Business Models for Internet of Things (IoT) Providers in South Africa

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A research article submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration

Johannesburg, 2019

Protocol number: WBS/BA1745449/726

DECLARATION

I, Duduetsang Kgosi Mogase, declare that this research article is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the Graduate School of Business Administration, University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Duduetsang Kgosi Mogase

Signed at Dimension Data Bryanston

On the 28th day of March 2019

ACKNOWLEDGEMENTS

First and foremost I want to take this opportunity to thank God for blessing me with the opportunity and means to complete my Master of Business Administration (MBA) professional qualification – none of this would have been possible without His strength, wisdom, guidance and provision throughout this journey – Philippians 4: 13 – "*I can do all things through Christ who strengthens me.*"

This journey could not have been possible without the selfless love and support of my wife, Pebetsi Mogase, and our unborn son. She has been my cornerstone throughout the PDBA and MBA journey, and none of what I have achieved would have been possible without her words of encouragement, love and discipline. To my father, my mother, and sister, I love you for being patient with me and understanding my reasons for continuing with my postgraduate studies and always allowing me the space to develop myself as a work in progress during the days of sunshine and rain. To my late brother, Boitshoko Keodirelang More, your encouragement, your support, and most of all your brotherly love served as a beacon of hope and light on this journey. I will always carry you in my heart and thoughts wherever God leads me – love you.

To my employer, Dimension Data MEA, a special thank you to Grant Bodley, Jay Reddy, Stephen Green, Barry Hatfield and Michaela Voller for believing in me and making the investment in mine and Dimension Data's future through the MBA. To all of the research participants, a heartfelt thank you for your time and knowledgeable input during our insightful interview sessions, it was a humbling experience for me given the amount of knowledge I gained from each of you. An extended thank you to my supervisor, Professor Gregory Lee for the discussions that shaped my research project.

Lastly, to the executives, leaders, managers and technologists of established and emerging IoT provider companies, I would like to thank you in advance for your time in reading this research and more importantly, in taking the time to understand your instrumental role in helping companies of the 21st century realise their strategic business outcomes led objectives through your emerging and disruptive technology and robust business models within the wake of the 4th Industrial Revolution.

SUPPLEMENTARY INFORMATION

Nominated journal: Journal of Business Models

Supervisor / Co-author: Professor Gregory Lee

Word count †:

1. **Abstract:** 385 words
2. **Research Article Content:** 16 398 words
3. **References:** 929 words
4. **Appendices A – D:** 3286 words

Supplementary files:

1. Schedule of interview questions – Appendix A
2. Requested Documentation – Appendix B
3. Qualitative Code Book Template – Appendix C
4. Interview Response Sample – Appendix D

Journal of Business Models (2019), Vol.1 No.1 pp. 1-52

JOBM
Journal of Business Models

Business Models for Internet of Things (IoT) Providers

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ABSTRACT

Purpose: To investigate existing IoT business models and use cases across South African and global companies; with the extended primary aim of exploring vertical taper integration across the IoT value chain as a candidate future IoT business model, for IoT providers aiming to exploit future IoT opportunities, and be in a position to control and deliver business outcomes based value across the IoT value chain, from edge-to-application.

Design: Field data was gathered through interviews with IoT industry practitioners. Inductive data analysis and interpretation was used to analyse the raw qualitative data collected through structured interviews, transcribed audio recordings and documentation provided by the research participants - IoT industry practitioners.

Findings: *Vertical Taper Integration*, as a *value based business model* is indeed, the ideal candidate future IoT business model for edge-to-application IoT providers who wish to exploit future IoT opportunities and be in a position to control and deliver business outcomes-based value across the IoT value chain, from edge-to-application. However, IoT providers operating from the commoditised lower end of the IoT stack, operating in specific verticals of the stack (e.g. sensors and actuators), are still profitable with their *transaction based business model* and are comfortable operating from this part of the stack for the time being, until such a time that their skills, capabilities, scalability and capital allow them to move further up the IoT stack and too, become an end to end edge-to-application IoT provider.

Research limitations: The scope of companies covered in the research was limited due to the confidentiality concerns raised by candidate research participants, as a result of the researcher working for a competing company. However, a breadth of industry verticals was covered from the research participants interviewed, given their experience across multiple industry verticals in South Africa and globally.

Value: For those IoT providers aspiring to or focused on controlling and delivering across the entire IoT value chain (also referred to as the IoT stack), from edge-to-application, *vertical taper integration* into each layer of the IoT value chain will enable that, unlike current standalone IoT business models. *Vertical Taper Integration* will provide the IoT provider with an inimitable competitive advantage in comparison to current IoT providers, as well as a future IoT Business Model capable of fully exploiting emerging IoT opportunities from billions of connected devices projected for and beyond 2020.

Keywords: IoT; IoT Business Model; IoT Value Chain; Business-outcomes; IoT Stack; Vertical Taper Integration; Go-to-Market

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1.0. Introduction

We live in an era where profit-driven companies are faced with the challenge of operating profitable and sustainable going concerns, in markets which have become volatile, uncertain, complex and ambiguous in nature (Lüttgens & Diener, 2016; Schwab, 2016; Turber & Smiela, 2014). At the same time, these profit-driven companies are striving to remain client-centric and relevant within the wake of the 4th Industrial Revolution of emerging and disruptive technology, such as Artificial Intelligence (AI), Robotics Process Automation (RPA), Machine Learning (ML), Blockchain (BC), and more importantly, the Internet of Things (IoT).

The Internet of Things (hereafter referred to as "IoT") is the amalgamation of physical devices, made digital, through intelligently enabling them with sensors, actuators, communication protocols and networking capabilities. Digitisation of the physical devices further aids in their intelligent interactions as smart devices with each other via the Internet, Near Field Communication (NFC) technology, Local Area Networks (LANs) and Wide Area Networks (WANs), all communicating in a heterogeneous ecosystem (Jin, Chun, Jung, & Lee, 2017; Ju, Kim, & Ahn, 2016; PricewaterhouseCoopersEU, 2017; Silva & Maló, 2014).

IoT is projected to encompass an ecosystem in excess of 50 billion connected devices embedded with sensors, actuators and communication protocols connecting to the internet by 2020 (Coetzee & Eksteen, 2011; Dijkman, Sprenkels, Peeters, & Janssen, 2015; Gartner, 2014; Ju et al., 2016; Krotov, 2017; Metallo, Agrifoglio, Schiavone, & Mueller, 2018; Westerlund, Leminen, & Rajahonka, 2014), making autonomous and intelligent decisions based on stimuli detected from the environments within which they operate. This increase in the number of connected devices will drive high Compound Annual Growth Rates (CAGR) of up to 15.6% by 2020 in IoT, with high growth in *Consumer Electronics* ($2,225bn), *Automotive* ($1 780bn), *Health Care* ($1 335), *Energy & Utilities* ($890bn), *Retail* ($890bn), *Construction* ($890bn), and in *Industrial/Manufacturing* ($890bn) (PricewaterhouseCoopersEU, 2017).

IoT serves as a point of departure in enabling the value creation and capture process for the other emerging and disruptive technologies, such as, Artificial Intelligence (AI), Robotics Process Automation (RPA), Machine Learning (ML) and Blockchain (BC), because of the accurate sensor generated data (Inmarsat, 2017) that can be exploited further, for fulfilling business driven objectives and outcomes. Thus, with such a plethora of connected devices, continuously sense-checking their environments, and making real data driven, and autonomous decisions, this triggers a new era of opportunity for value creation by IoT providers…the emergence of new IoT business models as a result of digitalisation within the larger ambit of Digital Transformation (Ghanbari, Laya, Alonso-Zarate, & Markendahl, 2017; Nicolescu, Huth, Radanliev, & De Roure, 2018). Digitalisation has further resulted in the emergence of new business models and industry opportunities which can be exploited (Amit & Zott, 2001, as cited in Lüttgens & Diener, 2016) for profitable gain by IoT providers, as companies such as Apple, Google and Amazon have already found (Lüttgens & Diener, 2016).

Thus, the emergence of new IoT business models that are capable of enabling value creation and subsequently, are capable of generating economic gains (Khan, Khan, Zaheer, & Khan, 2012) across the entire IoT value chain, especially where existing standalone IoT business models have fallen short, is key for IoT providers.

Business models are built to deliver value to the consumer of the value, the client (be it a Business-to-Business (B-2-B) or a Business-to-Consumer (B-2-C) client), in terms of creating the value, positioning the value, communicating the value, understanding the channels through which the value is distributed, and how the value is captured from a commercial perspective (Ghanbari et al., 2017; Lüttgens & Diener, 2016; Metallo et al., 2018). However, many business models fail to deliver this value as a result of not innovating or adapting their business models in line with the disruptive rate of market changes (Lüttgens & Diener, 2016), and from an IoT perspective, not aligning them with the IoT value chain. Business models are the new currency for companies and serve as the new competitive advantage upon which companies will compete (Chen, Mao, & Liu, 2014; Gassmann, Frankenberger, & Csik, 2013), especially within the realm of emergent and disruptive technology i.e. IoT.

At the core and underlying blueprint of an IoT business model is the IoT value chain (also referred to as the “IoT stack”), across the physical devices, the sensors and actuators, the network connectivity, the platform, and ultimately the applications (Agrawal, 2016). Agrawal (2016) establishes that the IoT value chain is comprised of multiple IoT providers across the different vertical layers of the IoT stack, from edge-to-application:

i. the **device providers** (physical devices and sensors and actuators layers) – deliver products and/or services focused on the device, the sensor, the actuator and overall, in digitising the physical device;
ii. the **connectivity providers** (connectivity layer) - deliver products and/or services focused on providing the network connectivity and transmission (e.g. long-haul internet connectivity);
iii. the **platform providers** (platform layer) – deliver products and/or services focused on connecting the smart devices, the transmission and providing the data processing and storage logic;

iv. the **application providers** (applications layer) – deliver on business focused outcomes through the provision and presentation of the digital services consumed by the client (e.g. application services, data insights and visualisation dashboards).

However, there is minimal empirical evidence of IoT providers who offer edge-to-application IoT solutions as part and parcel of their go-to-market value proposition, via end-to-end control and delivery in each of the vertical layers in the IoT value chain. Hence the inclination of IoT providers to partner with other IoT providers who have expertise in areas across the IoT stack where they lack, as part and parcel of the value creation and capture process. This form of vertical cross stack partnering is imperative if non edge-to-application IoT providers are to remain relevant and in business, and Agrawal (2016) is of the same view in that *"no one provider has an end to end IoT solution yet and hence the only choice is to partner or perish."* (Agrawal, 2016, p. 1) and is further supported by Ghanbari et al. (2017) who state that *"in fact, development of services based on connected devices requires diversity in resources and activities from a network of actors. This perspective is an emerging trend to explicitly develop business models that leverage on vertical cooperation within and across industries, creating services based on the IoT."* (Ghanbari et al., 2017, p. 139), as well as by Coetzee and Eksteen (2011) in that *"currently, many manufacturers are creating vertical solutions (a slice in the IoT application space), using their own technologies and inaccessible services… As yet, no holistic approach to IoT has been proposed; coherent concepts that unify IoT do not exist, leading to silo solutions"* (Coetzee & Eksteen, 2011, p. 5).

Thus, the challenge to be addressed and the opportunity to be exploited for companies, as IoT providers offering IoT as part and parcel of their go-to-market value proposition, relates to adopting the right type of business model capable of exploiting the profitability of digitised products and/or services, and enabling the capability to control and deliver value across the entire IoT value chain, from edge-to-application (Ju et al., 2016; Turber & Smiela, 2014).

The evidence of such business models capable of controlling and delivering value across the IoT value chain (from edge-to-application) is not apparent in today's existing and standalone IoT business models, further echoed by Inmarsat (2017) in that *"for one company to master the whole IoT value chain is a tall order - deployments will typically depend on the experience, technical capabilities and support from a whole ecosystem of partners to be successful.."* (Inmarsat, 2017, p. 25).

From a South African perspective, there is minimal evidence of IoT business models which are capable of exploiting future IoT opportunities via the ability to control and deliver value across the IoT value chain, from edge-to-application. There have been great concepts on the introduction and application of e-services through IoT, for example, in addressing service delivery issues (water & electricity supply, sewage management, refuse removal, health services and roads maintenance) (Dlodlo, Olwal, & Mvelase, 2012) and environmental management issues (natural resources, oceans and coastal management, conservation management, and climate change) (Dlodlo, 2012); however, there is no empirical evidence of the underlying IoT business models thereof (Coetzee & Eksteen, 2011).

If the projected opportunities within IoT (arising from the billions of connected devices) are to be fully exploited, it is imperative to have (i) business outcomes-based and industry agnostic business model(s); (ii) which leverage the layered IoT technology stack underpinning IoT (Ju et al., 2016); (iii) that enable the profitable exploitation of future industry opportunities emerging from IoT; and (iv) that are capable of enabling the process of value creation and capture (Agrawal, 2016; Gassmann et al., 2013), through the capability of controlling and delivering business outcomes-based value across the IoT value chain, from edge-to-application.

Thus, the aim of this research is to:

investigate existing IoT business models and use cases across South African companies, with the extended primary aim of exploring *Vertical Taper Integration* across the IoT value chain as a candidate future IoT business model, capable of exploiting future IoT opportunities through the ability to control and delivery business outcomes-based value across the IoT value chain, from edge-to-application.

Accordingly, the sub-problems are **a)** to investigate existing IoT business models and use cases across South African companies, **b)** to explore *Vertical Taper Integration* across the IoT value chain as a candidate future IoT business model, capable of exploiting future IoT opportunities, by controlling and delivering business outcomes-based value across the IoT value chain, from edge-to-application.

In order to achieve the abovementioned research aims (in ***a*** and **b**), the following points of discussion and management theories are covered in detail throughout the paper, the:

- *(i)* *IoT Industry Use Cases;*
- *(ii)* *IoT Information as an Asset;*
- *(iii)* *IoT Business Models;*
- *(iv)* *Vertical Taper Integration; and*
- *(v)* *Transactions Cost Economics of IoT.*

2.0. Background

2.1. IoT Industry Use Cases

Disruptive technologies, like IoT, enable companies to be more competitive, profitable and innovative within their respective industry value chains (e.g. Mining - *Pit to Port*, Agriculture – *Farm to Factory*) (i) by revising how products, services and/or solutions are developed, delivered and consumed; (ii) through efficient utilisation of factors of production, based on advanced sensor-driven analytics and insights; and (iii) being an environmentally “green” and compliant company (e.g. through carbon footprint reduction), subsequently creating shared value across people, profit and planet (Khan et al., 2012; Porter & Kramer, 2011).

Smart devices at the edge are able to identify, sense, collect, network, and process the data collected through to the Applications layer of the IoT stack, for data driven decision making, aimed at understanding and meeting market demands, as well as driving the development of tailored products, services and/or solutions in line with the market demand (Inmarsat, 2017; Ju et al., 2016; Remane, Hanelt, Nickerson, & Kolbe, 2017). From an industry perspective, the IoT edge-to-application business use cases can be seen in (i) *Connected Agriculture*, (ii) *Smart Energy*, (iii) *Connected Mines*, (iv) *Natural Disasters*, and (v) *Connected Conservation*, to mention a few:

2.1.1. Connected Agriculture

With an increase in the growth of the African and global population, a key priority for the Agriculture industry pertains to ensuring sustainable farming in the most efficient and lean manner possible, by leveraging sensor-based technology (IoT) which can enable precise decision making, based on predictive analytics and insights in near-real time. Effective data driven decision making further maximises farm yields across Agriculture’s *Seed to Bin* and *Farm to Fork* value chains. Deployment of IoT in relation to *Fish Farming*, with the primary objective of knowing what conditions are ideal for feeding, would pertain to the monitoring of the water speed and temperature, the monitoring of the fish movements, and subsequently, through analytics and insights, knowing when the optimal times to deliver feed are. The same would apply to ensuring optimal irrigation for *Almond Farming* (Inmarsat, 2017), or *Sugarcane Farming*, with the primary objective (in this instance) of reducing wasteful water usage, hence, *“farmers will need to produce far more, with less waste, and far fewer resources… IoT-based solutions have an important function in making sure fish are fed in the most efficient way possible”* (Inmarsat, 2017, p. 9).

2.1.2. Smart Energy

Renewable energy and extraction of fossil fuels are key contributors to the supply of energy and the national energy grids. Leveraging IoT to enable smart grids to regulate energy supply, based on environmental weather conditions, as well as in ensuring preventative infrastructure maintenance, is key to the continuous and uninterrupted supply of energy. This will assist with avoiding energy loss due to collapsed plant infrastructure, and to ensure guaranteed energy supply by monitoring the power stations and plants, offshore oil rigs, and wind farms. Hence, *"the ability to monitor remote operations like oil rigs and wind farms is creating a range of efficiencies and system improvements."* (Inmarsat, 2017, p. 13).

2.1.3. Connected Mines

With a primary focus placed on reducing the cost to operate mines and in ensuring miner safety in South Africa and globally, whilst remaining profitable, given the fluctuating commodity prices, the deployment of IoT within mines would enable the exploration of dangerous parts of the mine underground, prior to sending miners underground to commence with drilling, as well as assist in monitoring the conditions, usage and maintenance of industrial equipment and machinery (Pelino & Gillett, 2016). Hence, *"by deploying connected smart sensors in a network, IoT makes it possible to automatically pick up data from previously elusive locations and for this data to be communicated rapidly to other devices"* (Inmarsat, 2017, p. 17).

2.1.4. Natural Disasters

Proactive identification and mitigation of natural disasters, such as land-slides in rural remote areas and flash floods taking place, allows for real-time fact-based decision making, as compared to extracted data being simulated for possible events, hence the problem in that *"… remotely sensed data that may be used together with simulation tools (including PC based tools right up to supercomputer applications) do not provide real-time information and resolution necessary to take appropriate action in time. Flash floods present another example where in-situ monitoring is very important."* (Coetzee & Eksteen, 2011, p. 8; Dlodlo, 2012)

2.1.5. Connected Conservation

Proactively monitoring and responding to active rhino poaching in South African and African game reserves, through the sensor-based tagging of rhinos, with demarcated geographical landscapes (Dlodlo, 2012), is vital to the perseveration of wild life, rhinos in particular. Hence, a *"system for monitoring rhino herds has to be put in place, to detect their movement and alert the authorities in* *case there are no detected animal movements for a prolonged period and hence dispatch rapid response"* (Dlodlo, 2012, p. 6).

It is evident from the multiple and varying South African and global industry use cases of IoT, that at the heart of any IoT solution is a set of business outcome-based objectives, which in turn, are realised through intelligent sensors and actuators that are able to proactively monitor, provide analytics, key insights, and information for real-time decision making.

2.2. IoT Information as an Asset

The core value within an IoT ecosystem is centered on the identification, collection, categorisation and translation of raw data into accurate information driven and business outcomes-based decision making, with a high premium being placed on the information (the insights) extracted from the raw data generated by the smart devices at the edge. The extracted information (the insights) is what enables the value creation process for IoT business models and is further positioned in Moody and Walsh's (2002) laws of information in that:

i. purpose built and generated information serves as an asset which can be commercialised on a consumption based model and distributed to interested stakeholders on a request basis by Information Service Providers (ISPs) (Bucherer & Uckelmann, 2011) leveraging the *IoT Pay-Per-Use Business Model* (see *Existing IoT Business Models)*; (Elizalde, 2017; Fleisch, Weinberger, & Wortmann, 2014; Gassmann et al., 2013);
ii. as the cost of identifying, collecting, categorising and translating the raw data into accurate information reduces, the higher the demand and cheaper the cost of acquiring the purpose-built information becomes; and
iii. categorisation of multiple sets of information, enables new information relationships, insights and subsequently, a new value creation process to be initiated by third party aggregators and distributors (Ghanbari et al., 2017).

What is also evident is that the information (the insights) produced is being packaged as an *Information (Insights)-as-a-Service* business model, no longer requiring the consumer to have end-to-end ownership of the infrastructure across the IoT value chain in order to derive the end value, subsequently changing the IoT provider's business model to one of X-as-a-Service.

2.3. Existing IoT Business Models

A business model serves as a medium of explicitly communicating the products, services and/or solutions that an organisation (i) produces and specialises in; (ii) the value proposition and commercialisation thereof; (iii) the addressable and segmented markets; (iv) the clients and channels; (v) the key resources and activities; and (vi) the associated costs thereof to enable the delivery of the value proposition, providing a competitive advantage across people, profit and planet (Bucherer & Uckelmann, 2011; Ghanbari et al., 2017; Ju et al., 2016; Osterwalder & Pigneur, 2010; Pólkowski, Dutta, & Savulescu, 2017; Silva & Maló, 2014; Wei, Zhu, & Lin, 2012).

Below we discuss how value is delivered and consumed across the existing and varying IoT business models used by IoT providers in industry:

2.3.1. Product-as-a-Service

Given the rate at which disruptive technologies are challenging traditional business B-2-B and B-2-C models by no longer requiring the consumer to own the asset from which the value is derived, but rather to consume the service provided thereof, has brought forth ***Product-as-a-Service*** (Bucherer & Uckelmann, 2011; Pelino & Gillett, 2016; PricewaterhouseCoopersEU, 2017), the migration from product ownership to service consumption (Servitisation). ***Product-as-a-Service*** further enables the ability to pre-empt client needs through advanced analytics, and subsequently enable recurring revenues through the introduction of new consumption-based services (PricewaterhouseCoopersEU, 2017).

2.3.2. IoT Value Exchange Business Model

Gassmann et al. (2013) indicate that this model enables the delivery and consumption of value via a secondary opportunity and solution engagement to on-sell a product or service to the client as a result of the value received by the client from the first product and/or service delivered free of charge, in exchange for future business.

For example, an IoT provider engaging a commercial property and facilities management company and offering to place sensors on personnel workstations so as to monitor workspace utilisation as a Proof of Value (POV) pilot (first IoT service being offered free of charge), with an agreement to sell a *Workspace Optimisation* solution (the secondary solution opportunity – charged at a rate) based on the data received from the sensors from the Proof of Value (POV) pilot.

2.3.3. IoT Digital Add-On Business Model

Fleisch et al. (2014) and Gassmann et al. (2013) indicate that this model enables the delivery and consumption of value only once the additional digital smart services associated with the physical device are purchased by the client. The physical device serves as a base and as an enabler for deriving value from the catalogue of additional digital smart services, which the client can further tailor on an ad-hoc basis.

For example, enhancing the performance of a racing car for a particular racing event by purchasing additional kilowatts online for the model type, for a set duration of time, and furthermore, including additional digital services like insurance for that set duration of time, given the increase in car performance (Fleisch et al., 2014).

2.3.4. IoT Freemium Business Model

Fleisch et al. (2014) indicate that this model enables the delivery and consumption of value primarily at the digitised physical device, with basic entry level digital smart services being offered for free without fully leveraging the true value that can be derived from edge-to-application. For that, additional and more value adding services, premium services, leveraging the true capabilities of the digitised physical device, are purchased at a premium.

For example, a smart home alarm system that comes standard with digital security services related to (i) basic breach detection, (ii) alerts and (iii) sirens. However, the premium services like breach alert messaging via sms and e-mail, breach event recording (with sound), and a triggered call to a predefined third party security response company, would be purchased at a premium; fully leveraging the edge-to-application capabilities of a smart home security system.

2.3.5. IoT Device Self-Service Business Model

Fleisch et al. (2014) and Gassmann et al. (2013) indicate that this model enables the delivery and consumption of value at the intelligent edge, where autonomous and commerce based decisions are taken by the digitised intelligent devices based on predefined parameters having been reached, enabling a direct selling business model.

For example, a smart gas cylinder (connected to a gas stove) autonomously reordering new gas cylinders once certain low liquid gas levels are detected within the gas cylinder.

2.3.6. IoT Sensor-as-a-Service Business Model

Fleisch et al. (2014), Elizalde (2017) and Gassmann et al. (2013) indicate that this model enables the delivery and consumption of value at the device sensor level whereby all of the data generated from the smart sensor device, based on the stimuli from the environment, is collected, consolidated, packaged and commercialised for third party consumption, who will utilise the aggregated data to deduce key findings and in turn, create client-centric value added services emerging from the aggregated data, subsequently enabling recurring annuity based revenue for IoT providers at the edge.

For example, using parking bay sensors at airports or shopping malls to alert travelers and customers respectively of available parking spaces via a parking application (e.g. Parking-as-a-Service). This aggregated data and insight will assist airports and shopping malls with better utilisation of parking bays and in turn, an improved return on the investment made in the development of the parking facility based on billable parking bays. Furthermore, cross selling enables multiple addressable target markets' value chain data to be on-sold, for an example, to insurers across the mining industry in terms of *pit to port*, agriculture in terms of *farm to factory*, and retail in terms of *Smart Store / Connected Shelves* (Potgieter, 2018).

2.3.7. IoT-as-a-Service Subscription Based Business Model

Elizalde (2017) indicates that his model enables the delivery and consumption of standardised, predictable and repetitive value for the client, at a standard fixed price. The value is derived over a set period of time and/or is derived from a certain objective being continuously fulfilled up until such a time that a certain goal/milestone is reached. The client acknowledges that the value creation from edge-to-application is consumed for as long as the output serves the business outcome objective or time bound based objective. The IoT provider utilising the *Subscription Based Business Model* manages the IoT solution as an end-to-end managed service and ensures that the device, the network, the communications, the platform and the application infrastructure is maintained and deliver on the expected client business outcomes.

2.3.8. IoT Pay-Per-Use Business Model

Elizalde (2017) and Gassmann et al. (2013) indicate that this model enables the delivery and consumption of value, based on a predefined benefit as an outcome, without the burdensome capital expenditure involved in owning the infrastructure required for the product and/or service, similar to that of ***Product-as-a-Service*** (Bucherer & Uckelmann, 2011; Pelino & Gillett, 2016;

PricewaterhouseCoopersEU, 2017). The beneficial output produced by the digitised device, from edge-to-application, is what is purchased and consumed. Revenue generation is based on usage pricing per request, collection, metering and consumption of data (Bucherer & Uckelmann, 2011). The usage of the product/service is measured and billed at a per unit of consumption rate.

2.3.9. IoT Asset Sharing Business Model

Elizalde (2017) indicates that this model enables the delivery and consumption of value based on more than one client sharing the benefit derived, from the edge to the application, through a proportional ownership of the IoT solution itself in relation to the value consumed. The value not consumed by the one party is the surplus value consumed by the other sharing party, as opposed to the surplus value being unutilised, yet paid for.

Having presented and discussed the existing IoT business models in literature and their application, this presents an opportunity for companies providing IoT as part and parcel of their go-to-market value proposition, with the aim of controlling and delivering across the IoT value chain, to exploit them across each layer of the IoT value chain by using a new *Cross Cutting Open Business Model* leveraging *vertical taper integration* and *transactions cost economics* (Harrigan, 1984; Wei et al., 2012). Lüttgens and Diener (2016) understand that the abovementioned IoT business models exist as isolated and standalone business models, however, to fully leverage, control and deliver across the IoT value chain, a new IoT business model and approach is required: *"For Bosch it will become increasingly important to not only develop excellent products, but to also exploit new business models. The 55 business model types that are enumerated and presented here are an excellent tool kit with which to develop our own business models, especially in regards to the Internet of things and services. - Dr. Heinz Derenbach, CEO of Bosch Software Innovations GmbH"* (Lüttgens & Diener, 2016, p. 13).

2.4. Cross-Cutting Open Business Model

The industry agnostic and layered IoT technology stack provides a detailed view of the building blocks required for any edge-to-application IoT solution, requiring each layer of the stack to be collaboratively leveraged in conjunction with multiple industry providers as part and parcel of the value creation and capture process across the IoT value chain. Thus, a *Cross-Cutting Open Business Model (CCOBM)* (Gassmann et al., 2013; PricewaterhouseCoopersEU, 2017), as adopted and endorsed by global players such as Philips, Qualcomm, Google and Procter & Gamble (PricewaterhouseCoopersEU, 2017), enables the required level of integrated value chain collaboration between the company providing IoT as a go-to-market value proposition and other upstream and/or downstream IoT providers. The company has an opportunity to leverage the competitive strengths of upstream and downstream IoT providers, across the IoT value chain, in terms of relational networks, information, skills, frameworks, technology, and intellectual property in areas where the company falls short in the value creation and capture process, by using *vertical taper integration* and *transactions cost economics* (Harrigan, 1984; Hendrikse, 2003; Rothaermel, Hitt, & Jobe, 2006; Wei et al., 2012; Williamson, 1998).

2.5. Vertical Integration and Transaction Cost Economics of IoT

Vertical value chain integration, *vertical taper integration* (Harrigan, 1984) to be exact, enables IoT providers to apply their tacit knowledge to newly acquired capabilities from upstream and downstream providers within a value chain. In doing so, IoT providers gain competitive intelligence, create product and service differentiation, enable an economic cost per transaction approach by managing *co-ordination costs* and *transactions risk* (Hendrikse, 2003; Wei et al., 2012), reduce vulnerability and uncertainty, and benefit from any innovations and developments across the value chain as a result of backward and forward vertical integration (Adner & Kapoor, 2010; Harrigan, 1984; Rothaermel et al., 2006); without requiring 100% actual physical ownership (*full vertical integration*) of upstream and downstream providers, through smart partnering (with decision making rights), whilst delivering value to the end client (Ghanbari et al., 2017). Furthermore, *vertical taper integration* is best suited for IoT providers seeking technological quality, are aiming to be market leaders within markets which are volatile, uncertain, complex and ambiguous, as is IoT within the 4th Industrial Revolution, and are aiming to develop edge-to-application IoT solutions in house. Thus, IoT providers providing IoT as part and parcel of their go-to-market value proposition, with the primary aim of controlling and delivering value across the IoT value chain for competitive gain and market leadership, are more likely to integrate vertically throughout the IoT value chain (Harrigan, 1984).

However, care should be taken with vertical integration across the IoT value chain by ensuring a balanced combination of in-house development and delivery vs. outsourcing (if required) in delivering valuable and business outcomes-based IoT solutions, as this will impact their degree of *value creation* (*potential value* less *monetary costs* – see Figure 1 *Maximizing Value Creation* Wei et al. (2012)). Furthermore, Wei et al. (2012) and Harrigan (1984) advise IoT providers adopting the *vertical taper integration* business model to assess the number of integration activities, the points of integration, the internal transfers, and the vertical integration agreement ownership (equity invested in the vertical integration with decision making rights agreed), so as to maximise *value creation* from a transaction cost economics perspective by increasing the *potential value* of transactions and reducing the *monetary costs* (Wei et al., 2012), as depicted in Figure 1.

Vertical taper integration across each vertical layer within the IoT value chain will serve as an enabler to IoT providers delivering edge-to-application IoT solutions so as to maximise the *potential value* and minimize the *monetary costs* internal to the provider, as well as the *monetary costs* of the other downstream and/or upstream IoT providers, and in turn maximise *Value Creation*.

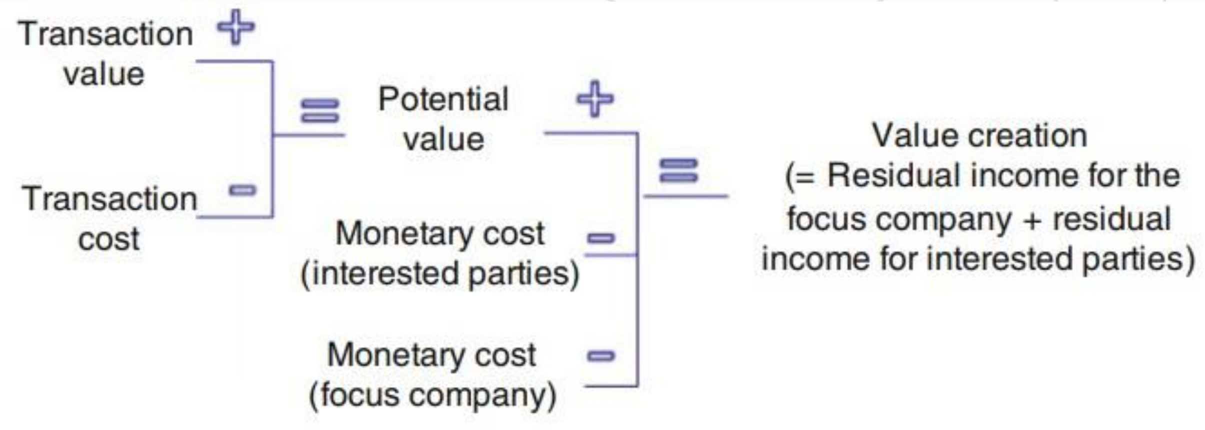

Figure 1: Maximising Value Creation **(Wei et al., 2012)**

Furthermore, IoT providers that are able to control and deliver value across the IoT value chain from edge-to-application, by correctly leveraging *transactions cost economics* in terms of **(i)** *asset specificity* in terms of *product specificity* (ensuring that upstream development of products are tailored specifically to their IoT value propositions), *human capital specificity* (training sales and support personnel to be well versed about their IoT value propositions), and *physical specificity* (by investing in tools, equipment and platforms specific to their IoT value propositions); and **(ii)** engaging in long term contracts with upstream and downstream key IoT providers across the IoT technology stack, within the constructs of *vertical taper* integration across the technology stack (Hendrikse, 2003; Williamson, 1998), will enable IoT providers with a competitive market advantage over other industry competitors.

However, the extent of *asset specificity* will increase the *transactions costs* (consisting of *co-ordination costs* and *transactions risk*) due to an increase in *co-ordination costs* between engagements with the other IoT providers further up and/or down the stack, as well as an increase in *transactions risk* as a result of opportunistic behaviour by the other IoT providers further upstream and/or downstream the IoT stack, compromising on quality and agreed pricing (Grover & Malhotra, 2003).

It is evident that IoT providers that are able to vertically taper integrate into the IoT value chain will be able exploit future IoT opportunities, control and deliver value across the IoT value chain, gain competitive advantage, and become market leaders in IoT services and solutions, which will be empirically tested in the field study with experienced IoT practitioners across South African companies and industry verticals.

The field study enables the investigation of **a)** existing IoT business models and use cases across South African companies, and **b)** explore *vertical taper integration* across the IoT value chain as a candidate future IoT business model, capable of exploiting future IoT opportunities, by controlling and delivering business outcomes based value across the IoT value chain.

3.0. Method

3.1. Research Design and Paradigm

Given the nature and volume of IoT business models being utilised in practice today, an IoT business model of the future that can exploit future IoT opportunities emanating from billions of connected devices, will bring forth multiple and varying views from IoT industry practitioners. Thus, embracing the reality of differing views and subjective interpretations (Creswell & Creswell, 2017) regarding the blueprint of the candidate future IoT business model, a qualitative and interpretive research design was best suited (Creswell, 2009; Oates, 2006) for the field research.

Self-designed research instruments were utilised in order to enable detailed, in-depth, non-biased, non-distorted, non-restrictive, transparent and insightful (learning) dialogue on the research question pertaining to IoT business models, use cases and exploring *vertical taper integration* across the IoT value chain as a candidate future IoT business model.

There was an expectation that additional qualitative research questions would arise and subsequently, the exploration of previously unexplored IoT business model concepts, with the primary aim of further interpreting the research participants' responses and the meanings thereof within their context (Creswell, 2009; Oates, 2006).

3.2. Population and Sample

Given that IoT is a global emerging and disruptive technology, the target population of this research is also applicable to global IoT practioners, however, with the focus being on IoT providers in South Africa, it was important to target IoT practioners in South Africa with exposure and experience within emerging and disruptive technology, IoT in particular. Thus, adopting an interpretivism paradigm (Oates, 2006), between 10 and 15 IoT industry practitioners (hereafter referred to as “research participants”), from varying companies and industry sectors within South Africa, were directly engaged at their places of work or practice, in face-to-face interviews.

IoT industry practitioners were deemed as being experienced personnel in IoT, based on having been exposed to, at minimum, one of the following forms of IoT exposure:

- IoT client consulting engagements;
- IoT business development;
- IoT proof of value (POVs) pilots;
- IoT solution design;
- IoT solution development ;
- IoT solution implementation; and/or
- IoT managed services from edge-to-application.

The primary rationale for ring-fencing IoT practitioners under the abovementioned industry exposure criteria is due to the expectation that they had experienced and had been exposed to IoT business models, use cases and the IoT value chain/ technology stack in some shape or form.

3.3. Data Collection

This qualitative research (interpretive research) aimed at best to cover as many research participants as possible from an array of industry verticals prone to adopting IoT solutions. In preparation for the interviews, the interview schedule questionnaire and discussions points pertaining to (i) *IoT Industry Focus*, (ii) *IoT Business Models & Use Cases*, and (iii) *IoT Value Chain & Vertical Integration* were shared with the research participants ahead of time in order to afford them adequate time to review and reflect on the interview questions (Oates, 2006) – see *Appendix A.*

The qualitative research made use of the interviews and documentation as key research instruments, given their ability to unlock the required detailed, in-depth, non-biased, non-distorted, non-restrictive, transparent and insightful (learning) dialogue from the research participants, with the primary objective of adequately answering the sub problems and subsequently, the primary research aim pertaining to candidate future IoT business models for IoT providers:

3.3.1. Interviews

Individual 90 minute, face-to-face and semi-structured interviews were held with each research participant in order to avoid the risk of interview fatigue (Oates, 2006) from the research participants. Furthermore, these sessions were one-on-one sessions to avoid the risk of groupthink emerging from group-based interviews and subsequently distorting the true views of the research participant in question. Research participant permission was requested and explicitly acquired for the purposes of allowing the interview sessions to be recorded to assist in the comprehensive and accurate transcribing of the qualitative feedback provided.

An *interview protocol* data recording procedure (Creswell, 2009) was utilised during the interview sessions, by asking interview based questions and audio recording the interviews. Both verbal and non-verbal feedback (voice intonations and body language (Oates, 2006), articulated and observed, respectively, were documented as handwritten notes in real-time and the audio recordings were transcribed post the conclusion of each interview.

The transcribed audio recordings include additional informal notes related to the research participants' non-verbal language, the association to themes identified from previous interviews, and other discussion points taken into account without drastically deviating from the interview format and content (Creswell, 2009; Oates, 2006). Furthermore, to ensure standardisation in how the interviews were conducted with each of the research participants (in order to not unduly influence their responses in a certain way), *Appendix A* contains the interview questions posed to each research participant, in the same order and approach.

The benefit of using face-to-face interviews in relation to understanding IoT business models of the future pertains to the ability of the research participants to recall and relay historical, present and future use cases on how IoT has been embedded and utilised within the day-to-day operations or solutions of their companies or clients as IoT providers, and the business models thereof (Creswell, 2009). It also allowed the line of questioning within the interview to be driven by the researcher, based on the responses provided by the research participants (Creswell, 2009).

Challenges of using face-to-face interviews, especially with subject matter experts on disruptive technology and its application, may influence the richness and in-depth responses provided by the research participants, depending on whether they perceive the researcher as being knowledgeable enough to engage them at the practitioner level they (the research participant) may be accustomed to. Furthermore, there were some initial concerns related to research participants potentially not being able to sufficiently convey their thoughts on IoT business models, use cases and the IoT value chain, given their inability to adequately articulate themselves and their core perceptions on the topic (Creswell, 2009). However, none of the above challenges were experienced by the researcher during the interview sessions.

3.3.2. Documentation

Any representation of information that can be collected, stored and retrieved pertaining to IoT business models of the future, is deemed as a form of documentation (Oates, 2006) and was requested and utilised, with explicit permission obtained from the research participants. Documentation in terms of go-to-market collateral, sales guides, client presentations, infographics, operating models, commercial model s, digital transformation industry reports, recommended industry analyst reports, organisation websites, annual reports and any other physical or electronic material pertaining to IoT within the research participants' company, was requested and where provided, collected for in-depth analysis, transcribed, coded, themed and interpreted with the primary aim of answering the sub-problems and primary research aim related to candidate future IoT business models for IoT providers. Utilising the "Documents as Objects" (Oates, 2006, p. 236) approach, all documentation obtained from the research participants during the interview and research engagement process took into significant consideration the intention of the document, the intended audience, the author, the time period within which the documentation was produced, the relevancy of the document and the value add it provided in answering the sub-problems and the primary research question related to candidate future IoT business models for IoT providers (Oates, 2006).

All research participants were advised that all documentation shared as part of the research interview and engagement would be treated as confidential, would not make any references or inferences to them as research participants or their companies as IoT providers, and would only be used for the purposes of the research.

To ensure standardisation in how the interviews were conducted with each of the research participants, so as not to unduly influence their responses in a certain way, *Appendix B* contains the documentation requested from each research participant.

The benefit of using documentation in relation to understanding candidate future IoT business models for IoT providers pertains to the ability to gain access to standardised and organisation endorsed operating and business model content related to their IoT go-to-market value propositions and delivery models, in an unobtrusive and convenient manner (Creswell, 2009).

Challenges of using documentation, especially in relation to candidate future IoT business models for IoT providers is the potential inability to gain access to the requested artefacts being used by the research participants as practitioners in IoT, be it at their place of work or clients. Some documentation may also be incomplete, outdated and inaccurate, given the rate at which IoT as a disruptive technology has evolved over the years in its application (Creswell, 2009).

3.4. Data Analysis

Based on the raw qualitative data collected through the interviews, the transcribed audio recordings and the documentation provided, the inductive data analysis and interpretation was primarily focused on organising and preparing the data, reading through each of the transcripts, the captured inline transcript notes, and the documentation collected, with the aim of coding (using descriptive, value and in vivo (verbatim) codes), categorising, theming and subsequently interpreting the underlying themes, meanings and relationships thereof (Creswell, 2009; Saldaña, 2015), as depicted in Figure 2 *Future IoT Business Models: Qualitative Data Analysis - Codes, Categories, Themes and Assertions*.

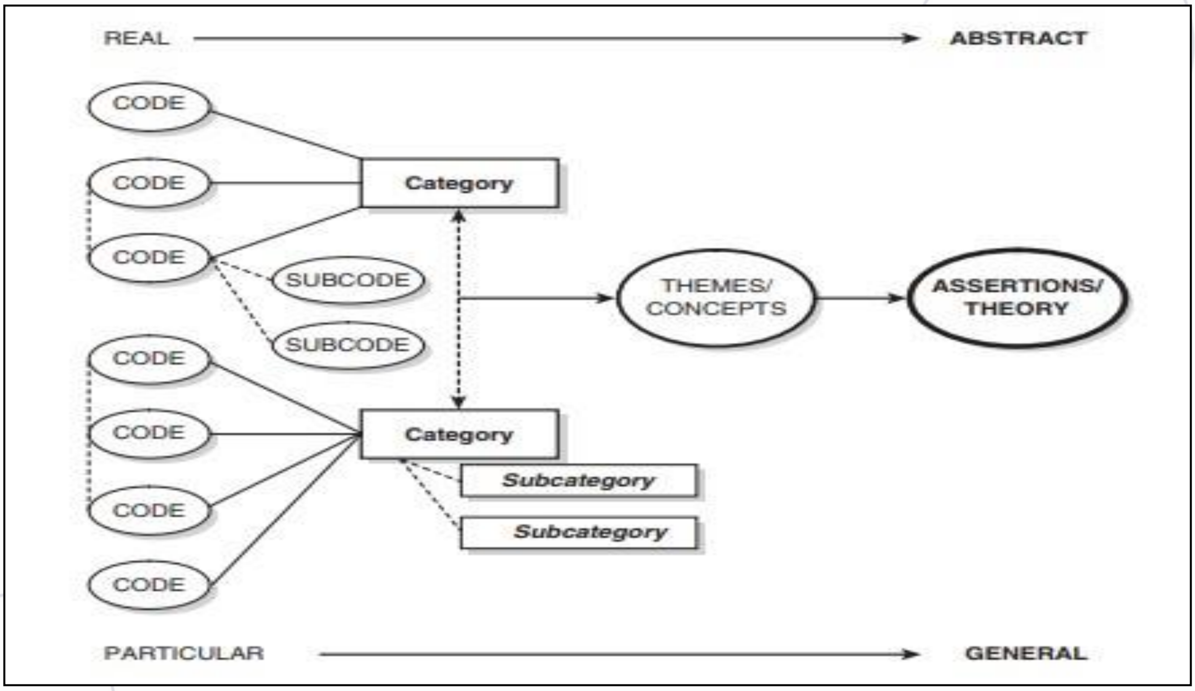

Figure 2: Future IoT Business Models: Qualitative Data Analysis - Codes, Categories, Themes and Assertions **(Saldaña, 2015)**

A *qualitative codebook* (Creswell, 2009) was utilised, making combined usage of predetermined codes emerging from the literature on IoT business models, and emerging codes from the interviews held with the research participants and documentation provided. Each of the predefined and emerging codes were named, a description provided, and overlaid on each transcript reviewed. This was an iterative process whereby the qualitative codebook was updated with each transcript analysed and retrospectively applied to transcripts which may have already been analysed prior to the emerging codes being identified, in order to ensure standardisation and completeness of application of the predetermined and emerging codes. See Appendix – C for the *Qualitative Code Book Template*.

3.5. fResearch Limitations

Competing Objectives

Given that (i) the researcher is at the centre of the qualitative research design as a key research instrument and (ii) that a subset of five of 15 identified research participants emerged from competing companies to that of the researcher, compromised the scope of companies that were covered. The scope of the companies covered in the research was limited due to the confidentiality concern raised by candidate research participants as a result of the researcher working for a competing company. However, a breadth of industry verticals was covered from the remaining 10 research participants interviewed, given their experience across multiple industry verticals in South Africa and globally.

4.0. Validity

Validity of the qualitative research and the findings thereof were ensured through (i) acquiring and triangulating several data sources through the interviews and documentation from several research participants; (ii) reflecting and commenting on the possible biases the researcher may have had in interpreting the data collected from the research participants, given the researcher's level of understanding and background on IoT; (iii) contradictory findings to the literature and the themes identified from the interviews were not dismissed, but rather understood and the merits thereof presented in the results and discussion; and (iv) the findings, the themes and interpretations of the research were tested with a fellow researcher (a peer debriefer (Creswell, 2009)) to assess the sub-problems and primary research aim against the data collected and the inductive analysis conducted.

5.0. Reliability

Reliability of the qualitative research and the findings thereof were improved through (i) the asking of clarification questions and the understanding thereof being played back to the research participant during the interviews held; (ii) ensuring transcribed scripts were accurate and reflective of the feedback provided; and (iii) that a documented and crosschecked *qualitative code book* was utilised during the coding process to ensure consistency on the application of the codes, sub-codes, themes and assertions.

6.0. Ethical Concerns

Company Transparency

Given that (i) the researcher was at the centre of the qualitative research design as a key research instrument and (ii) that a subset of five of 15 identified research participants emerged from competing companies to that of the researcher, the researcher's place of work was communicated up-front to those research participants working for competing organisations, who were advised not to present any confidential information which they were not comfortable to share, irrespective of the content being ring-fenced to the research project and confidentiality being ensured. This resulted in five of the candidate research participants withdrawing their participation from the research.

7.0. Results

Ten research participants, widely spread and experienced across the industry sectors of real estate, agriculture, mining, retail, and logistics, were engaged in structured and in-depth interviews held at their companies as IoT providers. It was evident from the in-depth and extended discussions held, that the distributed interview schedule (containing 15 open ended interview questions) was well received and perused in advance. The interviews triggered a plethora of varying and thought-provoking views on the emerging and disruptive technology of the Internet of Things (IoT), the business use cases thereof, the types of existing business models for IoT providers, and especially on *vertical taper integration* as a candidate future IoT business model for IoT providers delivering edge-to-application IoT solutions.

Figures 3 to 17 reflect the key results from the interview questions categorised into (i) *IoT Industry Focus, (ii) IoT Business Models & Use Cases* and (iii) *IoT Value Chain & Vertical Integration* sections, depicting the actual interview question asked, the coded responses and the subsequent themes and assertions thereof that emerged. The themes and assertions are further unpacked in detail in the *Discussion and Managerial Implications* section.

7.1.1. IoT Industry Focus

7.1.1.1. Internet of Things (IoT)

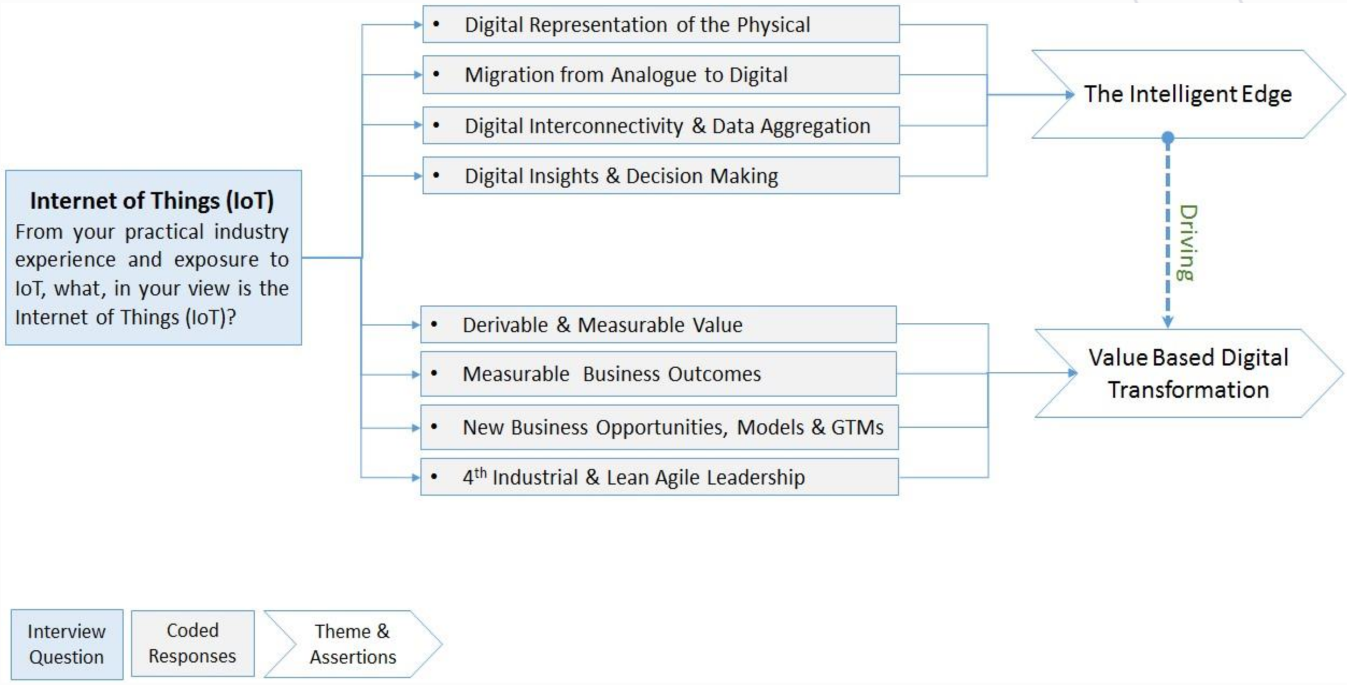

Figure 3: Internet of Things (IoT)

It was evident from the research participants' views that IoT was more than just the conglomeration of multiple sensor-based devices collecting and aggregating data, but that IoT was truly about creating a digital twin for our sensory perceptions about the analogue environments within which we live and work, by digitising the analogue**.** By digitising the analogue events of our environments would result in higher volumes of data driven, real time and value-based decision making from the edge right through to the application – *Migration from Analogue to Digital*. From an edge perspective, IoT was regarded as the act of transforming physical devices into smart digital devices – a *Digital Representation Of The Physical* - and through digital interconnectivity, creating a network of smart interconnected devices that are reliant on each other and intelligent enough to sense, measure and make decisions based on the external raw data events taking place within their natural environments – *Digital Interconnectivity and Data Aggregation*. It was further seen that the value gained from the network of interconnected smart devices was their ability to aggregate multiple event-driven raw data inputs for intelligent decision making at the edge through actuators, and delivering intelligent insights for decision makers – *Digital Insights and Decision Making*. Given the migration from analogue to digital, the intelligent capability of data collection, data aggregation and autonomous decision making at the edge by the network of interconnected smart devices, IoT from this perspective was deemed as the ***Intelligent Edge***.

With aggregated data generated from the ***Intelligent Edge***, decision makers are in a better position to translate the aggregated data into information, insights and subsequently, into value based decisions driving internal efficiencies (e.g. cost efficiency, workforce efficiency) and exploiting new opportunities (e.g. new products and services, new business models and new GTMs (Go-To-Markets)) for companies – *Derivable and Measurable Value, New Business Opportunities, Models and GTMs*. For IoT to drive a competitive advantage within the company (the IoT provider), IoT must be seen as addressing business outcomes and being an enabler of value creation, value delivery and value capture within the ambit of driving company relevance, survival, and demonstrable business value – *Measurable Business Outcomes*, as was evident in some of the research participants' views "*…it's (IoT) about addressing the client's business needs by resolving their business outcomes…and arriving with new answers to old questions… and arriving to more accurate answers, with measurable insights and decisions in order to drive business value…It (IoT) is a new way of doing business and many businesses struggle to incorporate IoT in order to drive Business Value and maximise the potential of IoT*." However, research participants were vocal about IoT being misplaced within their and most companies and as a result, foregoing the true value creation potential of IoT, "*…existing business models don't support digital transformation and IoT deployment within the business. Current business models will struggle to drive innovation and value on a consistent basis because of the way they are currently structured...*"

As a result, it was ***Value Based Digital Transformation*** which was regarded as the right vehicle to ensure that IoT was not being perceived as a cool technology or gadget but rather as an emerging and disruptive technology that is capable of providing new answers to old business outcome challenges, based on aggregated data from the ***Intelligent Edge***, and also about ensuring the right level of thought leadership is in place to ensure its growth and survival within the company's digital transformation journey, "*IoT is part of digital transformation and is very topical for digital transformation especially given its ability to drive new insights and create new value in the commercial and mercantile sense and also in terms of the quality of living…so what often happens is that Business look at IoT and think wow this can really help us, let's go out* *there and see what cool technologies are out there, and then they literally go off and try out cool technologies, forgetting that there's a bigger digital business transformation strategy required in order for it to converge into business value."- 4th Industrial and Lean Agile Leadership.*

7.1.1.2. IoT Industry Sectors

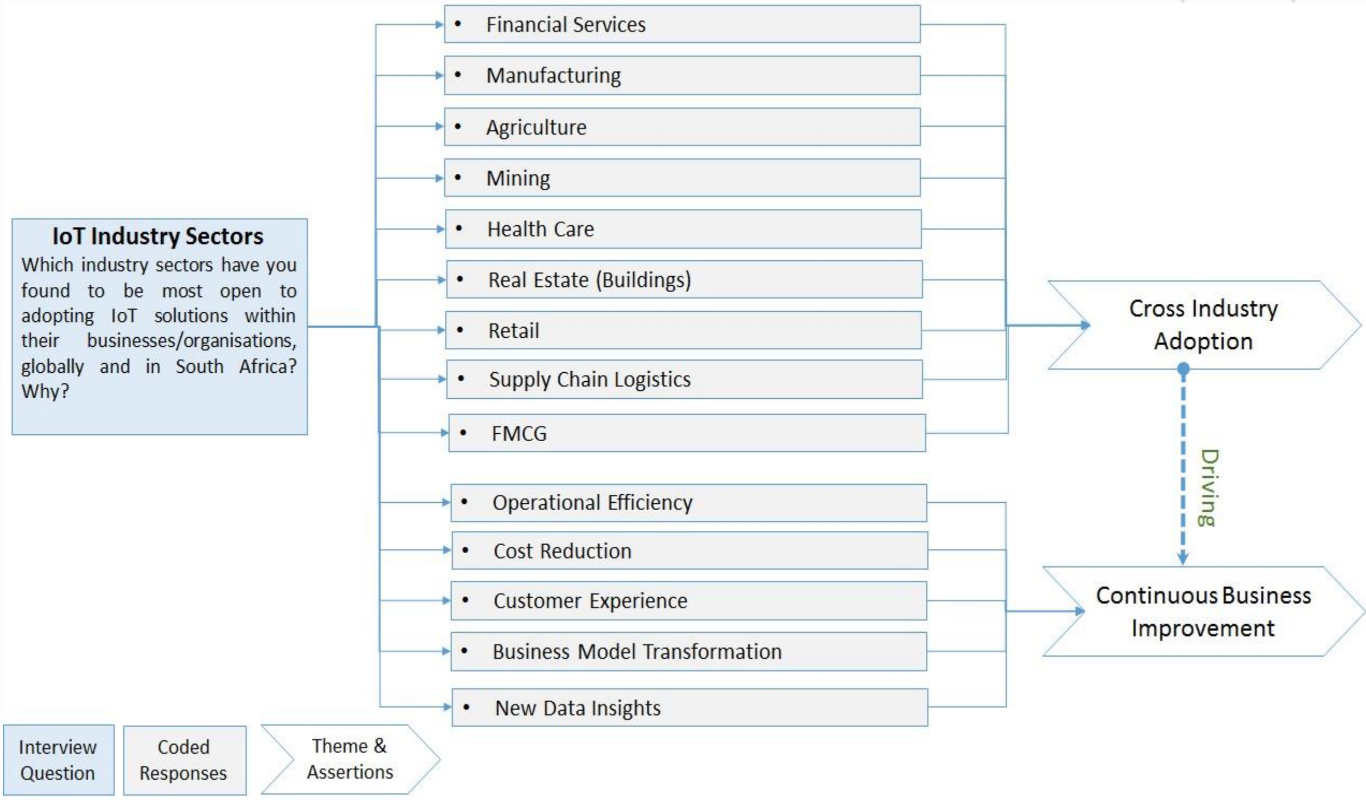

Figure 4: IoT Industry Sectors

Financial Services, Manufacturing, Agriculture, Mining, Health Care, Real Estate, Retail, Supply Chain Logistics, and Fast-Moving Consumer Goods came out as the industry verticals most prone to adopting IoT as a means of using emerging and disruptive technology to address their unique business outcomes per industry, globally and in South Africa – ***Cross Industry Adoption***. From a Manufacturing perspective, research participants were quick to highlight that the IoT uptake in Manufacturing was significantly larger in China, compared to the uptake in South Africa, but that was as a result of the limited knowledge on Manufacturing in South African, compared to that in China. It was believed that the adoption of IoT in Manufacturing would enable companies with proactive decision making abilities so as to drive operational continuous business improvement through operational efficiency, and cost reduction across people and machinery, as was highlighted by one of the research participants, "*…having visibility on people in a factory that are close to a disaster that I can foresee taking place, and machinery, heavy machinery that is expensive, and having visibility on when they need to be maintained is the* *true return on IoT in this context (Manufacturing)…One of the values of IoT is that If you can change your strategy from just-in-case to a just-in-time preventative strategy, you are allowing yourself to increase your operational profit without having to go and acquire new market share whilst balancing your risk”*

Agriculture was another industry seen to be having a large adoption in IoT in the form of connected Agriculture, primarily for better understanding and mitigating the environmental risks outside of their control. The absence of new environmental decision making insights can be detrimental to the life of their produce and subsequently, the commercial gains thereof, as indicated by one of the research participants when referring to the locus of control farmers should be enabled with via IoT, in that “*…scarce resources and large influencing factors such as pests, heat, and water, are out of their control, and the more data points they can collect the better they can actually plan and draw up models of information that didn't exist previously to best handle and mitigate risks*”.

Next in line to Agriculture, although not as large, was Mining. Mining was also regarded as an adopter of IoT, however, much like in Manufacturing, not as high when compared to global players in other countries, “*Mining's lagging in RSA but catching up because of the high value of precious metals and gem stones, as well as unethical side of the black market*”. From a Real Estate perspective, the focus was primarily on commercial property, plant and equipment, by ensuring that there is a significant return on (i) every square meter invested in - “*Smart Cities and Smart Buildings. Being able to monitor multiple data points across the city so as to provide rich data to make informed decisions on service delivery”*, (ii) on every Full Time Equivalent (FTE) invested in – “*…knowledge worker focus because it is expensive real estate in metropolitan areas and as a result, they (companies) need to maximise their return on investment in terms of having the right end-user collaboration tools and maximum floor space*”, and (iii) on every utility invested in – “*Managing utilities, optimising the costs (e.g. heating the building based on the number of people in the building, constantly right sizing, brand value and being green) be it across connected factories, smart buildings, and/or smart cities”*, as was mentioned by one of the research participants.

Finally, the Retail industry being so consumer focused and highly competitive, was another prominent and early adopter of IoT, primarily for driving informed and proactive customer centric “*hyper-personalisation*” engagements with consumers, reducing costs to drive profitability, and enabling a differentiated competitive advantage over its competitors – *“Retail – there is still a large footprint of brick-and-mortar stores with limited insights of client interactions inside store and retail engagement is now across multiple channels, making it difficult to maintain customer* *experience and monitoring channels with the best customer experience so as to retain clients, gaining insights into how successful they are in generating foot traffic past their stores, into their stores and then converting that foot traffic from a browsing customer to a purchasing customer –' hyper-personalisation' ".*

Irrespective of the industry vertical, one commonality amongst *Operational Efficiency, Cost Reduction, Customer Experience,* and *New Data Insights* that resonated with the research participants pertained to *Business Model Transformation* as a common reason for IoT adoption across each industry vertical; with the aim of driving ***Continuous Business Improvement.***

7.1.1.3. IoT Industry Use Cases

Figure 5: IoT Industry Use Cases

Unanimously, *Operational Efficiency, Cost Reduction, Revenue Growth* and *Informed Decision Making* were the dominant use cases for which companies adopt IoT. The rationale for these use cases, in particular, is because of their significant weight as business metrics linked to the financial performance of the company against which decision makers are measured. Therefore, it is predominantly these metrics, that truly leverage and apply the data collected, that key decision makers focus on when making business decisions related to market penetration, product development, market development and in speculative scenarios, diversification (Johnson, Whittinton, Scholes, Angwin, & Regner, 2017) , as was commented by one of the research participants in that – "*The most important uses case are however not related to* *information gathering, but to the utilisation of the information, where the interpretation of the information is used to affect real time business decisions.*"

Deviating from the dominant use cases, *New Product Development, Market Growth* and *Brand Value and Relevance* were the other use cases that were raised by the research participants. It was very clear that there was a golden thread that spanned all three use cases in that the insights gained from the aggregated and transformed data, led companies to develop new products and services for their markets, subsequently leading to product development and market penetration to which the end client benefitted – "*IoT is also being used for new product and new business process offerings. Insurers are using IoT to change their product offers but none of them are differentiators, both Telesure and Mi-Way releasing Early Detection, for consumers it is a gain because we are getting a better service for the same price*". In turn, product development and market penetration were viewed as key drivers of market growth, resulting in market relevant products and services being developed, and subsequently enhanced brand value and survival. Given the competitive nature of the industries mentioned earlier, survival of the fittest within the age of volatility, uncertainty, complexity and ambiguity, was a core theme that resonated with many of the research participants as clearly articulated by one participant in that – "*If my competitor is able to deliver a product more efficiently and on time better than I can do, and say I'm a retailer or manufacturer, then you are out of the game, because the economy is not going to slow down for anyone especially if your competitors have an SI to do these things and drive efficiency*." The IoT industry use cases of *Operational Efficiency, Cost Reduction, Revenue Growth, Product Development, Market Growth, Brand Value & Relevance,* and *Informed Decision Making* were collectively deemed as enabling and ensuring ***Business Continuity***, especially for 21st century companies operating within the age of emerging and disruptive technology – the 4th Industrial Revolution.

7.1.1.4. IoT Opportunities from Multiple Connected Devices

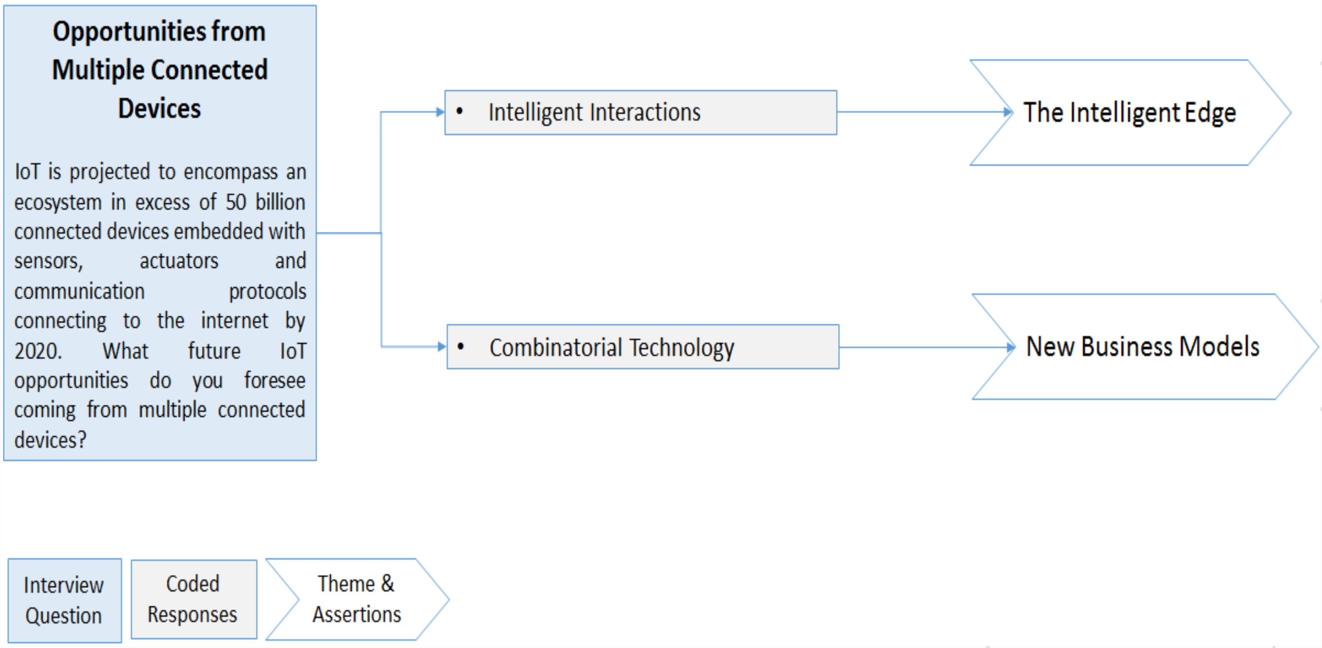

Figure 6: IoT Opportunities from Multiple Connected Devices

Given the multitude of connected devices at the ***Intelligent Edge*** and the volumes of interactions between the smart edge devices, research participants were quick in identifying the enablement of Artificial Intelligence (AI) at the edge as a key opportunity. Artificial Intelligence at the edge would result in what they referred to as intelligent edge interactions taking place without any human stimuli, as mentioned by one of the research participants in that "*there will be an increase in the intelligent interaction between the physical edge devices through AI at the edge, because as AI and predictive learning mature, you can push it to the edge; where devices will talk to each other without being prompted by human involvement*." Another participant referred to AI at the edge as "*driving dynamically joint decision making.*" AI would be further supplemented through better processing and computational power at the edge through Fog computing, which in turn, would allow for the distribution of critical core functions like storage, communication, computation, local data analysis, decision making and application of services close to where the data is generated, as simplified by one of the research participants in that – "*Fog computing, is a high level of local processing closer to the edge and associated with the cloud sitting remotely with connectivity to the cloud but at the edge.*"

On the other hand, the opportunity emerging from combinatorial technologies (e.g. printing of blood tissues utilising 3D printing) was raised by the research participants. Their view was that combinatorial technologies result in new products and services, leading to new sources of data that can be exploited for insights and decision making, and subsequently new business models, *"So we have a breakthrough in materials engineering biotech and a breakthrough in battery technology, those two combined creates a perfect storm in user adoption in a product of some sort. It is also the new data points that emerge from combinatorial technology that will be the differentiating factor and a competitive edge that companies will have over their competitors."*

The potential value from the AI driven intelligent interactions at the edge and the exponential potential of combinatorial technologies, highlights the power of the ***Intelligent Edge*** and the opportunity for ***New Business Models*** respectively, for IoT providers to enhance omni-channel customer-centric interactions, improve consumer lifetime value and access new markets, as highlighted by one of the research participants, *"The future of IoT is shifting (i) to find ways of better serving customers using digital channels, driving loyalty and customer lifetime value; and (ii) transforming the business models – finding new ways of serving customers, gaining access to new markets, sustaining their businesses and maximising their market share and competitiveness."*

7.1.2. IoT Business Models and Use Cases

7.1.2.1. IoT Business Models and Use Case

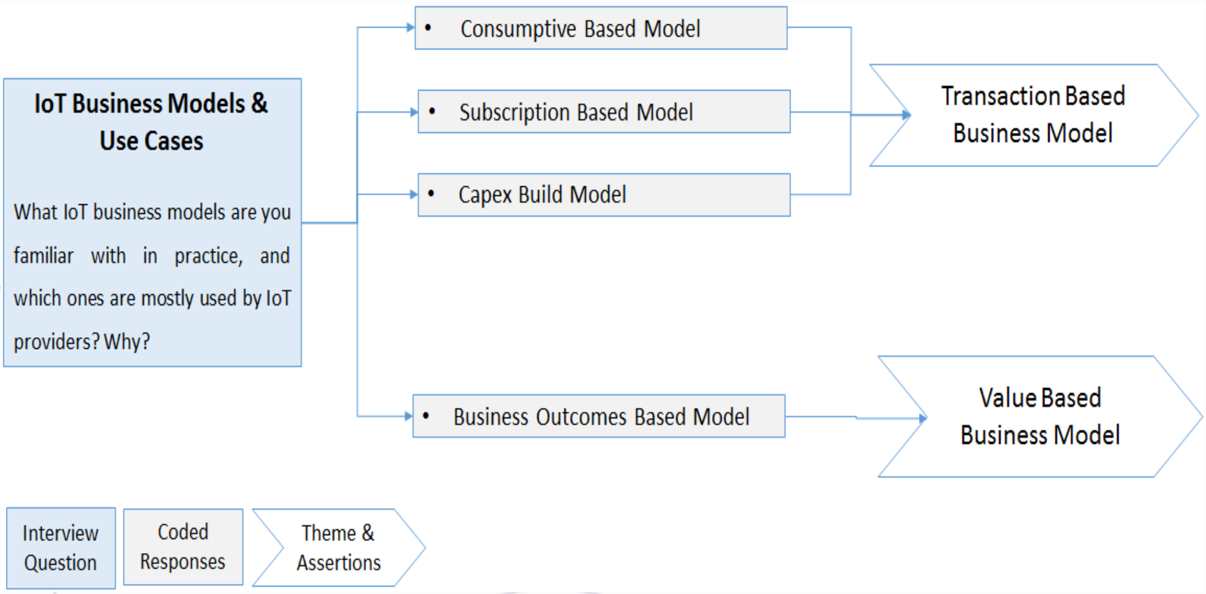

Figure 7: IoT Business Models and Use Cases

It was evident from the research participants' feedback that Business Models, for the majority of the IoT providers, was an afterthought as compared to the focus they placed on the IoT technology services they were providing. Given the varying views provided on Business Models, it was also evident to see that there was no outright IoT based Business Model for IoT providers, *"Business adopt technology faster than business models. Currently IoT is providing just better* *information to existing use cases. In future, information sources and insights will become commercial products…The service providers will adopt new models around insights and data trading".* However, given the newly chartered territory of understanding how IoT can deliver value against the company's needs, by successful delivering on the use cases discussed earlier in Figure 5 above, a *Consumption Based Business Model* for realising incremental value resonated with many of the research participants – "*In the early stages of testing the business value, the consumption model works best and is the key driver of incremental value realisation, and is also applicable to fast moving markets (e.g. the solution you put down today is not necessarily the one you will require in a year's time). If the data points are going to shift, then the consumption model is best.*" Based on the research participants' experience, the *Consumption Based Model* allows customers to consume IoT services in a manner which puts them in the driving seat to test, measure and adopt the value of IoT within their company. For IoT providers the *Consumption Based Model* works well when the economies of scale are present because the challenge with the consumption based model, as pointed out by the research participants, is that the IoT provider's monthly revenue is not predictable given that the customer is in control of which services and how much of them they consume.

The *Subscription Based Model* was highlighted as the next progressive business model and the most common business model for the provision of IoT services by IoT providers, especially for those IoT providers playing at the lower end of the IoT stack (e.g. physical devices through to connectivity). The *Subscription Based Model* provides the IoT provider and the client with predictable annuity-based revenue and service consumption costs respectively, "*If you can have an annuity-based income you don't have to worry about the budget for next year because it feeds itself…*". It was further highlighted that although there is a high level of predictability in revenue, IoT providers are aware that there are subscription based services which can be variable in nature when offering their IoT services and would need to be congnisant of that when pricing, "*subscription type service which is variable, you have a hosting services which is a combination of fixed and variable subscriptions.*"

The ***Capex Build Model*** was associated with a turnkey solution approach to building an end-to-end IoT solution for the client, from edge-to-application, in that the entire solution would be owned by the client. One of the primary reasons for this was that in circumstances where the client has a mature IT capability within their company, the customer prefers not to be locked in by third party vendors and as a result, wants to maintain ownership over the built IoT solution, "*Migrating from a Proof of Value to a full on turnkey solution. A client in a stagnant market wants to avoid* *vendor lock-in because the client can get rid of the System Integrator if need be and consult another or consume the services from Hyperscalers in AWS, Azure, and Google Cloud*." In contrast, one respondent indicated that the idea of a single IoT edge-to-application solution being delivered as a turnkey solution will not stack up for some time just because of the makeup of the IoT stack. Each function within the IoT value chain will be treated and charged as a separate line item which can be provided by one or more IoT providers, "*Therefore, the Business Model for IoT will for a long time remain a bill of charges across sensor, device, connectivity and not a turnkey solution, reflecting the stack. Which is why IoT is a GTM proposition and not a business unit, because if it was, then it would encompass the entire company. There's also the scenario where the client can dictate how they wish to have the service delivered to them but not necessarily having one company delivery the entire IoT stack but rather play companies off against each other across the different functions in the value chain because they know that by allowing a single player to provide the entire stack means that there is cross subsidisation and that they are not necessarily getting the best price possible, unlike putting IoT providers up against each other.*"

The *Business Outcomes Based Model* was deemed as the model with the most risk, the most reward and required the IoT provider to have an array of skills and capabilities across the IoT stack, especially at the platform and application layer, where most of the value is realised and consumed by the client. Respondents were of the view that the *Business Outcomes Based Model* is the most ideal model because of the ongoing and evolving managed advisory services that can be provided to the client as a result of the insights gained from the aggregated data, "*A lot of them (IoT providers) do understand that you do need to move towards the business outcome approach (which is critical) because the customer narrative reads like 'I don't have the skill to interpret the data, I don't want to buy tech, so come and advise me on how I should be changing. It is Business Outcomes Centric.".* However, very few IoT providers utilise the *Business Outcomes Based Model* because it is complicated to get right and deliver. The IoT provider would need to manage what is within their control and explicitly understand and demonstrate how it links back to the projected commercial gains and define performance KPIs with commercial value upfront. The additional challenge for the IoT provider in relation to the client is that very few clients would be open to showing them that direct linkage or would dilute the provider's service by indicating that other internal factors within the company's control also contributed to the commercial gains. The *Business Outcomes Based Model* also requires performance contracting between the IoT provider and the client in order to ensure that whichever amount of incremental value delivered by the IoT provider, that they take a percentage of the commercial gains realised therefrom. However, the respondents indicated a very valid point in that being able to link the commercial gains directly to the IoT provider's edge-to-application solution has been a contentious matter, "*Performance Contracting is implemented by measuring a customer's baseline and further implementing the right technology and services to reduce your energy cost or drive savings. After the value is delivered and realised, we'll take a percentage of that saving but there are so many factors that are outside of your control which can influence the outlined performance metrics. E.g. Energy Consumption*".

The *Consumption Based Model* and *Subscription Based Model* were predominantly associated with the tail end of the IoT value chain, from the physical devices through to the connectivity layer, with the exception of the *Capex Build Model.* The *Capex Based Model* was associated with the entire IoT value chain/stack. However, all three business models were transaction-focused and as a result, were classified under the category of ***Transaction Based Business Models***. **The *Business Outcomes Based Model*** was predominantly associated with the upper end of the IoT value chain/stack, from platform to applications and as result, was classified under the category of ***Value Based Business Models*.**

7.1.2.2. Existing IoT Business Models for Cross Value Chain Delivery

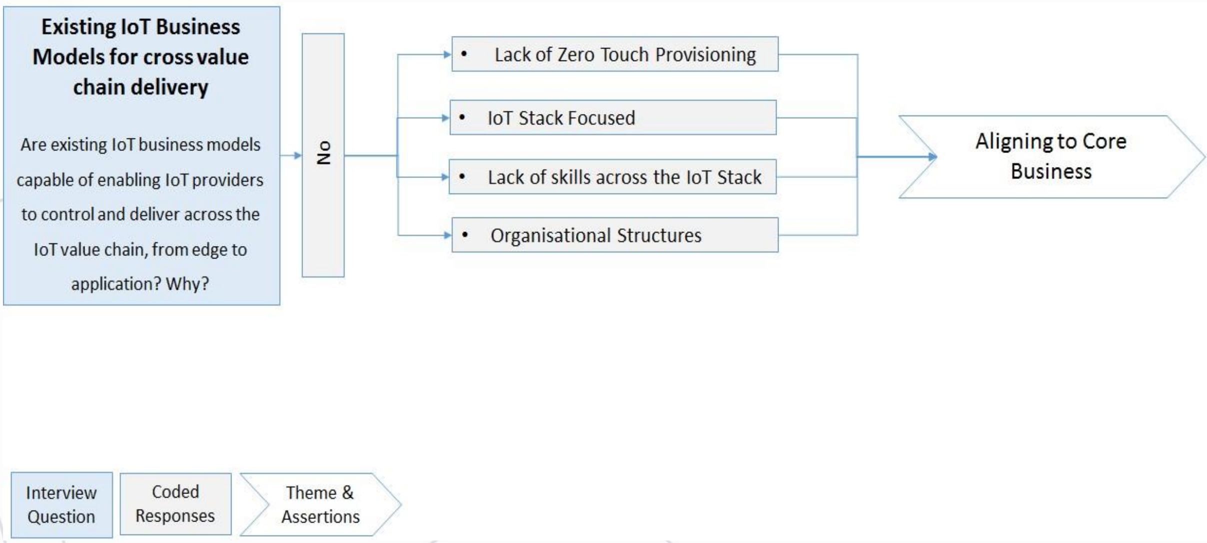

Figure 8: Existing IoT Business Models for Cross Value Chain Delivery

From their experience, the research participants were very quick to signal that no existing IoT Business Model was capable of enabling a provider to control and deliver across the IoT value chain from edge-to-application. The core reasons provided by the research participants related to:

i. **Lack of Zero Touch Provisioning:** the lack of Zero Touch Provisioning across the thousands of sensors sitting at the edge. There is a lifecycle involved in terms of managing them, deploying, updating the firmware, and ensuring that they are powered up. The sensors tend to push the risk of the edge to the client's IT Department because of the Lifecycle Management of the sensors. It is the lack of field services ownership and because most of the time, the client's tech-savvy personnel are normally not at the edge or where the sensor is. Thus, the design needs to be of such a nature that you can get the sensor in the hand of the customer who is at the edge and simply place and on-board it. Zero Touch Provisioning is key to ensuring plug and play sensors into an IoT ecosystem as was indicated by one of the research participants in that "*You would need to fit into the service provider community that already exists within that community. Your physical product needs to be positioned in such a way that the client can contact an electrician to conduct the physical wiring without compromising the network of data. It is about re-using the field services within the geographical location*".

ii. **IoT Stack Focused:** current IoT incumbents are focused on parts of the IoT stack by selling in pockets across the stack and not end-to-end across the stack. Few IoT providers are taking control of the end-to-end IoT value chain, are predominantly comfortable with selling across parts of the IoT value chain/stack as their business model and are still realising good revenues and margins from it**.**

iii. **Lack of Skills Across the IoT Stack:** given their identified focus on parts of the stack and the good margins being realised, existing IoT providers have not expanded their core businesses by investing in additional competencies that would allow them to play further up the IoT stack. As a result, they do not have the required skills to play across the IoT value chain/stack, from edge-to-application.

iv. **Organisational Structures:** current IoT providers' company structures have not been designed to cater for end-to-end delivery across the IoT value chain as yet, hence their level of comfort and capability is in providing IoT products and/or services in portions of the IoT value chain and not across it, from edge-to-application.

Based on the contributing factors provided by the research participants of *Zero Touch Provisioning, IoT Stack Focus, Lack of Skills across the IoT Value Chain/Stack* and the Organisational Structures, IoT providers are predominantly focused on horizontal integration where they focus on a particular vertical of the IoT stack. As a result, this can be deemed as IoT providers aligning themselves to their core business for the time being – ***Aligning to Core Business***.

7.1.2.3. Cross IoT Value Chain Business Model Challenges

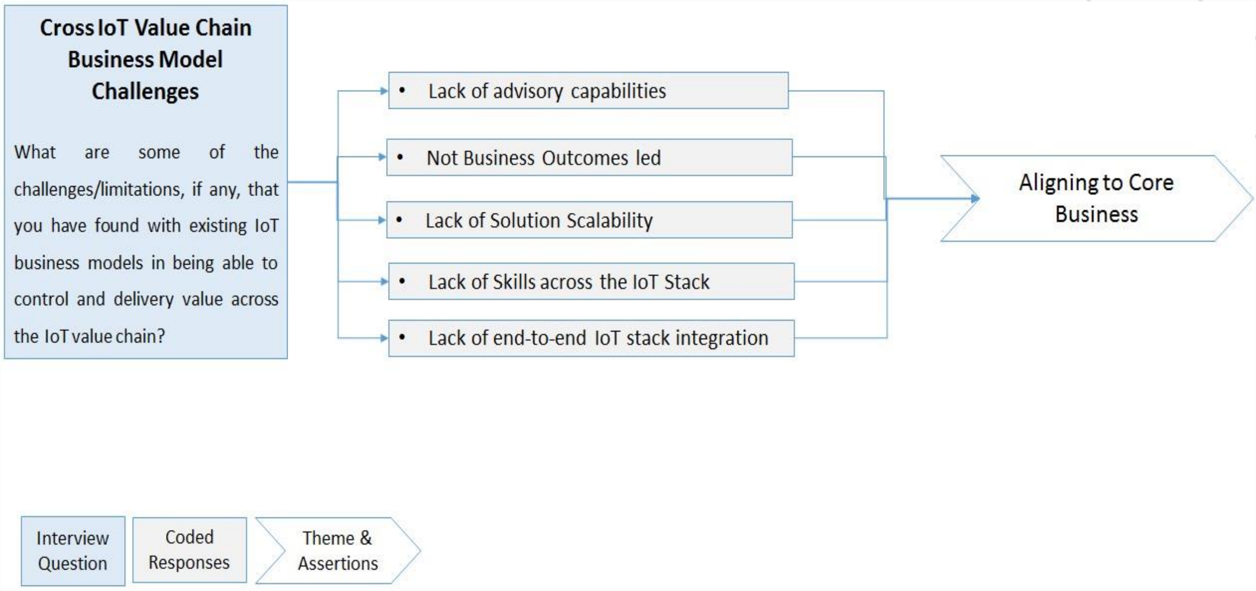

Figure 9: Cross IoT Value Chain Business Model Challenges

The *Lack of Advisory Capabilities*, the *Lack of IoT Providers Being Business Outcomes Led*, the *Lack of Being Able To Scale* the IoT solutions beyond a single engagement, yet again, the *Lack of Skills Across the IoT Stack*, and the *Lack of End-To-End Integration into the IoT Stack*, were the predominant factors identified by the research participants. Of the challenges identified in Figure 9 above, *Lack of Advisory Capabilities* and *Lack of IoT Providers being Business Outcomes Led* resonated more with the research participants. From an advisory capability perspective, it was with regard to the lack of advisory elements on the data gathered and the generation of insights to the extent required by clients, *"the value is added by providing advisory services, however, that value decays and becomes stale at some point in time because the client also starts to interpret the data and does not require you to always come and interpret the data. The conundrum lies in keeping that advisory service evergreen, you need access to new data points and insights…".* From a business outcomes led perspective, it was mentioned that the existing IoT Business Models are not value driven or business outcomes led and as a result, they have no need to encompass or own the end-to-end value, *"So they end up providing once off services using a cost plus margin business model, irrespective of whether the client has received value or not."* Yet again, IoT providers are aligning their Business Models to their core business and have not put capabilities in place to deliver across the IoT stack because the focus of their business models are not business outcomes led or value focused – ***Aligning to Core Business***.

7.1.2.4. Internal Organisational/Business IoT Business Models

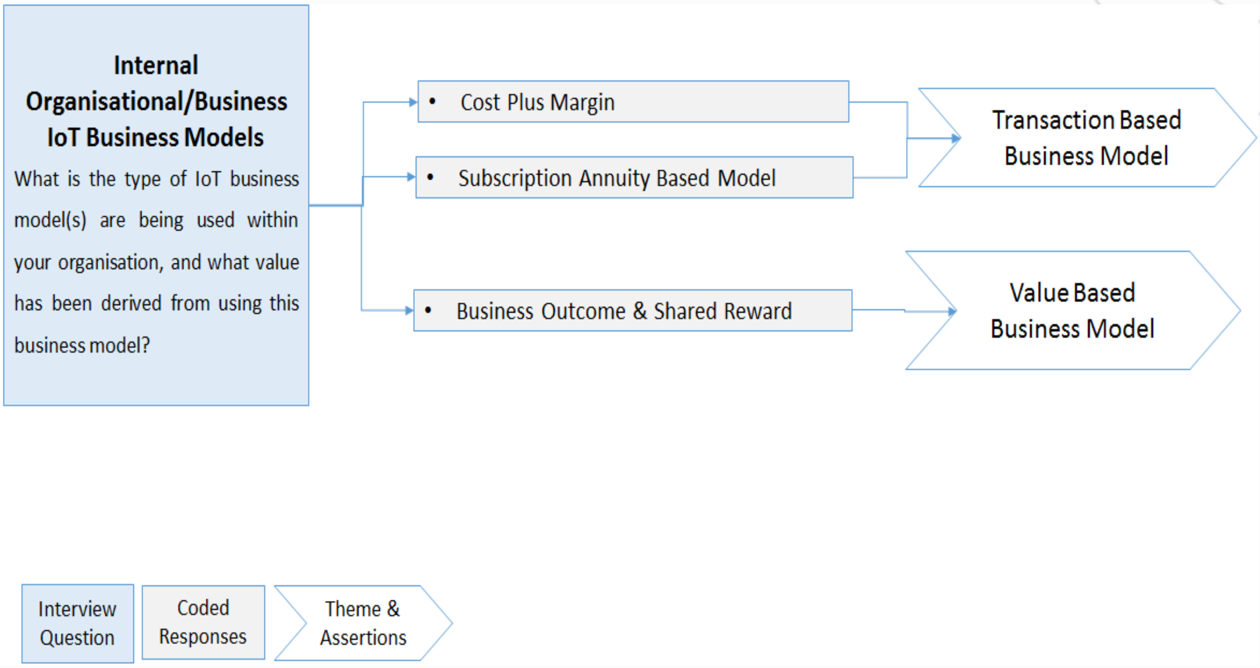

Figure 10: Internal Organisational/Business IoT Business Models

The majority of the research participants indicated that their companies, as IoT providers, utilised a ***Transaction Based Business Model***, varying between the *Traditional Cost Plus Margin Model* and the *Subscription Annuity Based Model*, depending on the type of IoT service they were offering and where in the IoT stack they played. Research participants were of the view that the *Traditional Cost Plus Margin* was applicable to their core business as an IoT provider and still provided good margins, "*Cost Plus is not the most effective model given the opportunity cost lost along the way. However, Cost Plus is still paying heavy dividends and as a result, a business model across the end-to-end IoT Value Chain could break the business because we are not architected in that manner*." In terms of the *Business Outcome and Shared Reward Model,* there was one participant who indicated that because of their co-creation and co-innovation with the client, they were able to have the discussion regarding shared reward and shared risks in terms of a performance measured business outcome based delivery, and that it was challenging, yet showed great margins. Great margins because they were able to control their input costs across the stack because of their vertical integration across the entire IoT stack, "*Our strength is in the ability to deliver an edge-to-application service. Our capability is our ability* *to deliver across the entire stack and deliver business outcomes that are measurable. You must also craft the edge-to-application solution via co-creation and co-innovation with the client. It is very much solution dependent, however, we both share the risk and reward with the client based on the business outcomes led and shared reward model.*"

7.1.2.5. IoT Business Model Capabilities

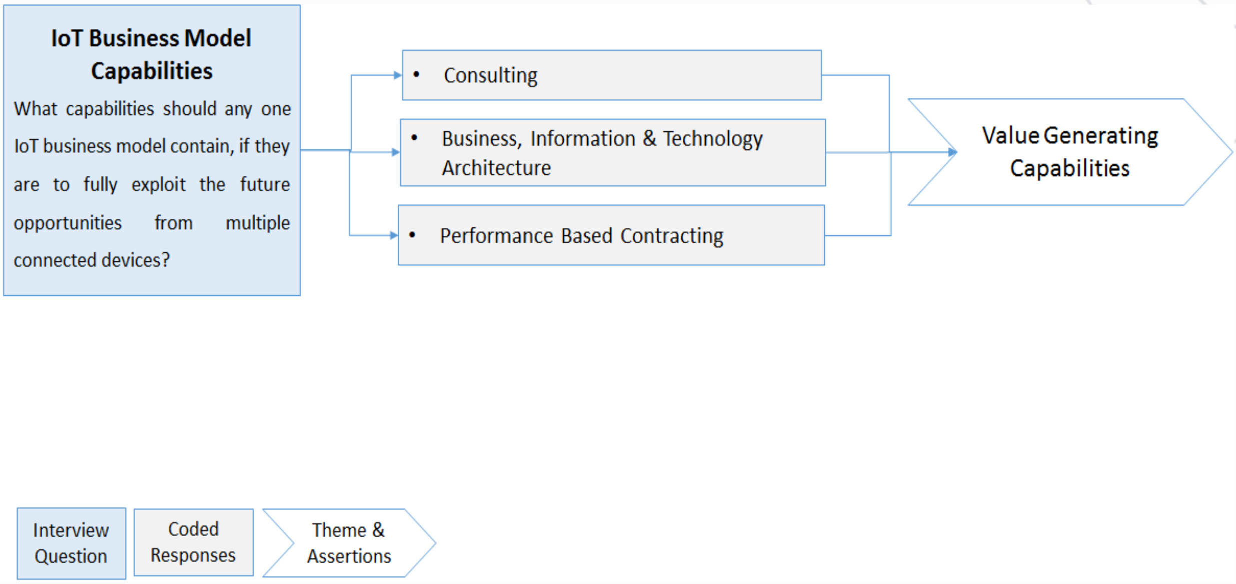

Figure 11: IoT Business Model Capabilities

The research participants highlighted a *Consulting* capability, a *Business Information and Technology Architecture* capability and a *Performance Based Contracting* capability as the key ***Value Generating Capabilities*** any IoT Business Model should have to fully exploit future IoT opportunities from an ecosystem of multiple connected devices. *Consulting* was further explained in that "*you need the constant consultative engagement to identify business value that can be unlocked and translate that into either people process and/or technology. The advisory services need to be able to derive insights for that client specifically based on their data and also use benchmarking data that they collect out of their customer pool to provide comparison against competitors in South Africa and globally*."

From a *Business, Information and Technology Architecture* perspective, it was about having the ability to design the technical architecture, the application architecture, and the business architecture from edge-to-application. Having the analytical, integration, and domain knowledge of the client's core business and "*fulfilling against the IoT Stack capabilities, having the ability to have devices talk through connectivity to edge compute, to data accumulation and abstraction, eventually into the application and then into collaboration and business outcomes*."

Performance Based Contracting was regarded as having the capability to manage the data effectively by deploying analytics on top of the data to derive insights and ultimately being able to develop cloud first applications to present the findings related to the metric based and measured Business Outcomes. *Performance Based Contracting* would also ensure that specific, measurable, accurate, realistic and time bound objectives are put in place to easily link all of the benefits realised back to the IoT solution deployed by the IoT provider, as was highlighted by the research participants.

7.1.3. IoT Value Chain & Vertical Integration

7.1.3.1. IoT Value Chain

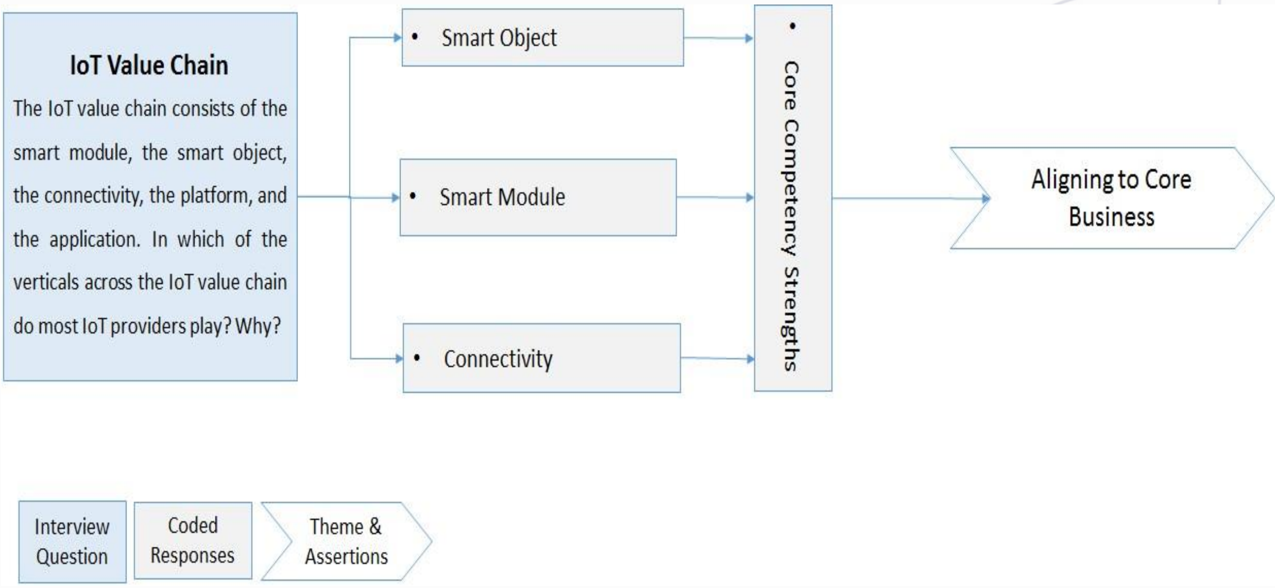

Figure 12: IoT Value Chain

Based on their experience, the research participants were of the view that the majority of IoT providers are operating within the smart module, smart object and connectivity layer of the IoT stack. The rationale for operating at the lower end of the IoT stack is driven by the providers' understanding of IoT, where IoT starts and ends for them, requires minimal capital expenditure investment, and as previously mentioned, requires less of a complex set of competencies and capabilities because, *"most providers are playing from a position of comfort and strength. The competencies required to move further up the stack requires higher level competencies and skills which very few players can actually deliver on and also deliver against the entire stack. Many new providers don't have the ability to scale and the economies of scale to deliver against the entire stack."* Furthermore, it was also viewed that new technology is constantly coming out with regard to visual capabilities and chips, and because there are thousands of physical devices that require digitisation, in the device and sensor market the IoT provider can sell you a product and walk away because the sensor market is a commodity and fast moving market.

Yet again, IoT providers are operating from a place of strength, a place of their own understanding of IoT and as a result, are aligning their strengths and capabilities to their core business – ***Aligning to Core Business*.**

7.1.3.2. IoT Value Chain Verticals (Stack Functions)

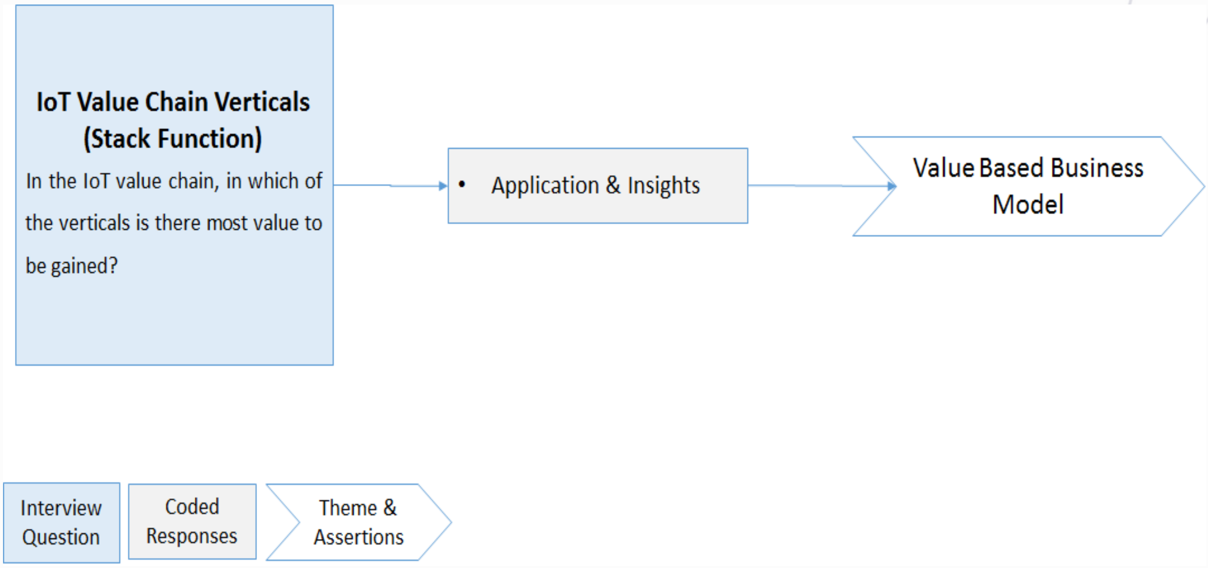

Figure 13: IoT Value Chain Verticals (Stack Functions)

It was overwhelmingly evident that every vertical function within the IoT value chain from the smart device right through to the platform was deemed as a commodity and as an enabler for the application layer, where all of the key customer insights are derived for value-based decision making. Furthermore, the research participants all saw the application layer as the catalyst in the ***Value Based Business Model***, *"from an application layer, you can move away from an effort-based model to a value-based pricing model. It can take me 2 days to develop an insight that saves a company R30m, so do I charge for the 2 days effort or a percentage of savings? The value-based model is unlocked through the applications layer."*

The research participants pointed out that the most value delivered and perceived by the client is at the application layer - data management, analytics and applications. The rest of the stack is becoming commoditised and becoming a lot more competitive with the entrance of many IoT providers, resulting in reduced and tighter margins. However, in the application space, there is less competition, and as a result existing IoT providers in the applications layer are driving the business outcomes and are able to see higher margins given the minimal number of providers within this space. However, the application layer requires the rest of the stack to be in place to fulfill its business outcomes-based purpose.

7.1.3.3. *IoT Value Chain Competency*

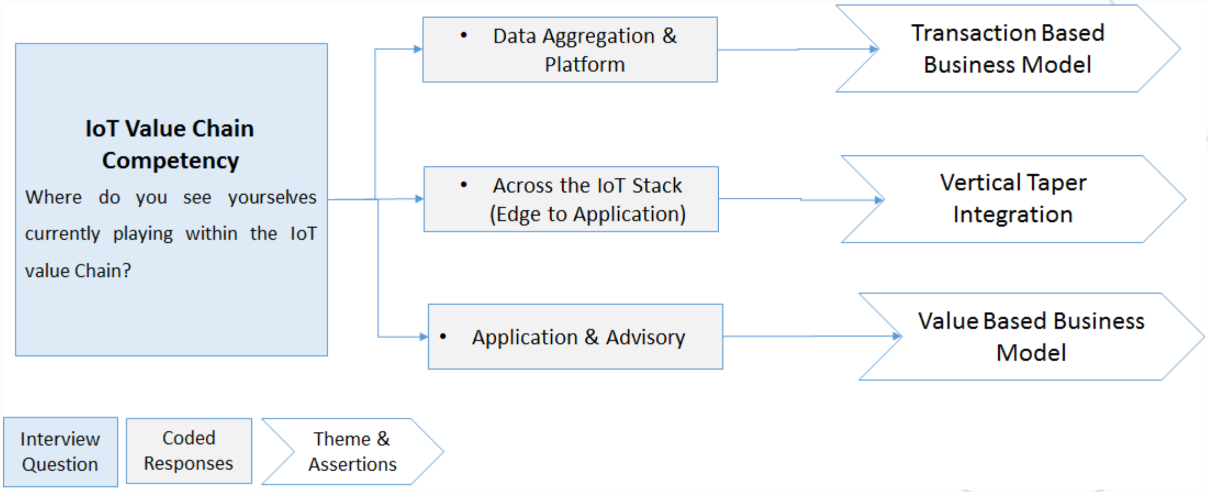

Figure 14: IoT Value Chain Competency

Data Aggregation and Platform, *Edge-to-Application* and *Application and Advisory* were the common verticals of the IoT value chain that the research participants reflected they were operating within as IoT providers. Of interest, was the one participant who indicated that they play across the entire IoT value chain/stack from edge-to-application and given their maturing capabilities, have vertically integrated into every layer of the IoT value chain, however, for the commoditised part of the IoT value chain, they have partnered with other IoT providers for which that function is their core business, "*Across the entire value chain, however, we may contract with other partners to deliver on some of the functions within the IoT stack but are the client's single point of contact and accountability, and choosing the right services providers and technology partners. Most of our partnerships will be within sensor, device, network and the platform.*" Another research participant t also reflected that they operate across the entire IoT value chain but realise that the most value to be realised is at the applications layer, "*We play across the entire stack, however still lacking on the application and advisory services even though we are building out and strengthening the capability. Application and analytics leading to value added business outcomes*."

7.1.3.4. IoT Value Chain Participation

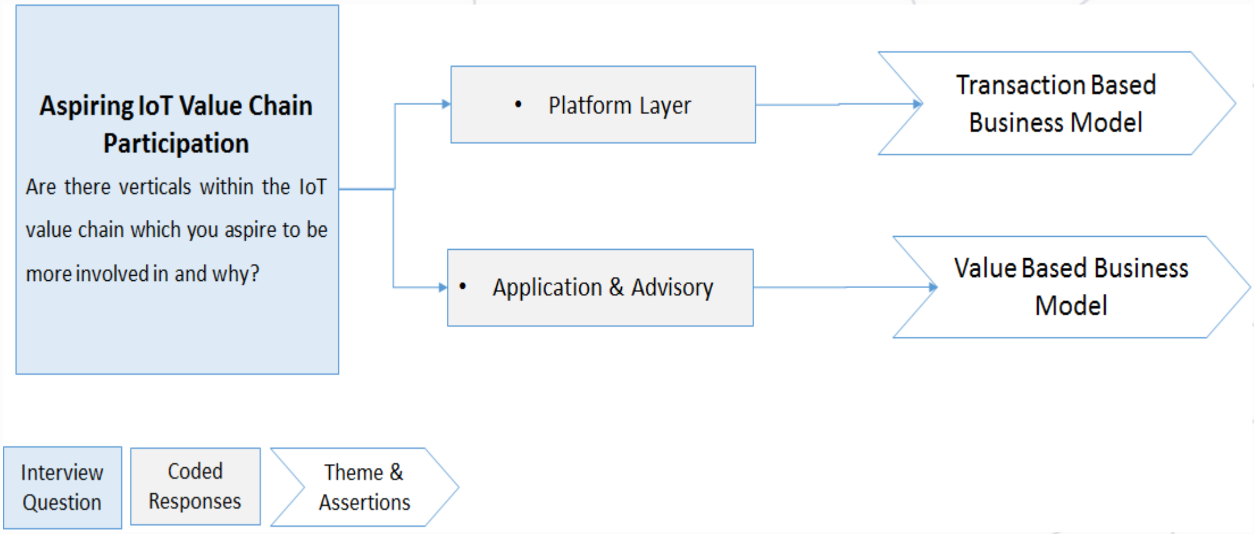

Figure 15: Aspiring IoT Value Chain Participation

It was interesting to see the varying responses regarding the aspirations to participate in the platform layer and the application layer. For those IoT providers operating within the lower part of the stack from the physical devices to the connectivity layer, the platform layer was the next layer of the IoT value chain they aspired to operate in and the same for the IoT providers operating within the platform layer, they wished to move further up into the application layer. Device and sensors players felt that operating at the platform layer was a natural progression for them further up the stack and would provide them with a new service offering and value proposition, "*Platform. Our value proposition would be stronger if we provide a platform that offers integration of a wide range of information elements and provide integrated business insights*." Platform providers were of the view that to further augment the outputs of their platforms, the applications layer would deliver the real value the client would be looking for in order to drive the use cases discussed earlier on in Figure 5 (*IoT Industry Use Cases*) and that the margins at the application layer were much higher, given the outcomes and performance based contracting that would take place, "*Application Layer, focused capability on data analytics, advisory and business consulting…because that's where the real value lies and the margins are better.*"

7.1.3.5. IoT Value Chain Vertical Integration Business Model

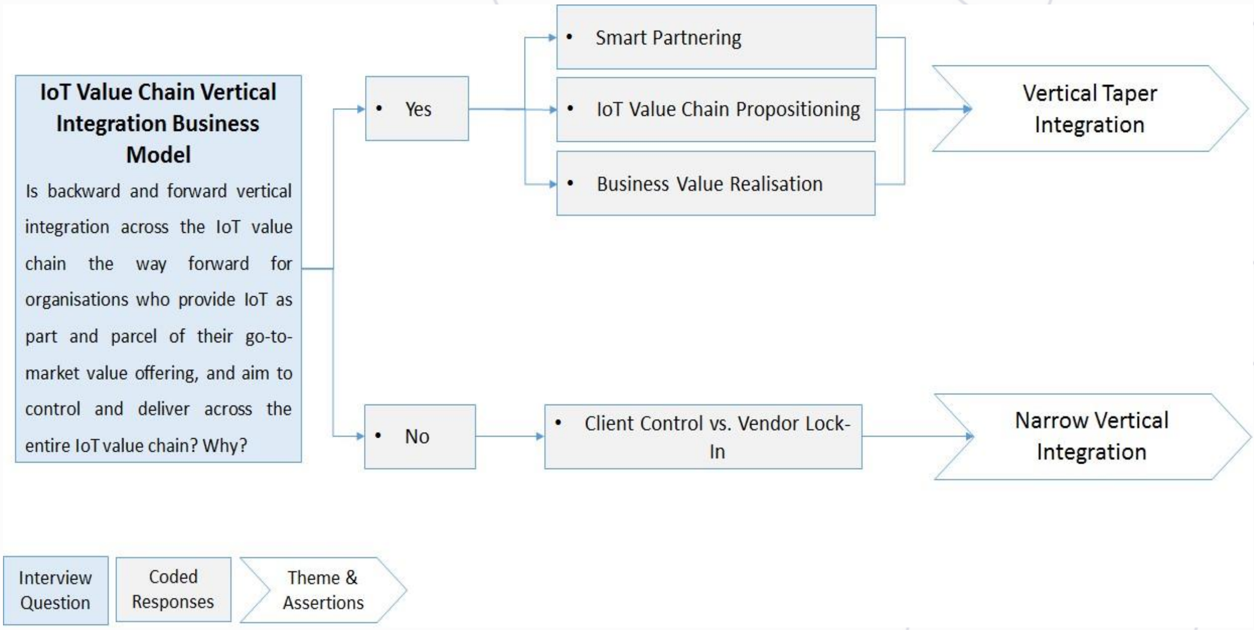

Figure 16: IoT Value Chain Vertical Integration Business Model

Research participants were of the view that IoT providers aiming to control and deliver across the entire IoT value chain had to keep in mind that their responsibility is about the transformation of their clients business; by generating new insights and answers to business outcomes based questions, and adequately driving client-centric value delivery at the application layer. As a result, partnering with key IoT providers further downstream or upstream the stack and having adequate decision-making authority on the services provided thereof was imperative, which was deemed as *Smart Partnering*. From an *IoT Value Chain Propositioning* perspective, the IoT provider is delivering a turnkey solution as part of their value proposition and is accountable for the business outcome (depending on the contractual agreement terms and conditions), and as result, needs to control all of the vertical functions within the IoT stack, *"Yes, absolutely. That is our value proposition, having the ability to talk across the entire stack."*. However, one research participant indicated that the edge-to-application IoT provider must be mindful of trying to control the bottom end of the IoT value chain, "*having said that, many value chain elements are becoming commodities, to "control" could be limited. For instance, connectivity via 3G does not imply that the solution provider needs to provide its own 3G service*." From the business value realisation perspective, the research participants were very clear that if you are able to provide across the entire stack, it means that the IoT provider has a much better chance of delivering against the business outcomes stipulated by the client because they are responsible and have the capability to control the entire value chain. "*It is critical, and you must have good knowledge* *across each vertical. Very few companies are able to do that today. There is a risk that you become less agile, so it's key to balance scale, economies of scale with agility across the entire stack."*

There was however, one research participant who strongly disagreed with backward and forward vertical integration across the IoT value chain. They were of the view that although cross IoT value chain vertical taper integration may sound like a compelling value proposition and a story to tell, it is not. From the client's perspective, the participant was of the view that the client may not be comfortable with an IoT provider delivering and controlling the entire value chain, and as a result, the client would want to break it up because the IoT stack logically allows the client to do that. It also gives the IoT provider too much power, and clients do not want that over themselves, "*providers will start to focus rather on the high value end functions further up the stack, as client's can easily procure the rest of the stack given that it is commoditised. And if the impact is going to be so massive, the client would rather do the high-end value items in house and outsource the bottom half of the IoT Stack."*

7.1.3.6. Vertical Integration for Future IoT Opportunities

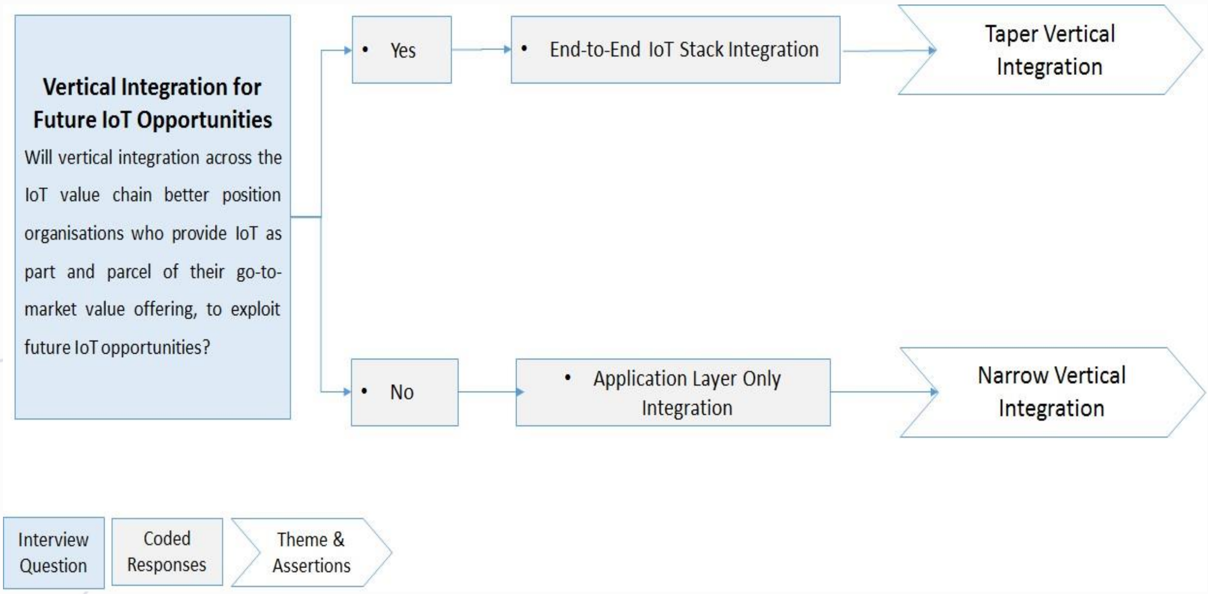

Figure 17: Vertical Integration for Future IoT Opportunities

In closing, all of the respondents, with the exception of one, were in agreement that end-to-end *vertical taper integration* into the IoT value chain was a competitive game changer, given that the IoT provider would be able to exploit any opportunity and a business outcomes-based discussion anywhere across the value chain, be it from the smart device right through to the application layer, "*If you get the entire IoT stack correct, then you can have a discussion starting anywhere across the stack because you are setting yourself apart from thousands and* *thousands of providers providing vanilla platforms and are able to derive that business value at scale and at decent margins."* The research participant who was in disagreement, indicated that given how commoditised the lower end of the IoT stack already is, vertically integrating into it would not be of great value. Margins would need to be compromised, given the high degree of competition and because of the client being in control, given their ability to put providers up against each other at a reduced cost to procure the service, "*I don't think it is a necessity because the value sits in the upper part of the IoT value stack and single stack players can also exploit opportunities, when they are closer to the business insights layer.*"

The following key and interconnected themes mentioned above, and the assertions thereof, emanating from the interviews held with the IoT industry practitioners, are depicted and discussed in detail by the researcher in Figure 18 - *IoT Vertical Taper Integration Business Model,* under *Discussions and Managerial Implications.* Furthermore, it is key for managerial decision makers to understand how these interconnected themes drive edge-to-application value delivery through *vertical taper integration*:

- *The Intelligent Edge,*
- *Value Based Digital Transformation,*
- *Cross Industry Adoption,*
- *Continuous Business Improvement,*
- *Business Continuity,*
- *Aligning to Core Business*,
- *Transaction Based Business Models*,
- *Value Generating Capabilities*,
- *Value Based Business Models*, and
- *Vertical Taper Integration.*

8.0. Discussion & Managerial Implications

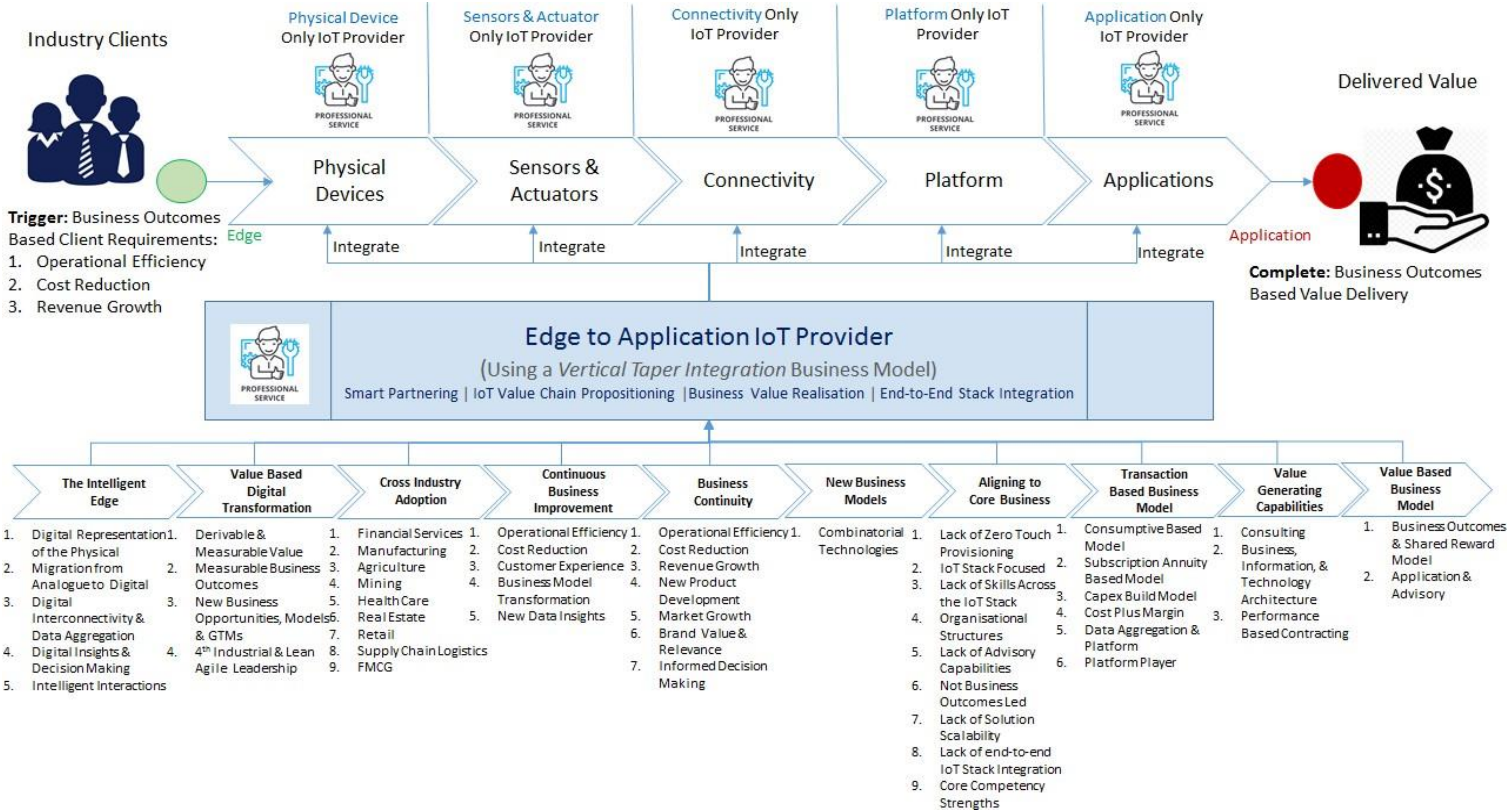

Figure 18: IoT Vertical Taper Integration Business Model

South African and global business leaders of 21st century companies are on a daily basis, challenged with making the right decisions, at the right time, with the information available to them, in order to deliver high performing, profitable and sustainable businesses in the midst of disruptive markets, as well as emerging and disruptive technologies (Lüttgens & Diener, 2016; Schwab, 2016; Turber & Smiela, 2014) such as the Internet of Things (IoT). For an edge-to-application IoT provider, *vertical taper integration*, as depicted in Figure 18 – *IoT Vertical Taper Integration Business Model*, serves as a key catalyst and business model that is capable of delivering the business outcomes based value, however edge-to-application IoT providers must acknowledge and appreciate that it all starts with *Big Data* right at the *Intelligent Edge.*

With *Big Data* regarded as a new economic asset, likened to that of a new currency (Chen et al., 2014), the profitability thereof can only be realised through the *Intelligent Edge* of IoT, being the data collection, the data aggregation and the autonomous decision making at the edge by the network of interconnected smart devices, instantiating intelligent AI driven interactions within an ecosystem, with the primary aim of enabling near real-time decision making. Business outcomes-based decisions are predominantly focused on realising the value creation, the value delivery and the value capture for the company and its clients within the ambit of a *Value Based Digital Transformation* engagement and journey. Consumption of IoT outside of a *Value Based Digital Transformation* journey will in the majority of cases be treated as a shiny new gadget and technology, rather than as a transformative disruptive technology that is capable of deriving new answers to old business questions, given the plethora of interconnected and intelligent autonomous devices at the *Intelligent Edge*, and in turn, drive true *value creation* as defined by Wei et al. (2012) from a *transactions cost economics* perspective.

Value Based Digital Transformation is about IoT deriving measurable value for the company and its clients, deriving measurable business outcomes, establishing new business opportunities, emerging business models and developing new go-to-markets within the era of the 4th industrial revolution. The value of IoT in addressing business outcomes is truly realised in *Value Based Digital Transformations* as is evident from the projected Compound Annual Growth Rates across global industry verticals such as *Consumer Electronics, Automotive, Health Care, Energy and Utilities, Retail, and Construction* (PricewaterhouseCoopersEU, 2017) and the emergence of exploitable and *New Business Models,* as per Lüttgens and Diener (2016), given the outputs emanating from combinatorial technologies and digitalisation. Thus, the symbiotic relationship that exists between IoT as an emerging and disruptive technology and companies of the 21st century is that of the *Intelligent Edge* driving *Value Based Digital Transformation*.

At the core of every IoT solution being developed, is a business based outcome, focused on creating and maximising shared value across people, profit and planet (Khan et al., 2012; Porter & Kramer, 2011), and most companies aim to excel across all three, hence the *Cross Industry Adoption* of IoT across *Financial Services, Manufacturing, Agriculture, Mining, Health Care, Real Estate, Retail, Supply Chain Logistics*, and *FMCGs*. In addition, operational efficiency, cost reduction, revenue growth, customer experience, business model transformation, new and compliant product development, market growth, brand value and relevance, and gaining new insights for decision making are the common business use cases in South Africa and globally for which IoT is adopted, which collectively link back to the survival and objective of any 21st century company, *Continuous Business Improvement* so as to ensure *Business Continuity*.

Thus, the *Cross Industry Adoption* of IoT is high, given the collective focus by companies being on *Continuous Business Improvement* for ensuring *Business Continuity,* where *"…arriving to new answers to old questions…and arriving to more accurate answers, with measurable insights and decisions in order to drive business value."* has become non-negotiable in the wake of *Big Data* and IoT, as highlighted earlier in the findings.

Furthermore, the best adopters who would realise the largest return on their IoT investment and those the edge-to-application IoT providers should be targeting, are those companies with significant investments in their property, plant and equipment, as reflected on their balance sheets. The rationale thereof was that one of the profitability measures of any company is their ability to sweat their assets in relation to revenue generation – *return on assets* – and as a result, those companies would be very keen on adopting IoT as a means to driving operational efficiencies, cost reductions and higher returns on their asset utilisation, given the new data driven insights of their assets' performance – "*Capex equipment & Trucks . Anyone with a large value of Property, Plant and Equipment on their balance sheet are a great candidate. It's about making an informed decision to sweat your asset, which is data driven. Cost and brand impact associated with recalls, that is another driver within Manufacturing*".

At this point of the discussion, it is evident that the *Intelligent Edge* drives *Value Based Digital Transformation* for companies across multiple industry verticals, hence the high *Cross Industry*

Adoption with the objective of driving *Continuous Business Improvement* in order to ensure *Business Continuity.*

Business Continuity is very subjective and relative, depending on where in the IoT stack the IoT provider delivers their IoT product and/or services from, because there will be varying objectives, varying capabilities and competencies applied, and varying business models utilized, depending from where on the IoT stack the provider operates. There are a few IoT providers who deliver edge-to-applications IoT solutions across the entire IoT value chain, as indicated by Agrawal (2016) and Inmarsat (2017), and as a result , most IoT providers play at the lower commoditised end of the IoT stack, and are using IoT business models that are aligned to their core business, based on their competencies, their core business and their place of comfort - *Aligning to Core Business*. IoT providers operating at the lower commoditised end of the IoT stack acknowledge that the utopian state is where they can be in a position to deliver edge-to-application IoT solutions, however, they realise their limitations across skill, capability, scalability and capital to move further up the IoT stack, where margins are higher, however, where the degree of value creation accountability is higher and material in nature.

It is for this reason that IoT providers operating at the lower commoditised end of the IoT stack utilise *Transaction Based Business Models* such as *IoT Sensor-as-a-Service, IoT Device Self-Service, IoT-as-a-Service Subscription, IoT Digital Add-On, IoT Freemium, and IoT Pay Per Use* as per Fleisch et al. (2014), Gassmann et al. (2013) and (Elizalde, 2017). The rationale thereof is that these business models are transactional in nature and are product and/or service focused rather than business-outcomes value focused, especially given that most IoT providers operating at the lower commoditised end of the IoT stack are focused on providing a once-off product and/or service, in a single engagement and can walk away without any OLA or SLA obligations to the end consumer of value, the client.

Transaction Based Business Models are transaction cost focused and not transaction value creation focused, and as a result, the majority of IoT providers operating within the lower commoditised part of the IoT stack are aware of this and also acknowledge that competition is high, prices are competitive and margins are tight, however, their *Transaction Based Business Models* are lucrative enough to maintain their *Business Continuity,* as a single IoT stack player (e.g. *Sensors & Actuators only IoT Provider*, as depicted in Figure 18). It was this point of *Transactions Based Business Models* still being viable and lucrative enough for IoT providers operating in the lower commoditised end of the IoT stack that challenged the true need for IoT providers to strive to be edge-to-application IoT providers and subsequently, move to *Vertical Taper Integration.* The conclusion thereof was that IoT providers operating in the lower commoditised end of the IoT stack should continue operating in these specific verticals of the IoT stack and rather focus on horizontal integration, until such a time that their *Business Continuity* is at risk, and until such a time that their skills, capabilities, scalability and capital allow for further vertical integration further up the IoT stack.

From a *transactions cost economics* perspective, IoT providers operating in the lower commoditised end of the IoT stack are primarily focused on managing and keeping the transaction costs (*co-ordination costs* and *transactions risk,* per Grover and Malhotra (2003)) at a low, as they are not capable of generating high transaction value and subsequently value creation, unlike IoT providers who control and deliver across the entire IoT stack with higher transaction value and value creation, as was depicted and discussed in *Figure 19: Maximising Value Creation* (Wei et al., 2012).

For edge-to-application IoT providers to be in a position where they can control and deliver across the IoT value chain, deliver business outcomes, exploit future IoT opportunities and be value focused in terms of value creation, value positioning, value communication, value distribution and value capture as highlighted by Wei et al. (2012), Lüttgens and Diener (2016) and Metallo et al. (2018), *Value Generating Capabilities* in the form of *consulting, business information and technology architecture*, and *performance based contracting* are required. These *Value Generating Capabilities* bring forth the emergence of *Value Based Business Models* such as *IoT Value Exchange, IoT Asset Sharing* as highlighted by Fleisch et al. (2014), Gassmann et al. (2013) and Elizalde (2017), and *business outcomes and shared reward* and *performance based contracting,* as highlighted by the IoT practitioners.

To be in a position where an edge-to-application IoT provider can commit to delivering value against certain performance metrics, so as to achieve the client business outcomes and subsequently share in the gains realised, requires the IoT provider to be vertically integrated and in control of (not 100% ownership of) each function in the IoT value chain, from the intelligent edge right through to the application and insights layer, with the ability to scope, architect, cost, proof of value (POV) and deliver an end-to-end IoT solution, which *Vertical Taper Integration* enables.

8.1.1. Recommended Future Research and Managerial Implications

Given that *Vertical Taper Integration* is acknowledged as the utopian state and business model by IoT providers operating from the commoditised lower end of the IoT stack, it is recommended that further research be carried out on developing robust migration readiness assessments for IoT providers wanting to migrate further up the IoT stack and become an end-to-end edge-to-edge application IoT provider using *Vertical Taper Integration*., as well as the ideal organisational structure to support such an IoT business model.

From a managerial industry perspective, *Vertical Taper Integration* comes with its complexities for edge-to-application IoT providers, in that the organisational structures and business units within the company need to align to the IoT value chain. Furthermore, the commercial model, remuneration model, and the rewards model needs to be one that does not drive isolated vertical stack function behaviour between the business units and the personnel thereof within a company e.g. only providing higher bonuses and recognition to personnel operating out of the Applications Layer, given that is where the end edge-to-application value is consumed by the client.

9.0. Conclusion

The investigation of existing IoT business models and use cases across South African companies, with the extended primary aim of exploring vertical taper integration across the IoT value chain as a candidate future IoT business model, capable of exploiting future IoT opportunities through the ability to control and delivery business outcomes based value across the IoT value chain, was the primary objective of the research.

IoT as an emerging and disruptive technology of the 4th Industrial Revolution has brought about a new era of connected industries, connected value chains and an increased adoption of IoT across multiple industry verticals such as *Financial Services, Manufacturing, Agriculture, Mining, Health Care, Real Estate, Retail, Supply Chain Logistics, and Fast-Moving Consumer Goods* by 21st century companies.

With IoT to consist of between 30 and 50 billion devices to be connected by 2020, one can only try to understand the exponential volumes of data that will be generated at the *Intelligent Edge* and available to company decision makers for the primary business use cases of driving operational efficiency, cost reduction, revenue growth, customer experience, business model transformation, new and compliant product development, market growth, and brand value and relevance, for *Continuous Business Improvement*, in light of ensuring *Business Continuity*.

End-to-end edge-to-application IoT providers are the providers who are better positioned, as compared to the single vertical IoT stack providers, to have the IoT business outcomes-based discussions and in turn, deliver on the business use cases for which 21st century companies are looking to IoT providers to help realise through their *Value Based Business Models*. Hence, it is for this reason that that *Vertical Taper Integration* across the IoT stack (*Physical Devices, Sensors and Actuators, Connectivity, Platform, Applications*) is the right candidate IoT business model for edge-to-application IoT providers, because it is through the *Vertical Taper Integration IoT Business Model* that they can commit to ensuring business outcomes-based value delivery.

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11.0. Appendix – A: Interview Schedule

CONSENT FORM

CONSENT FOR PARTICIPATION IN AN MBA APPLIED RESEARCH PROJECT

COMMERCE, LAW AND MANAGEMENT

BUSINESS MODELS FOR INTERNET OF THINGS PROVIDERS

RESEARCH CONDUCTED BY: DUDUETSANG KGOSI MOGASE (1745449)

Dear Candidate Research Participant

You are invited to participate in an academic research study conducted by Duduetsang Kgosi Mogase, a Master of Business Administration (MBA) student from the Commerce, Law and Management Faculty at the Wits Business School. The purpose of the study is to investigate existing IoT business models and use cases across South African companies, with the extended aim of exploring vertical integration across the IoT value chain, as a candidate future IoT business model, capable of exploiting future IoT opportunities through the ability to control and delivery value across the IoT value chain?

Please note the following: This research study involves an anonymous face-to-face interview. Yours and the institution's names will not appear on the final research document and the answers you provide (respond to) will be treated as strictly confidential. You and the institution cannot be identified in person based on the answers you provide (respond to). Any artefacts provided (e.g. documents, recordings, reports etc.) will be treated as strictly confidential. Your identified participation in this research study, as an IoT practitioner, SME and/or expert is of value and utmost importance to the purpose of this study. You may, however, choose not to participate and you may also stop participating at any time without any prejudice.Please peruse the questions in the attached questionnaire prior to the scheduled interview. The interview should not take more than one hour and thirty minutes (90minutes) of your time. The results of the research study will be used for academic purposes only as part of the MBA research project requirements. The final research study may be provided to you upon formal request.Please contact my research supervisor, Prof. Gregory Lee , on Tel. (011) 717-3626 (e-mail: gregory.lee@wits.az.za) should you have any questions or comments regarding the research study. Please sign the form to indicate that:

1. You have read and understand the information provided above.
2. You give your consent to participate in the study on a voluntary basis.

Respondent's signature______________________ Date_______________

Sample: IoT Business Models of The Future – Interview Schedule
IoT Industry Focus
1. From your practical industry experience and exposure to IoT, what, in your view is the Internet of Things (IoT)?
2. Which industry sectors have you found to be most open to adopting IoT solutions within their businesses/organisations, globally and in South Africa? Why?
3. What are the common business use cases for which businesses/organisations adopt and deploy IoT solutions?
4. IoT is projected to encompass an ecosystem in excess of 50 billion connected devices embedded with sensors, actuators and communication protocols connecting to the internet by 2020. What future IoT opportunities do you foresee coming from the billion number of devices
IoT Value Chain & Vertical Integration
5. The IoT value chain consists of the smart module, the smart object, the connectivity, the platform, and the application. In which of the verticals across the IoT value chain do most IoT providers play? Why?
6. In the IoT Value chain, in which of the vertical functions is there most value to be gained?
7. As an IoT provider, which of the IoT value chain verticals would you position yourselves in? Why?
8. Is backward and forward vertical integration across the IoT value chain the way forward for organisations who provide IoT as part and parcel of their go-to-market value offering, and aim to control and deliver across the entire IoT value chain? Why?
9. Will vertical integration across the IoT value chain better position organisations who provide IoT as part and parcel of their go-to-market value offering, to exploit future IoT opportunities?
IoT Business Models & Use Cases
10. What IoT business models are you familiar with in practice, and which ones are mostly used by IoT providers? Why?
11. Are existing IoT business models capable of enabling IoT providers to control and deliver across the IoT value chain, from edge-to-application? Why?

12. What are some of the challenges/limitations, if any, that you have found with existing IoT business models in being able to control and delivery value across the IoT value chain?
13. What is the type of IoT business model(s) are being used within your organisation, and what value has been derived from using this business model?
14. What capabilities should IoT business models contain, if they are to fully exploit the future opportunities from billions of connected devices?

12.0.Appendix – B: Documentation

IoT Business Models of The Future – Documentation
1. Go-To-Market Collateral 2. Sales Guides 3. Client Presentations 4. Infographics 5. Operating Models 6. Commercial Model 7. Digital Transformation Industry Reports 8. Recommended Industry Analyst Reports 9. Organisation Websites 10. Annual Reports

13.0.Appendix – C: Qualitative Workbook Template Example

Qualitative Code Book			***Research Participant Transcript Theme***		
Code Name	***Code Description***	***Code Key***	***Transcript No.***	***Transcript Line Item No.***	***Theme***
Performance Based Contracting	*XXXXXXXXXXXXXXXXXXXXX*	*PBC*	RP_1 RP_3 RP_6	RP1_Line 2 RP3_Line 17 R6_Line 12	***Value Based Business Models***
Digital Interconnectivity	*XXXXXXXXXXXXXXXXXXXXX*	*DT*	RP_4 RP_7 RP_10	RP4_Line 18 RP7_Line 22 RP10_Line 15	***Intelligent Edge***

14.0.Interview Responses Sample – Appendix D

Interview Schedule

COMMERCE, LAW AND MANAGEMENT

BUSINESS MODELS FOR INTERNET OF THINGS PROVIDERS

RESEARCH CONDUCTED BY: DUDUETSANG KGOSI MOGASE (1745449)

Business Models for Internet of Things Providers – Interview Schedule
IoT Industry Focus
1. From your practical industry experience and exposure to IoT, what, in your view is the Internet of Things (IoT)? *The internet of things is a conglomeration of technologies, many of them, to produce an outcome and that outcome can be internally focused (i.e. Cost Efficiency, Workforce Efficiency) or externally focused (i.e. Business Model Changes, Service Changes, Product Changes). The primary thing that it does is augments the physical and digital world, so at some point there is a touch between the physical and digital world and that's where the value lies. That's where the complexity lies in terms of people thinking about IoT for their business, I don't think people can play out what that means in the different industries just yet. Which is why it is important to be a pseudo or layman's expert about IoT just to understand what it does in other contexts and so that you cause your own experience and subject matter expertise to find out where the linkages may be In your sector and function. Hence, once the functional experts gain and understand IoT at its core will we start to see amazing use cases emerging across industry verticals. Particularly on Business Models and GTM Models. Right now we don't have a large number of people who understand IoT well enough and the art of the possible to emerge with great use cases as yet.*
2. Which industry sectors have you found to be most open to adopting IoT solutions within their businesses/organisations, globally and in South Africa? Why? *Anyone who has assets, Capex equipment out in the field of any nature (e.g. Buildings, Agriculture, any form of manufacturing, logistics), anywhere where people own things out in the market (property, plants, trucks, buildings). Strongly focused on* ***Manufacturing and Logistics****. Anyone with a large value of Property, Plant and Equipment on*

their balance sheet are a great candidate. Have we even though who has a large PPE on their balance sheet, especially looking to sweat their assets. However, primary on the cost savings side and efficiencies.

Anywhere in the manufacturing chain from raw materials to finished products. Most PPE of those Business is high.

- *Mining*
- *Agriculture*
- *Manufacturing and Logistics*
- *Why: (i) human resource intensive and part of the automation discussion, you require data of which IoT is a prerequisite of such; and (ii) sweating of assets*.

3. What are the common business use cases for which businesses/organisations adopt and deploy IoT solutions?

Future ones are the ones that don't exist today. I think we are going to be in a position where IoT is commoditised, the 50 billion sensors will commoditise everything so that anything has the ability to be monitored. We all know the use cases, I can build a IoT into a T-shirt without a chip or with a baby chip, the sensors is integrated into the fabric, I think we are going to forget about the sensors eventually ultimately, you are going to have data access all over and be discerning about what data inputs we decide to use in our services because you can flood your machine learning with too much data, I think ultimately it will be discerning what data is important and which is not, and which ultimately comes down to what sensors/ data access points are important and which are not. The other huge opportunity I see is within the security space just given the number of connected devices and people wanting to exploit these sensors, not necessarily to be harmful but just being disruptive or shutting things down (e.g. imagine finding a Bosch sensor in a fridge which is used to across 20 manufacturers and overnight switch off their thermostats), especially people's excitement to have edge devices connected. It's about connecting for purpose. Insurers are using IoT change their product offers but none of them are differentiators, both Telesure and Mi-way releasing early detection, For consumers it is a gain because we are getting a better service for the same price. Companies that are using IoT in their Business Models have short term gains because they do not own the underlying technology and as a result, the gains made are easily replicable by competitors (e.g. Early Crash Detection - Discovery, Miway and Telesure)

4. IoT is projected to encompass an ecosystem in excess of 50 billion connected devices embedded with sensors, actuators and communication protocols connecting to the internet by 2020. What future IoT opportunities do you foresee coming from multiple connected devices?

These technology gains are combinatorial. So we have a breakthrough in materials engineering biotech and a breakthrough in battery technology, those two combined creates a perfect storm in user adoption in a product of some sort. Same with micro engineering and radio, we can see them independently of each other today but can't see what the opportunities that they can provides us when combined. So only once IoT is understood as much as the Internet will we see functional experts begin to explore and experiment with combinatorial technology. It is also the new data points that emerge from combinatorial technology that will be the differentiating factor and competitive edge that companies have over their competitors.

IoT Business Models & Use Cases

5. What IoT business models are you familiar with in practice, and which ones are mostly used by IoT providers? Why?

We don't have a single IoT Providers that can provide an end-to-end IoT Solution across the stack, so what you have is everyone playing at different levels in the value stack. So right now everyone is playing on their traditional business model. If I had to take the fog network, the cloud network, or the core network, we have people playing in their with their traditional business models, and they might be different from each other and if I was to look at the infrastructure layer, of the edge device, you have central computing and people are coming with a different business model which is different from the connectivity model. So I don't think anyone's looked at this end to end and trying testing or coming up with what the different business models are. I haven't seen someone price up and IoT solution end-to-end to end up knowing what their doing and it's going to be difficult because you're going to have a per kilobit rate , a hosting rate which includes power consumption as a separate line item, which includes throughput to through data centre as a separate line item, which includes the capacity of the VM or the physical infrastructure as a separate line item, of which none of those do you knows what they are going to be when you project the solution, then you are going to have the analytics stuff which is a build once up and tweak later model, which is project and consultative based. So now you have a subscription type service which is variable, you have a hosting services which is a combination fixed and variable subscriptions, and now you have a consultative/project based model and now you need to put that all together in a single price that the client can understand. Actually, they are pricing it up as individual components. Is there a possibility to price it up as one thing, one price, one metric (e.g. cost savings, connected devices). The challenge with that is that. People don't know how to do it and how to test the model, and it is going to take someone with a lot of money and brave to do that or play around with it. However, before that, any organisation who has an end-to-end IoT play is not organisationally structured (e.g. Business Silos, Inflexibility) to do that and as a result, business units across the IoT Value chain from the sensor to the platform are at risk of their services being priced at market or base cost or below cost – eroding margins, and everything north of the platform being priced aggressively given position that that is where the Business case stacks up. This results in the risk of never being able to cost those services further down the stack above cost or market rates given the contractual obligations and precedence that would have been set with the client. Those that would be probably be able to are smaller players given the minimal or no bureaucracy like the large entities but then again they would not have the same breadth and depth of capabilities.

Therefore, the Business Model for IoT will for a long time remain a bill of charges across sensor, device, connectivity and not a turnkey solution, reflecting the stack. Which is why IoT is a GTM proposition and not a business unit, because if it was, then it would encompass the entire company. Do you then have the other business units from the sensor to the platform provide their services at cost and in turn becoming a cost centre whilst every business unit north of the platform layer includes high margins on their pricing to the client run profitable business units – it would never work, also having an impact on the culture because everyone would want recognition and if not, then why should the other business units contribute of participate.

There's also the scenario where the client can dictate how they wish to have the service delivered to them but not necessarily having one company delivery the entire IoT stack but rather play companies off against each other across the different functions in the value chain because they know that by allowing a single player to provide the entire stack means that there is cross subsidisation and that they are not necessarily getting the best price possible, unlike putting IoT providers up against each other. The risk for IoT providers who delivery the entire stack is that in the pricing you

will have to show the pricing breakdown across the stack, of which the client could decide that they want to take you up as a provider for one of the functions which you may have costed at cost or below market rates, alternatively going with another provider for the remainder for the stack – "There's the price, you were willing to sell it at that price". The other risk from the client's perspective of providing an end-to-end IoT service is that because the gains are very much specific a client's operations to such an extent that they could ask that the similar solution which they helped to co-create cannot be sold to a another client or competitor within the same industry given that whatever competitive advantage or gain would soon be lost, given that you are the end-to-end provider of my solution. Creating unnecessary lock in given that the Client would deem the solution as their IP.
6. Are existing IoT business models capable of enabling IoT providers to control and deliver across the IoT value chain, from edge-to-application? Why? *See above*
7. What are some of the challenges/limitations, if any, that you have found with existing IoT business models in being able to control and delivery value across the IoT value chain? *See above*
8. What is the type of IoT business model(s) are being used within your organisation, and what value has been derived from using this business model? *Cost Plus in every part of the value chain function. However, at the applications layer is using Cost Plus but at a higher rate. Cost Plus is not the most effective model given the opportunity cost is lost along the way. The risk with using a value based model up front is that the client can decide upfront to use an alternative provider who uses a cost plus model given that now they are aware of the possible savings that can be realised. Cost Plus is still playing heavy dividends and as a result, a business model across the end-to-end IoT Value Chain could break the business because we are not architected in that manner.*
9. What capabilities should any one IoT business model contain, if they are to fully exploit the future opportunities from multiple connected devices? • *See 5 & 8*
IoT Value Chain & Vertical Integration
10. The IoT value chain consists of the smart module, the smart object, the connectivity, the platform, and the application. In which of the verticals across the IoT value chain do most IoT providers play? Why? *Most people are playing from a position of comfort and strength:* • *Sensor Layer* • *Platform Layer* • *Network Layer* • *Security*
11. In the IoT value chain, in which of the verticals is there most value to be gained? *Application Layer – the capability focused on data analytics & advisory*

12. Where do you see yourselves currently playing within the IoT value Chain? *Not at the high value end. We are playing from Data Aggregation to the Platform layer.*
13. Are there verticals within the IoT value chain which you aspire to be more involved in and why? *Application Layer – the capability focused on data analytics & advisory*
14. Is backward and forward vertical integration across the IoT value chain the way forward for organisations who provide IoT as part and parcel of their go-to-market value offering, and aim to control and deliver across the entire IoT value chain? Why? *It may sound like a compelling value proposition and a story to tell, however, no, because from a client's perspective, they may not be comfortable with a provider delivering and owning the entire value chain and as a result will want to break it up because the IoT stack logically allows the customer to do that. It also gives that provide too much power, of which customers do not want to do that. Subsequently, providers will start to focus rather on the high value end functions further up the stack , as client's can easily procure rest of the stack given that it is commoditised. And if the impact is going to be so massive, the client would rather do the high end value items in house and outsource the bottom half of the IoT Stack.*
15. Will vertical integration across the IoT value chain better position organisations who provide IoT as part and parcel of their go-to-market value offering, to exploit future IoT opportunities? *No because the value sits in the upper part of the IoT Value Stack*