	MIIO	LIIO	Laggard
Engagement	High	Medium	Low	Non-Existent
Risk and Reward	High	Medium	Medium	Low
Plausible Control	Low	Medium	High	High
Cloud and Landscape	High	Medium	Low	Low / Non-Existent
Technology	High	Medium	Low	Non-Existent

The value assessment against each core tenet for different kinds of incumbents is elaborated in the Table 19 Highly Innovative Incumbent Organizations , Table 20 Medium Innovative Incumbent Organizations, Table 21 Low Innovative Incumbent Organizations and Table 22 Laggard Incumbent Organizations elaborated in the Appendix E:

In the present study case study is developed between 2 cases both belonging to IoT/5G wave incumbents belonging to different clusters of population. This has helped compare the decision-making process observed separately in both organizations. It was then observed for what constitutes the differences in the mental model at work on how the Influential Forces interconnect to support in forming a response to the wave. The organizations belong to the following clusters:

- Highly Innovative Incumbents (Cluster 1) – Case 1
- Low Innovative Incumbents (Cluster 3) – Case 2

4.8 Interpretive Structural Modeling (ISM)

With access to the case subjects, data collection was initiated in accordance with the case study protocol established in 3.10.7 and 0. The methodology has been to maximize the observations around the Influential Forces that have been derived during the data analysis phase. To define the Adequate Response Framework and further analyze the qualitative data that has been collecting in these case studies, research used Interpretive Structural Modeling (ISM) as called out in the qualitative design section 3.4.

Interpretive Structural Modeling (ISM) refers to the systematic application of some elementary notions of graph theory in such a way that theoretical, conceptual, and computational leverage is exploited to efficiently construct a directed graph, or network representation, of the complex pattern of a contextual relationship among a set of elements (Malone, 1975). ISM is a decision tool which is normally used for exploring interrelationships among variables in a particular issue (Lin, Lee and Tai, 2017). Based on Interpretive Structural Modeling (ISM), this research identifies the flow of information between various factors in transitive relation, revealing the internal structure and rules of business processes; analyzes the redundant business processes that may exist; and turns the complex and messy relationships between various elements in the system into a clear multi-level hierarchical structure (Zheng, Li and Zhao, 2009) . The various steps involved in developing the ISM were developed during this research and are explained in Figure 28 Steps used in Interpretive Structural Modeling Technique.

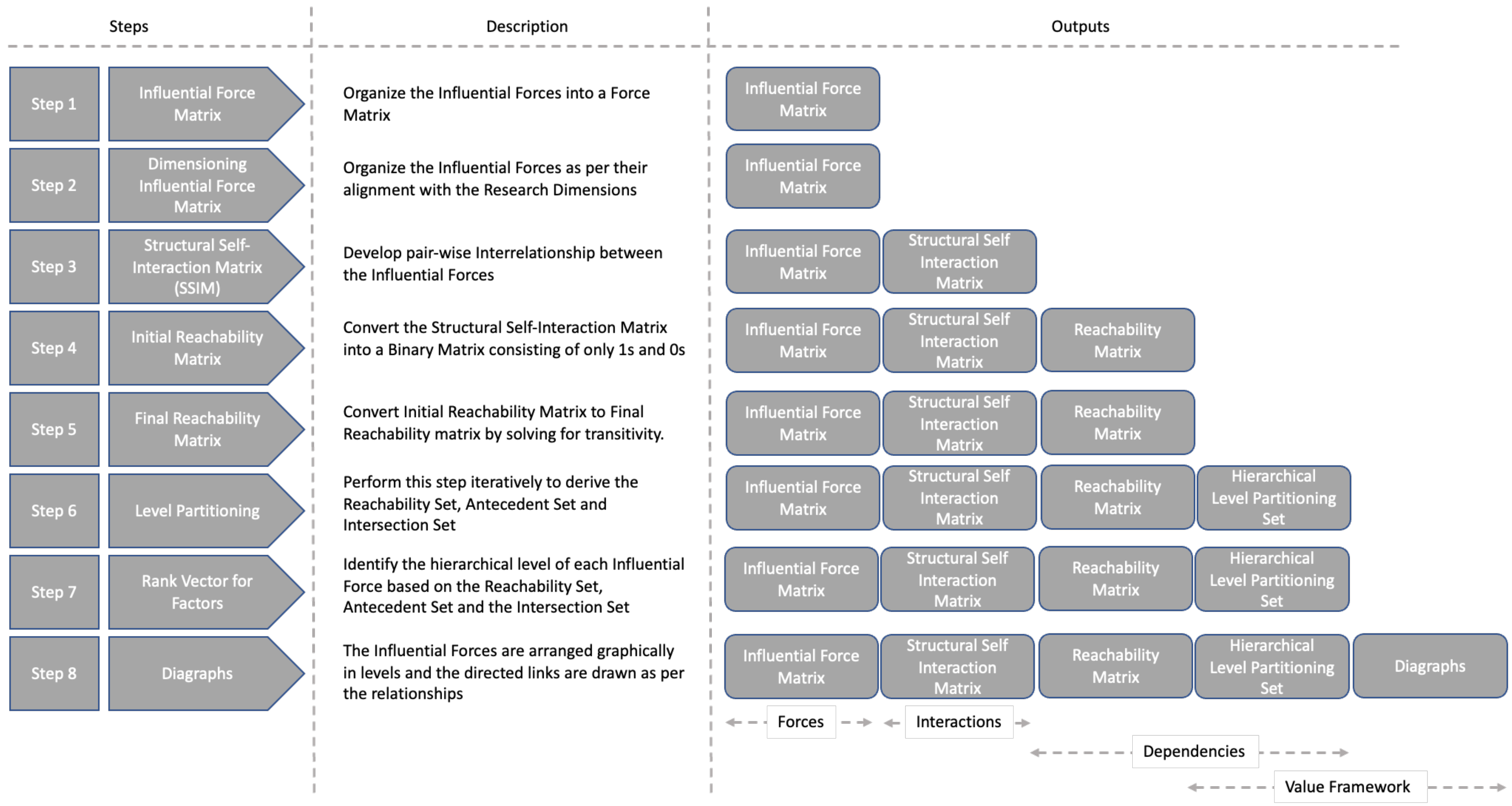


Figure 28 Steps used in Interpretive Structural Modeling Technique

4.8.1 Step 1: Influential Force Matrix

All the eleven Influential Forces identified from the section 4.6.1 were arranged in a matrix, with the elements arranged so that the experts from Case 1 and Case 2 can give their opinion about the relationships withing these Influential Forces. These 11 Influential Forces are as follows:

1. Gain
2. Driver
3. Landscape
4. Servitization
5. Cloud Enablement
6. Technology
7. Utility
8. Control Plane
9. Ecosystem
10. Latent Inhibition
11. Ability to respond

This “Influential Force Matrix” is shown as Figure 29 Influential Force Matrix

Influential Force Matrix	Ability to respond	Latent Inhibition	Ecosystem	Control Plane	Utility	Technology	Cloud Enablement	Servitization	Landscape	Driver	Gain
Gain											
Driver											
Landscape											
Servitization											
Cloud Enablement											
Technology											
Utility											
Control Plane											
Ecosystem											
Latent Inhibition											
Ability to respond											

Figure 29 Influential Force Matrix

4.8.2 Step 2: Dimensioning the Influential Forces Matrix

The Influential Forces used here are the core tenets on which the interrelationships will be developed using ISM. Research has used the three research dimensions to classify them – this will be helpful in developing the Adequate Response Framework.

- Dimension 1: Prevalence of the competitive business models
- Dimension 2: Adoption of cloud-based services to proliferate IoT offerings
- Dimension 3: Engagement of the Ecosystem.

4.8.3 Step 3: Structural Self-Interaction (SSIM)Matrix

All the experts were asked to identify the relationships among eleven Influential Forces that model an adequate response to the 5G/IoT technologies wave given their current strategy and collective understanding. Each participant has been given a worksheet which had Structural Self-Interaction Matrix (SSIM) to fill. The participants built their SSIM individually and separately.

These matrixes contextual relationship of "affects" is used. To develop contextual relationship among Influential Forces, the experts were asked to respond on a worksheet by indicating 'V', 'A', 'X' and 'O' in each cell of the matrix, where the process of conversion has been carried out during the workshop.

- V for the relation from i to j
- for the relation from j to i
- X for both directions, relations from i to j and j to i.
- if the relation between the indicators does not appear valid.

The data to fill in the matrix has been collected over a workshop done in Case 1 and Case 2 organizations. The participants for the workshop included the New Product Development Head, Chief Architect responsible for technical solution, 5G/IoT Consultants and Leads for brands under consideration. The objective given during the workshop to all the participants has been to identify and finalize SSIM matrix, followed these steps:

- "Address differences of opinion": When it becomes apparent that a group member is not in agreement, address the participant specifically. Failure to acknowledge disagreement now may cause problems in the future. (Stark and Flaherty, 1999).
- "Convergent values": Once we had a convergence as a unanimous vote on a relationship between 'i' and 'j' then that has been assigned to the cell within the SSIM.
- "Convergence of the divergent values": There were instances when there were divergent values for a cell where the below mentioned methods were followed (Wilson, 2013):
- "Consensus": Consensus is an accord reached by a group. The participants must all agree on the best ideas through discussion and debate.

- “Compromise”: Participants come to agreement about what ideas to consider further by giving up some of their individual demands.

“Decision by a leader”: The final decision has been made by a designated leader the New Product Development Lead in Case 1 and Managing Director in Case 2. The Structural Self-Interactive Matrix for HIIO and LIIO are shown in Figure 30 Structural Self-Interactive Matrix for HIIO and Figure 31 Structural Self-Interactive Matrix for LIIO respectively.

d) The Structural Self-Interactive Matrix for HIIO

	Ability to respond	Latent Inhibition	Ecosystem	Control Plane	Utility	Technology	Cloud Enablement	Servitization	Landscape	Driver	Gain
Gain	A	A	A	O	O	A	A	A	O	A	X
Driver	A	A	V	A	A	A	A	A	V	X	
Landscape	O	V	A	O	V	O	O	O	X		
Servitization	V	V	A	A	A	V	A	X			
Cloud Enablement	A	V	V	O	A	A	X				
Technology	A	A	A	V	O	X					
Utility	A	A	A	A	X						
Control Plane	O	O	O	X							
Ecosystem	V	V	X								
Latent Inhibition	A	X									
Ability to respond	X										

Figure 30 Structural Self-Interactive Matrix for HIIO

e) The Structural Self-Interactive Matrix for LIIO

	Ability to respond	Latent Inhibition	Ecosystem	Control Plane	Utility	Technology	Cloud Enablement	Servitization	Landscape	Driver	Gain
Gain	A	V	V	A	A	V	V	A	V	V	X
Driver	A	V	A	A	O	A	A	A	O	X	
Landscape	O	A	X	A	V	O	O	V	X		
Servitization	A	A	A	O	V	V	V	X			
Cloud Enablement	A	A	O	A	O	A	X				
Technology	O	A	O	O	A	X					
Utility	O	O	A	A	X						
Control Plane	O	A	A	X							
Ecosystem	A	O	X								
Latent Inhibition	A	X									
Ability to respond	X										

Figure 31 Structural Self-Interactive Matrix for LIIO

4.8.4 Step 4: Initial Reachability Matrix

The SSIM must be converted into a Binary Matrix, called the Reachability Matrix by substituting X, A, V and O by 1 and 0. The rules for substituting 1's and 0's are given as follows:

- If (i, j) entry in the SSIM is V, then (i, j) entry in the reachability matrix is 1 and (j, i) entry is 0.
- If (i, j) entry in the SSIM is A, then (i, j) entry in the reachability matrix is 0 and (j, i) entry is 1.
- If (i, j) entry in the SSIM is X, then entry for both (i, j) and (j, i) is 1.
- If (i, j) entry in the SSIM is O, then entry for both (i, j) and (j, i) is 0.

The Initial Reachability Matrix is developed using the above rules. The Initial Reachability Matrix is referred to has Reachability Matrix and has been derived for HIIO and LIIO as shown in Figure 32 The Reachability Matrix for HIIO and Figure 33 The Reachability Matrix for LIIO respectively.

a) The Reachability matrix for HIIO

	Ability to respond	Latent Inhibition	Ecosystem	Control Plane	Utility	Technology	Cloud Enablement	Servitization	Landscape	Driver	Gain
Gain	1	1	1	0	0	1	1	1	0	1	1
Driver	1	1	0	1	1	1	1	1	0	1	0
Landscape	0	0	1	0	0	0	0	0	1	1	0
Servitization	0	0	1	1	1	0	1	1	0	0	0
Cloud Enablement	1	0	0	0	1	1	1	0	0	0	0
Technology	1	1	1	0	0	1	0	1	0	0	0
Utility	1	1	1	1	1	0	0	0	1	0	0
Control Plane	0	0	0	1	0	1	0	0	0	0	0
Ecosystem	0	0	1	0	0	0	1	0	0	1	0
Latent Inhibition	1	1	1	0	0	0	1	1	1	0	0
Ability to respond	1	0	1	0	0	0	0	1	0	0	0

Figure 32 The Reachability Matrix for HIIO

b) The Reachability matrix for LIIO

	Ability to respond	Latent Inhibition	Ecosystem	Control Plane	Utility	Technology	Cloud Enablement	Servitization	Landscape	Driver	Gain
Gain	1	0	0	1	1	0	0	1	0	0	1
Driver	1	0	1	1	0	1	1	1	0	1	1
Landscape	0	1	1	1	0	0	0	0	1	0	1
Servitization	1	1	1	0	0	0	0	1	1	0	0
Cloud Enablement	1	1	0	1	0	1	1	1	0	0	1
Technology	0	1	0	0	1	1	0	1	0	0	1
Utility	0	0	1	1	1	0	0	1	1	0	0
Control Plane	0	1	1	1	0	0	0	0	0	0	0
Ecosystem	1	0	1	0	0	0	0	0	1	0	1
Latent Inhibition	1	1	0	0	0	0	0	0	0	1	1
Ability to respond	1	0	0	0	0	0	0	0	0	0	0

Figure 33 The Reachability Matrix for LIIO

4.8.5 Step 5: Final Reachability Matrix

The Final Reachability Matrix has been developed from the Initial Reachability Matrix by solving for transitivity. The transitivity is a basic assumption of ISM methodology, which stated that if variable-A related to variable-B and variable-B related to variable-C, then variable-A necessarily related to variable-C (Amrina and Vilsi, 2014). This is depicted in Figure 34 Transitivity Rule as follows

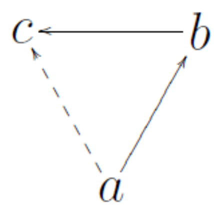


Figure 34 Transitivity Rule

Thus, the Initial Reachability Matrix is modified by solving for transitivity to form Final Reachability Matrix. The Final Reachability Matrix for HIIO and LIIO are derived as shown in Figure 35 Final Reachability Matrix for HIIO and Figure 36 Final Reachability Matrix for LIIO respectively:

a) Final Reachability Matrix for HIIO

	Ability to respond	Latent Inhibition	Ecosystem	Control Plane	Utility	Technology	Cloud Enablement	Servitization	Landscape	Driver	Gain
Gain	1	1	1	0	0	1	1	1	0	1	1
Driver	1	1	0	1	1	1	1	1	0	1	0
Landscape	0	0	1	0	0	0	0	0	1	1	0
Servitization	0	0	1	1	1	0	1	1	0	0	0
Cloud Enablement	1	0	0	0	1	1	1	0	0	0	0
Technology	1	1	1	0	0	1	0	1	0	0	0
Utility	1	1	1	1	1	0	0	0	1	0	0
Control Plane	0	0	0	1	0	1	0	0	0	0	0
Ecosystem	0	0	1	0	0	0	1	0	0	1	0
Latent Inhibition	1	1	1	0	0	0	1	1	1	0	0
Ability to respond	1	0	1	0	0	0	0	1	0	0	0

Figure 35 Final Reachability Matrix for HIIO

b) Final Reachability Matrix for LIIO

	Ability to respond	Latent Inhibition	Ecosystem	Control Plane	Utility	Technology	Cloud Enablement	Servitization	Landscape	Driver	Gain
Gain	1	1	1	1	1	0	0	1	1	0	1
Driver	1	0	1	1	0	1	1	1	1	1	1
Landscape	1	1	1	1	1	1	1	1	1	1	1
Servitization	1	1	1	1	0	1	1	1	1	0	0
Cloud Enablement	1	1	1	1	0	1	1	1	0	0	1
Technology	1	1	0	1	1	1	0	1	1	0	1
Utility	1	1	1	1	1	1	1	1	1	1	1
Control Plane	1	1	1	1	0	0	0	0	0	0	0
Ecosystem	1	1	1	0	0	1	1	1	1	1	1
Latent Inhibition	1	1	1	1	1	0	0	1	1	1	1
Ability to respond	1	0	0	0	0	0	0	0	0	0	0

Figure 36 Final Reachability Matrix for LIIO

4.8.6 Step 6: Level Partitions

From the Final Reachability Matrix, the reachability set, antecedent set, and intersection set for each Research Element have been derived. The Reachability Set consists of the entry itself and other entries to which it may reach, whereas the Antecedent Set consists of the entry itself and the other entries which may reach to it. Then the Intersection Set of these sets is derived for all elements.

The Influential Forces for which the Reachability and Intersection sets are the same is the top-level Influential Force.

Once the top-level Influential Forces has been identified, it is removed from the next iteration such that the other Influential Forces cannot reach it. Then, by the same process, the next level of set of Influential Forces are found.

The intersection of the Reachability Set and the Antecedent Set will be the same as the Reachability Set in case of the Influential Forces in a particular level. This iteration is continued until the level of all Influential Forces is obtained.

The Levels Partitions for HIIO and LIIO are shown as Figure 37 Level Partitions for HIIO and Figure 38 Level Partitions for LIIO respectively:

ITERATION	ELEMENTS	REACHABILITY SET	ANTECDENT SET	INTERSECTION SET	PARTITION LEVEL
ITERATION 1	1	1..11	,1	,1	
	2	2..11	1,2,3	2,3	
	3	2,3,9	1,2,3,6,7,9	2,3,9	1
	4	4..11	1,2,4,5,6,7,8,10,11	4,11	1
	5	4,5,6,7,9,10,11	1,2,4,5,6,7,8,9,10,11	4..11	
	6	3,4,5,6,7,9,10,11	1,2,4,5,6,7,9,10,11	4,5,6,7,9,10,11	
	7	3..11	1,2,4,5,6,7,9,10,11	4,5,6,7,9,10,11	
	8	4,5,6,8,9,10,11	1,2,4,7,8	4,8	
	9	2,5,6,7,9,10,11	1...11	2,5,6,7,9,10,11	1
	10	3,4,5,6,7,9,10,11	1,2,4,5,6,7,8,9,10,11	4,5,6,7,8,9,10,11	
	11	4,5,6,7,9,10,11	1,2,4,5,6,7,8,9,10,11	4,5,6,7,9,10,11	1
ITERATION 2	1	1,2,5,6,7,8,10	,1	,1	
	2	2,5,6,7,8,10	1,2	,2	
	5	5,6,7,10	1,2,5,6,7,8,10	5,6,7,10	2
	6	5,6,7,10	1,2,5,6,7,10	5,6,7,10	2
	7	5,6,7,8,10	1,2,5,6,7,10	5,6,7,8,10	
	8	6,8,10	1,2,7,8	,8	
	10	5,6,7,10	1,2,5,6,7,8,10	5,6,7,10	2
ITERATION 3	1	1,2,7,8	,1	,1	
	2	2,7,8	1,2	,2	
	7	7,8,	1,2,7	,7	
	8	,8	1,2,7,8	,8	3
ITERATION 4	1	1,2,7	,1	,1	
	2	2,7	1,2	,2	
	7	7,	1,2,7	,7	4
ITERATION 5	1	1,2	,1	,1	
	2	2,	1,2	,2	5
ITERATION 6	1	1,	,1	,1	6

Figure 37 Level Partitions for HIIO

ITERATION	ELEMENTS	REACHABILITY SET	ANTECDENT SET	INTERSECTION SET	PARTITION LEVEL
IITERATION 1	1	1,3,4,7..11	1,2,3,5,6,79,10	1,2,3,7,9,10	
	2	1..6,8,9,11	2,3,7,9,11	2,3,9,11	
	3	1,,11	1..4,6,7,9,10	1..4,6,7,9,10	
	4	3..6,8..11	1..7,9,10	3,4,5,6,9,10	
	5	1,4,5,6,8..11	2,3,4,5,7,9	2,3,4,5,9	
	6	1,3,4,6,7,8,10,11	2..7,9	3,4,6,7	
	7	1..11	1,3,6,7,10	1,3,6,7,10	
	8	8..11	1..8,10	8,10	
	9	1..6,9..11	1..5,7..10	1..5,9,10	
	10	1,2,3,4,7..11	1,3..10	1,3,4,7,8,9,10	
	11	**11**	**1..11**	**11**	**1**
ITERATION 2	1	1,3,4,7..10	1,2,3,5,6,7,9,10	1,3,7,9,10	
	2	1..6,8,9	2,3,7,9	2,3,9,10	
	3	1,,10	1..4,6,7,9,10	1..4,6,7,9,10	
	4	3..6,8..10	1..7,9,10	3,4,5,6,9,10	
	5	1,4,5,6,8..10	2,3,4,5,7,9	2,3,4,5,9	
	6	1,3,4,6,7,8,10	2..7,9	3,4,6,7	
	7	1..10	1,3,6,7,10	1,3,6,7,10	
	8	8..10	1..8,10	8,10	**2**
	9	1..6,9,10	1..5,7..10	1..5,9,10	**2**
	10	1,2,3,4,7..10	1,3..10	1,3,4,7,8,9,10	**2**
ITERATION 3	1	1,3,4,7	1,2,3,5,6,7	1,3,7	
	2	1..6	2,3,7	2,3	
	3	1..7	1..4,6,7	1..4,6,7	
	4	3..6	1..7	3,4,5,6	**3**
	5	1,4,5,6	2,3,4,5,7	4,5	
	6	1,3,4,6,7	2..7	3,4,6,7	
	7	1..7	1,3,6,7	1,3,6,7,10	
ITERATION 4	1	1,3,7	1,2,3,5,6,7	1,3,7	**4**
	2	12,3,5,6	2,3,7	2,3	
	3	1,2,3,5,6,7	1..4,6,7	1,2,3,6,7	
	5	1,5,6	2,3,5,7	,5	
	6	1,3,6,7	2,3,5,6,7	3,6,7	
	7	1,2,3,5,6,7	1,3,6,7	1,3,6,7	
ITERATION 5	2	2,3,5,6	2,3,7	2,3	
	3	2,3,5,6,7	2,3,6,7	2,3,6,7	
	5	5,6	2,3,5,7	,5	
	6	3,6,7	2,3,5,6,7	3,6,7	**5**
	7	2,3,5,6,7	3,6,7	3,6,7	
ITERATION 6	2	2,3,5	2,3,7	2,3	
	3	2,3,5,7	2,3,7	2,3,7	
	5	0.5	2,3,5,7	,5	**6**
	7	2,3,5,7	3,7	3,7	
ITERATION 7	2	2,3	2,3,7	2,3	**7**
	3	2,3,7	2,3,7	2,3,7	**7**
	7	2,3,7	3,7	3,7	
ITERATION 8	7	7	7	7	**8**

Figure 38 Level Partitions for LIIO

4.8.7 Step 7: Rank Vector of Factors

The next step is to identify the hierarchical level of each Research Element based on the reachability set, antecedent set and the intersection set values. This has been achieved by arranging the factors into a Rank Vector of Factors for each case. With the level of the partitioning achieved, on several iterations, the following Rank Vector of factors has been arrived and shown in the Table 15 Rank Vector of Factors for HIIO and Table 16 Rank Vector of Factors for LIIO for HIIO and LIIO respectively:

a) Rank Vector of Factors for HIIO

Table 15 Rank Vector of Factors for HIIO

FACTORS	REACHABILITY SET	ANTECDENT SET	INTERSECTION SET	LEVEL
Gain (1)	1..11	,1	,1	VI
Driver (2)	2..11	1,2,3	2,3	V
Landscape (3)	2,3,9	1,2,3,6,7,9	2,3,9	I
Servitization (4)	4..11	1,2,4,5,6,7,8,10,11	4,11	I
Cloud Enablement (5)	4,5,6,7,9,10,11	1,2,4,5,6,7,8,9,10,11	4..11	II
Technology (6)	3,4,5,6,7,9,10,11	1,2,4,5,6,7,9,10,11	4,5,6,7,9,10,11	II
Utility (7)	3..11	1,2,4,5,6,7,9,10,11	4,5,6,7,9,10,11	IV
Control Plane (8)	4,5,6,8,9,10,11	1,2,4,7,8	4,8	III
Ecosystem (9)	2,5,6,7,9,10,11	1...11	2,5,6,7,9,10,11	I
Latent Inhibition (10)	3,4,5,6,7,9,10,11	1,2,4,5,6,7,8,9,10,11	4,5,6,7,8,9,10,11	II
Ability to respond (11)	4,5,6,7,9,10,11	1,2,4,5,6,7,8,9,10,11	4,5,6,7,9,10,11	I

b) Rank Vector of Factors for or LIIO

Table 16 Rank Vector of Factors for LIIO

FACTORS	REACHABILITY SET	ANTECDENT SET	INTERSECTION SET	LEVEL
Gain {1)	1,3,4,7..11	1,2,3,5,6,79,10	1,3,7,9,10	IV
Driver {2)	1..6,8,9,11	2,3,7,9,11	2,3,9,11	VII
Landscape {3)	1,,11	1..4,6,7,9,10	1..4,6,7,9,10	VII
Servitization {4)	3..6,8..11	1..7,9,10	3,4,5,6,9,10	III
Cloud Enablement {5)	1,4,5,6,8..11	2,3,4,5,7,9	2,3,4,5,9	VI
Technology {6)	1,3,4,6,7,8,10,11	2..7,9	3,4,6,7	V
Utility {7)	1..11	1,3,6,7,10	1,3,6,7,10	VIII
Control Plane {8)	8..11	1..8,10	8,10	II
Ecosystem {9)	1..6,9..11	1..5,7..10	1..5,9,10	II
Latent Inhibition {10)	1,2,3,4,7..11	1,3..10	1,3,4,7,8,9,10	II
Ability to respond {11)	11	1..11	11	I

4.8.8 Step 8: Develop Diagraphs

The Influential Forces are arranged graphically in levels and the directed links are drawn as per the relationships shown in the Final Reachability Matrix. A simpler version of the initial digraph has been obtained by eliminating the transitive relationships step-by-step by examining their interpretation from the knowledge base (Kedia and Sushil, 2013).

The key question is whether the simplifications capture the most important features of the problem being considered (Ormerod, 2007). The diagraphs are checked for conceptual inconsistency, and in case of any inconsistency necessary modifications are carried out.

4.9 Diagraphs Framework

As stated in the objective of the qualitative study using case study method in section 4.7.3, the relationship between Influential Forces and how these relationships can be used to explain the difference between an adequate response and an adequate response.

Diagraphs are directed graphs that are derived from the Interpretive Structural Modeling discussed in detail in 4.7.6. The final graph is useful to determine relationships visually and handles the findings of the partitioning process carried on the Final Reachability Matrix. This is also referred to as the ISM-Based Network Model (Amrina and Vilsi, 2014) and Interaction Network (Kedia and Sushil, 2013). Diagraphs represent the structural linkages between Influential Forces that form part of the decision-making process and helps explain the role of different Forces in the context of an Adequate Response Framework for the incumbents.

The Diagraphs for HIIO and LIIO are shown in Figure 39 Digraph Framework for HIIO and Figure 40 Digraph Framework for LIIO respectively.

4.9.1 Directed graph for HIIO

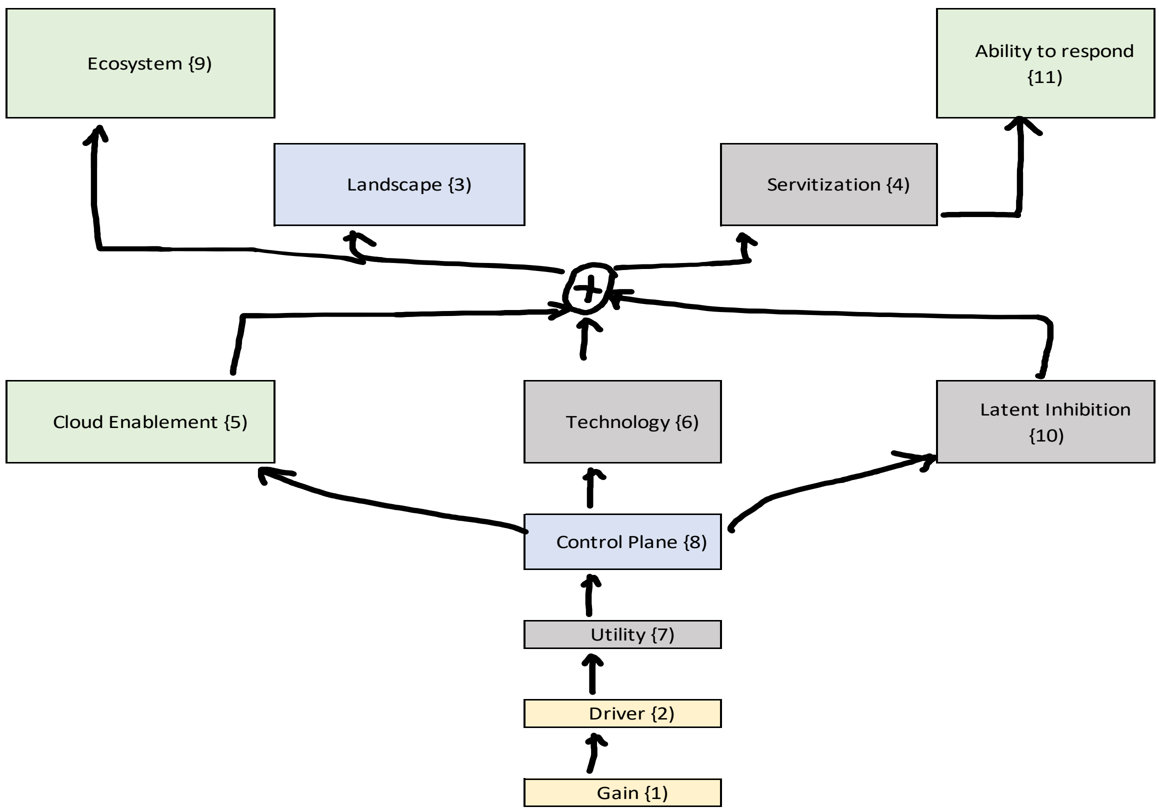


Figure 39 Digraph Framework for HIIO

4.9.2 Directed graph for LIIO

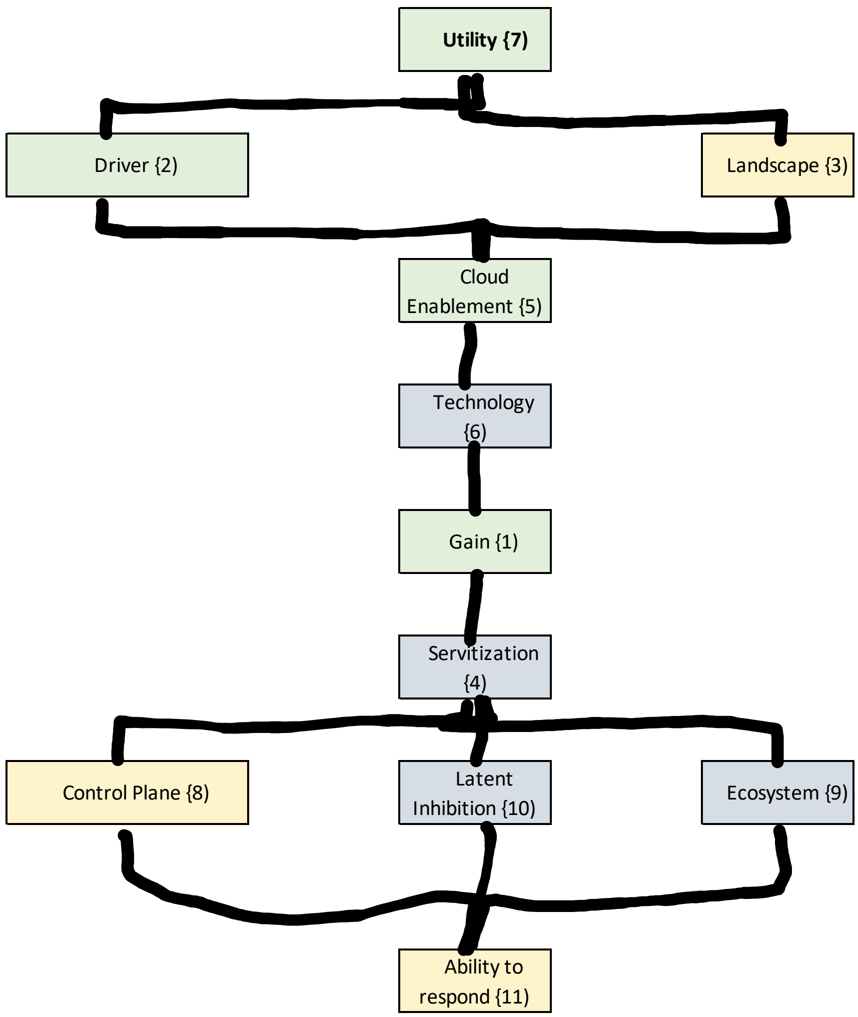


Figure 40 Digraph Framework for LIIO

4.10 Calculation of Driving and Dependence Power

The sums of the rows and columns of the Final Reachability Matrix are called as the 'Driving Power' and 'Dependence Power' respectively. Driving Power is the degree to which the given Influential Force affects other Influential Forces while Dependence Power is the degree to which the given Influential Force is affected by other Influential Forces. The number under the driver column indicates the number of nodes (or elements) that an element can reach (directly and indirectly) while the dependence metric tells us how many nodes can reach a particular node (or element) (Vinayak, 2013).

The Driving Power and Dependence Power has been calculated for HIIO and LIIO are as follows in Table 17 Driving and Dependence Power for HIIO and Table 18 Driving and Dependence Power for LIIO.

4.10.1 HIIO Organization

Table 17 Driving and Dependence Power for HIIO

FACTORS	DRIVING	DEPENDENCE
Gain (1)	11	1
Driver (2)	10	4
Landscape (3)	3	6
Servitization (4)	8	8
Cloud Enablement (5)	7	8
Technology (6)	8	7
Utility (7)	9	7
Control Plane (8)	7	2
Ecosystem (9)	7	7
Latent Inhibition (10)	8	8
Ability to respond (11)	7	7

Following inference are derived from the Table 17 Driving and Dependence Power for HIIO:

- “Gain” is the Influential Force with maximum Driving Power followed by “Driver”
- “Servitization”, “Cloud Enablement” and “Latent Inhibition” are the Influential Forces that have maximum Dependence Power.
- It is worth noting though that “Servitization”, “Technology”, “Utility” and “Latent Inhibition” have nearly equal Driving and Dependence Powers.

4.10.2 LIIO Organization

Table 18 Driving and Dependence Power for LIIO

FACTORS	DRIVING	DEPENDENCE	MICMAC
Gain (1)	8	2	DEPENDENT
Driver (2)	9	5	DEPENDENT
Landscape (3)	2	8	DRIVER
Servitization {4)	8	9	RELAY
Cloud Enablement (5)	8	6	DEPENDENT
Technology (6)	8	8	RELAY
Utility {7)	11	5	DEPENDENT
Control Plane (8)	4	9	DRIVER
Ecosystem (9)	9	9	RELAY
Latent Inhibition {10)	9	9	RELAY
Ability to respond {11)	1	11	DRIVER

Following inference are drawn from Table 18 Driving and Dependence Power for LIIO:

- “Utility” is the Influential Force with maximum Driving Power followed by “Driver”, “Ecosystem” and “Latent Inhibition”.
- “Ability to Respond” are the Influential Forces that have maximum Dependence Power.
- It is worth noting though that “Servitization”, “Technology”, “Ecosystem” and “Latent Inhibition” have nearly equal Driving and Dependence Powers.

4.11 Cross-impact matrix multiplication applied to classification (MIC-MAC) Analysis

The main objective of MICMAC is to classify the elements according to their Driving Power and Dependence Power (Choi, Kim and Kim, 2014).

These Driving Power and dependencies become the base of calculations for MICMAC analysis, providing classification of Influential Forces into four groups of Autonomous, Dependent, Relay, and Independent (Driver).

“Influential Forces” are plotted as points in the conventional X-Y co-ordinate system. As moving to right of the scale, Dependence Power increases while bottom to top indicates a rise in Driving Power. In each axis, the Driving and Dependence Power match the relative rank among Influential Forces, i.e. The larger power about variable increases, the higher rank is (Choi, Kim and Kim, 2014).

The Influential Forces are classified in four categories, namely: Autonomous, Dependent, Relay and Independent. These quadrants provide fundamental understanding of related Influential Forces as shown in Figure 41 MICMAC Plot.

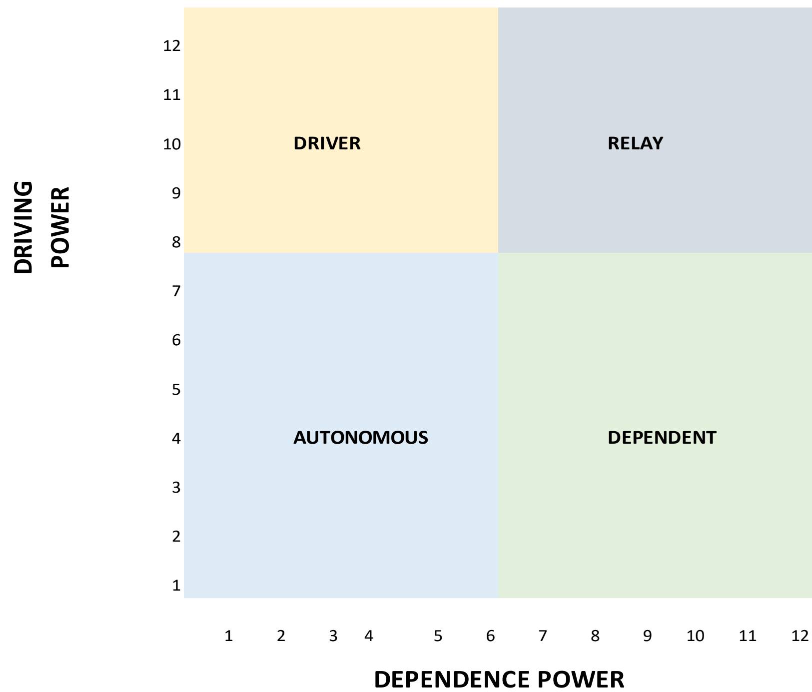


Figure 41 MICMAC Plot

- "AUTONOMOUS": Weak Driving Power and weak Dependence Power factors. These factors are autonomous or excluded factors.
- "DEPENDENT": Weak Driving Power and strong Dependence Power factors, a group of so-called dependent or dominated factors.
- "RELAY": Strong Driving Power and strong Dependence Power factors. These linkage or relay factors impact others.
- "DRIVING POWER": Strong Driving Power and weak Dependence Power factors. They are called Independent or Dominant factors. The forces in this cluster are the most important forces as they strongly influence others. Therefore, they are called Driving Forces.

The MICMAC analysis has been carried out based on the Final Reachability Matrix derived in 4.8.5 to both Case 1 and Case 2. The resulting plots are depicted in

Figure 43 MICMAC Analysis for HIIO Influential Forces along with analysis in Figure 43 MICMAC Analysis for HIIO Influential Forces.

4.11.1 HIIO Organization

FACTORS
Gain (1)
Driver (2)
Landscape (3)
Servitization (4)
Cloud Enablement (5)
Technology (6)
Utility (7)
Control Plane (8)
Ecosystem (9)
Latent Inhibition (10)
Ability to respond (11)

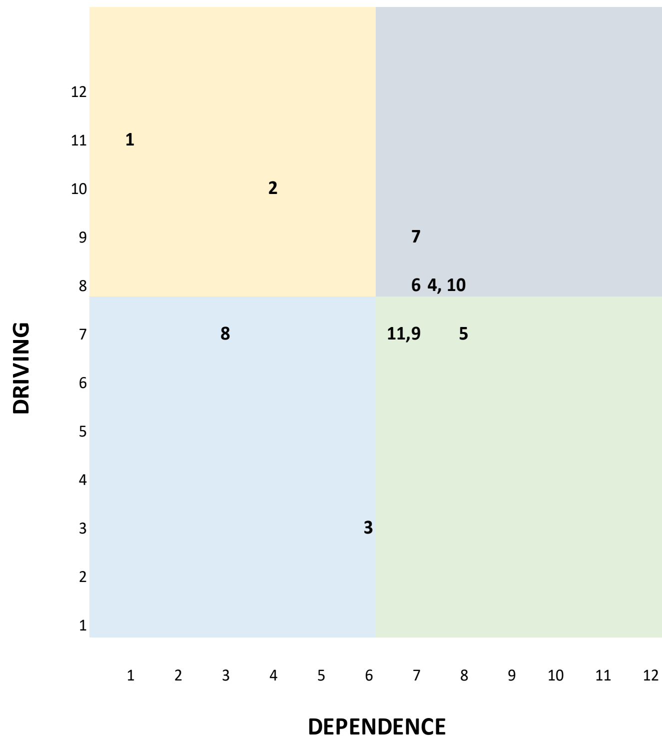


Figure 42 MICMAC Plot for HIIO

DRIVER	Gain (1), Driver (2)
AUTONOMOUS	Landscape (3), Control Plane (8)
RELAY	Servitization (4), Technology (6), Utility (7), Latent Inhibition (10)
DEPENDENT	Cloud Enablement (5), Ecosystem (9), Ability to respond (11)

Figure 43 MICMAC Analysis for HIIO Influential Forces

Here are the observations about the relative relationships between the Influential Forces analyzed using MICMAC analysis:

- "Gain" and "Driver" are the essential Driver Forces amongst the Influential Forces. They have hardly any Dependencies on other Influential Forces and are identified as the source for driving the adequate response for the incumbent.
- "Cloud Enablement", "Ecosystem" and "Ability to Respond" have strong Dependence Power but weak Driving Power. These forces are affected highly by other factors.
- It is worth noting though that "Servitization", "Technology", "Utility" and "Latent Inhibition" have nearly equal driving and Dependence Powers. They are identified as Relay Forces as any actions on them will affect the other Influential Forces significantly. These are the Forces that cause a feedback effect and impart transitivity to the decision-making process.

- “Landscape” and “Control Plan” have weak Dependence Power and Driving Power. They are relatively disconnected from the decision-making with few linkages to other Influential Forces.

4.11.2 LIIO Organization

The resulting plots for LIIO are depicted in Figure 44 MICMAC Plot for LIIO along with analysis in Figure 45 MICMAC Analysis for LIIO Influential Forces.

FACTORS
Gain (1)
Driver (2)
Landscape (3)
Servitization {4)
Cloud Enablement (5)
Technology (6)
Utility {7)
Control Plane (8)
Ecosystem (9)
Latent Inhibition {10)
Ability to respond {11)

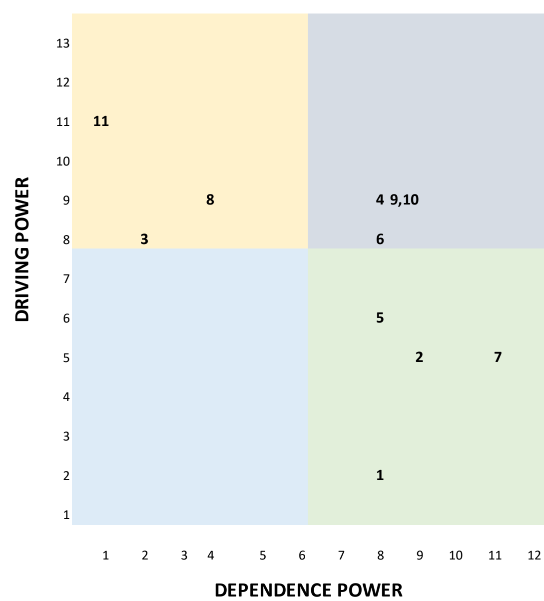


Figure 44 MICMAC Plot for LIIO

DRIVER	Landscape (3), Control Plane (8), Ability to respond {11)	3,8,11
AUTONOMOUS		
RELAY	Servitization {4), Technology (6), Ecosystem (9), Latent Inhibition {10)	4,6,9,10
DEPENDENT	Gain (1), Driver (2), Cloud Enablement (5), Utility {7)	1,2,5,7

Figure 45 MICMAC Analysis for LIIO Influential Forces

Here are the observations about the relative relationships between the Influential Forces as analyzed using MICMAC analysis:

- "Landscape", "Control Plane" and "Ability to Respond" are the essential Driver Forces amongst the Influential Forces. They have hardly any dependencies. They are identified as the source for driving the adequate response for the incumbent.
- "Gain", "Driver", "Cloud Enablement" and "Utility" have strong Dependence Power but weak Driving Power and are highly affected by other factors.
- It is worth noting though that "Servitization", "Technology", "Ecosystem" and "Latent Inhibition" have nearly equal Driving and Dependence Powers. They are identified as the Relay Forces as any actions on those factors will affect the other Influential Forces significantly. They cause a feedback effect on themselves.
- There were no Influential Forces that were found autonomous that are relatively disconnected from the decision making.

4.12 Summary of Findings

This section captures the key findings across the research and present them as tenets for formulating adequacy research framework. It is organized in accordance with the different phases of the research, identifying key elements of research, quantitative analysis findings, qualitative analysis findings and inter relationships of influential forces. These are detailed in the sections below.

4.12.1 Identifying key elements of research

A comprehensive literature review of related articles has been conducted to identify the initial set of elements that can be used.

- During the literature review of the selected prior articles on relevant topics to adequate response for a 5G / IoT wave, a total of 69 Research Elements were discovered. Scalable Architecture, Business Model, Industrial IoT, 5G, Connected Products, Cloud Adoption, as-a-service model, and Value Chain were some of the most research topics that found similarity and highest degree of relevance to the research endeavor.
- During the primary data collection process “Telecommunications”, “Information Technology Consulting”, “Energy and Utility” are the industry verticals that provided the best response is in terms of response rate. And overall response rate of 38.2% has been achieved that provided a data set of 201 completed questionnaires. “Energy And Utility” and “Heating, Ventilation and Air Conditioning” were the 2 industries where maximum cohesiveness [in terms of correlation of responses] was observed.

4.12.2 Quantitative Analysis Findings

- Since 2:1 ratio for item/variable ratio in Principal Component Analysis has been found favorable to provide correct results (Costello and Osborne, 2005), with 201 responses this research study item/variable ratio stood at **2.91:1** allowing to implement Varimax Rotation of Principal Component Analysis as the choice for Data Analysis. The principle Component Analysis carried out on the respondents data gives us 35 components that have an explained variance of 71%.

- Conducting Horn's Parallel Analysis by using Screeplot on the identified 69 Research Elements validated that 35 components identified as the Principal Components as they adequately explain over 70% variance in the original set of Research Elements.
- Similarly, carried out Horn's Parallel Analysis on the 201 respondent's that provided the completed questionnaires to establish that classifying them into 4 different clusters will adequately explain their:
    a. Similarities around the centroid of the cluster
    b. differences in accordance with distance between these clusters
- Then Kmeans++ Cluster Analysis was conducted on the 35 Principal Components to discover that they can be adequately represented by 11 distinct clusters. These 11 distinct clusters are significant as they can be used collectively to explain the adequacy of response from the incumbents.
- The identified 11 distinct clusters are referred to as "Influential Forces" and they are as follows: "Gain", "Driver", "Landscape", "Servitization", "Cloud", "Technology", "Utility", "Control", "Ecosystem", "Inhibitions" and "Response".
- Research employed Homogeneity (each cluster contains only members of a single class), Completeness (all members of a given class are assigned to the same cluster) and the V-measure (measures how successfully the criteria of homogeneity and completeness have been satisfied) to establish the reliability and validity of these Influential Forces. The deterministic and significant value of K is found to be maximum at 11 which proves to be the most optimal numbers of clusters to represent the Principal

Components. Similarly, the deterministic and significant value of K is found to be maximum at 4 which proves to be the most optimal numbers of clusters to represent the respondents' groups.

4.12.3 Qualitative Analysis using Case Study

Research has Case Study Methodology to derive the relationships between the Influential Forces study and interpret them into a repeatable framework. The two selected cases represented incumbents from two extreme clusters. Case 1 represents an organization from Energy and Utility vertical that exhibits the characteristics of "Highly Innovative Incumbent Organization" which is the cluster one in the Quantitative Analysis. Case 2 represents an organization from Heating, Ventilation and Air Conditioning vertical that exhibits the characteristics of "Low Innovative Incumbent Organization" which is the cluster three in the quantitative analysis.

Interpretive Structural Modeling (ISM) has been carried out on the qualitative data that has been collected during the tenure of the case studies – Case 1 and Case 2. Interpretive Structural Modeling (ISM) is used here to refer to the systematic application of some elementary notions of graph theory in such a way that theoretical, conceptual, and computational leverage is exploited to efficiently construct a directed graph, or network representation, of the complex pattern of a contextual relationship among a set of elements (Malone, 1975).

- Case 1 (HIIO) exhibits interrelationship of Influential Forces with 6 levels hierarchy.
- Case 2 (LIIO) has been more hierarchical in their interrelationship of Influential Forces with 8 levels of such hierarchy.
- The hierarchical structure implies that both the organizations follow a sequential process in building their adequate response to 5G/IoT technologies wave disruption.

4.12.4 Inter relationship of Influential Forces

The diagraphs for both the cases have been analyzed for the comparing interrelationships between the Influential Forces. While both organizations exhibited very different output, there were some striking similarities in the sequential decision-making as follows:

- "Driver" Influential Force drives "Utility" Influential Force implying that customer experience digital transformation, automation in terms of control and processes are some of the key drivers that make up the driver Influential Force. These factors have been identified as Research Elements along with increased effectiveness of supply chain. "Utility" Influential Force, such as increasing the efficacy of the cloud based systems in terms of data plane communication due to the common knowledge about the data and effectively employing analytics to build actionable insights has been the core driving force. Thus, it is the need for new customer experience and automation that mandates the data analytics for finding supporting data or boundary breakthroughs in both the organizations.
- "Cloud Enablement" Influential Force drives "Landscape" Influential Force. "Cloud Enablement" Influential Force relates to the ability to leverage on the cloud computing paradigm encompassing different models of engagement and hybrid architectures that combines and unifies public cloud and private cloud services from multiple cloud vendors to create a single, flexible, cost-optimal IT infrastructure (Hurwitz & Kirsch, 2019). "Landscape" Influential Force refers to the level of fragmentation, effect of digital evolution, diversity and ability to create self organizing systems across the breath of value chain. "Cloud Enablement" and "Landscape" Influential Forces are interelated. It is the power of cloud technology that is used to manage the fragmentation of Ecosystem and its impact on the digital

evolution. Cloud is seen as a prerequisite capability to build self organizing systems that require collaboration across the landscape.

- "Latent Inhibition" Influential Force drives "Servitization" Influential Force. "Latent Inhibition" Influential Force captures the inhibitions in engaging with the Ecosystem to build extendable experiences on the connected products such as inability to build the new set of skills, security and data privacy concerns and the ability to build a culture of graceful failures so that new experiences options can be built in a agile way. "Servitization" represents capability of connected products, Product-Service-Systems, Service Orientation that the incumbents are experiencing. Industry 4.0 and Industrial IoT are leading edge of this change. Strategies such as product extensions, building ontological models of services and creating new "as-a-service" models are also referred to as tenets of "Servitization". The inter-relationship exhibits the behavior that both organizations acknowledge that they have latent inhibitions in terms of skills and ability to build business models that drive Servitization.

While there are similarities across both diagraphs, there is a significant difference in terms of a particular element appearing at a particular level in the respective adequate response model. These differences finally account for the structures of the two incumbent organizations being different.

- The treatment of the following Influential Forces: "Gain", "Ecosystem", "Control", "Inhibitions" and "Response" has been different in both organizations which explains how they differ in using these Influential Forces for decision making.
- The following Influential Forces were the initiating points or triggers of decision-making and were significantly different for both the organizations.

- “Ability to Respond” has been identified as the top driving Influential Forces for LIIO. This Influential Force represents organizational tactical movement with respect to the business environment. During the workshops some of the key responses that were collected were regarding their “ability to move fast”, “be influential in Business Innovation” across the industry. There were thematic picked by the Product Managers regarding retrofitting their existing product and service lines with new capabilities that are enabled by 5G/IoT technologies. There were also discussions regarding building horizontal business models.
- But, “Ability to Respond” ironically has been identified as the most dependent Influential Force for HIIO. It is “Cloud Enablement”, “Technology” and “Inhibition to Response” Influential Forces that influences “Ability to Respond” Influential Force in HIIO.
- It clearly indicates that LIIO – which lack innovative response abilities – tend to feel the urge to take tactical action so that they can remain relevant in the market place. Experts in the business world are all in agreement that the ability to digitally reinvent the business is not just about the technologies being adopted, but rather about a radical strategic and cultural change within the organization (Ismail, Khater and Zaki, 2017). Thus, LIIO struggle with the motivation factor that requires them to adopt and provide an adequate strategy to harness the 5G/IoT potential.

- The following Influential Forces were idenified as the most dependent forces that made the most through the relay and driving forces and they were significantly different for both the organizations.
    - In HIIO, “ “Ecosystem”, “Landscape”, “Servitization” and “Ability to respond” Influential Forces have been identified as the most dependent Influential Forces.

- This implies that HIIO drive the change by becoming a partner of choice and a leader in the value chain and thus builds an "Ecosystem" around it to support their endeavor.
- They leverage the fragmentation of the "landscape" to their advantage and emerge as a leader. HIIO are pliable to deconstructs its products and services so that they can be reconstructed in a Connect-Product-System paradigm that thrives on "Servitization".
- They categorically decide their tactical play and constructs business models as its "Ability to Respond" Influential Force.
- While in LIIO, "Utility" Influential Force is defined as the most dependent Influential Force.
- This implies increasing the efficacy of the cloud based systems in terms of data plane communication
- LIIO effectively employ analytics to build actionable insights has been the core driving force. LIIO use the data to find ways to build a "utility" for its promoters and customers.
- It is evident that while HIIO confidently uses their capabilities to build a clear value proposition and "go to market" strategy for their market innovation, LIIO struggles to find ways to tactically utilize its resources to create demand for its revised service and product lines.

MICMAC analysis undertaken reveals the dependence of Influential Forces, how Autonomous or Independent are some of these Influential Forces, which Influential Forces act as Relay and thus enable other forces in the sequence of a decision-making framework. These are explained further herein terms of which forces drive the process of sequential decision-making in the incumbent organizations.

- In HIIO, “Gain” and “Driver” Influential Forces were identified as drivers; “Cloud Enablement”, “Ecosystem” and “Ability to Respond” have been identified as the dependent Influential Forces;” Servitization”, “Technology”, “Utility” and “Latent Inhibition” have been identified as relay so that they enabled the other Influential Forces; “Landscape” and “Control Plane” have been identified as autonomous or independent forces that hardly influence any other forces while the organization adopts to provide an adequate response framework.
- In LIIO, “Landscape”, “Control Plane” and “Ability to Respond” have been identified as the driving Influential Forces; “Servitization”, “Technology”, “Latent Inhibition” and “Ecosystem” have been identified as relay forces that influence and enable other Influential Forces to formulate the framework; “Gain”, “Driver” , “Cloud Enablement” and “Utility” have been identified as dependent forces data driven in the framework by either the driving or the really Influential Forces. There were no autonomous or independent Influential Forces identified in this organization.
- “Driver Forces”: These Influential Forces have strong Driving Power and weak Dependence Power factors. They are most certainly the most dominant forces within the framework and they strongly influence other forces in the framework. HIIO and LIIO did not have any driving or dominant forces common in their analysis.
- “Relay Forces”: These Influential Forces heavily influence and enable other forces within the framework. HIIO and LIIO had “Servitization”, “Technology” and “Latent Inhibition” as common forces identified that formed the relay cluster within the framework.

- "Autonomous Forces": These Influential Forces are characterised by weak Driving Power and weak Dependence Power factors, they are thus also called as the Autonomous or Excluded Forces. They hardly participate in influencing any other forces within the framework. HIIO and LIIO did not have any autonomous forces commonly identified during the analysis.
- "Dependent Forces": These Influential Forces are characterised with weak Driving Power but a strong Dependence Power factor and thus they form a cluster of Dominated or Influenced Forces within the framework. "Cloud Enablement" has been identified as a comment dependent or a dominated force within the framework across both case studies.

4.13 Conclusion

This chapter summarizes the results achieved through the Mixed Method Research. During this research undertaking, This research has initially carried out a Quantitative Analysis to derive the key Influential Forces that make up the Adequate Response Framework.

To extract the key Research Elements, selected 225 articles from which 69 key Research Elements have been identified. Empirical data from the Industry Consultants and Subject Matter Experts was obtained to ensure that identified research elements provided the required relevance to formulate the Adequate Response Framework. Conducted an online survey where the respondents used Likert Scale to provide the relevance of these Research Elements. The survey has been built on 11 postulates which collectively and exhaustively classified they required Research Elements and received 38.2% response rate providing the data set of 201 responses.

By conducting Principal Component Analysis on these responses, identified 35 Principal Components which collectively could explain over 70% variance of the entire dataset. These components were further validated by employing Horn's Parallel Analysis and Screeplot.

Conducted Kmeans++ Cluster Analysis to find homogeneous groups that explain these observations. This provided 11 distinct clusters which became the base for defining key Influential Forces that are used for technology decision-making by the incumbents.

Similarly, cluster plot to identify that the incumbents themselves are classified into a quad-framework, Highly Innovative Incumbents, Moderately Innovative Incumbents, Low Innovative Incumbents and Laggards. The findings were tested for validity and reliability by calculating Homogeneity, Completeness and V- Measure plots.

This provided the base of formulating The Framework for Adequate Response. The key 11 Influential Forces defined are. "Gain", "Driver", "Landscape", "Servitization", "Cloud", "Technology", "Utility", "Control", "Ecosystem", "Inhibitions" and "Response".

These Influential Forces have been organized into Adequate Response Framework, an artifact that allows us to define the maturity across key domains or tenets. 6 key tenets that were identified for the Adequate Response Framework are Objective, Engagement, Risk and Rewards, Plausible Control and Cloud and Landscape. A comparative study across the 4 groups of incumbents provided Innovation Maturity Assessment.

Multiple Case Study Methodology allowed to run 2 cases in parallel, one with a Highly Innovative Incumbent Organization and the other with a Low Innovative Incumbent Organization. To compare the decision-making process across these 2 cases Interpretive Structural Modelling technique has been used that provided 2 visually distinct Directed Graphs representing the sequential decision-making process that these 2 organizations currently undertake to manage 5G/IoT technologies wave response.

Driving and Dependence powers for all the Influential Forces have been calculated separately. This allowed to undertake Cross-impact matrix multiplication applied to classification (MICMAC) Analysis. By cross examining Directed Graphs, MICMAC analysis, Driving and dependence Power Analysis; this research has been able to formulate the similarities and striking dissimilarities between the two extremely poised organizations- in terms of their ability to manage innovation and thus formulate inadequate response to the technologies wave. These findings have been summarized and helps understand how the key driving Forces, dependence Forces and Relay Forces differ significantly across both the organizations-a discussion on these aspects will help formulate the Adequate Response Framework and the response framework which are the key objectives of the research endeavor.

CHAPTER V:

DISCUSSION

5.1 Discussion of Research Question

The collective impact of 5G, cloud and IoT can be studied broadly by examining the impacts on their decision-making process. This research seeks to explore what the incumbents can do better to take the advantage of 5G and IoT technologies wave. The objective of this research endeavor is to build Adequate Response Framework then the incumbents of the industry can utilize to build an adequate response to the wave of 5G and IoT.

The incumbents acknowledge a lack of Adequate Response Framework in the academic findings which could work as a guiderail for them to assess analyze their thought process in adopting these new technologies into their design as an extension.

Current methodologies limit themselves to the realm of advisory and impose the following constraints: technical domain focuses only on technology interventions and innovations and lacks the aspect of Adequate Response Framework which helps understand the value of Ecosystem and how to foster these ideas as intrapreneurial ventures; management domains focus on general intraneural advisory strategy and methodology but are challenged with specifics that can help leverage the 5G/IoT technologies advancements.

Researcher thus choose the research on the following question:

"Adequate Response Framework to 5G/IoT technologies disruption for incumbents"

The study helps evaluate and build and Adequate Response Framework which would explain the impact of the following three dimensions that have been sought out as research dimensions in the study. These are:

- Dimension 1: Prevalence of the competitive business models
- Dimension 2: Adoption of cloud-based services to proliferate IoT offerings
- Dimension 3: Engagement of the Ecosystem.

Analyzing the data during the research tenure, these research dimensions are used to build and Adequate Response Framework. This framework has been tested and validated to document the findings across 2 case studies carried out in two different organizations, i.e. They differ to the extent at which they have leveraged innovation to build an adequate response to the wave of 5G and IoT.

These findings support the research dimension- “Prevalence of The Competitive Business Models” – validating that competitive business models ensure a higher propensity to stimulate a more adequate response by the incumbents. Highly Innovative Incumbent Organizations have utilized the advent of 5G and IoT technologies to build new business models while the laggards and Low Innovative Incumbent Organizations perceive these technologies wave as a threat.

The findings further support that Highly Innovative Incumbent Organizations have leveraged cloud best services by adopting them in their design and engineered products and services with the objective or proliferating the IoT offerings. This supports the conjunction that adoption of cloud services is essential to building IoT based Servitization models as Servitization has been identified as in essential step in creating significant value during the product and services extensions.

The findings have proved that technology interventions like 5G/IoT technologies change the landscape of collaborative engineering design for products and services forever. Laggards and Less Innovative Incumbent Organizations are severely challenged in meeting the revised service demands from their customers. Whereas, Highly Innovative Incumbent Organizations do not work in isolation, instead see themselves as a part of a Digital Ecosystem. They helps create sustainable and effective Servitization Models that impart value from meaningful innovations as service. They have also improvised product extensions or process of introducing of new products and services to existing customer portfolios. They have focused on opening new markets that help foster growth.

5.2 Discussion related to Literature Review

Research has undertaken an exhaustive literature review by examining 794 research publications of which selected 225 research publications that were published during the 24 years from 2000 to 2022.

Existing literature establishes the following:

- The abundance of business models in industry today is indicative of the fact that this abundance is primarily driven from the advent of the 5G/IoT technologies wave.
- 5G/IoT technologies are pushing the incumbents towards Servitization.
- The rise in cloud computing is a mega trend and is converging with the wave of 5G/IoT disruption.
- Incumbents need to leverage Ecosystem to build meaningful innovations in IoT offerings.
- Incumbents have to alter their business models to achieve successful Servitization.

The key research gaps that were found in the literature review in the context of adequate response that incumbents can provide to the surge of 5G/IoT technologies disruption wave are as follows:

1. Does prevalence of competitive business models ensures a higher propensity to stimulate a more adequate response by the incumbents?
2. Adequate response to any 5G/IoT disruption wave would translate to identifying new innovative business models and retiring some of the old business models.
3. Examining the conjecture that the advent of 5G/IoT creates an unprecedented opportunity to build new business models for the incumbents else they are likely to lose significant business value.
4. Is adoption of cloud-based services an essential element to garner an adequate response by the incumbents and failing which can lead to a failure in Industry 4.0 requirement like Servitization of products?
5. Is adoption of cloud services a key differentiator in the era of 5G/IoTdisruptions being experienced in the industry?
6. Support to establish that adoption of cloud services is thus an essential part of Servitization transformation.
7. No adequate research provides a comprehensive understanding of impact of engagement in Ecosystem as an essential response for the incumbents in the wake of 5G/IoTdisruption?
8. Is deeper level of engagement with Ecosystem is essential to achieve Servitization?
9. Do Incumbents need to adapt to flexible organizations that build meaningful innovations in 5G/IoTessentially due to a scalable and sustainable Ecosystem?

The first dimension, “Prevalence of the competitive business model”, has been suggested as further research work on how industrial IoT Business Models are changing the key drivers in the now and infers that adoption of IoT leads to profit optimization related to production value chain (Deogratius, 2018).

The second dimension, “Adoption of Cloud Based service to proliferate IoT offerings” has been suggested as further research work by Saldivar et al. (2015) stating that a methodology that integrates Cyber-Physical Systems, Cloud Computing and real-time analysis is key to achieving innovation and a high productivity, because the system at the end becomes self-aware and self-predictive among other properties that are suitable for future.

The third dimension, “Engagement of the Ecosystem”, has been cited as further research work concluding that for getting better insights into the potential differences might reveal how successful alliances and partnerships are formed and what the critical success factors to these alliances and partnerships might be (Thiagarajan, 2016). In addition, case studies of successful organizations in different roles will prove to be a valuable source of best practices for successful industrial adoption (Thiagarajan, 2016).

This research strives to build a framework that will help the incumbents in the following ways:

- Impact of the business models, cloud adoption and the engagement of Ecosystem on the adoption of 5G/IoT for the incumbent players.
- Identify different clusters of organizations with respect to their ability to innovate in the presence of 5G/IoT technologies.
- Identify key Influential Forces that help build an adequate response to the 5G/IoT technologies wave.
- Identify the Influential Forces interrelationships with respect to the ability to innovate.
- Establishes how the Influential Forces interdependencies are different for different organizations.

- Guidelines for Low Innovative Incumbent Organization to leverage Influential Forces in readjusting their decision-making process to provide an adequate response to 5G/IoT technologies disruption.

With these value additions, this research stand in a unique position to guide the industry on how to convert a plausible threat into a remarkable opportunity so that this research can help the incumbents build innovative 5G/IoT led products and services extensions that will spur new demand for the industry.

5.3 Discussion related to Quantitative Data Collection

Research undertook and exhaustive research across published literature to select 225 research articles from 794 overall research articles that were accessible to identify a comprehensive list of Research Elements that would create the core construct of Adequate Response Framework. 69 Research Elements were identified which were prepared for validation and quantitative analysis as further steps. “Scalable Architecture”, “Business Model”, “Industrial IoT”, “5G”, “Connected Products”, “Cloud Adoption”, “As-a-Service Model”, and “Value Chain”, were some of the most research topics that found similarity and highest degree of relevance to the research endeavor.

A multipart questionnaire has been used in this research that collects background information about industry and how the respondents are affiliated in providing an adequate response to the 5G/IoT technologies wave and captures the relevance of the Research Elements.

A total of 201 completed responses have been received representing a rate of 38.2%. “Energy And Utility” and “Heating, Ventilation and Air Conditioning” were the 2 industries where maximum cohesiveness [in terms of correlation of responses] was observed.

The survey data that has been collected across the 69 Research Elements lend itself to quantitative analysis in 2 distinct pathways. The first pathway has been to mine this data set and identify if there are components available that would collectively represent majority of these Research Elements. The second pathway has been to mine the data set to identify if the respondents could be classified into clusters that represented gradients of innovativeness in terms of providing adequate response 2 technologies disruption waves.

Traversing the first pathway, Principal Component Analysis on the respondent data provided 35 components explaining 71% of variance. The validity of these identified 35 components has been confirmed by carrying out Horn's Parallel Analysis. Research then carried out cluster analysis to finally discover 11 Distinct Clusters which would represent the Influential Forces that make up the adequate response model. The identified Influential Forces are as follows: "Gain", "Driver", "Landscape", "Servitization", "Cloud", "Technology", "Utility", "Control", "Ecosystem", "Inhibitions" and "Response". Research employed Homogeneity (each cluster contains only members of a single class), Completeness (all members of a given class are assigned to the same cluster) and the V-measure (measures how successfully the criteria of homogeneity and completeness have been satisfied) to establish the reliability and validity of these Influential Forces by plotting the K-value. The deterministic and significant value of K is found to be maximum at 11 which proves to be the most optimal numbers of clusters to represent the Principal Components.

Traversing the second pathway, Principal Component Analysis on the respondent data provided 4 components explaining over 70% of variance. The validity of these identified 4 components has been confirmed by carrying out Horn's Parallel Analysis. Cluster analysis was conducted to finally discover 4 Distinct Clusters which would represent the Innovation Clusters that the Respondent make up the adequate response model. The identified clusters are as follows: "Highly Innovative Incumbent Organization", "Moderately Innovate Incumbent Organization", "Low Innovative Incumbent Organizations" and "Laggards". Similarly, employed Homogeneity, Completeness, and the V-measure to establish the reliability and validity of these Incumbent Clusters by plotting the K-value. The deterministic and significant value of K is found to be maximum at 4 which proves to be the most optimal numbers of clusters to represent the Principal Components.

5.4 Innovation Framework related to Research Dimensions

The quantitative data analysis allowed to identify the Influential Forces that would by the research constructs on which Innovation Framework for the incumbents can be developed. But the inter relationships and dependencies amongst these Influential Forces were not explained through the Quantitative Analysis phase. To explain them through Innovation Framework, research undertook 2 case studies in parallel. Case 1represents Highly Innovative Incumbent Organization, an Energy and Utility organization that wanted to become a digital leader that utilizes 5G/IoT technologies to drive value. The second case represents a Low Innovative Incumbent Organization, a Heating Ventilating and Air Conditioning (HVAC) organization, which has seen competition introduce innovative products around telemetry that drive the 5G/IoT technologies interventions.

The research design has been to work with both these organizations in parallel, be a part of their meetings come out conduct workshops, one to one interview an access their archives to formulate and validate the theory of adequate response by incumbents.

To achieve this objective, Interpretive Structural Modelling (ISM) has been used as the decision tool to explain the inter relationships amongst these Influential Forces, this is achieved by organizing them into a Directed Graph. Developed a Diagraph for both the organizations individually and separately. Directed Diagraph helped the organizations participants to visually analyze inter relationships between the Influential Forces pertaining to the sequential decision-making framework that forms an adequate response to 5G/IoT technologies wave.

Analyzed these two Directed Diagraph to look for similarities, significant differences in terms of a particular Influential Force appearing at a particular hierarchy in the decision-making framework. Conducted analysis by identifying and isolating the initiating trigger points or entry points as Influential Forces for this decision-making process and understanding the endpoint of this decision-making process. This level of analysis formed an excellent bedrock for understanding how these two organizations differ in their decision making. This helps explains why one organization can create highly innovative product interventions and service extensions while the other struggled to retrofit their existing product and service lines with thematic they borrowed from 5G/IoT technologies advancements. The results and inferences observed here are then aligned to the three research dimensions to better explain the research question.

After building the Directed Diagraph for both the organizations based on Interpretive Structural Modelling, Cross-impact matrix multiplication applied to classification (MICMAC) Analysis was conducted. The power of this analysis is to classify the Influential Forces according to their Driving Power and the Dependence Power. It further elaborates each Influential Force by classifying them into 4 key clusters, namely, Autonomous, Dependent, Relay, and Independent (Driver) Forces. This classification is then plotted on 2-dimensional graph with Driving Power as why axis against Dependence Power on X axis which is called as the MICMAC plot. The MICMAC analysis makes the narrative more intuitive by bringing in the dimension of relative relationships of these Influential Forces during the sequential decision-making framework. The MICMAC plots and the MICMAC analysis of both the organizations significantly different which help understand, correlate, and explain the difference in their innovativeness to provide an adequate response to the 5G/IoT technologies wave.

The combined qualitative analysis from interpretive structural modelling, Diagraph models, MICMAC analysis and MICMAC plot lend themselves to explain how each research dimension relates and affects the research question. The discussion pertaining to individual research dimensions is followed below.

5.4.1 Dimension 1: Prevalence of Competitive Business Model

a) Gain

This Influential Force establish that the prevalence of competitive business models leads to an adequate response. The diverse views of HIIO and LIIO are depicted in the Figure 46 Gain Influential Force.

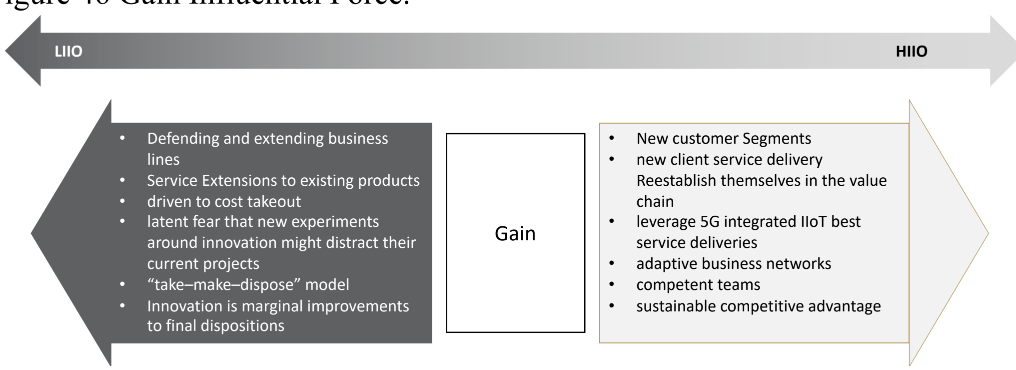


Figure 46 Gain Influential Force

While leveraging on technology advancements like 5G and IoT, Highly Innovative Incumbent Organizations strive to create new customer segments rather than just defending and extending business lines through cost cutting automation or service improvements for existing customers. HIIO have used technology advancements and their disruptions to re-establish themselves in the value chain. They assert the need for developing adaptive business networks such that they can fuse e-servicing capabilities that are promoted with competent teams and serve as core competencies to extend organizational boundaries and convert this into a sustainable competitive advantage.

On the contrary, Low Innovative Incumbent Organizations, have ascribed “Gain” Influential Force as a Dependent Influential Power. The Influential Force is driven by Service Extensions to existing products. LIIO are inadvertently driven to cost takeout, while innovative organizations focus on utilizing IoT driven solutions to implement new client service delivery innovations thereby reducing the cost of ongoing service deliveries. LIIO exhibited a latent fear that new experiments around innovation might distract their current projects thereby reducing overall productivity with marginal improvements to final dispositions. HIIO Instead want to leverage 5G integrated IIoT based service deliveries that decrease latencies, increase data throughputs, and thus improve processing time which would result in overall systems productivity. HIIO also find themselves within unprecedented opportunity of undertaking sustainability thereby deviating from “take–make–dispose” model to fostering they are supply chain and material research to be restorative and regenerative by design.

b) Driver

“Driver” as an Influential Force establishes clear drivers for innovativeness exist and are improvised with the prevalence of competitive business models. The diverse views of HIIO and LIIO are depicted in the Figure 47 Driver Influential Force.

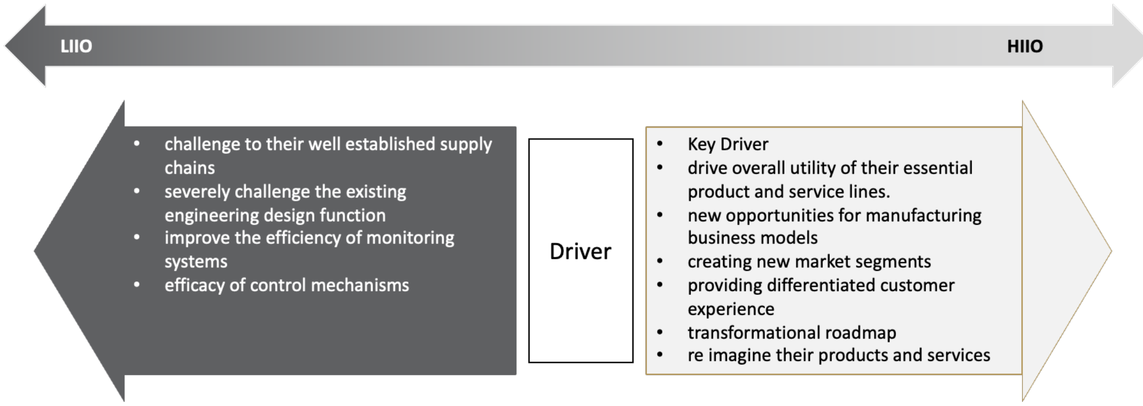


Figure 47 Driver Influential Force

Highly Innovative Incumbent Organizations have classified this Influential Force as a key driver in the sequential decision-making process. They tend to use the advantages of technology advancements in the business environment to drive overall utility of their essential product and service lines.

During the workshops with HIIO, the participants especially the technology architecture team emphasized that the deployment of 5G will open new opportunities for manufacturing business models thus thereby creating new market segments for the organization.

The innovative organizations are aware of providing differentiated customer experience and thus want to utilize the technology advancements to create experience as they saw in some of the startups that have disrupted the current definitions and boundaries of products and services.

LIIO perceive technology advancements adversely as a challenge to their well-established supply chains. They perceive a risk that some of the participants of the supply chain are working collaborating to create disruptive and smart technologies which would severely challenge the existing engineering design function within the organization.

They do acknowledge that if these technology advancements can be harnessed then it can improve the efficiency of monitoring systems thereby increasing the efficacy of control mechanisms to detect faulty products at early stage.

HIIO acknowledge that the technology advancement has made transformational roadmaps imperative, and they would have to re-imagine their products and services. These re-imagined products and services can enhance the value by opening the business models.

HIIO are addressing the need to increase the utilization of key assets, resources across the value chain and extended Ecosystem. HIIO thus classifieds this Influential Force as an essential driver.

LIIO also has classified this Influential Force as a driver but caveats that that there is a precedence and adoption of cloud – a prerequisite without which it would be extremely difficult for LIIO to realize the value and compete with prevalent business models.

c) Landscape

Landscape Influential Force represents the diversity which leads to collaboration across the Ecosystem that is more prominent with prevalence of competitive business models. The diverse views of HIIO and LIIO are depicted in the Figure 48 Landscape Influential Force.

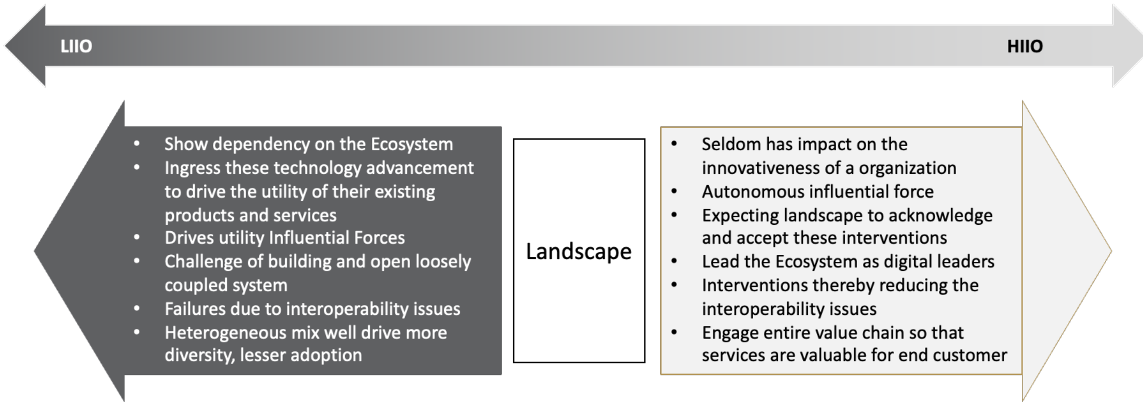


Figure 48 Landscape Influential Force

Highly Innovative Incumbent Organizations support the viewpoint that while collaboration and cooperation across the participants of the Ecosystem in a fragmented landscape improves, it seldom has impact on the innovativeness of an organization.

Organizations develops intelligence on customers, markets, competitors, and other external forces affecting decisions about what technologies might be needed to support innovative efforts (Paap, 2020). On the contrary, Low Innovative Incumbent Organizations show dependency on the Ecosystem and expect that Landscape Influential Force can ingress this technology advancement to drive the utility of their existing products and services.

Thus, HIIO classifies this Influential Force as an autonomous Influential Force while LIIO classify is as driver that drives "Utility" Influential Forces, which has been identified as end point of the decision-making framework.

HIIO lead with their product and service extensions, introduce new innovative products to new market segments. HIIO increasing the value to their current market offerings thereby expecting landscape to acknowledge and accept these interventions.

HIIO envisage to lead the Ecosystem as digital leaders and drive symbiosis, adoption of their interventions thereby reducing the interoperability issues about data generated through connected heterogeneous sensors across the Ecosystem.

HIIO are heavily investing in developing IoT platforms that would cover the entire value chain such that services are delivered to the end customer and essentially supported through multitude of IoT based applications.

On the other hand, LIIO see forthcoming challenges of building and open loosely coupled system in an Ecosystem as they perceive risk of their product failures due to interoperability issues and marginal adoption by other participants of the value chain.

LIIO seem myopic about feature enablement and evolution road maps but are very keen in ensuring and defending their existing product and service lines. LIIO rationalize the argument of heterogeneous mix of technologies will drive more diversity, lesser adoption and price war which would end up disrupting their established supply chain.

d) Servitization

Servitization as an Influential Force confirms that the prevalence of competitive business model allows greater collaboration across the Ecosystem and within the participants of the value chain to create meaningful service extensions on existing products. The diverse views of HIIO and LIIO are depicted in the Figure 49 Servitization Influential Force.

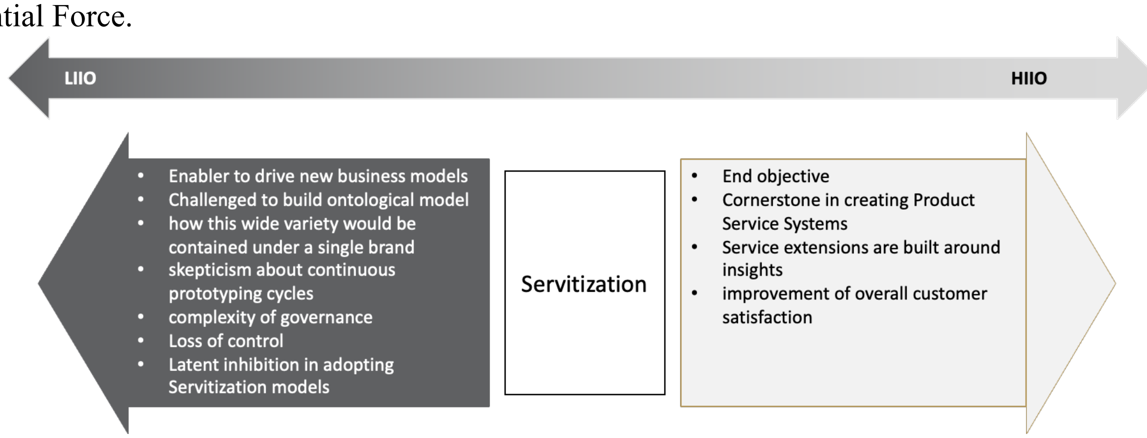


Figure 49 Servitization Influential Force

Servitization Influential Force is identified as an endpoint in the decision-making process by the Highly Incumbent Innovative Organizations and one of the most influential enabling forces within the sequential framework.

During the workshops with HIIO, the participants called Servitization as a cornerstone in creating Product-Service-Systems which would help them garner more value. According to HIIO, Servitization Influential Force fosters service extensions that are built around insights of how customers use the product leading to an improvement of overall customer satisfaction. HIIO perceive Servitization Influential Force as a logical response to the customer needs and thus would increase the customer loyalty and provide resistance to economic cycles.

However, LIIO perceive Servitization Influential Force as an enabler to drive new business models but struggle to define ontological model which would help bring e-service provisioning into the product engineering and design. LIIO also struggle with creating logical product extensions and understanding how this wide variety of extensions would be contained under a single brand that does not confusing the customer as value engineered product.

HIIO instead found Servitization Influential Force as an essential enabler of creating metered services. LIIO respond to metered service with an argument with skepticism about continuous prototyping cycles, complexity of governance and loss of control in the new connected product domains that would be unleashed in the Ecosystem.

Logically, LIIO found the decision-making process towards Servitization being led by Control Plane Influential Force that allows a single pane of control across the entire product life cycle.

In decision-making process, LIIO also called out the role of Ecosystem as a prerequisite to be understood and well controlled which has been also a latent inhibition in adopting Servitization models.

5.4.2 Dimension 2: adoption of cloud-based services to proliferate IoT offerings

e) Cloud Enablement

Cloud Enablement Influential Force is the ability to leverage on the cloud computing paradigm so that organizations can utilize different models of engagement and hybrid architectures which drive the cloud benefits and builds cost optimal IT infrastructure. The diverse views of HIIO and LIIO are depicted in the Figure 50 Cloud Enablement Influential Force.

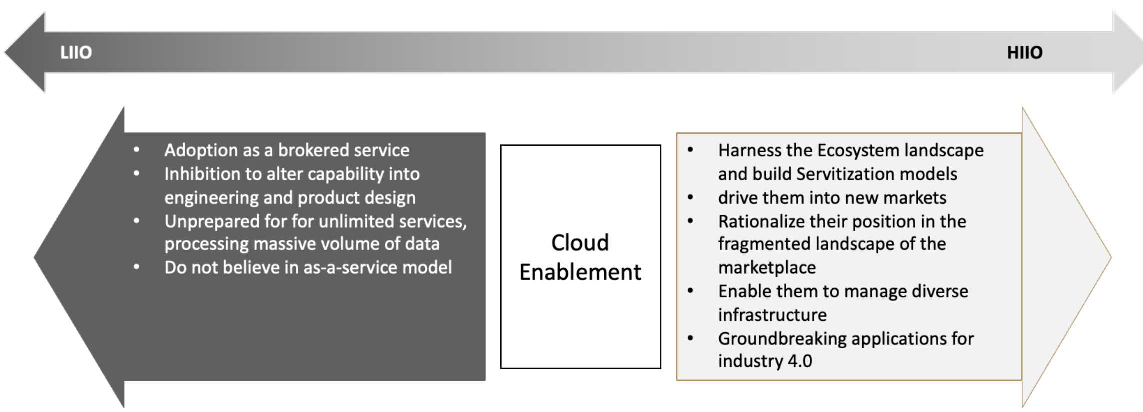


Figure 50 Cloud Enablement Influential Force

While both organizations had classified Influential Force as an important dependent influential, the approach widely differed.

HIIO understands Cloud Enablement Influential Force as a driver force to harness the Ecosystem landscape and build Servitization models.

HIIO does not want to build control plane ahead of device strategy in their cloud adoption strategy.

LIIO, on the other hand, see Cloud Enablement Influential Force essential to realize the breadth of technology advancements brought in by 5G/IoT technologies.

LIIO envisage Cloud Enablement Influential Force to drive them into new markets and rationalize their position in the fragmented landscape of the marketplace.

HIIO describe the value of cloud-to-cloud management capabilities which will enable them to manage diverse infrastructure across their premises, edge and multauthor cloud environments.

HIIO have clearly articulated what services and product extensions would utilize cloud they evaluate hybrid cloud as capabilities of creating multiple cloud models that would bring to life some groundbreaking applications for industry 4.0.

LIIO have realized that there is a demand shift towards always-on services that IoT devices and distributed Federated cloud networks can provide, but they rather think of cloud adoption as a brokered service that is enabled through a cloud broker which would help formulate the strategy and coordinate this capability into engineering and product design.

There is a clear inhibition towards cloud for Low Innovative Incumbent Organizations towards gearing up for unlimited services, processing massive volume of data that would be generated by the IoT devices and IoT enabled product and service extensions while maintaining their organization agile in terms of new product innovations.

f) Technology

Technology Influential Force has been identified as an enabling Influential Force and drives cloud adoption to proliferate IoT offerings. The diverse views of HIIO and LIIO are depicted in the Figure 51 Technology Influential Force.

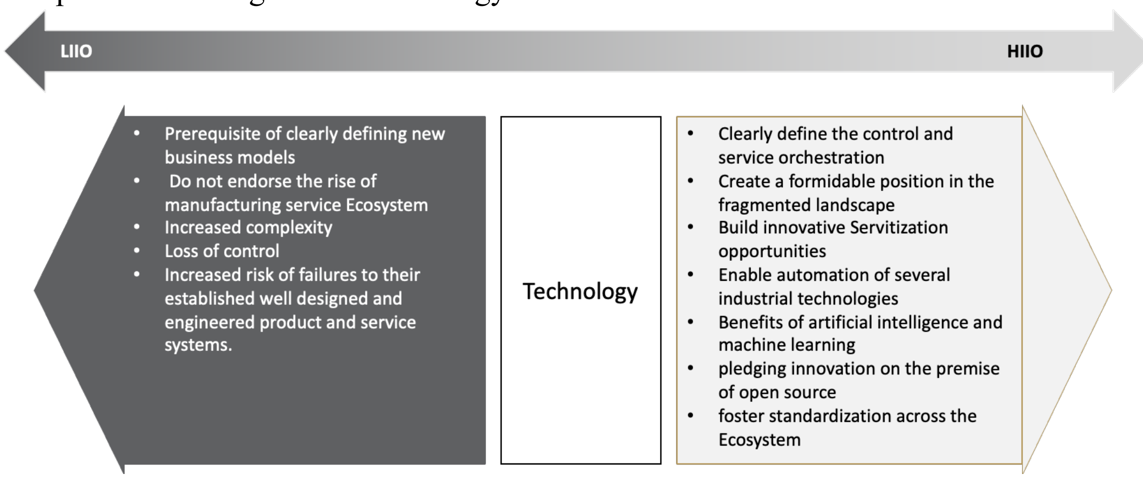


Figure 51 Technology Influential Force

HIIO advocate to clearly define the control and service orchestration before enabling their products with these technology advancements.

HIIO envision that once the design and Servitization models are identified, Technology Influential Force helps drive innovation throughout the Ecosystem, helps them as organization to create a formidable position in the fragmented landscape.

HIIO build innovative Servitization opportunities and improves their prospects to respond adequately to the 5G/IoT technologies wave.

LIIO describe Technology Influential Force as a prerequisite of clearly defining new business models and devices. LIIO expect Technology Influential Force to shape up their adoption of cloud strategy to proliferate the IoT offerings in the marketplace.

HIIO find 5G as a driving force which would enable automation of several industrial technologies and bring forth the practical benefits of artificial intelligence and machine learning. HIIO are proliferating Distributed and Federated architecture to bring forth the power of edge computing and so are increasing the number of connected devices by bringing the cloud closer to the devices that produce data at the edge of the network. HIIO believe that such capabilities will alleviate the issues of performance that are constraining the proliferation of IoT devices.

LIIO show more skepticism and do not endorse the rise of manufacturing service Ecosystem which proliferates distributed collaboration empowered by 5G technology.

HIIO are investing in technology advancements such as digital twins which would help them define a virtual replica of a physical object so that these virtual replicas can be subjected to simulation models fostering the efficiency of trust agreements across the value chain. LIIO adversely meet digital twins (IoT led technologies) with a primary rejection. LIIO argue of increased complexity, loss of control and increased risk of failures to their established well designed and engineered product and service systems.

HIIO notably foresee a major play in Cyber-Physical-Systems where smart objects can sense ambient environmental conditions and utilize machine learning to communicate and cooperate so that they can perform many advanced tasks. HIIO embrace the idea of open innovation by pledging innovation on the premise of open source- a development method that harnesses the power of distributed peer review and transparency.

HIIO advocate that open innovation technology would end the era of vendor lock-ins and foster standardization across the Ecosystem.

g) Utility

Utility Influential Force describes utility of cloud-based systems depends on the effectiveness of the data plane, communication that is proliferated due to the common knowledge about the data and effective analytics that presents actionable insights. The diverse views of HIIO and LIIO are depicted in the Figure 52 Utility Influential Force

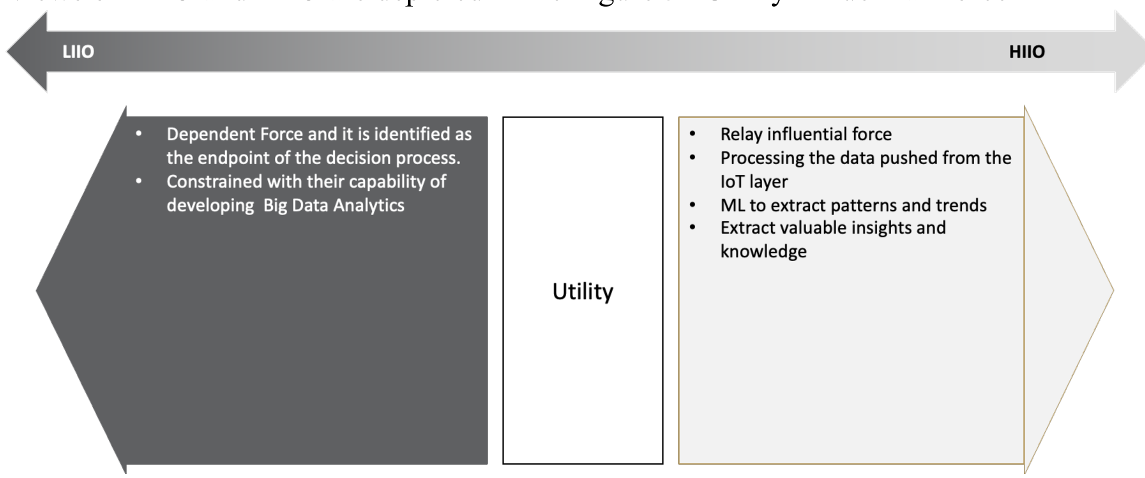


Figure 52 Utility Influential Force

HIIO classifieds Utility Influential Force as a Relay force and envisage the Influential Force driving the control plane.

LIIO classify Utility Influential Force as dependent, and it is identified as the endpoint of the decision process. HIIO find utility in processing the data pushed from the IoT layer and analyzed using various advanced analytical techniques to extract patterns and trends. This well-analyzed information is then used by ML algorithms and AI to accelerate time to extract valuable insights and knowledge, which is eventually exploited to support decision-making. Big Data Analytics, Artificial Intelligence, and IoT is becoming essential to boost productivity and operational efficiency (Tran-Dang and Kim, 2021). Therefore, HIIO believe and invest in the integration of IoT led technologies to drive utility.

LIIO find Utility Influential Force constrained with their capability of developing Big Data Analytics – as a complex set of data is characterized by huge volume, high velocity, and variety, it is described as big data urges the need for advanced data processing technologies to make full use of all of this data (Tran-Dang and Kim, 2021).

h) Control Plane

Control Plane Influential Force refers to the separation of concerns - and ability to build loosely coupled free bound open relationships between participants. The diverse views of HIIO and LIIO are depicted in the Figure 53 Control Plane Influential Force.

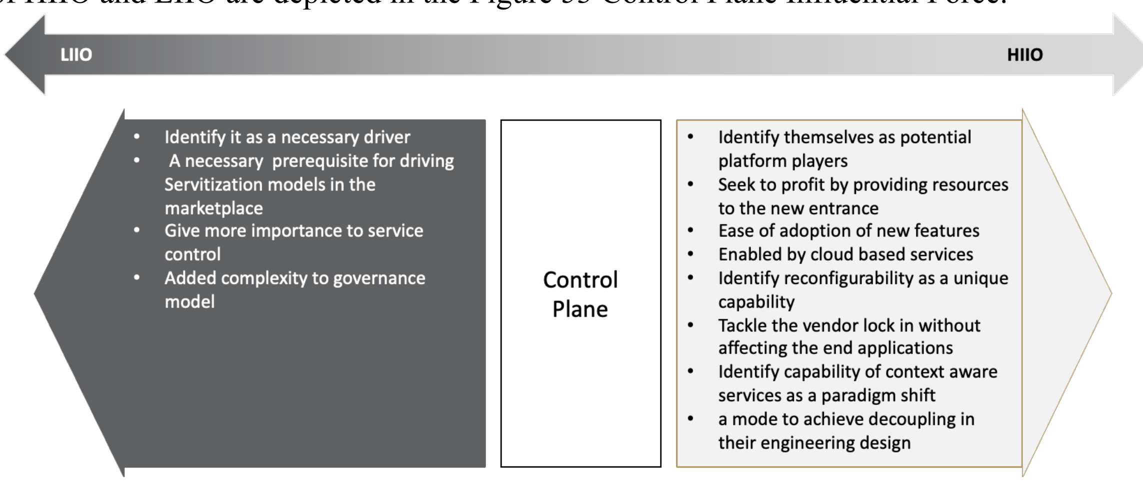


Figure 53 Control Plane Influential Force

The Highly Innovative Incumbent Organizations identify themselves as potential platform players who would profit by providing resources to the new entrance and upcoming players while maintaining the dominant positions as consumer facing organizations.

HIIO advocate that control plane proliferates ease of adoption of new features and is necessarily enabled by cloud-based services.

LIIO, On the contrary describe Control Plane Influential Force as a necessary driver force and dominant Influential Force.

According to LIIO, Control Plane Influential Force is driven by their ability to respond in the face of the technology advancements and believe the essential control is a prerequisite for driving Servitization models in the marketplace.

HIIO identify reconfigurability as a unique capability that can be provided by empowering IoT sensors-the viewpoint is to provide cost efficient sensor replacement to tackle the vendor lock in without affecting the end applications or service points. LIIO, alternatively give more importance to service control aspect promoting their service to becoming the default in the marketplace being supported by a composition of resources contributed by multiple participants.

HIIO find the capability of context aware services as a paradigm shift where in the optimal configurations are loaded and initialized into the sensors which may be changed with ease when the context evolves over time.

LIIO exhibit their skepticism on the complexity that a control plane will impact on the governance models due to new dimensions such as life cycle of IoT devices, amount of data to be analyzed security in the systems and the disparate and fragmented application landscape. HIIO instead identify control plane as a mode to achieve decoupling in their engineering design by transferring the capabilities or specific product or service components to the players and participants in the Ecosystem that have built niche and stronger capabilities around them.

5.4.3 Dimension 3: engagement of the Ecosystem

i) Ecosystem

Ecosystem Influential Force refers to ability to leverage the Ecosystem to build new capabilities and undertake the connected product experience onto new devices. This Influential Force certainly promotes the engagement of Ecosystem. The diverse views of HIIO and LIIO are depicted in the Figure 54 Ecosystem Influential Force.

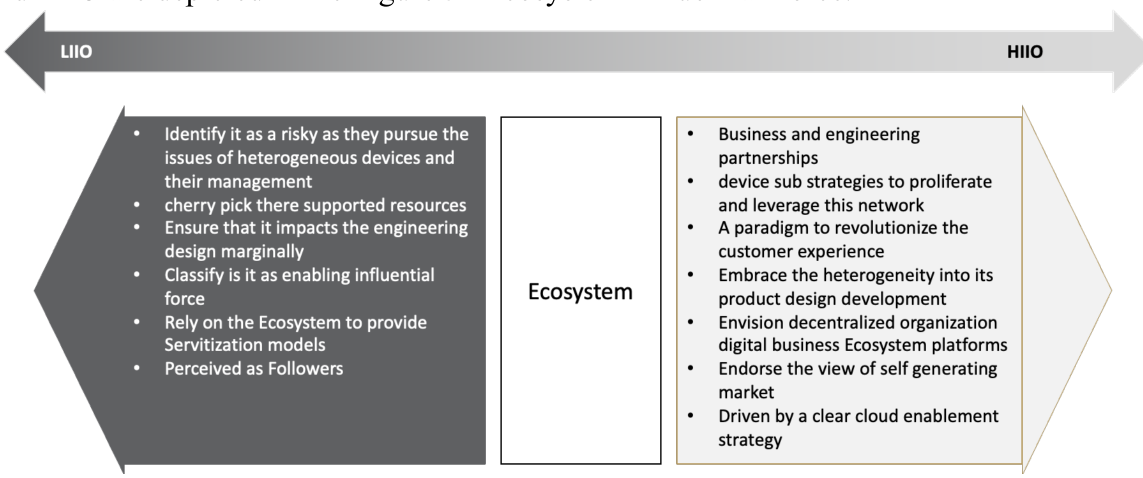


Figure 54 Ecosystem Influential Force

HIIO qualify the engagement of ecosystems in view of business and engineering partnerships and device sub strategies to proliferate and leverage this network. LIIO instead find engagement of the Ecosystem risky as they pursue the issues of heterogeneous devices and their management.

LIIO cherry pick there supported sensors, actuators so that it impacts the engineering design marginally. HIIO, on the other hand, view the heterogeneous mix of devices as potentially a paradigm to revolutionize the customer experience and embrace the heterogeneity into its product design development, to the full engineering process. HIIO perceive Ecosystem as a part of their extended organization such as decentralized organization digital business Ecosystem platforms. HIIO also advocate Ecosystem Influential Force promotes governance models whereby there exists no central governance handling the flow of goods and services but instead they find themselves as platform organizations that allow business transactions, devices content and rich experiences to be driven to masses by the Ecosystem participants. Thus, HIIO endorse the view of self-generating market - a self-generating market is about building a collaborative business model framed by a shared vision of opportunity (Singer, 2009).

HIIO classify Ecosystem Influential Force as a dependent force and an endpoint in their decision-making process. For HIIO, Ecosystem is driven by a clear cloud enablement strategy, other enabling technologies, and clear mitigation to the latent inhibitions.

LIIO classify Ecosystem Influential Force as enabling Influential Force and it is driven by their ability to respond in the marketplace. LIIO rely on the Ecosystem to provide Servitization models which they can adopt and extend their products and services portfolio accordingly.

j) Latent Inhibition

Latent Inhibition Influential Force represents the negative driver in the decision-making process that influences organizations capabilities in engaging with the Ecosystem thereby to build extendable experiences on connected products. The diverse views of HIIO and LIIO are depicted in the Figure 55 Latent Inhibition Influential Force.

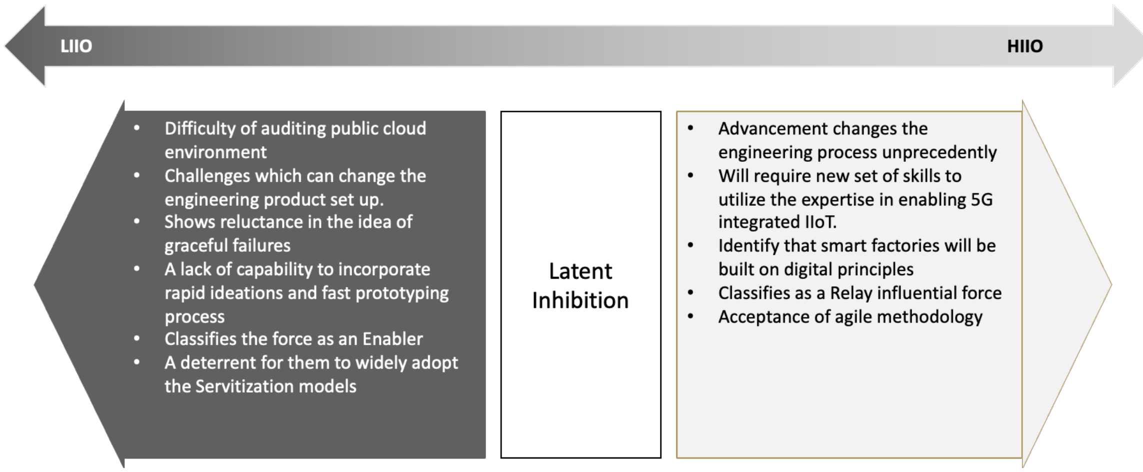


Figure 55 Latent Inhibition Influential Force

HIIO acknowledge that the technology advancement changes the engineering process unprecedently and will require new set of skills to utilize the expertise in enabling 5G integrated IIoT.

LIIO ascribe to the viewpoint- implementation of digital transformation requires many resources, including time and cost for investing in transformation technologies and skilled labor (Tran-Dang & Kim, 2021). LIIO also imply that there is a difficulty of auditing public cloud environment and there are challenges which can change the engineering product set up- Regulators have the authority to control the bandwidth of 5G technology which effects the latency of data transfer (TechVision Group of Frost & Sullivan, 2020).

Both, HIIO and LIIO identify security of sensitive data as a key concern which needs to be addressed through proper cloud computing frameworks.

HIIO Identify that smart factories will be built on digital principles and in the smart services belt that emerged afterwards, the restrictions of traditional mass production can be overcome. The idea is that products will be custom manufactured in response to individual needs and only on demand (Pfeiffer, 2017).

HIIO classifieds Latent Inhibition Influential Force as a Relay force. Innovative organizations acknowledge that there is a widespread acceptance of agile methodology required from its design to development and the rest of the engineering process - including quick feedback loops that enable trial-and-error learning for the development/improvement of the revenue model concept (Linde et al., 2021).

LIIO, on the other hand shows reluctance in the idea of graceful failures, they see a lack of capability to incorporate rapid ideations and fast prototyping process so that they can quickly discard the innovations that don't work and scale up the ones that do. LIIO thus classifies Latent inhibition Influential Force as enabler force that is driven by their ability to respond. LIIO thus see Latent Inhibition Influential Force as a deterrent for them to widely adopt the Servitization models for their existing product and service portfolio.

k) Ability to Respond

Ability to Respond Influential Force aligns with engagement of the Ecosystem as 5G/IoT technologies advancements would essentially create disruptions that warrant a response from the incumbents. The diverse views of HIIO and LIIO are depicted in the Figure 56 Ability to Respond Influential Force

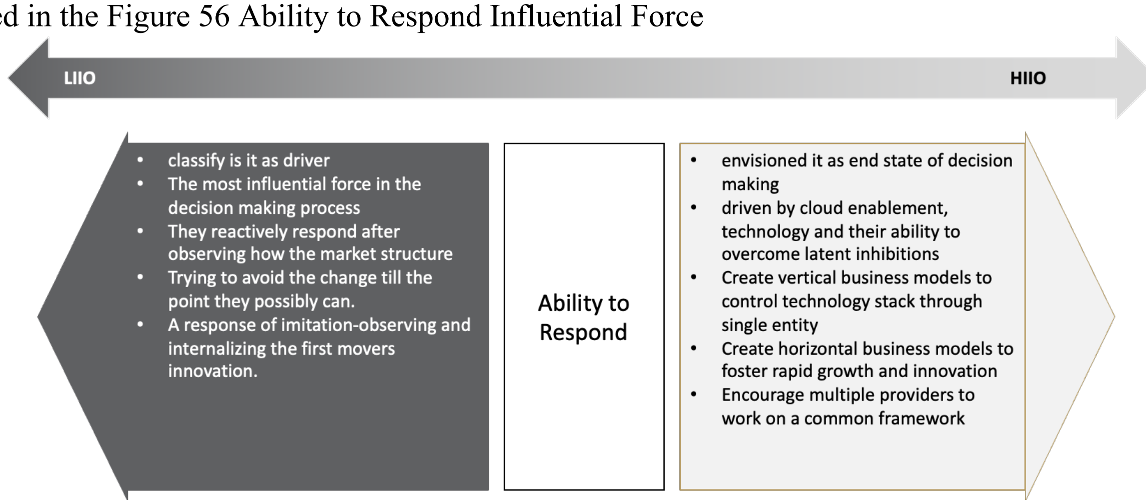


Figure 56 Ability to Respond Influential Force

HIIO logically envisioned Ability to Respond Influential Force as end state of decision-making driven by Cloud Enablement, Technology, and their Ability to Overcome Latent Inhibitions.

Conversely, LIIO classify is Ability to Respond Influential Force as driver and is the most Influential Force in the decision-making process. LIIO reactively respond, after observing how the market structure and dynamics have changed to the point that only after a significant threshold has been breached. LIIO ascribe Ability to Respond Influential Force as the trigger point or the start point in their decision-making process is to warrant control over the changes. LIIO defend their existing product and service lines and are not agreeable to conspicuous changes to their design and engineering process. For LIIO, their ability to respond develops into a latent inhibition, trying to discard the change till the point they possibly can and avoid the balance they have maintained with the rest of the Ecosystem.

HIIO respond to technology disruptions by creating vertical business models-ensuring that IoT device gateway cloud-based services are all provided and controlled by a single entity to ensure that there are no compatibility issues and greater control. Alternatively, HIIO also create horizontal business models to foster rapid growth and innovation wherein they allow multiple providers to work on a common framework such that known and open functionalities are provided on a common platform. HIIO proliferate and support innovators in the ecosystem on creating devices and services that they have created capabilities for.

LIIO negatively described to a response of imitation-observing and internalizing what the first movers and digital entrance have innovated. LIIO also ascribe to a response of moving fast-they look for brokers and technology partnerships which will help them build manageable hybrid cloud models that could act as defense in the light of the competitive threats and new innovative products being introduced by new entrants in the marketplace.

5.5 Adequate Response Framework– Decision Framework

Adequate Response Framework that has been discussed in 5.4 is then used to build a Transformation Artefact, which would help LIIO improve their innovativeness capabilities.

It is built on 6 important pillars that follows sequence to provide maximum gain required to transform and sustain an organization from a low innovative incumbent organization into a highly innovative organization. These pillars are depicted in the Figure 57 Adequate Response Framework– – highlighting the sequence of “Objective”, “Engagement”, “Risk and Rewards”, “Plausible Control”, “Cloud and Landscape” and “Enabling Technology”.

- “Objective” refers to the revised strategy map objectives that will help improve the innovativeness and overcome any impedance towards an adequate response to the 5G/IoT technologies wave. This pillar lays down guide rails in terms of aligning new strategic objectives as drivers actively seeking “Cloud First” thinking across the engineering process and thus enhancing the tactical responses in strategic relationships that organization forges in the Ecosystem.

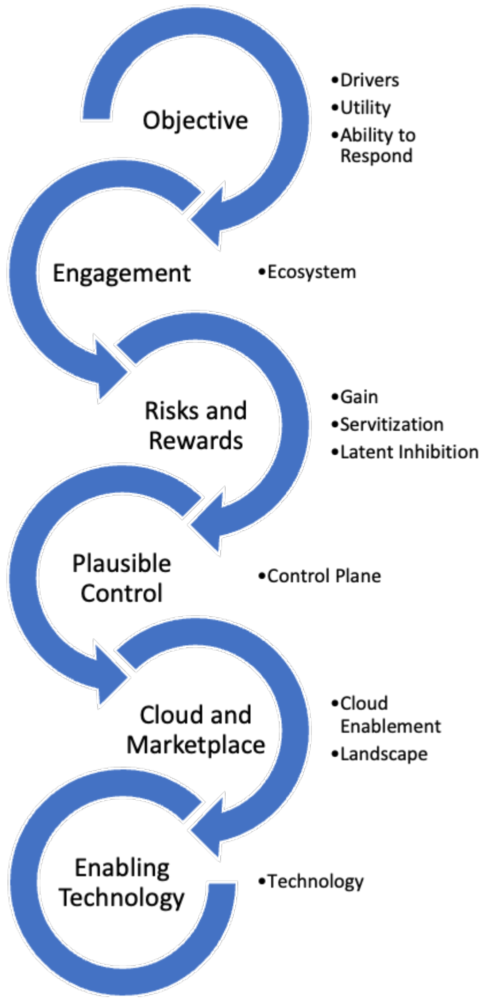


Figure 57 Adequate Response Framework– Decision Framework

- "Engagement" Refers to a cultural shift of working actively and seeking symbiotic relationships within the Ecosystem rather than where receiving them as a risk that could crystallize into building a heterogeneous mix of devices thus adding complexity in design and overall management.
- "Risks and rewards" refer to the start and the end points of a sequential decision framework that would help increase the innovativeness within the organization. These guidelines help Low Innovative Incumbent Organizations to realign their strategy to find rewards such as developing adaptive business networks that fuse servicing

capabilities and Servitization models extending organizational boundaries and converting them into sustainable advantage.

- "Plausible Control" refers to the ability of decentralizing and collaborating across the Ecosystem rather than arresting control which falsely gives the Low Innovative Incumbent Organizations an illusion of formidable defense for their existing product and services capabilities in the marketplace.
- "Cloud and Landscape" provides guidelines in correctly adopting the cloud computing paradigm to create sustainable and profitable collaborations and cooperation across the participants of the Ecosystem in fragmented landscape. These guidelines help Low Innovative Incompetent Organizations decouple their dependencies own isolated parts of the Ecosystem so must open their engineering process that can adopt technology advancements driving new utilities for existing product and service lines with a better degree of ease.
- "Enabling Technology" is a set of guidelines that would help Low Innovative Incumbent Organizations reimagine 5G and IoT technologies as a driving force that helps them nurture Federated architecture bringing forth several new opportunities in terms of artificial intelligence and machine learning. These guidelines help embrace the idea of open innovation helping organizations and vendor lock in and foster standardization of their revised and improved product and services.

5.5.1 Objectives - Ability to respond, Utility and Drivers

To refine the Objectives, which is the first set of guidelines for adoption, Low Innovative Incumbent Organizations can adopt the following:

6) Realign Gains as Driver Influential Force

- Low Innovative Incumbent Organizations have to re-imagine Gain to be an enabling force rather than a dependent force as shown in Figure 58 G1- Realign Gains as Driver Influential Force
- Reimagine and provide a culture shift within the organization to identify technology advancements in the business environment as opportunity that can drive overall utility of current product and service lines
- Do not perceive technology advancements as a challenge to well established supply chains which will be severely impacted by adoption of new sensors and capabilities as they also impact the engineering design function.

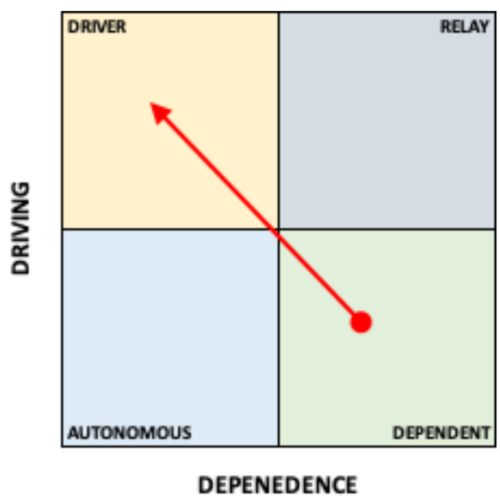


Figure 58 G1- Realign Gains as Driver Influential Force

7) Realign Utility as relay Influential Force

- Low Innovative Incumbent Organizations have to re-imagine utility as in enabling force rather than a dependent force as shown in Figure 59 G2 - Realign Utility as Relay Influential Force.
- Utility Influential Force has to be perceived in processing the data pushed, collected and aggregated from the IoT layer

- Utility Influential Force is used for various advanced analytic techniques to extract meaningful insights in terms of patterns and trends.

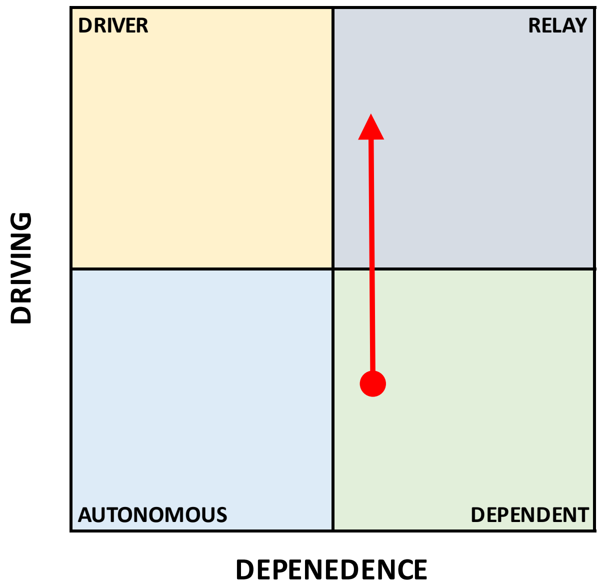


Figure 59 G2 - Realign Utility as Relay Influential Force

8) Realign Ability to Respond as Dependent Influential Force

- Low Innovative Incumbent Organizations have to re-imagine Utility as in Enabling force rather than a Dependent force as depicted in Figure 60 G3 - Realign Ability to Respond as Dependent Influential Force.
- Utility has just to be perceived in processing the data pushed all collected and aggregated from the IoT layer
- Utility is derived from analysing telemetry data using various advanced analytic techniques to extract meaningful insights in terms of patterns and trends.

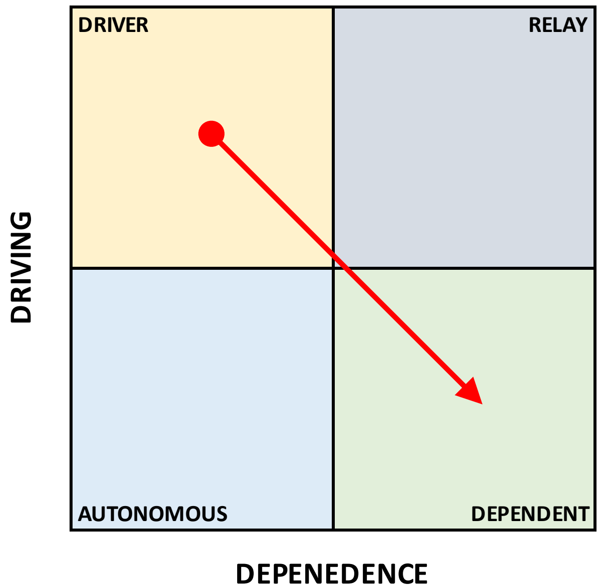


Figure 60 G3 - Realign Ability to Respond as Dependent Influential Force

5.5.2 Engagement – Ecosystem

9) Realign Ecosystem as Dependent Influential Force

- Ecosystem has to be realigned to be a dependent force instead of an enabling Influential Force in the framework as depicted in Figure 61 G4 - Realign Ecosystem as Dependent Influential Force.
- Organizations need a clear strategy to include connected product experiences onto new devices that are enabled within the Ecosystem.
- The Ecosystem is nurtured through clear objectivized business partnerships as decentralized organization digital business ecosystem platforms whereby they find themselves as platform organizations that allow business transactions, devices content and rich experiences to be driven to masses by the Ecosystem participants.
- The engagement of the Ecosystem should not be perceived as risky that can bring issues of heterogeneous devices and their management instead, organizations

should forge engineering partnerships and device sub strategies to proliferate and leverage the network.

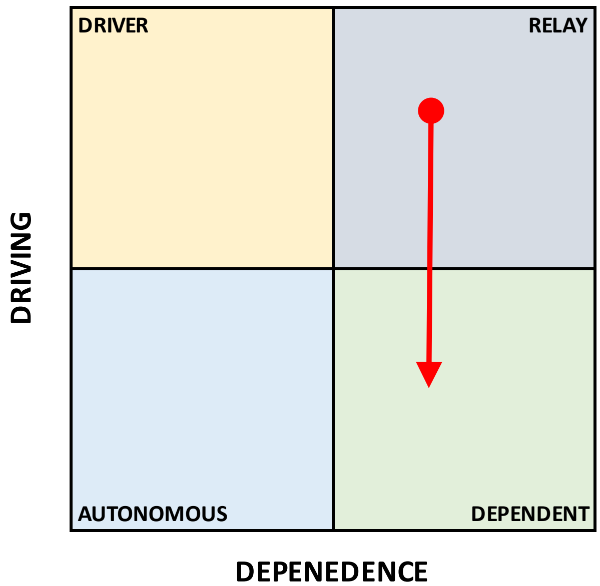


Figure 61 G4 - Realign Ecosystem as Dependent Influential Force

5.5.3 Risks and Rewards - Gain, Servitization and Latent Inhibitions

Risk and rewards are the enablers in the sequential decision-making process. Enjoy organizations can scale up their innovativeness

10) Realign Gain as Driver Influential Force

Low Innovative Incumbent Organizations have ascribed gain as a dependent influential power that is driven by service extensions to existing products. They should realign it as a driver variable as Figure 62 G5 - Realign Gain as Driver Influential Force.

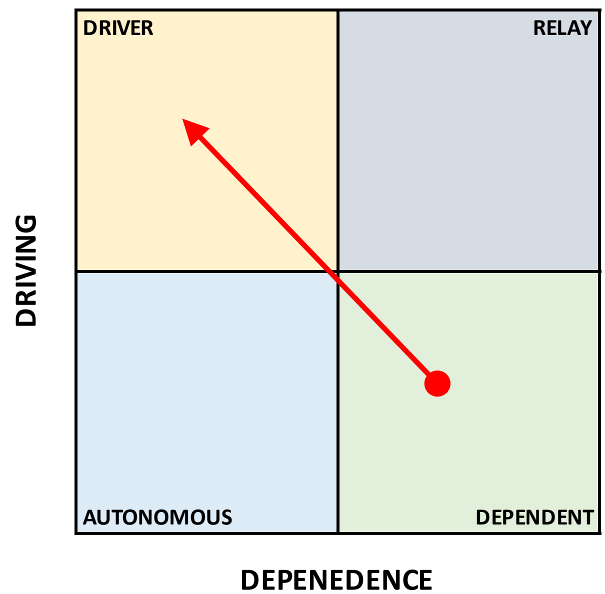


Figure 62 G5 - Realign Gain as Driver Influential Force

- LIIO should strive to create new customer segments rather than just defending and extending business lines through cost cutting automation or service improvements for existing customers.
- Technology advancements should be seen as an inflection point to re-establish the organization as a dominant player across the value chain.
- This Influential Force should be used for developing adaptive business networks that create new business capabilities like e-servicing.
- The strategic focus has to be driven into new product development rather than cost takeout, for example, Utilizing IoT driven solutions to implement new client service delivery models which would thereby reduce the ongoing maintenance cost as well as ongoing service delivery cost.
- The organizations have to overcome the latent fear of failure in new experiments that consumes resources which could otherwise be used to fuel current projects.
- 5G integrated IIoT best service deliveries are designed to decrease latencies, increase data throughput which eventually improves processing time thereby

resulting in overall systems productivity-Low Innovative Incumbent Organizations need to device this as a key driver for their Technology Strategy.

11) Improve driving capability of Servitization as Relay Influential Force

Servitization is an important Influential Force and Low Innovative Incumbent Organizations should advocate strategies that improve its driving influence over decision-making as shown in Figure 63 G6 - Retain Servitization as Relay Influential Force.

- Servitization should be looked upon as a capability that drives greater collaboration across the Ecosystem and the participants of the value chain so as to create meaningful customer experiences through service extensions on existing products.
- Low Innovative Incumbent Organizations should essentially increase the driving quotient of this force to the extent of enabling it as the end result of its decision-making process-all forces cohesively work to improve Servitization as an output of organizations capability.
- Servitization is efficient if it is fostered through actionable insights and advanced data analytics capabilities, thus, Low Innovative Incumbent Organizations should consciously develop their productive and prescriptive analytics capabilities.

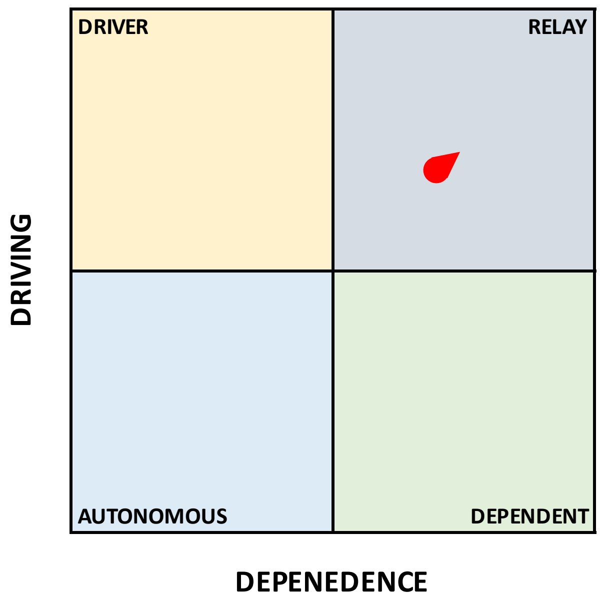


Figure 63 G6 - Retain Servitization as Relay Influential Force

- To improve the adoption of Servitization across the engineering process design, organizations would have to make ontological design as in essential part of engineering design.
- Product managers have to constantly think and innovate around how to create metered services for their offerings.
- Low Innovative Incumbent Organizations have to overcome the fear and scepticism about continuous prototyping cycles, complexity of governance and loss of control in the new connected product domain.
- Low Innovative Incumbent Organizations have to for a into digital collaboration without the bias of authority and control, instead be an advocate of open innovation business model.

12) Retain Latent Inhibition as Relay Influential Force

As latent inhibition represents the negative driving force in the decision-making process and heavily influences an organizational capability in engaging with the Ecosystem, Low Innovative Incumbent Organizations should reduce its dependency within the system as shown in Figure 64 G7 - Retain Latent Inhibition as Relay Influential Force.

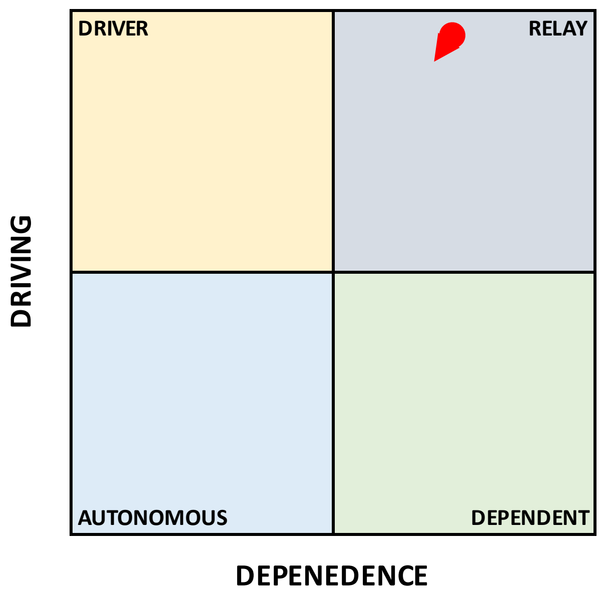


Figure 64 G7 - Retain Latent Inhibition as Relay Influential Force

- Low Innovative Incumbent Organizations have to acknowledge the fact that the technology advancements like 5G/IoT change the engineering process unprecedently and would require new set of skills to build expertise in enabling 5G integrated IIoT capabilities within there product and service lines.
- Organizations have to build cloud computing capabilities so that they can configure cloud environments so as to ensure that there products are set up efficiently.

- Low Innovative Incumbent Organizations would have to embrace and widely adopt agile methodology from its design to development and the rest of the engineering process.
- The engineering process design has to improve itself to be able to process quick feedback loops, machine learning capabilities and fail fast methodologies so that they can quickly discard innovations that don't work and accelerate the ones that work.
- Low Innovative Incumbent Organizations are currently driven and shortsighted to tactically respond these technology advancements rather than adopt digitization and digital transformation journeys to fully embrace Servitization and connected product paradigms into their engineering process.

5.5.4 Plausible Control - Control Plane

13) Realign Control Plane as Autonomous Influential Force

Low Innovative Incumbent Organizations should reduce they dependence on control and realign this Influential Force as in autonomous force within the decision-making framework as depicted in Figure 65 G8 - Realign Control Plane as Autonomous Influential Force.

- The focus has to be shifted from exercising control on product and service life cycle to ability of building loosely coupled free bound open relationships with other participants of the Ecosystem.
- Low Innovative Incumbent Organizations should bias their strategy about control plane with tenets like ease of adoption and feature enrichment driven by cloud based services.

- Organizations have to think of control plane as their ability of reconfigurability for product and services portfolio that is empowered by IoT and drives open innovation to avoid vendor lock-in.

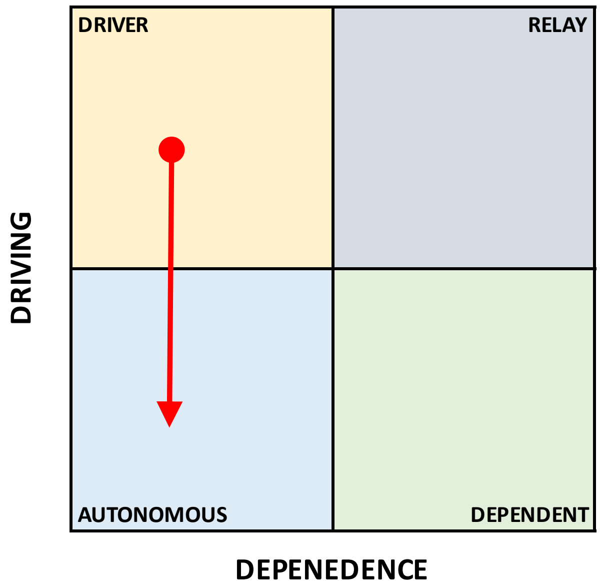


Figure 65 G8 - Realign Control Plane as Autonomous Influential Force

- Rigorous testing to make these services resilient would help them define a dominant place in the market and thus Gardner support of significant players in the Ecosystem.
- Control Influential Force has to be reimagined with the objective to achieve the coupling in the engineering design by transferring the capabilities to the players in the participants in the Ecosystem that have built niche and strong abilities around them.

5.5.5 Cloud and Landscape - Landscape and Cloud Enablement

14) Realign Landscape as Autonomous Influential Force

Low Innovative Incumbent Organizations show dependency on the Ecosystem to build adequate response on technology advancements. They see Ecosystem as a Driver Influential Force which must be realigned as an autonomous force in the decision-making framework as shown in Figure 66 G9 - Realign Landscape as Autonomous Influential Force.

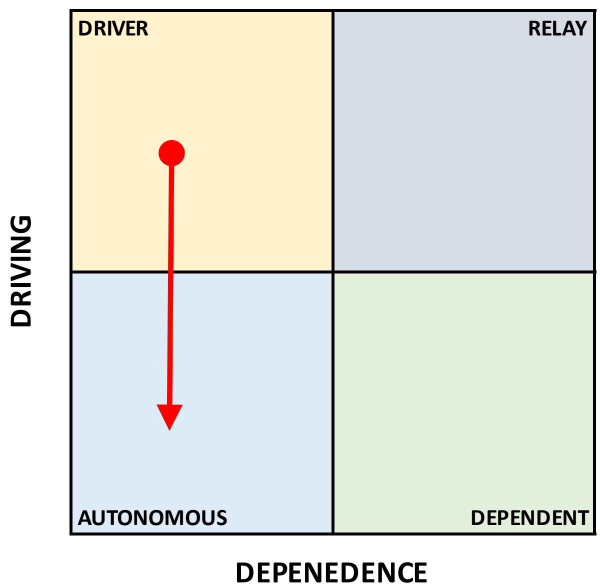


Figure 66 G9 - Realign Landscape as Autonomous Influential Force

- The dependency on the Ecosystem by the Low Innovative Incumbent Organizations is so high that Ecosystem is the most influential driving force and seen is the starting point or the trigger of there decision-making framework. Instead they have to reimagine the Ecosystem that would follow and support the innovations that are brought forth by the organization.
- Low Innovative Incumbent Organizations have to realign their strategy to become digital leaders and partners of preference in the Ecosystem that drive symbiosys and solve problems such as interoperability about data generated through connected heterogeneous sensors across the Ecosystem.

- Building an open loosely coupled system should not be seen as a challenge which leads to product failures but instead Be turned into an opportunity to drive digital transformation and connected products paradigm across the Ecosystem thereby emerging as the leader of the value chain.
- Often, Low Innovative Incumbent Organizations avoid heterogeneous mix of technologies as it deters the stability of their existing product and service lines. On the contrary, such adversity to change makes them myopic and significantly reduce their capability of creating exciting product roadmaps that increase customer loyalty. This requires tremendous mindset shift which should be driven by the senior management of the organization.
- Leaders can think of building competencies within Centers of Excellence to drive this digital adoption across it's connected engineering process the Jones Servitization models and connected products and fosters collaboration across the Ecosystem.

15) Retain Cloud Enablement as Dependent Influential Force

Low Innovative Incumbent Organizations should retain cloud enablement as enabler force, but they should increase their dependence on this Influential Force within the decision-making framework as shown in Figure 67 G10 - Retain Cloud Enablement as Dependent Influential Force.

- Organizations have to device strategies to utilize different models of engagement, hybrid architectures which drive the cloud benefits and builds cost optimal IT infrastructure.
- Cloud Enablement should be seen as a driver to harness the Ecosystem landscape.

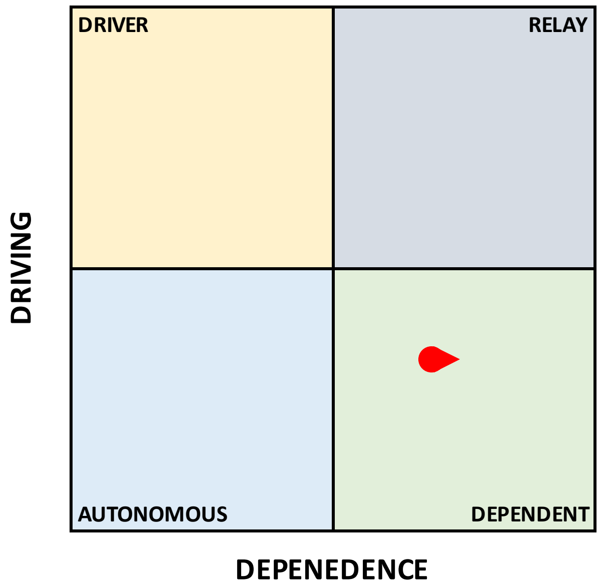


Figure 67 G10 - Retain Cloud Enablement as Dependent Influential Force

- This Influential Force is the key off transforming the engineering process design so as to churn out Servitization models
- As in innovative organization, it is imperative that organizations build and design a control plane ahead of building their cloud adoption strategy
- The value of cloud enablement is that it also helps manage diverse infrastructure across edge premises and multiple cloud environements.
- There has to be strategy of consuming vast cloud native service catalogue and processing capability of massive volume of data that would be generated by the IoT devices which becomes cornerstone for mining features that lead to new product inventions and innovations.

5.5.6 Enabling Technology

16) Retain Technology as Relay Influential Force

Low Innovative Incumbent Organizations should realign the Technology Strategy to clearly define the control and service orchestration before the enrich their current product and service lines or introduce new products in service lines leveraging the technology advancements of 5G and IoT technologies as shown in Figure 68 G11-Retain Technology as Relay Influential Force.

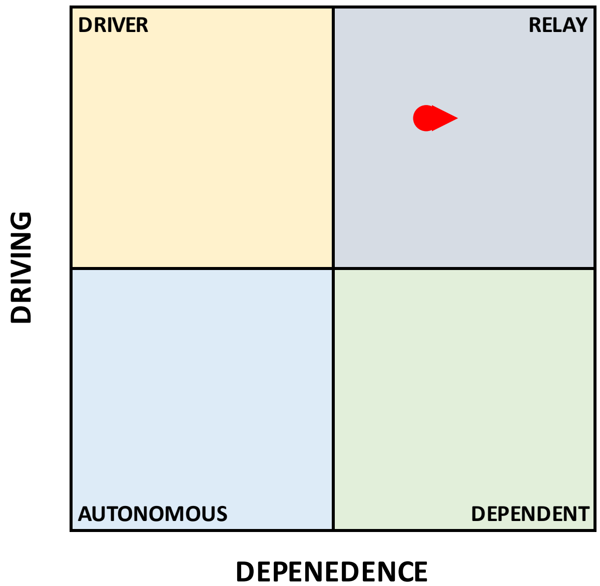


Figure 68 G11-Retain Technology as Relay Influential Force

- An essential component of a successful Technology Strategy what is the one that enables Ecosystem to support the identified and laid out designs of Servitization models
- Technology Strategy for Low Innovative Incumbent Organizations should build leverage on a fragmented landscape so as to clearly define new business models and device strategy that is designed on the principle of cloud first to proliferate IoT offerings in the marketplace.
- Technology Strategy should take advantage of 5G as a driving force along with artificial intelligence and machine learning to build a comprehensive extension suite on the top of existing product and service catalogue.

- Distributed and Federated architecture that introduces edge computing supporting the paradigm of exponential growth of cloud enabled connected devices and enhanced data processing capabilities should be also considered as core tenets of revising the Technology Strategy.
- Low Innovative Incumbent Organizations should overcome the skepticism of manufacturing service ecosystems and risk ascribed to adopting digital twin capabilities.
- Technology Strategy then should be focused on building efficiencies of trust agreements across the value chain instead of perceiving them as increased complexity, loss of control and risk of failures.
- Cyber Physical Systems where smart objects can sense ambient environmental conditions and learned to cooperate amongst each other to perform advanced tasks are seen as epitome of convergence between 5G and IoT technologies.
- Low Innovative Incumbent Organizations have to embrace the idea of open innovation by pledging open source support so that they can harness the power of distributed development, foster standardization and end the era of vendor lock in.

CHAPTER VI:

SUMMARY, IMPLICATIONS, AND RECOMMENDATIONS

6.1 Summary

This research is aimed at examining some of the fundamental issues faced by incumbents in developing an adequate response for to 5G/IoT technologies wave. Thus, this research proposes an Adequate Response Framework that will help the incumbents use and leverage the key Influential Forces in their decision-making framework.

6.1.1 Chapter 1: Introduction

The collective impact of 5G, Cloud and IoT technologies can so be studied broadly by examining impacts on the business model and the decision-making capability of the incumbents in terms of technology management. This research seeks to explore what the incumbents can do better to take advantage of 5G/IoT technologies wave. The objective of this research is to explore and build Adequate Response Framework that the incumbents utilize to build an adequate response to the surge of 5G/IoT technologies wave.

This research developed a linguistic model based on the guidance of seminal works (Saris and Gallhofer, 2014, 2020; Revilla, Zavala-Rojas and Saris, 2016) that help formulate the right research question. This research derived the research title as, "Adequate Response Framework to 5G/IoT technologies disruption for incumbents". To study this research, identified three research dimensions, "Dimension 1: Prevalence of the competitive business models", "Dimension 2: Adoption of cloud-based services to proliferate IoT offering", and "Dimension 3: Engagement of the Ecosystem."

The significance of this study is to build an Adequate Response Framework that Low Innovative Incumbent Organizations can use to better manage the 5G/IoT technologies disruption wave. This study also derives causal relationships between the key Influential Forces and how they impact the Incumbents. This research aims to help the incumbents in the following ways:

- Impact of the Business Models, Cloud Adoption, and the Engagement of Ecosystem on the adoption of 5G/IoT technologies by the incumbents.
- Identify different clusters of organizations with respect to their ability to innovate with 5G/IoT technologies.
- Identify key Influential Forces that help build an adequate response to the 5G/IoT technologies wave.
- Identify the Influential Forces interrelationships with respect to the ability to provide adequate response to 5G/IoT disruption.
- Establishes how the Influential Forces interdependencies are different for different organizations.
- Guidelines for Low Innovative Incumbent Organization to leverage Influential Forces in realigning their decision-making process to provide an adequate response to 5G/IoT technologies disruption.

Analyzed each research dimension by identifying the research gaps in support of the research title through comprehensive literature review, established the main objective of studying that variable and explained what part of the research title will be answered by the chosen research variable.

6.1.2 Chapter 2 – Review of Literature

Literature review involved evaluation of 974 different published research articles thereby classifying 225 of those chosen articles for 22 years period from 2000 to 2022.

Established the theoretical framework that would be utilized to conduct a comprehensive research of literature for the three identified dimensions in terms of "setting up the initial context and explaining key concepts", "undertaking key conjectures that build the inquiry for research and explaining why the variable is important to explain the current research endeavor" and "explaining the main issues and research gaps that were found in the literature review for the chosen research variable".

Literature review for dimension one- prevalence of competitive business models, highlighted the main issues would be to evaluate if prevalence of competitive business model ensured that incumbents would have high propensity to inadequate response; examining the conjecture that 5G/IoT have created an unprecedented opportunity to build new business models.

Literature review for dimension 2 - adoption of cloud-based services to proliferate iot offerings, highlighted the main issues that "Not adapting to cloud computing paradigm can deter the proliferation of IoT services in the incumbents", examining the conjecture that "adoption of cloud services is essential to build Servitization models" and "proliferation of IoT in the engineering design process as a capability is a prerequisite for creating Servitization models.

Literature review for dimension 3 - engagement of the ecosystem, highlighted the main issues that "incumbents cannot work in isolation to fulfill the service demands by the new age customers", "examine the conjecture that being a part of the digital Ecosystem is an essential part of the business strategy to provide adequate response to technology advancements" and "incumbents have to rely on effective and sustainable ecosystems to provide meaningful inventions and innovations to the customer."

Literature Review thus established have key research gaps such as, “adoption of cloud based services is essential to develop an adequate response by the incumbents failing which it can lead to the failure of creating industry 4.0 ready products”, “have adoption of cloud services is a key differentiator”, “adequate response food mean meaningful Servitization models for connected products systems”, “comprehensive understanding of the impact of engaging in Ecosystem all incumbents ability to manage technology advancements like 5G and IoT”, “5G/IoT disruption wave will impact existing business models and create need to develop new innovative business models”,” what is the need to create flexible organization models so that 5G/IoT enabled innovations can be managed at a scale and supported by a sustainable Ecosystem”.

6.1.3 Chapter 3- methodology

To conduct this research adequately, developed a research methodology based on Saunders, Lewis and Thornhill (2007) Research Onion as depicted in Figure 2 Research Onion (Saunders, Lewis and Thornhill, 2007). including 6 phases of research.

Phase 1: Discovered 69 Research Elements through comprehensive Literature Review: Classified 225 chosen research articles from 974 evaluated research articles to identify the 69 Research Elements that relate and explain the research question.

Phase 2: Conducted online survey with SME to identify the relevance of the identified Research Elements: Designed a questionnaire which had 2 parts-basic background of the respondent and representative industry, understanding of how the given Research Elements are utilized in the decision-making process to form an adequate response to technology advancements in case of 5G and IoT. Conducted a survey across close to 500 participants that represented manufacturers, system providers, technology consultants digit consultants, system integrators and other varied managers of 5G/IoT technologies related products and services. Received a response rate of nearly 40% providing 201 correspondents data set that can be utilized to understand the importance of the 69 Research Elements.

Phase 3: Conduct data analysis to define the Adequate Response Framework: The survey data that has been collected across the 69 Research Elements lend itself to quantitative analysis in 2 distinct pathways. The first pathway has been to mind this data set to identify if there are components available that would collectively represent majority of these Research Elements. The second pathway has been to mine the data set to identify if the respondents could be classified into clusters that represented gradients of innovativeness in terms of providing adequate response to technologies disruption waves.

Traversing the first pathway, principal component analysis on the respondent data provided 35 components explaining 71% of variance. The validity of these identified 35 components has been confirmed by carrying out Horn's Parallel Analysis. This research then carried out cluster analysis to finally discover 11 Distinct Clusters which would represent the Influential Forces that make up the adequate response model. The identified Influential Forces are as follows: "Gain", "Driver", "Landscape", "Servitization", "Cloud", "Technology", "Utility", "Control", "Ecosystem", "Inhibitions" and "Response". Employed Homogeneity (each cluster contains only members of a single class), Completeness (all members of a given class are assigned to the same cluster) and the V-measure (measures how successfully the criteria of homogeneity and completeness have been satisfied) to establish the reliability and validity of these Influential Forces by plotting the K-value. The deterministic and significant value of K is found to be maximum at 11 which proves to be the most optimal numbers of clusters to represent the Principal Components.

Traversing the second pathway, Principal Component Analysis on the respondent data provided 4 components explaining over 70% of variance. The validity of these identified 4 components has been confirmed by carrying out Horn's Parallel Analysis. Carried out cluster analysis to finally discover 4 Distinct Clusters which would represent the Innovation Clusters that the Respondent make up the adequate response model. The identified clusters are as follows: "Highly Innovative Incumbent Organization", "Moderately Innovate Incumbent Organization", "Low Innovative Incumbent Organizations" and "Laggards". Similarly employed Homogeneity, Completeness, and the V-measure to establish the reliability and validity of these Incumbent Clusters by plotting the K-value. The deterministic and significant value of K is found to be maximum at 4 which proves to be the most optimal numbers of clusters to represent the Principal Components.

Phase 4: Test framework through case study: Undertook 2 case studies in parallel case one represented highly innovative incumbent organization from energy and utility industry; Case 2 are represented no innovative incumbent organization from heating ventilating and air conditioning industry. The objective of studying 2 organizations in parallel has been to establish the inter relationships between the Influential Forces and how highly innovative incumbent organization utilizes it better to create market leading 5G/IoT technologies enabled product and service line extensions as compared to low innovative incumbent organization which has struggled to cope up with the technology advancement and is losing its current market share even for the established products and service lines. Employed interpretive structural modelling (ISM) which help organize these inter relationships in a directed graph and subsequently undertook cross- impact matrix multiplication applied to classification (MICMAC) analysis to explain how each research dimension effects, influences, and builds adequate response framework. The results work studied and elaborated in the section 5.4 which builds the ground of adequate response framework.

Phase 5: Present the final findings: Utilize this phase to explain the relationships working on the practical findings across the 2 case studies into a common framework which has been called the adequate response framework. This research also developed guidelines on how Low Innovative Incumbent Organizations can utilize this framework to increase their innovativeness and transform themselves into a high innovative incumbent organization with relation to the advancement in 5G/IoT technologies advancements. Each Influential Force has been explained in terms of its driving capability within the decision-making framework dependence capability within the decision-making framework, how it relates to other Influential Forces and a corresponding guideline that helps LIIO to become a highly innovative incumbent organization. Utilized this phase also to clearly call out the implications of this research and recommendations that can be utilized from this research endeavor.

6.2 Implications

6.2.1 For Academia

A key strength of the study is the broad nature of the literature survey that led to identifying the core tenets being called does its Research Elements of the subject. These Research Elements are discussed and deliberated by academic experts and then triangulated with the results obtained from the survey. A comprehensive quantitative analysis distills the Influential Forces. The study also derives a quad-form classification for incumbents with respect to innovativeness they garner to formulate an adequate response to the technology advancements of 5G and IoT technologies. Thus, this study represents a well-grounded extension of prior research.

The proposed Adequate Response Framework will provide following value to the academia:

- Impact of the business models, cloud adoption and the engagement of ecosystem on the adoption of 5G/IoT technologies by the incumbent players.
- Identify a quad-form classification for incumbents with respect to their ability to innovate in the presence of 5G/IoT technologies.
- Identify key Influential Forces that help build an adequate response to the 5G/IoT technologies wave.
- Identify the interrelationships between Influential Forces with respect to the ability to innovate.
- Establishes how the Influential Forces interdependencies differ across the incumbent organizations.
- Guidelines for Low Innovative Incumbent Organization to leverage Influential Forces in realigning their decision-making process to provide an adequate response to 5G/IoT technologies disruption.
- Provide methodology to prioritize the interventions so that they are best suited to an organization's business context.

Adequate Response Framework is an attempt to understand why highly Innovative Incumbent Organizations succeed and lead the digital Ecosystem.

6.2.2 For Low Innovative Incumbent Organization

The study revealed that there are key influential forces that drive decisions. Such a decision framework is responsible for formulating a tactical as well as a strategic response to advancements such as 5G and IoT technologies. Following is some of the findings that Low Innovative Incumbent Organizations can use as guidelines, and they are further elaborated in the decision framework which is one of the outputs of this research.

"Overcome Fear": Low innovative Incumbent Organizations need to overcome their current mindset of cost take out and perceiving the technology advancements as a threat. Instead, they must align themselves to leverage the new technology so that they can reestablish themselves in the value chain.

"Build new markets": The technology advancements are creating a great level of fungibility in the ecosystem, this is the time to forge engineering and business partnerships across the ecosystem so that adaptive business networks can be created that allows low innovative incumbent organizations to access new customer segments and build new client service delivery models.

"Reimagining products and services": Low Innovative Incumbent Organizations perceive the technology advancements as threads to their well-established engineering designs and supply chains. Instead, these technology advancements are opportunities to reimagine the products and services as service models, where products and services are consumed on metered basis. They must experiment and adapt Servitization models that allows then to create differentiated customer experience.

"Do not work in silos": Low Innovative Incumbent Organizations see challenges in building open and loosely coupled systems and argue that a heterogeneous mix will lead to failure due to interoperability issues. Instead, they should realize that the innovation is not dependent on the fragmentation of landscape. Organizations develops intelligence on customers, markets, competitors, and other external forces affecting decisions about what technologies might be needed to support innovative efforts (Paap, 2020).

"Adopt Servitization Models": Low Innovative Incumbent Organizations show reluctance in adopting new business models that are built around Servitization. Their argument is how a wide variety can be delivered under a single umbrella brand. Their skepticism is about continuous prototyping cycles and perceived loss of control on product as it becomes a consumable service. Low Innovative Incumbent Organizations must realize that Servitization models lead to overall customer satisfaction as products are built tests service extensions that is the utility.

"Cloud First": Low Innovative Incumbent Organizations must utilize cloud to build groundbreaking applications for Industry 4.0. They must overcome a latent fear that cloud leads to reengineering, an already well-established engineering product design process. Instead, cloud enables them to harness capabilities from the ecosystem so that they can drive new product and service extensions and engage in new markets.

"Build service orchestration layer": Low Innovative Incumbent Organizations do not endorse manufacturing service ecosystems because they perceive it as the loss of control and increase in complexity. Instead, they must realize that utilizing such advancements can help them define control and established service orchestration layer which has tremendous benefits - Artificial Intelligence, Machine Learning, and an ability to foster Standardization across the ecosystem.

"Platform business": Low Innovative Incumbent Organizations as an unprecedented opportunity to build a control plane across its product and service life cycle that spans across its ecosystem. Such a model does not add complexity into governance but allows them to tackle vendor lock in and achieve decoupling their engineering design.

"Partnerships": It is inopportune time to embrace heterogeneity in the product design development and build decentralized ecosystem that endorses the views of self-generating market. This can only be done by the Low Innovative Incumbent Organizations by adopting new business and engineering partnerships-they must take or rather leadership position then being the follower in the value chain.

"Build new skills": To take advantage of the technology advancements, low innovative incumbent organizations should accept agile methodology, build expertise in 5G, IoT and Cloud Computing. This means a change in mindset and openness in their product engineering strategy and methodology.

6.3 Recommendations for Future Research

"Consider other technology movements": This research has been undertaken to primarily focus on 5G/IoT technologies wave and its evident disruptions in the market. As a further research, researchers can consider other technology movements such as quantum computing, edge computing, blockchain and others which might have different dimensions of impact for the incumbents. Such an inquiry will provide value to the incumbents.

"Impact on Engineering product design": As research undertaking, research is focused on the impact of the essential influential forces on the decision-making ability of the organizations - more specifically, their ability to innovate in the wake of 5G/IoT technologies wave disruption. This research, however, does not deal with the specifics of this impact on engineering product design.. A further inquiry and specific research on impact of the technologies wave on engineering product design, their ability to create ontological models that can help them with specifics of adopting these technology advancements will be of great interest and value to the incumbent organizations.

"Integration with digital ecosystem": It is clear that this technology advancement will lead to an open digital ecosystem that will help the incumbents build platform businesses an established themselves in the value chain. A further inquiry on how specifically an incumbent can integrate into such a digital ecosystem will help create partnership models and strategies - one of the follow up steps from the Adequate Response Framework that the research proposes. A theory building or a theory validating research into this aspect will be of great value to the incumbent organizations.

"Building brand extensions": The research acts as a guide and provides a decision model for Low Innovative Incumbent Organizations to take advantage of the technology advancements. It does not go into the specifics of understanding how to create brand extensions and service extensions on their existing product and service lines, as this will be a very elaborate subject which has to be specifically researched for key verticals so that the knowledge can be generalized to a broader population of the incumbent organizations. Further research on this aspect is strongly recommended for researchers to undertake.

"Quantifying the existential risk": While the research establishes That Low Innovative Incumbent Organizations face an adversity if they do not act in the wake of the technologies wave, to the extent of existential threat, this research has not delved into quantifying the risk and formulating a mitigation framework. This is because such an endeavor would require action research so that the theory can be validated. Such a research endeavor will be a great help end of academic importance to strategy and risk fraternity.

"Decentralizing the organization model": One of the key findings of this research is that success means engaging with the ecosystem and harnessing the power of collaboration. That necessarily means transitioning formal structured organization into a decentralized organization that can orchestrate services and product design across the ecosystem. The impact of transitioning of this kind of organizational intervention is beyond the purview of the research but certainly of great interest and requires further research.

"Industry specific responses": This research endeavor treats all the industry incumbents that would be affected by 5G/IoT technologies wave as the population and draws a sample out of them to build generalizable Adequate Response Framework. The nuances that some of the industries faces are different from the incumbents that are from another industries. A further industry specific enquiry will yield more action-oriented insights that will be generalizable across the industry. While the purpose of this research is to build a generalizable Adequate Response Framework that the low innovative incumbent organizations can use to provide an adequate response to the technologies wave, industry specific action-oriented research will also be of great value. The success of an action-research study in producing knowledge for both research and practice lies in the ability to inform both the research and the problem-solving cycles and manage the interaction between them (Chiasson, Germonprez and Mathiassen, 2009).

6.4 Conclusion

This research provides Low Innovative Incumbent Organizations with the Adequate Response Framework that will help them enhance their response to technologies waves such as 5G and IoT. This research is an earnest attempt in identifying the key influential forces which drive technology adoption decisions within an organization. This impacts their ability to innovate when faced with new technology advancements. The research has clearly focused itself on 5G and IoT technology advancements because they are proven to be unprecedented inflection points that will change and heavily impact current business models, products, and services. The belief that this research endeavor will also interest academic fraternity in understanding the significance of adequate response framework. Research has identified the lack of Adequate Response Framework as a key gap that this research has attempted to build and fill up.

The research with incumbents, interactions with two appropriate representatives during the multi-case study methodology has helped understand that the importance of the influential forces and their interdependencies play a pivotal role in helping organizations innovate and take advantage of technology advancements. Adequate Response Framework thus provides key tenets, influential forces and set of guidelines for low innovative incumbent organizations to utilize to scale their innovativeness to the required threshold to build on 5G and IoT technologies. The three research dimensions have also proved to be of significance and primary constructs for understanding and building the response. For better understanding these dimensions, the influential forces have been aligned with them.

This research also provides a guideline for organizations which serves as a maturity model to understand and grade themselves on innovativeness to respond to the wave of 5G and IoT technologies.

To conclude this research firmly believes that the advancements of 5G and IoT technologies are of an unprecedented nature. Organizations will experience a change in the value chain and customer expectations which will drive them to build Servitization models. This will lead to an extraordinary opportunity that incumbents can use to forge technology and business partnerships across the ecosystem. They have an opportunity to transfer the skills across the ecosystem and collaborate to fulfill customer demand. New offerings and new ways of engaging with the customer will lead to reimagining the product and service lines and help them reestablish themselves as important players in an open digital ecosystem.

APPENDIX A

SURVEY COVER LETTER

ADEQUATE RESPONSE FRAMEWORK TO 5G/IOT TECHNOLOGIES DISRUPTION FOR INCUMBENTS.

Dear participant,

This study aims to obtain data about the influential forces and the key elements relevant in providing an adequate response to the 5G/IoT technologies wave.

It would be great if you can spare some time to complete this questionnaire. The questionnaire is straightforward and easy to complete within approximately 5 to 10 minutes. A clear and simple instruction of completing the questionnaire is given in the next page.

Your response will be completely confidential

Thank you so much again for your support.

Best regards,

Researcher

Contact Number: +91 7900147895

Email: rajeshsaxena@gmail.com

THE QUESTIONNAIRE

Importance of relevant research elements in the sequential decision-making process of the incumbents as a response to 5G/IoT technology wave. From the next page there are 13 influential forces that have been identified and their relevant elements r provided under each of these forces. Drawing from your experience, kindly rate these elements with relevance to their influential force accordingly

- **This is not an evaluation of performance of your company but and identification of the importance of the evaluation elements from your point of view.**
- **Please give a score from one to 5 for each of the following elements about the relevance of these research elements that you think you have been seeing and felt in your organization as well as you think it is important to you and your organization**
- **Five (5) means EXTREMELY IMPORTANT and one (1) means NOT IMPORTANT.**

PART A – YOUR DETAILS

Name		**Job Title**	
Age (Optional)		**Gender**	
Department		**Nationality**	
Years Of Experience at The Current Department		**Total Years of Experience**	

PART B – RESPONSE

Latent Inhibition

Captures the inhibitions the incumbents have in engaging with the Ecosystem to build extendable experiences on the connected products.

How well do these elements explain the Latent Inhibition of the incumbents?

New skills

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Regulators

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Security

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Flexible manufacturing systems

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Failure

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Agility

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Control Plane

Captures the ease of adoption for new features are that are enabled by cloud-based services. Control plane also refers to the ability to have strong governance across the Ecosystem and governance models.

How important are the following elements as a benefit of Control Plane for incumbents?

Separation of Concerns

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Reconfigurability

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Service Control

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Context Aware Services

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Governance

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Decoupling

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Ecosystem

Ecosystem help build new capabilities and extending the connected product experience onto new devices. Also refers to an ability to fully functionalized and leverage marketplaces required for such capabilities.

How important are the following elements for developing and managing the Ecosystem of the incumbents?

Device Management

¨ 1 ¨ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Decentralized Organization

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Marketplace

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Self-Generating Market

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Ability to Respond

Captures different responses that the incumbent ascertains as the most adequate to fosters Business Innovation, assess, and retrofit extensions to the existing product line and ability to scale the business models horizontally.

How important are the following elements for enhancing Ability to respond of the incumbents to the 5G/IoT Wave disruption?

Imitation

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Move Fast

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Retrofit

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Vertical Business Model

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Horizontal Business Model

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Gain

Explains the competitive business models in terms of value chain, value enhancement and new interventions for cost competitiveness and productivity enhancement

How important are the following elements to foster Gain for the incumbents?

Value Chain

¨ 1 ¨ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

New Customer Segments

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Value Enhancements

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Cost Competitiveness

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Productivity

¨ 1 ¨ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Sustainability

¨ 1 ¨ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Driver

Captures the real intent for the Incumbents to adopt new technologies like 5G/IoT.

How important are the following elements as a Driver for the incumbents?

Business Model Innovation

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Customer Experience

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Supply Chain Management

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Evolution Roadmap

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Automated Control

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Process Automation

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Landscape

The prevalence of competitive business models depends on some key dimensions of landscape to create self-organizing systems.

How important are the following characteristics of Landscape Strategy for the incumbents?

Fragmented

¨ 1 ¨ 2 ☐ 3 ☐ 4 ☐ 5

Not important Most important

Interoperability

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not important Most important

Value Networks

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not important Most important

Self-Organizing System

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not important Most important

Diversity

¨ 1 ¨ 2 ☐ 3 ☐ 4 ☐ 5

Not important Most important

Connected Products

¨ 1 ¨ 2 ☐ 3 ☐ 4 ☐ 5

Not important Most important

Technology

Technology refers to the advent of the new age technology spearheaded by 5G and IoT to build the cognitive aspect of connected systems.

How important are the following elements of Technology for the incumbents?

5G

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Artificial Intelligence / Machine Learning

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Cloud Adoption

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Cyber-Physical Systems

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Digital Twins

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Engineering Partnership

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Edge Computing

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Scalable Architecture

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Standardization

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Workload Management

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Utility

Captures what drives the effectiveness of cloud-based systems and capabilities to presents actionable insights.

How important are the following elements as a Utility to manage the 5G / IoT Technology Wave?

Analytics

☐ 1 þ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Data Communication

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Cloud Enablement

Cloud relates to the ability to leverage on the cloud computing paradigm from multiple cloud vendors to create a single, flexible, cost-optimal IT infrastructure.

How important are the following elements for Cloud Enablement of the incumbent organizations?

Broker

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Cloud Computing

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Cloud Management

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Cloud Models

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Cloud Of Things

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Hybrid Cloud

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Servitization

Servitization explores the realm of connected products Product service systems, service orientation that the incumbents are experiencing. Industry 4.0 and industrial IoT are leading edge of this change.

Rate according to importance of impact on Servitization Strategy for the incumbents?

Connected Products

¨ 1 ¨ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Product- Service- Systems

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Industry 4.0

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Industrial Iot

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Servitization

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Service Orchestration

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Ontological Model

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Product Extensions

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

As-A-Service Model

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

Metered Services

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Not Important Most Important

APPENDIX B

INFORMED CONSENT

ADEQUATE RESPONSE FRAMEWORK TO 5G/IOT TECHNOLOGIES DISRUPTION FOR INCUMBENTS

Thank you for agreeing to be interviewed as part of the above research project. The interview will take 30 to 45 minutes. I don't anticipate that there are any risks associated with your participation, but you have the right to stop the interview or withdraw from the research at any time. This consent form is necessary for us to ensure that you understand the purpose of your involvement and that you agree to the conditions of your participation.

RIGHT AS A VOLUNTEER

your participation in this research is voluntary. If you decide not to participate or to stop your participation in this research at any time it will not result in any consequence or any loss of benefit to you which you're otherwise entitled. If you have any question about this research project or your right as a participant, you may contact the researcher at + 917900147895.

PARTICIPANT AGREEMENT

The research of this study has been fully explained to me. I voluntarily consent to participate, and I have enough time and opportunity for my questions to be answered. I understand that I may refuse to take part or to stop my participation in the research at any time. I also understand that I may contact the researcher if I have got any questions about this research project or my rights as a participant. All or part of the content of your interview may be used.

- In academic papers, policy papers or news articles
- On our website and in other media that we may produce such as spoken presentations
- On other feedback events

In an archive of the project as noted above by signing this form I agree that.

- I am voluntarily taking part in this project. I understand that I don't have to take part, and I can stop the interview at any time.
- I don't expect to receive any benefit or payment for my participation.
- I have been able to ask any questions I might have, and I understand that I am free to contact the researcher with any questions I may have in the future.

I the undersigned, confirm the understanding of above participant agreement.

____________________	____________________	____________________
Participant Name	Signature	Date

____________________	____________________	____________________
Researcher Name	Signature	Date

APPENDIX C

INTERVIEW GUIDE

This study's central research title is:

1. "Adequate Response Framework to 5G/IoT technologies disruption for incumbents"
2. Can you tell a little more about yourself, your age, educational background, and employment status?
3. How are you involved in the technology adoption decision-making process?
4. How would 5G IoT technology wave impact your product and service lines?
5. Do you agree that the games that you would have from this technology wave are the key drivers for the technology adoption? Why?
6. What are the other essential drivers for your organization to start considering 5 5G /IoT technology adoption?
7. Explain us why these drivers build value and utility in your technology landscape?
8. What are the key considerations that come to your mind when you think about "control plane" 4 5G in IoT technologies?
9. Explain your journey on cloud adoption?
10. What aspects of 5G and IoT will impact this cloud adoption and why?
11. What is the queue key challenges and limitations that challenge technology adoption?

12. Explain how do you engage with ecosystem and why?
13. Have you considered Servitization models yet and to what extent?
14. What are the essential characteristics you see that you need to improve to become a platform-based business?
15. Explain how ecosystem help you in your endeavors?
16. How would the “ability to respond” enhance when you adopt 5G and IoT technologies?
17. Give us your comment on this diagraph?
18. What are Interactions and Management Model used for managing ecosystem?
19. Explain the current Cloudification process and its apparent challenges?
20. How are the practices aligned in terms of skilling the manpower and resources?
21. What were the key initiatives and roadmap projects, products, and services?
22. Any other prevalent point of view created with 5G/IoT based technology interventions?

APPENDIX D

RESEARCH ELEMENTS

17) **New Customer Segments** - This Research Element evaluates the following viewpoint - It is a prerequisite for organizations for developing new customer segments rather than just defending existing business lines through cost cutting, automation, or service improvements for existing customers (Bughin and Zeebroeck, 2017).

18) **Value Chain** – This Research Element evaluates the following viewpoint - Value Chain disaggregates a firm into its strategically relevant activities in order to understand the behavior of costs and the existing and potential sources of differentiation (Porter, 2001). The Research Element captures how technology advancements will enhance the position of the incumbent in the value chain. Existing linear closely wired value chains characterized by a one-to-one connection among business partners will be replaced by adaptive business networks to achieve seamless processes and real-time business across enterprises (Hoyer and Stanoevska-Slabeva, 2009).

19) **Value Enhancement** – This Research Element evaluates the following viewpoint - fusing the e-servicing capabilities with people interactions to create core competencies that would increase and mobilize the value chain proficiencies of the firm across targeted locations and organizational boundaries, and in doing so create competitive advantage (Cheah, 2007).

20) **Cost competitiveness** – This Research Element evaluates the following viewpoint - Emerging IoT solutions provide vendors and services firms with opportunities to implement new client service delivery innovation options, reduce costs of

ongoing service delivery to their clients, and increase margins based on driving better measurable outcomes (Miller, Pelino, Voce, Belissent, *et al.*, 2019).

21) **Productivity** – This Research Element evaluates the following viewpoint - The effects of 5G Integrated IIoT are prominent in saving material, decreasing latency, increasing data throughput, processing time, and pace for robots, improving the overall systems' productivity, and saving time and costs (TechVision Group of Frost & Sullivan, 2020).

22) **Sustainability** – This Research Element evaluates the following viewpoint - inspiring the transition of modern societies from the "take–make–dispose" model to an economy that is restorative and regenerative by design: a continuous cycle that preserves and enhances existing resources while optimizing their yields (Miaoudakis *et al.*, 2020).

23) **Business Model** – This Research Element evaluates the following viewpoint - the expected increase in data requirements ranging from mission-critical to massive machine connectivity, the deployment of 5G has raised expectations that it will open new opportunities for manufacturing business models (O'Connell, Moore and Newe, 2020).

24) **Customer Experience** – This Research Element evaluates the following viewpoint - Companies that provide the technology, services, infrastructure and other capability to allow an organization create a 'smart' experience; and new or established organizations who are using these enablers to create new products or enhance in some way existing products or operations (Jekov *et al.*, 2017).

25) **Supply chain management** – This Research Element evaluates the following viewpoint - an intensive collaboration in the supply chain networks between manufacturers, suppliers, and customers; adaptive organizational managements;

application of disruptive and smart technologies; and development of a functioning environment (Tran-Dang and Kim, 2021).

26) **Automated control** – This Research Element evaluates the following viewpoint - 5G integrated IIoT systems provide a greater degree of control of machines, robots, and equipment. This enables fully automated manufacturing platforms in which raw materials will be inputted into the system for autonomous manufacturing in the production system (TechVision Group of Frost & Sullivan, 2020).

27) **Process Automation** – This Research Element evaluates the following viewpoint - Allows for efficient process monitoring systems that control parameters or operations, influencing the production system. This includes effective control mechanisms to detect faulty products at the early stage of production to optimize utilities, save material costs, and reduce carbon footprint (TechVision Group of Frost & Sullivan, 2020).

28) **Transformation Roadmap** – This Research Element evaluates the following viewpoint - transformation road maps are supported by open business models which effectively help to create value by leveraging more ideas because of their inclusion of variety of external concepts open business models thus enhanced value by utilizing firms key assets, resources and organizations position in the value chain (Wang, Jaring and Wallin, 2009).

29) **Fragmented** – This Research Element evaluates the following viewpoint - standardization efforts target interoperability between IoT components from different stakeholders, the IoT market is still very fragmented, hence, the flexibility of IoT Ecosystem providers is significantly decreased if they are restricted to IoT component adhering to a specific standard (Willocx *et al.*, 2018).

30) **Interoperability** – This Research Element evaluates the following viewpoint - the emergence of semantic-oriented technologies in IoT scenarios is to address the interoperability issues of understanding data generated by connected heterogeneous sensors and smart objects. These technologies can extract sets of raw data into homogeneous and heterogeneous formats, and then process them into meaningful representations and interpretations (Tran-Dang and Kim, 2021)

31) **Value networks** – This Research Element evaluates the following viewpoint - Developments of IoT platforms involves an entire Ecosystem of stakeholders covering the whole value chain of the IoT that together coordinate and deliver the functionalities and the services required by the various supported IoT applications (Nedeltcheva and Shoikova, 2017).

32) **Self-organizing System** – This Research Element evaluates the following viewpoint - an open, loosely coupled, domain clustered, demand driven, agent led environment, where each agent of each entity is proactive and responsive regarding its own benefit/profit but is also responsible to its system (Krause *et al.*, 2009).

33) **Evolution Roadmap** – This Research Element evaluates the following viewpoint - Tremendous innovation framework encompassing the application of advanced technologies, a high level of cooperation and collaboration in both horizontal and vertical sectors, strategic planning and management, and excellent governance to achieve interconnectivity and interop rationality in physical, informational, and operational aspects (Tran-Dang and Kim, 2021).

34) **Diversity** – This Research Element evaluates the following viewpoint - most existing and emerging IoT platforms offer heterogeneous ways to access things and their data. This causes interoperability problems when developers aim to

create overarching, cross-platform, and cross-domain applications, and it eventually prevents the emergence of vibrant IoT ecosystems (Bröring *et al.*, 2017).

35) **Connected Products** – This Research Element evaluates if smart, connected products can provide insight into how customers actually use a product, how well the product performs and a new perspective into overall customer satisfaction (Murphy-Hoye, 2016).

36) **Product-Service-Systems (PSS)** – This Research Elements evaluates if Servitization enables firms to serve customers with enhanced value offerings, respond to customer needs, increase customer loyalty, enable services with higher margins, stabilize sources of revenue, and provide resistance to economic cycles (Agarwal *et al.*, 2021). Product-, use-, and result-oriented offerings consist of both product and service and are referred to as a 'Product-Service System' (Agarwal *et al.*, 2021).

37) **Industry 4.0** – The element evaluates if the adoption of 5G Integrated Systems will accelerate the digital transformation of industrial operations, which is the important element Industrial IoT (TechVision Group of Frost & Sullivan, 2020).

38) **Servitization** – Modern corporations are increasingly offering fuller market packages or "bundles" of customer-focused combinations of goods, services, support, self-service, and knowledge. But services are beginning to dominate. This movement is termed the Servitization of business (Kryvinska *et al.*, 2014).

39) **Service Orchestration** – This Research Element evaluates the following viewpoint - identifies linkages, relationships, constraints, challenges, new technologies, interoperability standards, interface agreements or process

development requirements among service entities to deliver planned service or for addressing potential future services (Opresnik *et al.*, 2014).

40) **Ontological Model** – This Research Element refers to evaluating if existing Ontological Models capture an evolutionary environment that is made up of tools and intelligent agents that apply new natural science principles in their design makeup and provide customisable and adaptive e-service provisioning and management capabilities (Cheah, 2007).

41) **Product Extensions** – This Research Element evaluates the following viewpoint - The extensions can satisfy consumers' desires by providing wide variety of products under a single brand, managers often use extensions are short-term competitive weapons to increase a brand's control (Biel, Wicke and Aaker, 1994).

42) **As-a-Service Model** – This Research Element evalues the premise that Capital-intensive products can be sold for the first time "as-a-service," shared among a pool of customers and handled as an OpEx item rather than a more expensive CapEx investment (Murphy-Hoye, 2016).

43) **Metered Services** – This Research Element evaluates the following viewpoint - Can incumbents expand sales by charging for the product in a metered, as-a-service way? Establishing a baseline experience, and sanctioning a continuous ideation and prototyping cycle, can help create the mindset and governance model needed to take advantage of the connected-things evolution of the Internet (Sastry, 2015).

44) **Cloud Management** – This Research Element evaluates the following viewpoint - To manage this diverse infrastructure across enterprise data centers, edge environments, hybrid cloud and multi-cloud environments – the diverse topology

previously depicted – enterprises will need an operational hub that makes these diverse environments work as a system (Rosse, 2019).

45) **Cloud Models** – This Research Element evaluates the following viewpoint - While the hybrid cloud offers public, private and on-premise computing and storage environment, it is 5G Edge Cloud, based on the principles of Edge Computing, that will bring to life some ground-breaking applications of Industry 4.0.

46) **Cloud Of Things** – This Research Element evaluates the following viewpoint - The commonality of a global always-on service of an loT device and the nature of a distributed federated cloud network is viewed as a novel paradigm between two very different technologies which support each other toward a common goal in a coordinated fashion to attain a mutual objective and profit maximization (Barril, Ruyter and Tan, 2016).

47) **Hybrid Cloud** – This Research Element evaluates the following viewpoint - A hybrid cloud is an environment that integrates traditional IT with a combination of public, private, or managed cloud services. In essence, a hybrid cloud becomes a virtual computing environment that matches workloads to the most appropriate computing model. All these services need to be managed as though they were designed to behave as a single unified environment (Hurwitz and Kirsch, 2019).

48) **Broker** – This Research Element evaluates the following viewpoint - massive growth opportunity that exists by combining and inter-connecting their Clouds through Cloud Federation - which is achieved when a set of CSPs voluntarily inter-connect their infrastructures in order to allow sharing of resources among each other and coordinated through a Cloud Broker (Barril, Ruyter and Tan, 2016).

49) **Cloud Computing** – This Research Element evaluates the following viewpoint - unlimited services to store and process the massive volume of data generated by IoT devices in IoT-enabled systems. Therefore, the majority of data and processes can be mitigated to the remote cloud layer, aiming to make the system agile (Tran-Dang and Kim, 2021).

50) **Cloud Adoption** – This Research Element evaluates the following viewpoint - Cloud computing introduced a wide set of unprecedented benefits in terms of investments, delivery time and scalability, enabling the diffusion of novel (mobile) services and the adoption of new technologies as Big Data, IoT and machine learning (Sfondrini, Motta and Longo, 2018).

51) **Workload Management** – This Research Element evaluates the following viewpoint - the principle of a cloud-agnostic strategy that enables businesses to use any existing or new service as part of their computing environment. This needs to be executed in a way that minimizes lock-in and promotes portability of workloads (Hurwitz and Kirsch, 2019).

52) **5G** – This Research Element evaluates the following viewpoint -manufacturing industry expects to maximize the innovations of 5G wireless communications by automating industrial technologies and utilising other enabling technologies such as artificial intelligence (AI) and machine learning. Industry expects this to lead to more accurate decision-making such as automation of physical tasks based on historical information and knowledge, or improved outcomes for a wide range of vertical marketplaces (O'Connell, Moore and Newe, 2020).

53) **Scalable Architecture** – This Research Element evaluates the following viewpoint - To realize IoT's business benefits, organizations must design and implement each layer of the architecture at-scale, with hooks across organization

functions to ensure tight integration with run-the-business legacy systems. Prioritizing criteria such as scalability and longevity is key, particularly because the IoT uses nascent technologies from an emerging and rapidly changing Ecosystem (Murphy-Hoye, 2016).

54) **Edge Computing** - This Research Element evaluates the following viewpoint - With a growing number of devices connected to the Internet, the pressure on the backbone links of the Internet is increasing. Edge computing proposes to move cloud services closer to the users and to the devices that produce data, at the edge of the network. Edge computing alleviates this issue by performing some or all computations closer to the devices that produce data (Loghin *et al.*, 2020).

55) **Manufacturing Service Ecosystem** – This Research Element evaluates the following viewpoint - in order to increase the exploitation of intangible and tangible assets in different phases of the P-S lifecycle, inter-organizational non-hierarchical and distributed collaboration during Servitization is set up; such organizational collaborative structure is called the Manufacturing Service Ecosystem (Opresnik *et al.*, 2014).

56) **Digital twin** – This Research Element evaluates the following viewpoint - A digital twin is defined as a virtual replica of a physical object that describes and stimulates the characteristics, states, and operations of its counterpart in a truly and comprehensive manner. The digital twin based simulation models also help in examining the efficiency of protocols, rules, and trust agreements established by the stakeholders in the networks (Tran-Dang and Kim, 2021).

57) **AI / ML** – This Research Element evaluates the following viewpoint - referred to as "AI capability integrated to the computer-based systems", which can draw inferences from the given input data of a specific domain after a learning process.

These inferences are further used to output insights and decisions (Tran-Dang and Kim, 2021).

58) **Standardization** – This Research Element evaluates the following viewpoint - The IoT reference architecture provides a set of architectural patterns and better practices (use cases) to be used in the development of IoT solutions. In addition, it describes the IoT solution structure, including all the components of the Ecosystem: the physical (devices, network), logical (software, application services, communication protocols), and the security of the complete solution. Adopting a reference architecture is a reliable strategy to maintain interoperability within the IoT scenario (Salazar Ch. *et al.*, 2019).

59) **Cyber-Physical Systems** – This Research Element evaluates the following viewpoint - Smart objects can sense ambient environmental conditions, monitor their operation status, determine their spatial locations, process data, make decisions, and communicate and cooperate to perform many advanced tasks (Tran-Dang and Kim, 2021).

60) **Open Source** – This Research Element evaluates - Open Source is a development method for software that harnesses the power of distributed peer review and transparency of process. The promise of Open Source is better quality, higher reliability, more flexibility, lower cost, and an end to predatory vendor lock-in (Hoyer and Stanoevska-Slabeva, 2009).

61) **Data Communication** – This Research Element evaluates the following viewpoint - the data pushed from the IoT layer are analyzed using various advanced analytical techniques to extract patterns and trends. This well-analyzed information is then used by ML algorithms and AI to accelerate time to extract valuable insights and knowledge, which is eventually exploited to support

decision-making. Therefore, the integration of Big Data Analytics, Artificial Intelligence, and IoT is becoming essential to boost productivity and operational efficiency (Tran-Dang and Kim, 2021)

62) **Big Data Analytics** – This Research Element evaluates the following viewpoint - As a complex set of data is characterized by huge volume, high velocity, and variety, it is described as big data urges the need for advanced data processing technologies to make full use of all of this data (Tran-Dang and Kim, 2021).

63) **Separation of Concerns** – This Research Element evaluates the following viewpoint -being observed as loosely coupled, as a freely bound open relationship between participants, when the term is opposite to a tightly coupled relationship (where each party is heavily dependent on one another and the roles are predefined) (Razavi, Krause and Strømmen-Bakhtiar, 2010). Considering SMEs and start-ups, the provider-consumer relationship that Cloud Computing fosters between the owners of resources and their users could potentially be detrimental, as there is a conflict of interest for the providers. They profit by providing resources to up and coming players, but also wish to maintain dominant positions in their consumer-facing industries (Briscoe and Marinos, 2009).

64) **Reconfigurability** – This Research Element evaluates the following viewpoint - IoT devices can be replaced by other ones – possibly provided by other sensor manufacturers – without affecting the application. Supporting cost-efficient sensor replacement is essential to tackle vendor lock-in, and enables the use of more accurate or less expensive sensors over time, depending on the specific application needs (Willocx *et al.*, 2018).

65) **Service Control** – This Research Element evaluates the following viewpoint - Cloud Computing makes this more explicit, breaking down the stand-alone

service paradigm, with any service by default being composed of resources contributed by multiple participants (Briscoe and Marinos, 2009).

66) **Context-aware services** – This Research Element evaluates the following viewpoint - The optimal IoT configuration is loaded and initialized based on contextual parameters, and context may evolve over time (Willocx *et al.*, 2018).

67) **Governance** – This Research Element evaluates the following viewpoint - the Governance Model should be considered as extension of the IT governance, focusing in the lifecycle of IoT devices, the amount of data to be analyzed, the security in the system and the applications landscape (Salazar Ch. *et al.*, 2019).

68) **Decoupling** – This Research Element evaluates the following viewpoint - The business model can be implemented, however, with the use Of Service-Oriented Architectures (SOA) and Web Services (WS) technologies, which have both received significant attention in e-business because they can provide a flexible environment for the interaction and economic exchanges between business enterprises and with customers (Fragidis, Tarabanis and Koumpis, 2007).

69) **Business Partnership** – Refers to the larger business Ecosystem - An economic community comprised of a number of interacting organizations and individuals, including suppliers, producers, competitors, customers and other stakeholders, that produces goods and services of value for the customers (Fragidis, Tarabanis and Koumpis, 2007).

70) **Engineering Partnership** - this Research Element evaluates that the dimension of engineering partnership is shaping the business partners within an Ecosystem - Different business species within an Ecosystem pursue different substrategies based on their role and contribution to the health of the system as a whole: “keystones” are small but important players that serve as hubs keeping the

Ecosystem together and shaping its overall direction; "dominators" take up the most space in terms of physical size and occupy the most nodes; a "niche" player develops specialized capabilities that differentiate it from other players, leveraging resources from the Ecosystem while occupying only a narrow part of it (Singer, 2009).

71) **Device Management** – This Research Element evaluates the following viewpoint - In the context of the device management pertaining to IoT ecosystems, the possibility to use virtual copies of sensors, actuators, more complex devices and even entire systems is a great challenge that can potentially revolutionize the approaches to product design, development, manufacturing and operations, through the adoption of a digital mirror of the IoT infrastructure that extends also to the full engineering process (Kulcsár *et al.*, 2021).

72) **Decentralized organization** – This Research Element evaluates the following viewpoint - There exists no central governance handling the flow of goods or services instead, the transaction are done between independent individual entities. The Digital Business Ecosystem platform provides only the technical infrastructure to perform business transactions whiie the process and content is driven by the mass of users (Hoyer and Stanoevska-Slabeva, 2009).

73) **Marketplace** – This Research Element reflects on the following viewpoint - Conceptualization and action are merged, so that when it comes to evaluating ideas, insights, and advances in information management, they are judged not on their individual merits, as technical issues to be solved separately, or as compartmentalized pieces and approaches that are marketed and sold individually (and splintering the marketplace even more), but as elements to progressively integrate and add value to the system already in place (Singer, 2009).

74) **Self-generating Market** – This Research Element refers to the premise that a self-generating market is about building a collaborative business model framed by a shared vision of opportunity (Singer, 2009).

75) **New skills** – This Research Element evaluates the following viewpoint - As employees gain more skill, the organization gains more data, and executives gain more confidence, the balance can shift from improving existing processes to transforming the business with entirely new models and augment existing business line (Miller, Pelino, Voce, Taylor, *et al.*, 2019). Lack of expertise of employees in the operation of 5G integrated IIoT. Training may be needed to analyze and make efficient decisions on information and data taken from 5G network(TechVision Group of Frost & Sullivan, 2020). Impedes the business from considering digital transformation as a strategic development plan. Moreover, the implementation of digital transformation requires many resources, including time and cost for investing in transformation technologies and skilled labor (Tran-Dang and Kim, 2021).

76) **Regulators** – The Research Element evaluates the viewpoint - Difficulty of auditing Public Cloud environments strongly reduce the percentage of migrated production workload and limit the number of suitable Cloud Service Providers (Sfondrini, Motta and Longo, 2018). Regulators have the authority to control the bandwidth of 5G technology which effects the latency of data transfer (TechVision Group of Frost & Sullivan, 2020).

77) **Security** – This Research Element evaluates the following viewpoint - Cloud computing is playing a significant role in telecommunication organizations, where business depends on technology, and financial institutions, where technology is a

key for real time and added value services and for the security of sensitive data (Sfondrini, Motta and Longo, 2018).

78) **Flexible Manufacturing Systems** – This Research Element evaluates the following viewpoint - Smart factories built on digital principles and in the smart service welt that emerges afterward, the restrictions of traditional mass production can be overcome. The idea is that products will be custom-manufactured in response to individual needs and only on demand (Pfeiffer, 2017).

79) **Agile** – This Research Element evaluates the following viewpoint - Agile development refers to the iterative sprint of an experimental nature. It relies on design and development processes, including quick feedback loops that enable trial-and-error learning for the development/improvement of the revenue model concept (Linde, Frishammar and Parida, 2021).

80) **Graceful Failures** – This Research Element evaluates the following viewpoint - A successful approach is to incorporate a rapid ideation and fast prototyping process to explore business opportunities, quickly discard those that don't work and scale the ones that do (Sastry, 2015).

81) **Imitation** – This Research Element evaluates the following viewpoint - incumbent responses to digital disruption can trigger "Red Queen" competition in which legacy organizations engage in aggressive imitation — first in response to digital entrants and then in response to one another — in a self-reinforcing process (Bughin and Zeebroeck, 2017).

82) **Move fast** – This Research Element evaluates the following viewpoint - The predictability and manageability of the hybrid cloud now enables the business to move fast to create new value in light of competitive threats, while at the same

time delighting customers with innovation and new products (Hurwitz and Kirsch, 2019).

83) **Business Model Innovation** – This Research Element evaluates the following viewpoint - A representation of the firm's underlying core logic and strategic choices for creating and capturing value within a value network (Wang, Jaring and Wallin, 2009). Thus, to thrive the organization must be more open to ideas and paths to market, thus can incumbents allow the knowledge to enter inside their core operations so that they can create value (Wang, Jaring and Wallin, 2009)\

84) **Vertical Business Model** – This Research Element evaluates the following viewpoint - In the vertical business model, the IoT device, the gateway, and the Cloud-based service are all provided and controlled by the one and the same organization. This approach has the advantage for the end-user that there are no compatibility issues to deal with among the various elements, and a single point of contact to deal with if anything goes wrong (Nedeltcheva and Shoikova, 2017).

85) **Horizontal Business Model** – This Research Element evaluates the following viewpoint - The motivation behind a horizontal model is to foster rapid growth and innovation in the industry by allowing multiple providers to work with a common framework. The idea is that by making the gateway and cloud resources something that can be assumed to be in place and have known and open functionality, innovators can concentrate their efforts on creating devices and services (Nedeltcheva and Shoikova, 2017).

APPENDIX E

QUAD CLASSIFICATION OF INCUMBENT ORGANIZATIONS

a) High Innovative Incumbents

The High Innovative Incumbent Organizations show the following characteristics:

Table 19 Highly Innovative Incumbent Organizations

Core Tenets	Maturity	Description
Objective	High	• Reimagine and provide a culture shift within the organization to identify technology advancements in the business environment as opportunity that can drive overall utility of current product and service lines
Engagement	High	• The Ecosystem is nurtured through clear objectivized business partnerships as decentralized organization Digital Business Ecosystem Platforms. • They find themselves as Platform organizations that allow business transactions, devices content and rich experiences to be driven to masses by the Ecosystem participants
Risk and Reward	High	• The strategic focus is about New Product Development by utilizing 5G/IoT technologies driven solutions to implement new Client Service Delivery Models.

Core Tenets	Maturity	Description
		• These new Client Service Delivery Models would thereby reduce the ongoing maintenance cost as well as ongoing service delivery cost. • Organization is active in developing adaptive Business Networks that create new business capabilities. • Product managers constantly think and innovate around how to create metered services for their offerings. • Servitization is very efficient as it is fostered through actionable insights and advanced data analytics capabilities.
Plausible Control	Low	• Organizations utilize Control Plane as their ability of Reconfigurability for product and services portfolio that is empowered by IoT technologies. • Organizations drives open innovation to avoid vendor lock-in. • Organizations have achieved the Ecosystem-coupling in the engineering design by transferring the capabilities to the players in the participants in the Ecosystem that have built niche and strong abilities around them.

Core Tenets	Maturity	Description
Cloud and Landscape	High	• They are building an open, loosely coupled system to drive digital transformation and Connected Products across the Ecosystem. • They emerge as the leader of the value chain. • There is a clear strategy of consuming vast Cloud Native Service Catalogue and processing capability of massive volume of data generated by the IoT devices. • Organizations drive symbiosis and solve problems such as interoperability about data generated through connected heterogeneous sensors across the Ecosystem. • The data becomes cornerstone for mining features that lead to new product inventions and innovations. • Organization has Centers of Excellence to drive digital adoption across it's connected engineering process, the Servitization models and connected products and fosters collaboration across the Ecosystem
Technology	High	• Technology Strategy takes advantage of 5G/IoT as driving forces along with Artificial Intelligence and Machine Learning to build a comprehensive extension

Core Tenets	Maturity	Description
		suite on the top of existing product and service catalogue. • Technology Strategy enables Ecosystem to support the identified and laid out designs of Servitization models. • Distributed and Federated Architecture that utilize Edge Computing paradigm to support exponential growth of Cloud Enabled Connected Devices and enhanced Data Processing capabilities. • Organization focuses on building efficiencies of trust agreements across the value chain.

b) Medium Innovative Incumbents

The Medium Innovative Incumbent Organizations show the following characteristics:

Table 20 Medium Innovative Incumbent Organizations

Core Tenets	Maturity	Description
Objective	High	• Evaluating the benefits of working collaboratively along with the Ecosystem. • Organizations have a consistent Technology Strategy to manage the advancements but grapples with acknowledging them as opportunities.

Core Tenets	Maturity	Description
		• Organizations have started working on logical Product and Service Line Extensions to manage the threat from early movers.
Engagement	Medium	• The organization has built collaboration across the Ecosystem based on complementary capabilities. • There are Tactical Governance Models available to manage the Ecosystem. • The organization have started actively working as a producer of services as well as consumes services from existing platforms available to execute the business transactions. • The organization has started decentralizing its functions to fully engage with the Ecosystem. • They are biased to customer centricity and open to innovative experiments that enrich in the customers experience through better content and rightly manage devices.
Risk and Reward	Medium	• The strategic focus is building Logical Product and Service Line Extensions that utilize 5G/IoT driven solutions.

Core Tenets	Maturity	Description
		• The organization is actively participating new Client Service Delivery Models in the Ecosystem and willing to re-evaluate the strategy around the ongoing service delivery cost. • Product managers have been encouraged to think about metered services models for their offerings. • Servitization is a value gain model that is cherry picked for some product and service lines but is not fostered through actionable insights.
Plausible Control	Medium	• Organizations have ability to manage control plane as their ability of reconfigurability for selective parts product and services portfolio. • The organization shows fungibility to open innovation and thus are striving to build designs that reduce vendor lock-ins. • Organizations demonstrate Ecosystem-coupling in the engineering design for selected product and service lines where they can transfer capabilities to the players in the participants in the Ecosystem that have built niche and strong abilities around them.

Core Tenets	Maturity	Description
Cloud and Landscape	Medium	• The organization have selective product lines that are built as open loosely coupled system. • The products however lack the portability and cloud advantages that are available to connected products design. • They are perceived as followers in the value chain. • There is a clear Cloud Mobilization Strategy, but they are challenged to build vast cloud native Service Catalogue. • They are collaborating in the Ecosystem to build processing capability of massive volume of data generated by the IoT devices. • The data is not seen as an asset that can be mined for features that lead to new product inventions and innovations. • Organization struggles to fully adopt the connected engineering process, the Servitization models and connected products.

Core Tenets	Maturity	Description
		• They collaborate across the Ecosystem only for selected products and services.
Technology	Medium	• Technology Strategy recognizes 5G, Artificial Intelligence and Machine Learning but in a limited extent as it does not fully reflect the connected product paradigm. • Organization has a well-defined framework to build a comprehensive extension suite on the top of existing product and service catalogue. • Technology Strategy enables Ecosystem to support Servitization but struggles to clearly identify and design Ecosystem driven Servitization models. • Organization focuses on building efficiencies of trust agreements across the Ecosystem.

c) Low Innovative Incumbents

The Low Innovative Incumbent Organizations show the following characteristics:

Table 21 Low Innovative Incumbent Organizations

Core Tenets	Maturity	Description
Objective	High	• Resistant to cultural change required to adapt in new Ecosystem. • Organizations are aware about the impact from the technology advancements and sees them as threats to existing business model. • Believes that the overall utility of current product and service lines is enhanced by marginal or feature enhancements
Engagement	Low	• The organization largely works in silos but has identified the capabilities and opportunities to build sporadic partnerships across the Ecosystem. • There is no clear Ecosystem centric management policy - the engagement within Ecosystem is tactical in nature and opportunity led collaborations. • The organization see themselves as a consumer of the platform available to execute the business transactions. • The organization is still clear about vesting control in engaging with the Ecosystem and vary about bringing in disruptive innovation to enrich in the

Core Tenets	Maturity	Description
		customers experience through better content and rightly manage devices.
Risk and Reward	Medium	• As these incumbents are working in silos, they do not have mechanism to build collaboration. • Organizations are in control of their product and services, but these are engineered with minimal ability of reconfigurability. • The engineering designs are built on deep standing relationships with vendors who are seen more as business partners that co-opt capabilities for deliveries. • The organization is severely challenged when it comes to transfer of skills to Ecosystem for coupled-engineering design as they have strategically remained away from collaboration – which can threaten the trade secrets.
Plausible Control	High	• As these incumbents are working in silos, they do not have mechanism to build collaboration. • Reconfigurability is co-opted with existing vendors to redesign some of the extensions on industry

Core Tenets	Maturity	Description
		standard interfaces so that they can build vendor agnostic modules. • The engineering designs are built on deep standing relationships with vendors, but the vendors are encouraged and constantly revaluated on their ability to provide industry standard driven modules that have generic interfaces and broader reconfigurability. • The organization is severely challenged when it comes to transfer of skills to Ecosystem for coupled-engineering design as they have strategically remained away from collaboration – which can threaten the trade secrets. • There are some tactical episodes where these organizations collaborate across the Ecosystem for specific opportunities that do not meet their core capabilities.
Cloud and Landscape	Low	• Building an open loosely coupled system seen as a challenge which leads to product failures. • Do not have any significant digitization programs that envision connected products paradigm across the Ecosystem.

Core Tenets	Maturity	Description
		• Organizations are seen as followers in the value chain and reactive in their decision making. • Organizations are exploring cloud to be able to connect with the other players of the Ecosystem, although, there is no clear cloud mobilization strategy. • Organizations have no processing capability for massive volume of data generated by the IoT devices. • Organization struggles to fully adopt the connected engineering process, the Servitization models and connected products. • Organizations collaborate across the Ecosystem only for selected products and services Core engineering team does marginal feature enablement to build product extensions.
Technology	Low	• Technology Strategy oblivious to any significant method for 5G, artificial intelligence and machine learning. • The organization has vision to build extensions for selective products and services.

Core Tenets	Maturity	Description
		• As the organization works in silo, there is no Ecosystem led strategy to build Servitization models. • Organization has limited capability of processing heterogenous mix of devices, and data. • Organization selectively collaborates with other players in the Ecosystem on a tactical basis.

d) Laggards

The Laggard Innovative Incumbent Organizations show the following characteristics:

Table 22 Laggard Incumbent Organizations

Core Tenets	Maturity	Description
Objective	Low	• Resistant to cultural change required to adapt in new Ecosystem. • Struggles to identify the value from the technology advancements and sees them as temporal sifts rather than unprecedented inflection points.

Core Tenets	Maturity	Description
		• Believes that the overall utility of current product and service lines is enhanced by marginal or feature enhancements
Engagement	Non-Existent	• The organization is still working in silos with minimum transactional influence and engagement of the Ecosystem. • Business partnerships across the Ecosystem are tactical in nature the incumbent is still planning a digital transformation but no plans to actively engaging a collaboration with the Ecosystem. • Organizations see themselves as a consumer of the platform available to execute the business transactions. • The incumbent has a restricted view about bringing in disruptive innovation to enrich in the customers experience through better content and rightly manage devices.
Risk and Reward	Low	• The strategic focus is to retain the existing product and services market share.

Core Tenets	Maturity	Description
		• There is no active strategy or funding to implement new client service delivery models. • Managers are focused on reducing costs in terms of service delivery and maintenance and their product strategies are often let by cost take out motives. • Organization does not believe in Servitization or connected products model and there are no active thought around metered services for existing product and service lines. • Data analytics capabilities are to provide better insights to management from reporting perspective.
Plausible Control	High	• These incumbents are working in silos, so they do not have mechanism to build collaboration. • Organizations are in control of their product and services, but these are engineered with minimal ability of reconfigurability. • The engineering designs are built on deep standing relationships with vendors who are seen more as business partners that co-opt capabilities for deliveries.

Core Tenets	Maturity	Description
		• The organization is severely challenged when it comes to transfer of skills to Ecosystem for coupled-engineering design as they have strategically remained away from collaboration – which can threaten the trade secrets.
Cloud and Landscape	Low / Non-Existent	• Building an open loosely coupled system seen as a challenge that can lead to product failures. • Organizations do not have any significant digitization programs that envision connected products paradigm across the Ecosystem. • Organizations are seen as followers in the value chain and reactive in their decision making. • There this no clear strategy of moving services to cloud native model. • Organizations have no processing capability for massive volume of data generated by the IoT devices. • Core engineering team does marginal feature enablement to build product extensions.

Core Tenets	Maturity	Description
		• The organization is oblivious to Servitization and connected products model. • Organizations work in silos and do not participate in collaborative product and service designs across the Ecosystem.
Technology	Non-Exist-ent	• Technology Strategy oblivious to any significant method for 5G, artificial intelligence and machine learning. • The organization does not see the need to build a comprehensive extension suite on the top of existing product and service catalogue. • As the organization works in silo, there is no Ecosys-tem led strategy to build Servitization models. • Organization still does not have any capability of processing heterogenous mix of devices, data, and edge to support their product portfolio. • Organization does not actively collaborate with other players in the Ecosystem.

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