SMARTER DECISIONS - THE INTERSECTION OF INTERNET OF THINGS AND DECISION SCIENCE PDF, EPUB, EBOOK

Jojo Moolayil | 392 pages | 29 Jul 2016 | Packt Publishing Limited | 9781785884191 | English | Birmingham, United Kingdom

Smarter Decisions – The intersection of IoT & Decision Science – Jojo John Moolayil

The entire journey of addressing the problem by defining it, designing the solution, and executing it using decision science is articulated in this book through engaging and easy-to-understand business use cases. You will get a detailed understanding of IoT, decision science, and the art of solving a business problem in IoT through decision science. By the end of this book, you'll have an understanding of the complex aspects of decision making in IoT and will be able to take that knowledge with you onto whatever project calls for it Style and approach This scenario-based tutorial approaches the topic systematically, allowing you to build upon what you learned in previous chapters.

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About the author JM. Description With an increasing number of devices getting connected to the Internet, massive amounts of data are being generated that can be used for analysis. Building Xamarin. Pragmatic Guide to Sass 3 Pages English.

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Even if your're a non-technical manager anchoring IoT projects, you can skip the code and still benefit from the book. With an increasing number of devices getting connected to the Internet, massive amounts of data are being generated that can be used for analysis. This book helps you to understand Internet of Things in depth and decision science, and solve business use cases.

Smarter Decisions – The Intersection of Internet of Things and Decision Science [Book]

Smart speakers driven by voice control have been one of the most successful consumer electronics trends in history. Yet, most of these devices are used for only a fraction of their full capability. What will it take for sm. Craig Paxman started working for Homemation 15 years ago, and is passionate about technology and the internet of things. I started as a techn. But the industry is evolving. The Internet of Things is everywhere. Giovanni Valle set up Amperauto back in to design and build electro-mechanical devices for the automotive industry which expanded into electronic ones as well. His policy since inception was to become a market leader by producing reliable, quali. The Shaun Lockyer Architect designed home sits high on a hill enjoying northerly Brisbane City views, with large open floor plates that create a sequence of public and private areas and a number of internal courtyards.

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In another 15 minutes, you are home and the air conditioning temperature is well set for three people. You then grab a can of juice from the refrigerator and discuss some math problems with your son on the couch. Intuitive, isn't it? How did it his happen and how did you access and control everything right from your phone?

Well, this is how IoT works! Devices can talk to each other and also take actions based on the signals received:. Lets take a closer look at the same scenario. You are sitting in office and you could access the air conditioner, microwave, refrigerator, and home controller through your smartphone. Yes, the devices feature Internet connectivity and once connected to the network, they can send and receive data from other devices and take actions based on signals.

A simple protocol helps these devices understand and send data and signals to a plethora of heterogeneous devices connected to the network. We will get into the details of the protocol and how these devices talk to each other soon. However, before that, we will get into some details of how this technology started and why we have so many different names today for IoT. So now that we have a general understanding about what is IoT, lets try to understand how it all started. A few questions that we will try to understand are: Is IoT very new in the market? If we try to understand the fundamentals of IoT, that is, machines or devices connected to each other in a network, which isn't something really new and radically challenging, then what is this buzz all about?

The buzz about machines talking to each other started long before most of us thought of it, and back then it was called Machine to Machine Data. In early , a lot of machinery deployed for aerospace and military operations required automated communication and remote access for service and maintenance. Telemetry was where it all started. It is a process in which a highly automated communication was established from which data is collected by making measurements at remote or inaccessible geographical areas and then sent to a receiver through a cellular or wired network where it was monitored for further actions. To understand this better, lets take an example of a manned space shuttle sent for space exploration. A huge number of sensors are installed in such a space shuttle to monitor the physical condition of astronauts, the environment, and also the condition of the space shuttle. The data collected through these sensors is then sent back to the substation located on Earth, where a team would use this data to analyze and take further actions.

During the same time, industrial revolution peaked and a huge number of machines were deployed in various industries. Some of these industries where failures could be catastrophic also saw the rise in machine-to-machine communication and remote monitoring:. Thus, machine-to-machine data a. M2M was born and mainly through telemetry. Unfortunately, it didn't scale to the extent that it was supposed to and this was largely because of the time it was developed in.

Back then, cellular connectivity was not widespread and affordable, and installing sensors and developing the infrastructure to gather data from them was a very expensive deal. Therefore, only a small chunk of business and military use cases leveraged this. As time passed, a lot of changes happened. The Internet was born and flourished exponentially. The number of devices that got connected to the Internet was colossal. Computing power, storage capacities, and communication and technology infrastructure scaled massively. Additionally, the need to connect devices to other devices evolved, and the cost of setting up infrastructure for this became very affordable and agile.

Thus came the IoT. However, this was mainly because of the time they evolved in. The difference between the two is bare minimum and there are enough cases where both are used interchangeably. Therefore, even though M2M was actually the ancestor of IoT, today both are pretty much the same. IoE or Internet of Everything was a term that surfaced on the media and Internet very recently. The term was coined by Cisco with a very intuitive definition.

It emphasizes Humans as one dimension in the ecosystem. It is a more organized way of defining IoT. The IoE has logically broken down the IoT ecosystem into smaller components and simplified the ecosystem in an innovative way that was very much essential. IoE divides its ecosystem into four logical units as follows:. Overall, all these different terms in the IoT fraternity have more similarities than differences and, at the core, they are the same, that is, devices connecting to each other over a network. The names are then stylized to give a more intrinsic connotation of the business they refer to, such as Industrial IoT and Machine to Machine for B2B heavy engineering, manufacturing and energy verticals, Consumer IoT for the B2C industries, and so on. Now that we have a clear understanding of what is IoT and the similar terms around it, lets understand the ecosystem better.

For convenience, IoE will be referred as IoT while exploring the four logical components of the stack in brief. Lets explore each of these components in brief. People or we interact with devices and other people on a daily basis. Considering People as a separate dimension in the IoT ecosystem is an essential move as the complexity in understanding this is really challenging. When any form of communication occurs where People play a role on either end of the interaction, it embeds a unique pattern that is intrinsic to the People dimension.

Lets understand this better with an example. Here, the communication paths are mainly People to People. Considering the previous example, we had people to device and device to people communication paths communication between the smartphone and microwave. Considering People as a dimension, everyone would differ in the way they interact with the system. I might find the new interface of Facebook very difficult to use but a friend may find it extremely easy. The real problem here is everyone is skilled, but the skillsets differ from person to person. The characteristics of the interaction identified by a person may be a representative for a very small community. With such a huge population consisting of a plethora of communities representing people of different geographical areas, culture, thinking, and behavior, defining one generic set of rules or characteristics to define people interaction is very challenging.

Instead, if we understand the People dimension in a more constructive way, we can tap the opportunity to capture the behavior more accurately and help them benefit from the ecosystem in the best way. With the advent of IoT, we have sensors capturing information and characteristics at more granular levels than ever before. Here, if we can accurately define People as a complete dimension, personalized experience will be a complete game changer.

The smart watch industry is investing humongous efforts to get its offering more personalized; if it succeeds, it will be a pivotal player in the coming revolution. A wide variety of things fall in the Processes dimension that includes technology, protocols, business logic, communication infrastructure, and so on. Broadly, they can be classified into two components- Technology and Business Processes. Lets explore these two components in brief in order to understand the Processes dimension in more detail. The technology required in the Processes dimension of IoT comprises of the software, protocol, and infrastructure. We will explore Technology by understanding its three broad divisions for Processes.

Software consists mainly of the operating system. Devices in IoT require a special kind of an operating device. Smart devices such as the smart refrigerator, smart microwave, and many others require an operating system running on them that can then enable it to be an active component in the network. Tasks executed can vary from sending, processing, and receiving data or executing instructions and sending signals to respective controllers within the device for action. Now, the question is, why do these devices require a special operating system? The answer is the same as the reason that we used Android for smartphones and not the existing OS back then. The devices that connect to the network in IoT are small or sometimes tiny. Ideally, these devices would be equipped with less powerful computing capabilities, lower memory, and lower battery life.

It is almost impossible to run a fully-fledged operating system on them. We need a specially designed OS that can take care of the limited memory, processing power and battery life of the device and yet provide maximum functionality to tag the device as a smart device. Google recently launched an operating system for IoT devices called Brillo. Brillo is an Android-based embedded operating system specifically designed for low power and memory-constrained IoT devices. Soon, we can expect a vast community of devices running Brillo and a plethora of apps that can be installed additionally for even better functionality something very similar to the Google Play store. Once the devices are software-enabled, we need to get a protocol in place that can help them communicate with other heterogeneous devices in the network. To understand this better, recollect the first example where we could defrost the refrigerator using our smartphone.

The smartphone needs to talk to the refrigerator that also needs to understand what exactly is being communicated. With a huge variety of heterogonous devices, this communication path just gets more and more complicated. Hence, we need to have a simplified protocol in place where complicated process can be abstracted and the devices can communicate with each other effectively. Google recently launched an open source protocol called Weave. Weave is basically an IoT protocol that is a communications platform for IoT devices that enables device setup, phone-to-device-to-cloud communication, and user interaction from mobile devices and the web. It has ushered productivity in the developers efforts by easing up device interoperability regardless of the brand or manufacturer. Infrastructure can simply be defined as the integration of the operating system, communication protocol, and all other necessary components to harmonize the environment for an IoT use case.

All major cloud infrastructure providers are now focusing on providing an IoT-specialized environment. All of these solutions integrate the disparate systems together to make the ecosystem scalable and agile. Digging deeper into these suites will be beyond the scope of this book. The second part of the Processes dimension is Business Processes. It basically covers the set of rules and processes to govern the communication and operation of the devices connected in the IoT ecosystem. There isn't a concrete definition till now that can be used here and the discussion of the topic will be beyond the scope of this book.

Things form the crux of the IoT ecosystem. They include any form of sensors, actuators, or other type of devices that can be integrated into machines and devices to help them connect to the Internet and communicate with other devices and machines. These things will be always active during their lifetime and will sense events, capture important information, and communicate them with other devices. A typical example would be the refrigerator, TV, or microwave that we considered in the previous use case.

Data is by all means the most value-adding dimension in the IoT ecosystem. Today, the devices that are connected to the Internet are capturing tons and tons of data that can represent the most granular-level details for the devices they are connected to. The magnitude of this data is colossal. Storing and processing such vast and varied amounts of data questions the fact whether the data is really valuable.

In a true sense, most of the data is transient in nature and loses its value within minutes of generation. With ever-improving technology and computing capabilities, the amount of data processing and storage that the devices are capable of today is great, but we can leverage this power to deliver better value than just delivering raw data. Tons of algorithms can be executed and business rules can be applied where a lot of value can be extracted from the data before sending it over to the server. This requires the combination of multiple disciplines together to solve the problem and deliver value.

To understand this better, consider the example of a pedometer installed in our smart watch. Rather than just reporting the number of steps that we have walked, it can calculate the amount of calories we have burned, average time taken for the activity, metrics like deviation from the previous days activity, deviation from milestones, and other social information such as how do we compare with our friends, and so on. To capture and process all of this information locally and send the final results to the server that can be directly stored for future actions requires the combination of multiple disciplines to make the task efficient.

Math, business, technology, design thinking, behavioral science, and a few others would need to be used together to solve the problem. In reality, it would be futile to send across all the raw data captured from devices to the servers assuming that it can be leveraged for future use. A variety of new algorithms have been designed to ingest this data locally and deliver only rich, condensed, and actionable insights in real time. We will explore this in more detail with fog computing in Chapter 8 , Disruptions in IoT. Smart watches such as the Microsoft Band and self-driving cars such as Tesla Model S are the best examples to understand the true scenarios where we can study the challenges of processing data in real time for insights and actions. In all true sense, data is what essentially helps in delivering the last mile value in the IoT fraternity. Hence, we need talent to deal with the data as a separate dimension in the IoT stack. The core agenda of this book is to solve IoT business problems using Decision Science.

Problem solving has been an art and has its origin ever since mankind evolved. I would like to introduce The Problem Life Cycle to learn how the problem keeps evolving. Understanding this topic is very essential to solve better problems in IoT. Every industry has been trying to solve a problem. E-retail solved the problem of inconvenience in physical shopping for busy and working consumers, the printing press solved the problem of mass producing documents for the consumers, and so on. A few visionaries such as Apple Inc. The iPod and iPad were devices that were a part of this revolution. The biggest challenge in solving a problem is that the problem evolves. If we take a deeper look at the problem life cycle, we can understand that the problem evolves from a Muddy to Fuzzy and finally to a Clear state and keeps repeating the cycle:. Lets take a simple example to understand this better.

Consider the Marketing problem. Every organization wants to promote their products and services better by marketing them. Marketing has been a problem since ages. Lets assume that the inception of marketing happened with the invention of the printing press. Initially, the problem for marketing would be in the muddy phase, where a team of analysts would try to get the best strategy to market a product or service in place. Back then, newspapers and print media were the only medium, and the strategies and nature of the problem was very much limited to them. When the problem is new, it is in the muddy stage; we have no clear idea about how to solve it. We would try to understand the problem by experimenting and researching. Gradually, we gain some knowledge about the system and problem and then define a couple of best strategies and guidelines to solve the problem. This is when the problem evolves to the fuzzy stage.

Here, the solution for the problem is still not clear, but we have a fair understanding of how to go about it. Finally, after a lot of research and experiments from a large pool of people sharing their results and understandings, we might finally have a concrete methodology in place that can be used as a complete guide to solve the problem. This is when the problem reaches the clear stage. It is the pinnacle of the problem solving methodology where we have a clear understanding about how to tackle the problem and solve it.

However, one fine day, a big disruption happens and the problem that was finally in the clear state collapses and returns to the muddy stage. In the case of marketing, when people aced the best strategies to advertise using print media and newspapers, it collapsed with the invention of the radio. All of a sudden, the nature of the problem changed and it required a radically different approach to solve it. The experts, who had concrete approaches and strategies for the problem solving back then, had to revisit and start from the beginning as the problem went back to the muddy stage.

The problem life cycle kept evolving, and this was repeated when television was introduced and again when social media was introduced. Today, with the social media booming and expanding to newer areas, we have the marketing problem currently stable at the fuzzy state. Soon, with the advent of virtual reality and augmented reality, it is expected to roll back to the muddy phase.

To get more real, lets relate the scenario with a more recent version of the problem. Consider a social media analyst trying to solve a problem: optimizing targets for sponsored ads that need to be placed in the Facebook newsfeed for a user based on his behavior. If we find the user to be a football enthusiast, we would insert an ad into his newsfeed for a sportswear brand. To keep things simple, assume that we are the first ones to do this and no one has ever attempted this in history. The problem will currently be in the muddy state. So logically, there would be no references or material available over the Internet for our help and research. Our problem solving task begins by identifying the users interest. Once he has been identified as a potential user with an interest in football, we need to place a sponsored ad in his newsfeed. How do we discover the users interest?

There are a variety of metrics that can help us discover his interests, but for simplicity, lets assume that the users interests will be identified purely by the Status Updates he posts on his wall. We can then simply try to analyze the statuses updated by the person and define his interests. If the word Football or names of any popular football players or football teams appear more than a desired threshold, we can possibly say that he would be following football and hence would be a potential target. Based on this simple rule, we create better strategies and algorithms where our accuracy of finding the potential users can be reached with the minimum amount of time and effort. Gradually, the problem moves from the muddy stage to the fuzzy stage. We now have a good amount of understanding regarding the problem. We may not have the best and most effective solution for the problem, but we definitely have a fair idea to get started and find a solution without too much research.

Over a period of time, we, and many other similar folks, conduct various experiments, publish various blogs and research papers of the results, and help others learn from our methods and experiment more. Eventually, there would be a time when we will have attempted the exhaustive solution paradigms and have the knowledge for the best and most effective solution for any sort of analysis in that domain.

Finally, it reaches its pinnacle point-the clear stage. One day, all of a sudden, Facebook and other social media giants launch a new feature. Users can now share photos along with their status updates. A radical change will be seen in the way the user will now use the social network. People tend to post more photos than text updates. All the thought-leadership frameworks and research papers and blogs that proved to be highly successful earlier now seem to be ineffective. We are not sure how to analyze photos updated by the user in order to understand his interests.

Unfortunately, the problem goes back to the muddy stage. These big changes keep happening again and again. After photos, it will be videos, then audios, and so on, and the cycle keeps repeating as usual. Recently, the user behavior on social networks has dramatically changed. People post more pictures than type any comment or status updates. These photos may or may not be symbolic of the message that the user wants to convey. Sarcasm or satire may be the objective. The memes that get viral over the Internet have no clear message embedded in them.

It may be sarcasm or simple smileys that the user wants to comment on. Analyzing the meaning of these images memes to understand the actual message that the user wants to convey with algorithms and computers to find out his interests is a challenging deal. Hence, understanding the problem life cycle helps prepare us better for the evolution of the problem and adapt the problem solving strategies better and faster. Lets see how this will be helpful.

While solving a problem, understanding the current state of the problem is essential for the analyst. Whenever we solve a problem, we would always prepare for the next state of the problem life cycle knowing that change in the problems current state is inevitable. If the problem is currently in the clear state, then the amount of time and effort we would invest as a data scientist would be considerably less than if the problem would have been in the muddy or fuzzy stage.

However, the problem remains for the least amount of time in the clear stage. The jump from clear to muddy is shorter compared to any other transition in the problem life cycle. We would need to design our solution to be agile and prepare for the next change. Similarly, if the problem is in the fuzzy stage, a lot of our solutions will be designed in such a way that they can be productized for a particular use case or industry.

Finally, when the solution is in the muddy state, our solutions in problem solving will be more of a service-based offering than a product. The amount of experiments and research that we would need for the problem to be solved is highest in the muddy state and least in the clear state:. So how does this relate to IoT and Decision Science and the intersection of the two? Decision Science has been a bit more widespread and prevalent in the industry than IoT. There have been tons of experiments and research conducted on data to find insights and add value that make Decision Science currently in the fuzzy stage.

IoT, on the other hand, is fairly new and requires loads of research and experiments to get tangible results, which makes it in the muddy stage. However, when we talk about the intersection of the two, we are dealing with a set of interesting problems. On one side, we have a fairly mature ecosystem of Decision Science that has given tangible value to the industry through its experiments whereas IoT is still nascent. The intersection of the two is a very promising and lucrative area for business.

It is in a position where it is steadily moving from the muddy to fuzzy stage. Very soon, we will see tangible results from large-scale IoT use cases in the industry that will immediately trigger the revolution for productization on Decision Science for IoT. Decision Science for IoT is rapidly being experimented and the initial results seem to be very promising. The era, where Decision Science for IoT will be in the fuzzy state, is very near. With this in mind, we can now get to the basics of problem solving while being prepared for the use case to evolve into a fuzzy state.

With the understanding of the problem life cycle concrete, lets now explore the problem landscape in detail. A simple answer would be, understanding the current state of the problem is just one dimension, but understanding the type of problem is a more essential part of problem solving. Lets make this simple. To understand the problem landscape, refer to the following image and try to visualize the problems on two dimensions-frequency and impact. Just like any other scatterplot, this one can also be divided into four major areas:. Here, the problems can be with a high or low frequency and also a high and low impact. So we name it the Region of Uncertainty :. Lets understand what kind of problems appear in each of these boxes. Every organization will have a plethora of problems; some of them occur very frequently and some of them very rarely. Some may have a huge impact whereas some may have a small impact. Consider a large organization with hundreds to thousands of employees.

There are a couple of problems where the frequency might be low and impact might also be very low. We would generally tend to avoid solving these problems as they are not worth the effort. Some problems, even though they may have a low impact, might have a huge frequency. They would mostly happen on a daily basis. These problems are solved with the typical IT solution approaches such as Support for Technology Infrastructure, CRM, attendance management, employee leave application portal, and so on.

There are some problems where the impact will be extremely huge, but the frequency will be extremely low. Events such as making the company public, acquiring a new company, or changing the business model would happen probably once in a lifetime or once in a few years. These problems can be solved from a consulting approach. Then there is one class of problems that has an extremely huge impact and occurs very frequently, for example, a pricing model for Amazon, Google's page rank algorithm, Search Engine Optimization, and others. These problems again require a completely different approach to solve. Here, we would need an approach that would be a combination of heuristics as well as algorithms blended with products. Apart from these four obvious types of problems, we will have a special set of problems that has a flavor of all these types: moderate problems. Here, we might have a moderately good impact and frequency. Solving these problems requires a special approach.

These are neither completely heuristic-based nor completely algorithmic. These are sweet spots for businesses where the tangible results can be experimented and validated very early and many companies can target for conceptualizations to deal with specific areas of the problem landscape:. When we explore the sweet spot, that is, the Circle of Uncertainty, we find that the problems again are of a different nature.

They could be any one of the following:. To understand the nature of the problem, we basically try to ask what question is the solution answering. It could be what, how, when, why, and so on.