Internet of Things (IoT) and Changing Face of Project Management

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Abstract

Internet of Things (IoT) or Industrial Internet is a modern day catchword, which over the past few years has tremendously impacted numerous aspects of almost-all the advanced technology fields. IoT framework envisions transforming the everyday objects into intelligent systems, while working under a common infrastructure and by connecting the global network of devices and machines over the internet. Based on many underlying interdisciplinary ecosystems, like sensor network, embedded systems, big data platforms, cloud computing and service-oriented architecture; IoT projects are non-traditional in many ways. Such projects involve research and development phase, more technical work, are lengthy, require advanced skill sets and lacks well-defined business models. A recent alarming rate of IoT project failures provide incentive to look for project management philosophies, which would emphasize on more flexibility, agility, teamwork and a developing a strong technical framework. This thesis work provides overview of IoT concepts and through a systematic review of scholarly research papers, blogs, review articles, and other literature available online, it addresses the current managerial challenges for such projects. Finally, to solve this issue a focused survey was conducted and collected data was analyzed. Based on the responses from IoT professionals various suggestions are made, which can be used to improve management of such projects.

Keywords: Internet of Things; Project management; Big Data; Cloud computing, Management

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Preface

This thesis explores how streamlining of the current project management philosophies can improve the Internet of things (IoT) projects in delivering a successful end product.

To begin with, I would like to express my gratitude to Dr. Stephen Onu, Dr. Robert Pittman, Dr. Iheb Abdellatif, and Dr. Thomas Sheives and all other faculty and staff at HU, for their continuous support and guidance during this two year course work and in finishing up this thesis work. It was both a privilege and an honor to work with them!

I would also like to extend a special thanks to my friends and graduate fellows Gauri Nadkarni, Dr. Ankit Bangar, Jitendra Narola, Joanne Iskandarani and Shalini Reddy and so many more who kept me motivated and were of great help throughout this journey.

Introduction

With the underlying concept of sensor embedded physical objects, Internet of Things (IoT) have become a common house hold thing, where use cases such as Wi-Fi connected smart gadgets, which one can control from anywhere with a smartphone have increased over the years. Coming out of its nascent phase, IoT projects have created many job opportunities and project managers are already working on such undertakings. With potential economic impact to increase from $3.9 trillion to $11.1 trillion a year by 2025, as predicted by McKinsey Global Institute researchers, one can expect a lot of new IoT projects and initiatives. The future projects such as Google's Project Wing, and Amazon's Prime Air, which would include drones, needs project managers engaged from starting in the research and development phase and going through deployment, and testing and then the future maintenance stages. In this never-ending cycle a manager needs to communicate with PMO office, internal and external stakeholders and customers and at the same time keeping up with the new technology.

Historically, project management methodologies are framed around system development life cycle, where waterfall like one dimensional model included defining, designing, developing, testing and then deploying the end product. But, then, the agile philosophies have nearly ended that, introducing the concept of concurrently performing many steps of traditional project phases. And now, we have IoT projects, where one can expect longer project timelines, no place for silos, many issues with staff morale, comprehensive testing that goes beyond traditional projects, strict rules around compliance, security and policy planning, once again demanding that we revisit the current project management philosophies and re-structure or scale to manage such advanced projects.

In the "Problem Statement and Justification" chapter of this thesis, key issues with successful deployment of IoT-based products and services are discussed, along with building a strong case for investing more time and research efforts into the management aspect of such projects. In addition, "Literature Review" chapter summarizes the current challenges and various reasons for failure or success of IoT projects; based on blogs, scholarly articles, research papers, conference proceedings, and from any other relevant related source. This follows the "Proposed Solution Approach" chapter of this thesis, which discusses all the techniques, like surveys, brainstorming, focused groups, qualitative and quantitative analysis that will be used to gather data, which could shed more light on what can be changed in the current management framework, especially to get ideas to come up with new methodologies for such complex programs and projects.

Finally, the "Conclusion and Future Work" chapter details how the need-of hour is to use bottom-up approaches to align technology with the current business objectives and how IoT project managers need to create effective cultures, philosophies, process and trends that will facilitate effective project planning and implementation for success of such projects.

Problem Statement and Justification

There is a problem with how IoT projects are managed now. Despite tremendous forward momentum in this field, a 2017 Cisco survey says that about 75 percent of IoT projects are failing (Christine Johansen, Ben Culp, Marilyn Mora, 2017). This problem has negatively affected several industries, which are feeling less confident to invest in the IoT space and see it as a risky endeavor. The main question that arises is "How can we scale the current project management processes, tools and techniques to successfully complete IoT Projects?"

The Cisco survey said that a possible cause of this problem is "human factor", be it their lack of communication, technical or managerial skills or the overall culture (Christine Johansen, Ben Culp, Marilyn Mora, 2017). Lack of universally accepted and recognized technical and managerial "jargon" is causing problems in interoperability (R.M. Dijkmana, 2015). IoT projects have longer project timelines, such as: the testing cycle will be longer in IoT projects and the teams would need to be co-located and fully involved during the whole product cycle (Scroxton, 2016). IoT itself will affect project management, like new project management software will be required. Because of the involvement of many systems at a time, huge risks are involved at various phases of a product development, which may be related to compliance, security and would probably need better policy planning (Scroxton, 2016). Projects will need to be run differently than simple and traditional IT, manufacturing or construction projects. Five phases, namely: collect, transport, store, analyze and archive of an IoT project should be streamlined with the current Project Management Institute (PMI) project phases, i.e. with Initiation, Planning, Execution, Monitoring and Control, and Closing (Bekker, 2017). Project manager should be involved in the research and development phase of an IoT project (Curlee, NA).

If we don't address all of these issues now, we will see some key players backing off in contributing to major changes in IoT infrastructure that are required to make it a reality. Perhaps research that investigates how to better project management, specifically for such interdisciplinary projects, could remedy this situation.

Literature Review

For this thesis work, Google Scholar, ResearchGate and Harrisburg University Library services were mainly used to search, save and cite various references from peer reviewed journals, literature reviews and published research works. In total, about 21 references, also including blogs, podcasts, and online available articles were used to gather information and to make a case for problem statement and for a possible approach to find the solution.

The following literature review walks one through the important concepts of Internet of Things, current trends in this complex field and both the managerial as well as the technical challenges being faced in such projects. Different views from the various sources help to provide a good understanding of how the need of hour is to focus on areas causing the failure of such projects, especially the management aspects.

When we connect the objects from the physical world, which have sensors and a communication technology piece as main ingredients, with the Internet, an IoT system is formed. In the recent years, when various domains ranging from healthcare to agriculture are exploring this concept, for efficiently developing new applications, it's the need of hour to develop a unique and specific business model for such efforts. As proposed by R.M. Dijkmana et al. in their study, based on numerous interviews, literature surveys among the practitioners, the building blocks of unique framework will help developers with IoT applications (R.M. Dijkmana, 2015). Based on qualitative and quantitative survey analysis, this study suggested that the value proposition will play the central role among all the building blocks in IoT business models.

For successful deployment of IoT-based products and services, the top five technologies that are essential are radio frequency identification (RFID), wireless sensor networks (WSN),

middleware, cloud computing and IoT application software (In Lee, 2015). A literature review by In Lee et al. (2015) focuses on technical and managerial challenges in putting these five components together and then proposes a net present value option to justify the investment in such project. Also, this work emphasizes the need of carrying on more studies that deals with economic, social, behavioral and project management aspects of IoT projects (In Lee, 2015). In addition, this article introduces to conceptual model of IoT applications, where challenges in implementing IoT projects for enterprises, especially from information sharing and collaboration, monitoring and control, and big data and business analytics aspects are highlighted.

A similar study by Somayya Madakam et al. (2015) walks one through the timeline of origin of IoT concepts, their initial usage and how slowly these technologies are seeping into our daily lives. Whereas the idea is to make our lives easy, simpler and more comfortable, it's becoming more challenging to keep everything intact (in sync), like: Sensing, Access, Network, Middleware and the Application layers of IoT infrastructure (Somayya Madakam, 2015). Even though, this review lists many useful applications of IoT into myriad of domains including healthcare, education, manufacturing, transportation, education, governance, and other upcoming industries, its core message lies around pointing to few deep-rooted flaws in the IoT governance, management, and implementation and development stages. The author lists key observations they gathered form several other authors, publications, researchers, and industry practitioners and summarize those by asking for "universalization" of jargon, processes and practices for IoT projects. This study asks for a standard of definitions around the world, a universally recognized architectural level, and technology interoperability standard protocols for global governance to have a better future in the IoT world.

Apart from providing an overview of Internet of Things, its various architectures, current and upcoming technologies and their socio-economic impacts, this study is a good compilation of basic concepts for newbies in this field (Somayya Madakam, 2015). Like, it talks about the prerequisites for implementation of IoT projects, their components and an example of a "European FP7 Research" project to help benchmark and develop a business case. This can help an enterprise in understanding the concept, search for the right tools and coming up with a solid business case, and a project management plan. This paper has plethora of ideas about the technical and management areas, which need to be worked on from both enterprise and project aspect. Each layer of IoT infrastructure would need a management plan, be it to cope with the issues or to take care of risks (Somayya Madakam, 2015). So, it's important to understand the IoT architecture. This review provides more insight into the IoT world and how stakeholders at large are receiving this technology disruption.

In a recent podcast interview, Wanda Curlee of www.wandacurlee.com said that the Internet of Things is an ever-growing network of physical objects, where communication occurs between these objects and other Internet-enabled devices and systems (Curlee, NA). And, Internet of Things (IoT) projects have the potential to change project management, and not because project management software will be dependent on IoT devices, but because project managers will need to better equip themselves to better handle on research and development aspect of such projects.

Like Internet has touched millions of lives, with the projected installment of IoT endpoints to be more than 82 billion in 2025, it will also be indispensable part of everyday life-style. Whereas this forecast sounds very optimistic, a CISCO survey last year showed a different story, where it was seen that about 60 percent projects fail at Proof of Concept stage, and if

completed only two third are considered successful (Christine Johansen, Ben Culp, Marilyn Mora, 2017). This survey consisted of more than 1,800 business and global IT leaders from across the world, and information on main challenges organizations are facing while adapting to IoT projects was gathered. Apart from resistance to change, poor quality of data to make decisions, lack of internal expertise, hurdles in project/product integrations and long completion times and budget overruns were the key reasons why IoT projects are failing (The main reasons why IoT projects fail, 2017).

To avoid these initial pitfalls, top management, business owners and the project managers have to plan diligently, carefully, and by benchmarking or using the lessons learned to fill the gaps in knowledge, for which they can seek help from external IoT experts. Also, for integrating such projects with the existing systems, thorough policies and technical implementation reviews, better communication channels among the teams and enterprise environmental factors should be considered. And, with this information, management can come up with realistic timelines, cost estimations, contingency reserves estimations, integration strategies, data privacy and management and a deployment plan. So, by combining data and good management skills, better results can be achieved for IoT projects (Woollacott, 2017). While talking to experts' form Intel and Capgemini at the 2016 SAP Executive Summit on IoT, Margaret Anne McPhee, North America National Vice President of S/4HANA Services at SAP, said that when coming to IoT projects, one should "Think big but start small." During this panel discussion on how to handle the challenges and bank on the opportunities provided by IoT projects, it was suggested that a sound business case, probably a pilot project and more customer and marketing engagement in the initiation phase of a project should be used to upfront establish Key Performance Indicators (KPI's) for data and personas for better use cases (Trites, 2016).

The complexity of such undertakings poses both: challenges as well as grand opportunities for the project managers, especially for IT project managers, for whom this experience can be intimidating as well as rewarding. To equip and strategize well, project managers should fully grasp the big picture, get a strong technical lead on-board, and phase a project into small achievable, viable phases/cycles, such as research and development phase or proof of concept phase. Also, they should select industry approved IoT reference architecture, which would require unique project infrastructure and a team with unique skill sets. Apart from this, a collocated, collaborative team should be built and should be constantly inspired to work on such cutting edge projects (Clark, 2015).

The large and complex IoT projects will need more engaged Project Managers, who apart from handling work-flow would be needed to control some programs. Like, for Amazon drone delivery project, a manager would be involved from research and development phase and going through the whole process of drones communicating with air traffic controller, corporate office and then the end customers. With the assistance of CEO or any executive officials, and portfolio managers, project managers will be able to subdivide projects into small phases and provide Return on Investment (ROI) estimations. Whereas there is already number of mangers working on IoT projects, this field will eventually provide more jobs for skilled technical and IoT mindset folks (Prescient, 2016).

IoT will disrupt the project management in several ways, as the data from sensors will help companies save money, reduce downtime, lower down the waste, increase productivity and help determining the workforce needs. Also, these long-term projects will need more focus on maintenance, security and monitoring and hence requiring the project managers to expect lengthier and onsite based commitments (Newman, 2018). For IoT projects the mantra is not just

to focus on the business but also the technology, and to pay serious attention to the security and privacy threats, to always have an exit strategy or a plan B, plan better risk management; including the vendor risk, making it easy to replace or update the IoT components and finally to have buy-in from across the organization (Buntz, 2016). If these things are kept in mind, a project manager can effectively lead an IoT project.

With lot of IoT projects coming up, the possibilities seems to be endless, but it is yet to be seen if such projects will impact the current management methodologies, measurement standards and planning strategies. Whereas this technical advancement will make a project manager's life easier, there will be certain areas where they need to be more agile, precise, and knowledgeable and need to use more rigorous parameters (Pettigrew, 2017).

While the technology world is continuously creating opportunities, it has also faced challenges from time to time. Over the last decade new approaches such as: Scaled Agile Framework (SAFe), Disciplined Agile Delivery (DAD), Scrum, Kanban, Extreme Programming, and other various Agile philosophies have been implemented to accommodate the big data, cloud computing and Service Oriented Architecture (SOA) based products development (Ivar Jacobson, 2017). Even though, these approaches have been tested for traditional projects, will these improve chances of IoT projects complete successfully, is still an unanswered question. Similarly, for IOT projects, do we need entirely new management practices or we can scale the current ones to find the best possible framework that can be universalized, has yet to be explored. Not only that, the impact of IoT on Project Management and the execution has not been studied due to lack of data, use cases, resources, focused research and efforts in this direction.

To summarize, here are few key points gathered from the above literature review: (1) what and how IoT projects are different from traditional or software projects? (2) What are the

main challenges faced in the IoT projects, ranging from being interdisciplinary to complexity in managing and planning such projects? (3) What approaches are currently being used to manage IoT projects in various domains and why management area will be affected the most. Concluding, project manager's role and responsibilities will be changing with the new technical upheaval, as their role will broaden from advocate to specialist, and so will be the need to have new management philosophies.

Proposed Solution Approach

Whether it's a tech or non-tech, what comes under the purview of Internet of Things is so vast that it covers nearly every domain and company, be it into agriculture, space exploration, retail, and health or even education sector. The Study Design for seeking solution to the above said problem involved reaching out to IoT professionals, via LinkedIn or any other social networking website, and especially focus was on to reach out to the top ten well-established as well as startup companies that are poised to make a mark in the IoT world (Merritt, 2018). These companies are: General Electric, Schneider Electric, ARM, Robert Bosch, The Channel, Riot Micro, zGlue, ETA Compute, Bebop Sensors and TrackNet.

Online or web based tools such as survey monkey was be used to define and disseminate the surveys for collecting data. From survey results, the data was collected, analyzed, and then discussed among the peers for their suggestions.

The main results are presented in the next section, where quantitative analysis of data gathered is used to point out the pain points in handling IoT projects.

Survey Results and Analysis

Survey takers were asked the basic demographic questions like: Which industry they primarily work in, their role in industry and how long they have been working on the Internet of Things (IoT) projects?

The captured demographic data about survey takers, as presented in Figure 1 has helped in building a profile of the 34 total respondents (see Appendix Figures 13-17 for more data and plots). These results were helpful in uncovering the important differences as to how different groups of people answer survey differently—whether they are Owners, Analysts or developers, working in different domains.

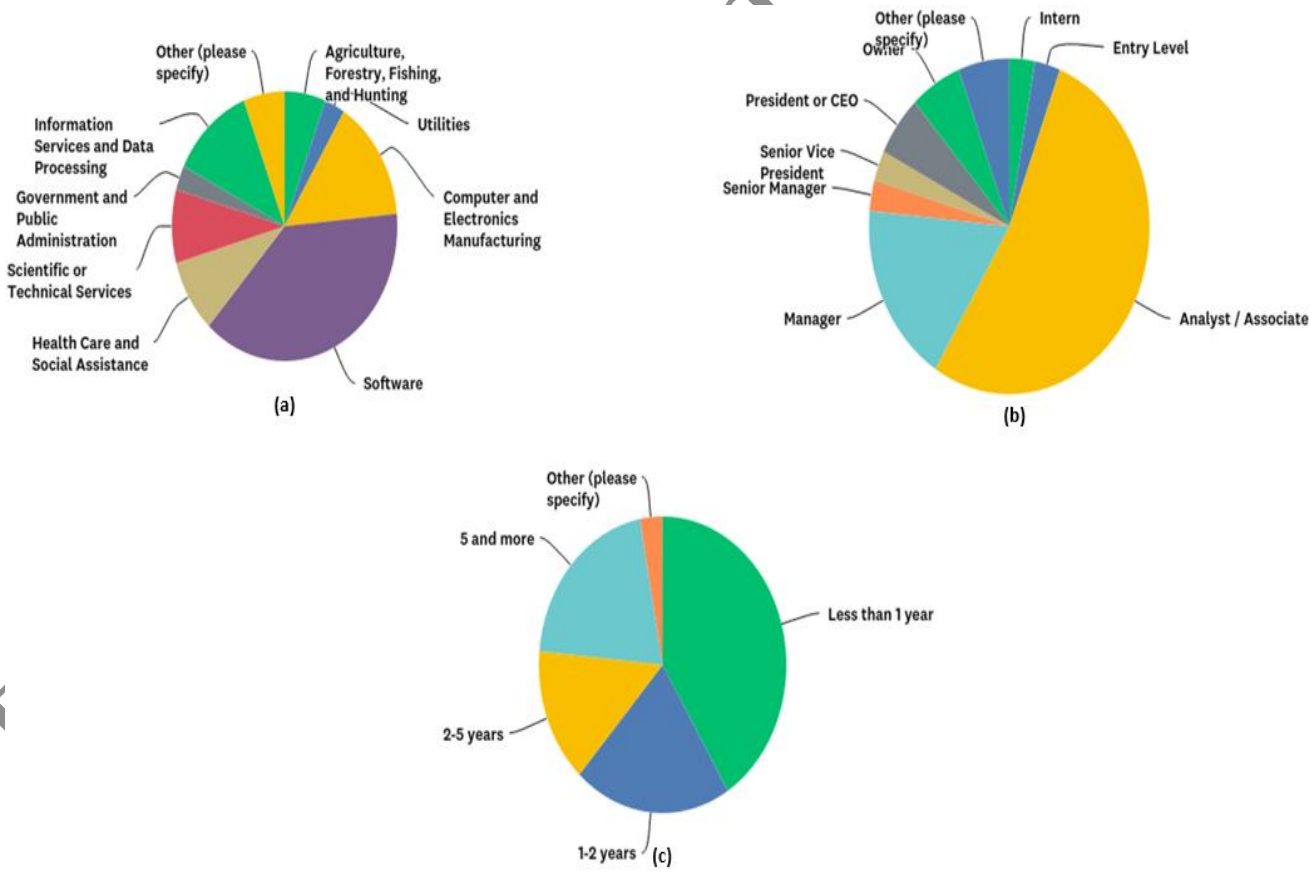

Figure 1: Demographic results.

IoT projects introduces combination of software and hardware components, which creates dependencies and is disrupting traditional product manufacturing mindset. Whereas Waterfall is known for delivering a predictable product and Agile is at the heart of small teams or startups working to get quick turnovers, what would work for IoT projects still remains under question? The survey takers were asked how often they follow various, such as Waterfall, Agile, Hybrid or RAD project management frameworks for IoT projects.

As shown in Figure 2, the results point to most survey takers embracing the agile and a hybrid of waterfall and agile features in IoT projects.

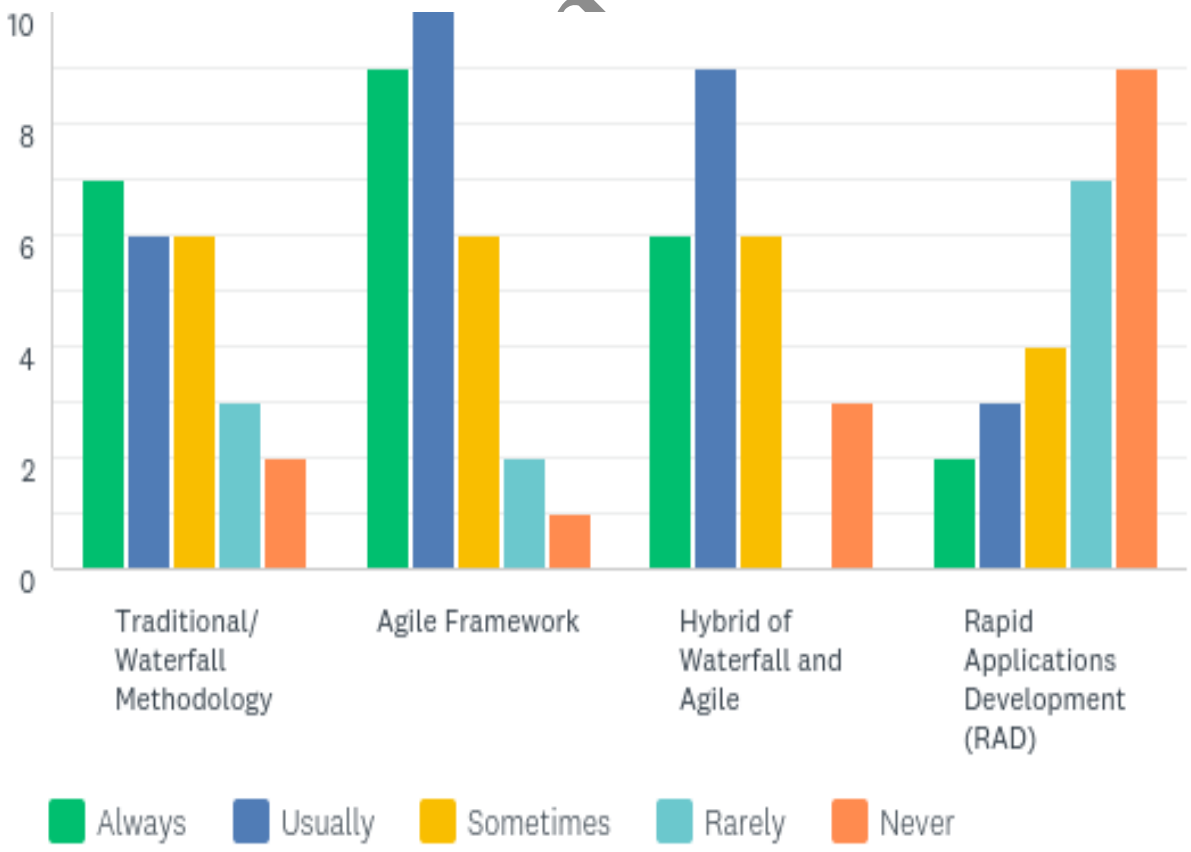

Figure 2: Preferable methodology for IoT projects.

Next, when asked, what were the main challenges while developing a project charter on an IoT project, for the following options, No clear link with overall organizational strategy The project statement of work is not clearly defined, any concerns about goals being realistic and attainable, no clear picture of the risks and assumptions related to the project or any concerns about realistically measuring the project success (ROI). As shown in figure 3, getting a better ROI stood out.

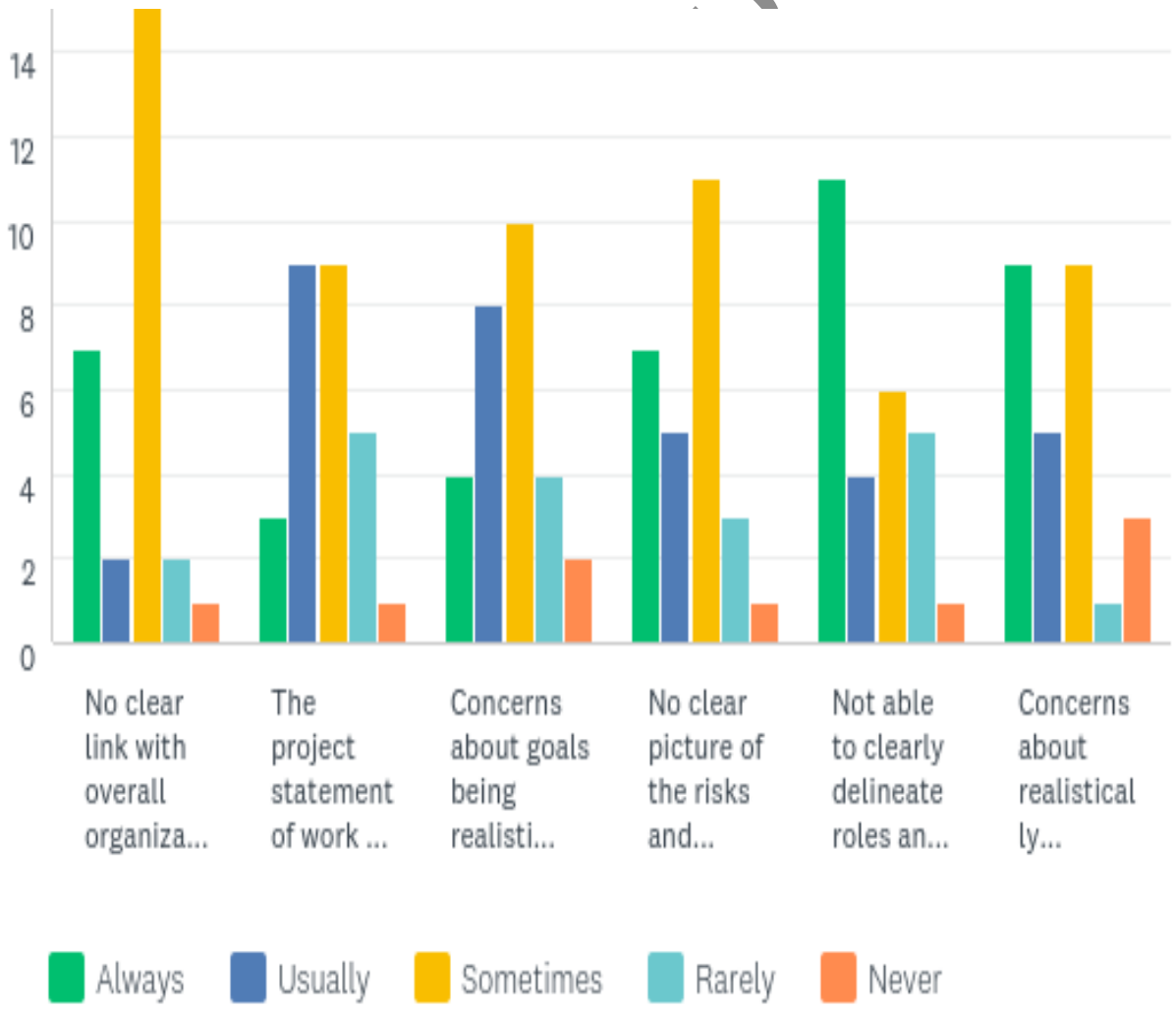

Figure 3: Challenges in creating a Project Charter.

Next, when survey takers were asked to rank the challenges that they may have faced while team building on an IoT project, such as: would they consider an IoT team management a challenge, do they agree that interdisciplinary teams are hard to manage, lack of team collocation poses challenges or if roles and responsibilities are not well defined for such projects and are such projects are more conflict prone and where a team-work skill set is an asset on an IoT project. For this, IoT being an interdisciplinary field and lack of team colocation stood out (Figure 4 and Figure 19).

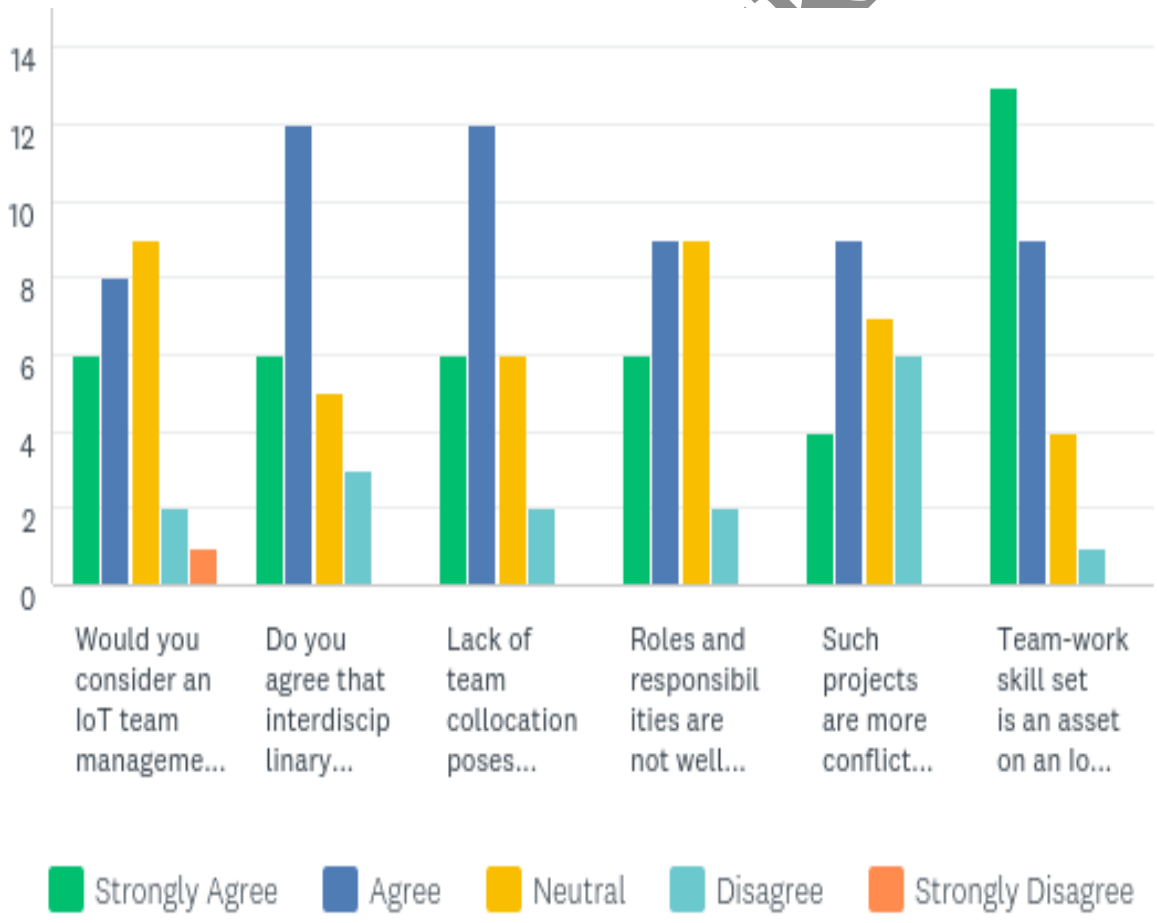

Figure 4: Team Building Challenges on IoT projects.

Based on their experiences, survey takers were asked how they see various stakeholders engaged on an IoT project. And the results were following (Figure 5 and Figure 18 (in Appendix)):

- Steering Committee/Leadership (Supportive)
- Program Manager (Leading)
- Project Sponsor (Supportive)
- Project Development Team (Neutral)
- Business/Product Analysts (Neutral)
- End Customer or Client (Leading)
- Local Communities (Unaware, Neutral)
- Regulators (Resistant)

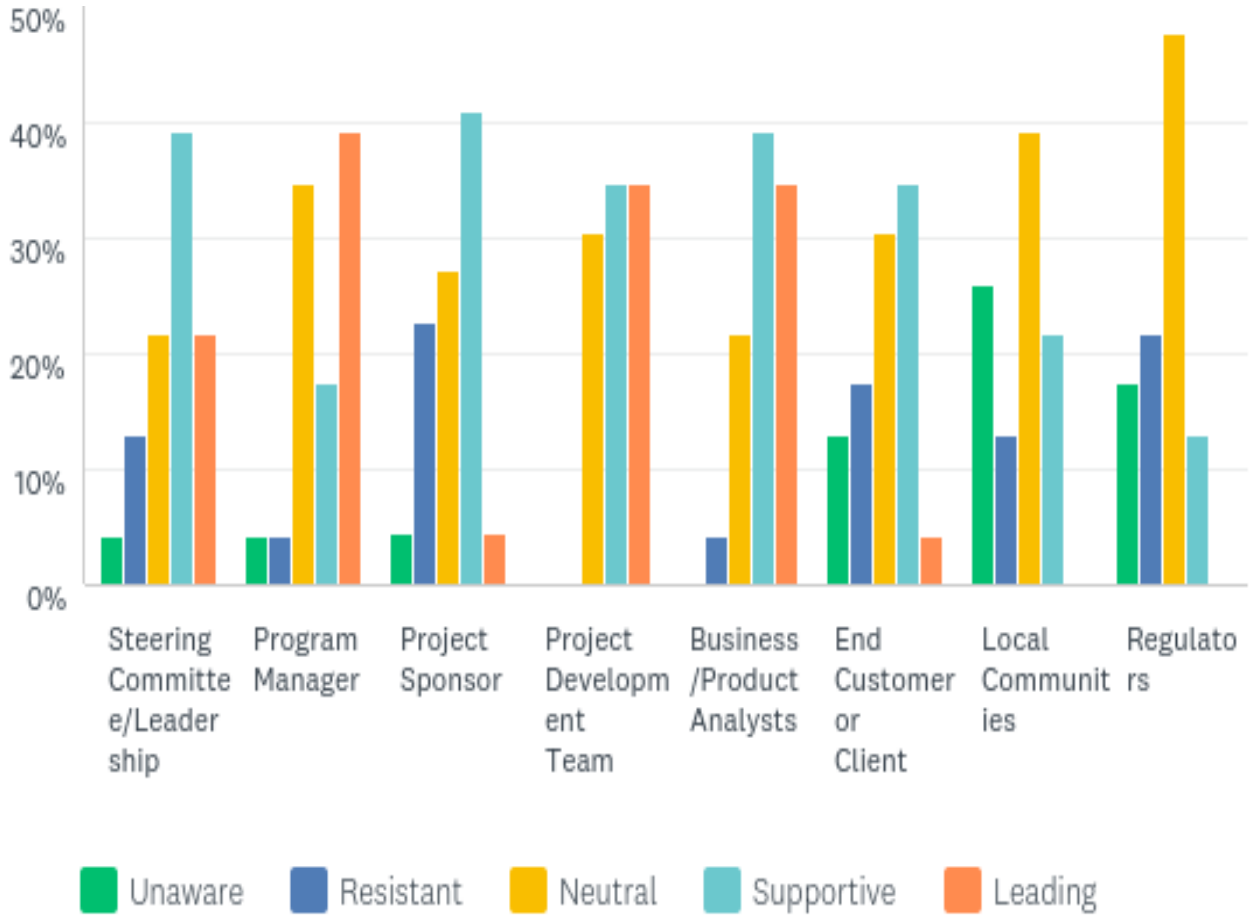

Figure 5: Stakeholder Engagement on IoT projects.

So, we can say that on IoT projects regulations pose a great resistance and leadership and project sponsors are very supportive. Also, we need to make local communities to be more aware of such initiatives.

When asked about the project management tools/software which can make them well equipped to manage IoT projects, as shown in Figure 6, among MS Project, Jira, VersionOne, Asana, and SmartSheet, Jira tool stood out.

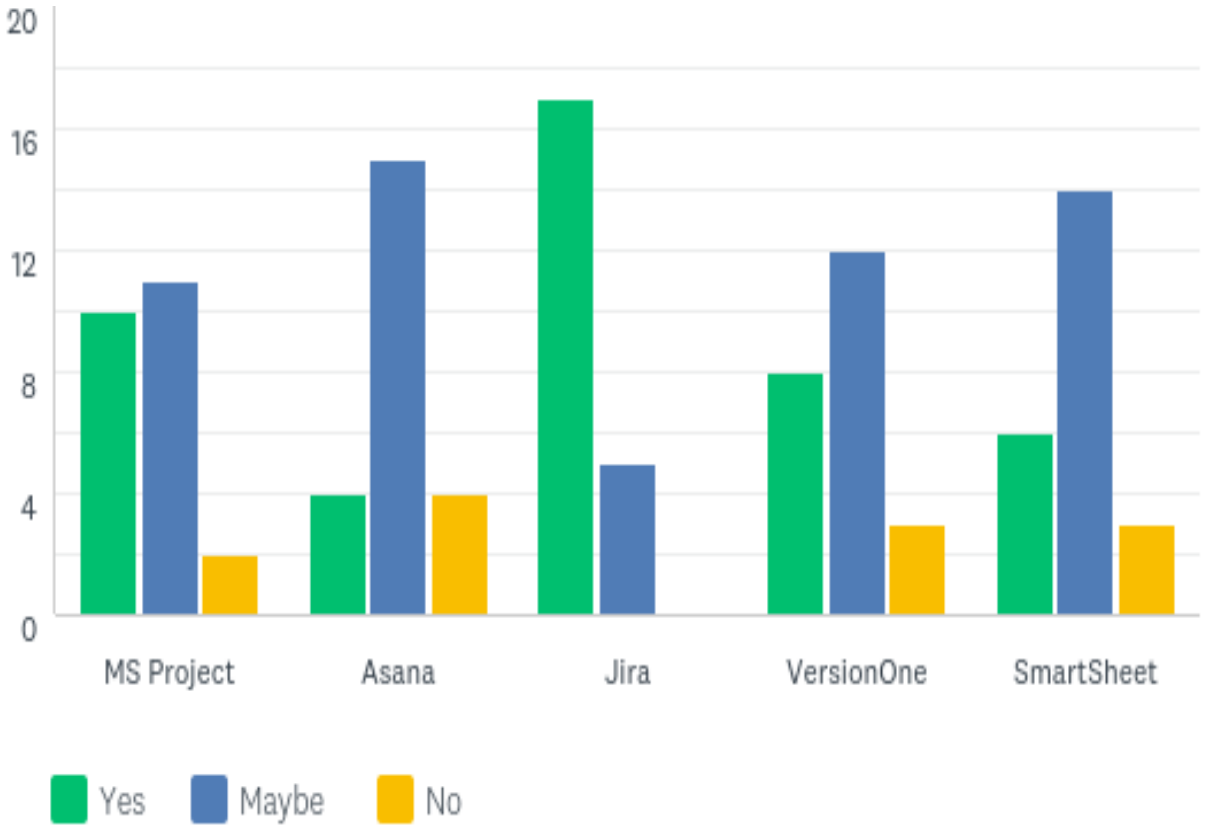

Figure 6: Project Management tools for IoT projects.

So, one can say that Jira, which is currently used for managing agile projects would be preferable choice for IoT projects as well.

Next, survey takers were asked to rank process groups are likely to increase the following few factors in IoT projects, and the factors along with the groups are (Figure 7-11):

- Cost (Execution)
- Schedule (Planning)
- Scope Creep (Execution)
- Conflicts (Planning)
- Quality Control (Execution)
- Risks (Execution)

- Vendor Management (Initiation)

Figure 7: Factors likely to increase on an Initiating Phase on IoT Project.

Figure 8: Factors likely to increase on Planning Phase on IoT Project.

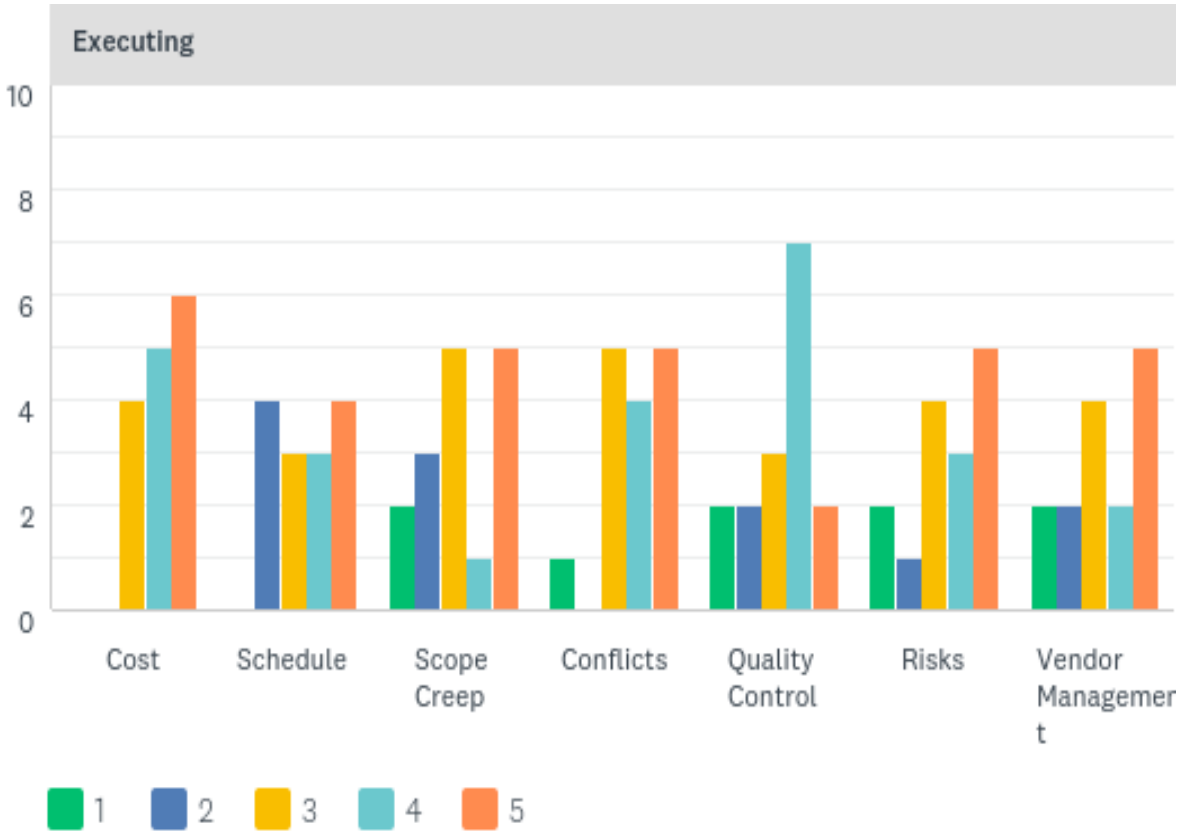

Figure 9: Factors likely to increase on an Executing Phase on IoT Project.

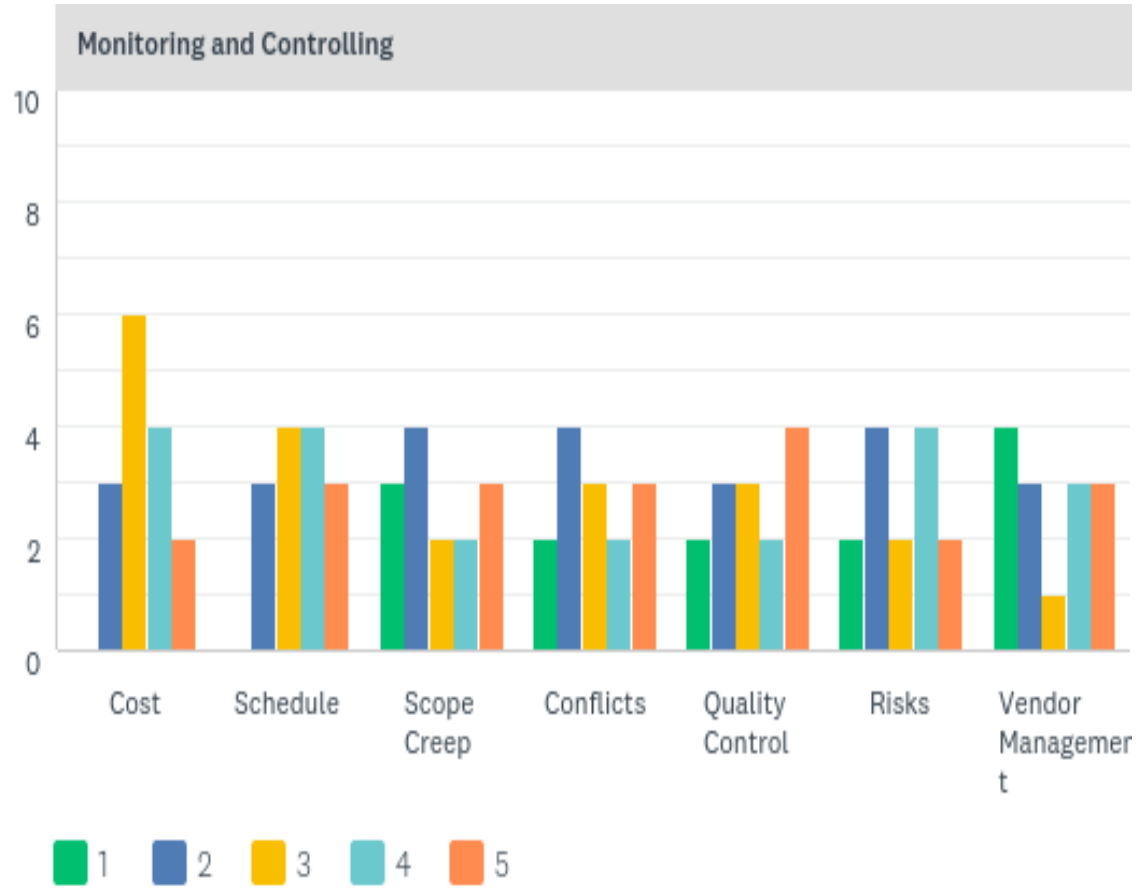

Figure 10: Factors likely to increase on a Monitoring and Controlling Phase on IoT Project.

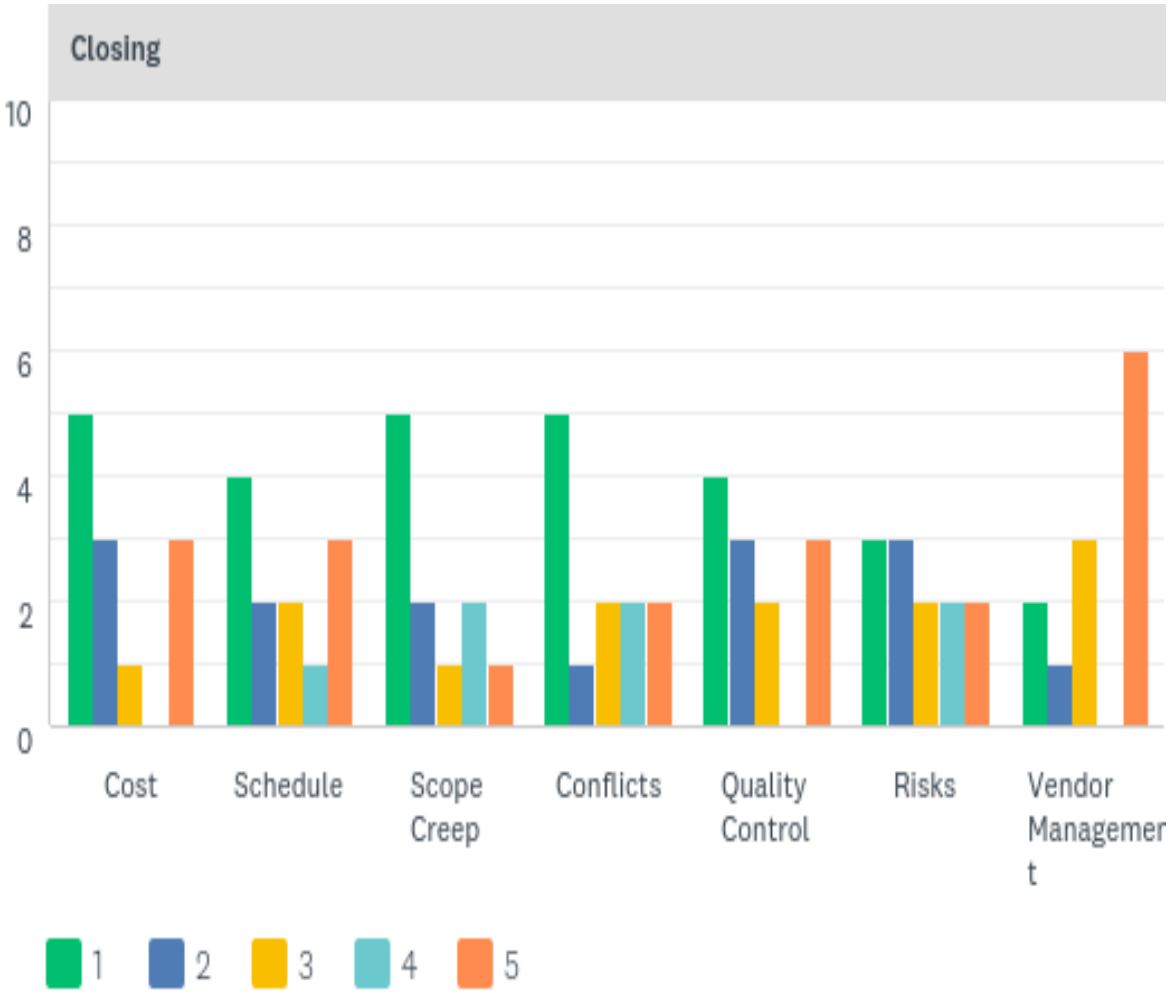

Figure 11: Factors likely to increase on a Closing Phase on IoT Project.

So, for the Execution Phase one can see Cost, Scope Creep, Quality Control and Risks are the factors that will be highly affected. Similarly, during the Planning Phase Schedule and Conflicts will be more seen, and in Initiation Phase Vendor Management will pose more challenges.

Another question about checking which factors in their views are likely to contribute to managing IoT projects, among the following:

- A separate research and development phase
- A Proof-of-Concept/Prototype before actual project begins

- Project managers with interdisciplinary technical knowledge
- Using hybrid of Waterfall and Agile methodologies
- Universally defined business and technical jargon

As seen from the responses in Figure 12 (also, see Appendix Figure 17), all of the above factors were selected were overwhelmingly selected and would add value to IoT project management.

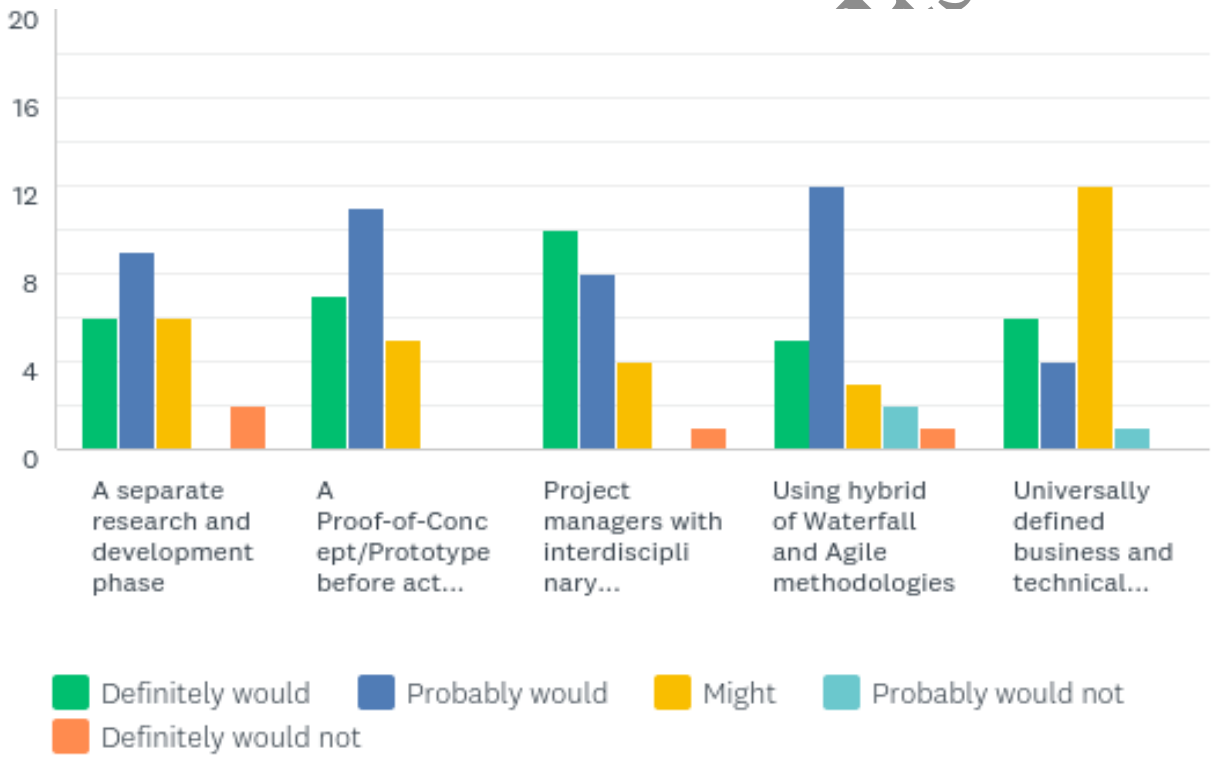

Figure 12: What factors would improve IoT project management?

Conclusion and Future Work

The fourth industrial revolution, which consists of the big data and the Internet of Things as its main ingredients, has already impacted wide range of industries. The companies affected are already trying to adapt to upcoming changes, by either changing their internal processes or by following the standard protocols. Even though IoT is such an important topic and has touched

our daily lives in so many ways, there is still a scarcity of studies on the managerial aspects of the IoT projects, and this is adding to the current challenges of adoption to IoT world.

This thesis lay out the fundamental building blocks of IoT projects and then based on exhaustive literature review; pin points the challenges in successfully completing IoT projects for enterprises and also provide reasons for failure of such projects. To summarize, a unique nature of such projects, where there are long product life cycles, complex nature of business models, lack of skill sets, no past projects to benchmark and ever-growing technology requires drastic changes in the philosophies, by which we currently carry on traditional projects.

Based on a mix of quantitative research, this thesis work identified the most important challenges being faced in management of IoT products development and then suggests solutions to tackle those. To reemphasize, a need to have separate research and development phase, where Proof-of-Concept/Prototype can be developed before the actual project begins can add to business value. Also, the stakeholder, especially the Project Managers need to be from or have interdisciplinary technical knowledge. Coming to management frameworks, a hybrid of Waterfall and Agile methodologies would work best for IoT projects and a well-defined universally accepted business and technical jargon would defiantly add to successfully complete the IoT projects.

Furthermore, with these findings form this work will help the IoT business owners, stakeholders, managers and developers in developing, designing, and carrying on the IoT projects in more systematic and in a universally accepted framework. And, as sown in Figure 13, need of hour is to bridge the gap between traditional project management philosophes and IoT initiatives, were more peer reviewed work is needed focused on IoT management.

Figure 13: Need of hour: Bridge the gap between traditional project management philosophies and IoT initiatives management.

Also, as future work, the above results will be presented to project management audience at large via conferences talks and poster presentations.

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Appendix

ANSWER CHOICES		RESPONSES	
Agriculture, Forestry, Fishing, and Hunting		5.88%	2
Utilities		2.94%	1
Computer and Electronics Manufacturing		14.71%	5
Wholesale		0.00%	0
Transportation and Warehousing		0.00%	0
Software		38.24%	13
Hotel and Food Services		0.00%	0
Health Care and Social Assistance		8.82%	3
Scientific or Technical Services		8.82%	3
Government and Public Administration		2.94%	1
Information Services and Data Processing		11.76%	4
Arts, Entertainment, and Recreation		0.00%	0
Other (please specify)	Responses	5.88%	2
TOTAL			34

Figure 14: Survey responders from diverse IoT initiative fields.

ANSWER CHOICES		RESPONSES	
Intern		2.94%	1
Entry Level		2.94%	1
Analyst / Associate		52.94%	18
Manager		17.65%	6
Senior Manager		2.94%	1
Director		0.00%	0
Vice President		0.00%	0
Senior Vice President		2.94%	1
C level executive (CIO, CTO, COO, CMO, etc)		0.00%	0
President or CEO		5.88%	2
Owner		5.88%	2
Other (please specify)	Responses	5.88%	2
TOTAL			34

Figure 15: Diverse portfolios of Survey Responders from various IoT initiative fields.

ANSWER CHOICES		RESPONSES	
Less than 1 year		41.18%	14
1-2 years		20.59%	7
2-5 years		14.71%	5
5 and more		20.59%	7
Other (please specify)	Responses	2.94%	1
TOTAL			34

Figure 16: Overview of Survey Responders experience in IoT initiatives.

	DEFINITELY WOULD (1)	PROBABLY WOULD (2)	MIGHT (3)	PROBABLY WOULD NOT (4)	DEFINITELY WOULD NOT (5)	TOTAL	WEIGHTED AVERAGE
A separate research and development phase	26.09% 6	39.13% 9	26.09% 6	0.00% 0	8.70% 2	23	2.26
A Proof-of-Concept/Prototype before actual project begins	30.43% 7	47.83% 11	21.74% 5	0.00% 0	0.00% 0	23	1.91
Project managers with interdisciplinary technical knowledge	43.48% 10	34.78% 8	17.39% 4	0.00% 0	4.35% 1	23	1.87
Using hybrid of Waterfall and Agile methodologies	21.74% 5	52.17% 12	13.04% 3	8.70% 2	4.35% 1	23	2.22
Universally defined business and technical jargon	26.09% 6	17.39% 4	52.17% 12	4.35% 1	0.00% 0	23	2.35

Figure 17: Basic statistics for factors likely to contribute to managing IoT projects.

	UNAWARE	RESISTANT	NEUTRAL	SUPPORTIVE	LEADING	TOTAL	WEIGHTED AVERAGE
Steering Committee/Leadership	4.35% 1	13.04% 3	21.74% 5	39.13% 9	21.74% 5	23	3.61
Program Manager	4.35% 1	4.35% 1	34.78% 8	17.39% 4	39.13% 9	23	3.83
Project Sponsor	4.55% 1	22.73% 5	27.27% 6	40.91% 9	4.55% 1	22	3.18
Project Development Team	0.00% 0	0.00% 0	30.43% 7	34.78% 8	34.78% 8	23	4.04
Business/Product Analysts	0.00% 0	4.35% 1	21.74% 5	39.13% 9	34.78% 8	23	4.04
End Customer or Client	13.04% 3	17.39% 4	30.43% 7	34.78% 8	4.35% 1	23	3.00
Local Communities	26.09% 6	13.04% 3	39.13% 9	21.74% 5	0.00% 0	23	2.57
Regulators	17.39% 4	21.74% 5	47.83% 11	13.04% 3	0.00% 0	23	2.57

Figure 18: Basic statistics for stakeholder's engagement on managing IoT projects.

	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE	TOTAL	WEIGHTED AVERAGE
Would you consider an IoT team management a challenge	23.08% 6	30.77% 8	34.62% 9	7.69% 2	3.85% 1	26	2.38
Do you agree that interdisciplinary teams are hard to manage	23.08% 6	46.15% 12	19.23% 5	11.54% 3	0.00% 0	26	2.19
Lack of team collocation poses challenges	23.08% 6	46.15% 12	23.08% 6	7.69% 2	0.00% 0	26	2.15
Roles and responsibilities are not well defined for such projects	23.08% 6	34.62% 9	34.62% 9	7.69% 2	0.00% 0	26	2.27
Such projects are more conflict prone	15.38% 4	34.62% 9	26.92% 7	23.08% 6	0.00% 0	26	2.58
Team-work skill set is an asset on an IoT project	48.15% 13	33.33% 9	14.81% 4	3.70% 1	0.00% 0	27	1.74

Comments (1)

Figure 19: Basic statistics for team building on IoT projects.