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# 1 A Comprehensive Study On IoT: Major Challenges

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***Abstract***

*IoT is the unique domain that will work on various things that enables human being to interact with web services as well as helps to obtain the goal of creating a smart world. In this context the research and development challenges to create a smart world, IoT works in all the fields such as making smart city, developing smart transportation system, making smart industry and many other things. The goal of Internet of Things is to connect the people, objects, places at anywhere by introducing various new paradigm. This is the aim of IOT to connect the people, places, things together. A Web service is a type of software application providing platform for IOT based protocols. This paper presents the glance on the IOT and a list of 10 common challenges faced by enterprises that cause quality issues, leading to the project failure, including budget overruns and long completion times.*

***Keyword:*** *Web service dictionary, WDL, SOAP, Web Server*

## 1. Introduction

The Internet of Things (IoT) refers to a system of interrelated, internet-connected objects that are able to collect and transfer data over a wireless network without human intervention. The Internet of Things (IoT) describes the network of physical objects—"things"—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. These devices range from ordinary household objects to sophisticated industrial tools.


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With more than 7 billion connected IoT devices today, experts are expecting this number to grow to 10 billion by 2020 and 22 billion by 2025.

By means of low-cost computing, the cloud, big data, analytics, and mobile technologies, physical things can share and collect data with minimal human intervention. In this hyperconnected world, digital systems can record, monitor, and adjust each interaction between connected things. The physical world meets the digital world—and they cooperate. The personal or business possibilities are endless. A 'thing' can refer to a connected medical device, a biochip transponder (think livestock), a solar panel, a connected automobile with sensors that alert the driver to a myriad of possible issues (fuel, tire pressure, needed maintenance, and more) or any object, outfitted with sensors, that has the ability to gather and transfer data over a network.

Today, businesses are motivated by IoT and the prospects of increasing revenue, reducing operating costs, and improving efficiencies. Businesses also are driven by a need for regulatory compliance. Regardless of the reasons, IoT device deployments provide the data and insights necessary to streamline workflows, visualize usage patterns, automate processes, meet compliance requirements, and compete more effectively in a changing business environment.

## 2. What Technologies Have Made IoT Possible?

While the idea of IoT has been in existence for a long time, a collection of recent advances in a number of different technologies has made it practical.

- **Access to low-cost, low-power sensor technology.** Affordable and reliable sensors are making IoT technology possible for more manufacturers.
- **Connectivity.** A host of network protocols for the internet has made it easy to connect sensors to the cloud and to other "things" for efficient data transfer.
- **Cloud computing platforms.** The increase in the availability of cloud platforms enables both businesses and consumers to access the infrastructure they need to scale up without actually having to manage it all.
- **Machine learning and analytics.** With advances in machine learning and analytics, along with access to varied and vast amounts of data stored in the cloud, businesses can gather insights faster


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and more easily. The emergence of these allied technologies continues to push the boundaries of IoT and the data produced by IoT also feeds these technologies.

- **Conversational artificial intelligence (AI).** Advances in neural networks have brought natural-language processing (NLP) to IoT devices (such as digital personal assistants Alexa, Cortana, and Siri) and made them appealing, affordable, and viable for home use.

### *3. What Industries Can Benefit from IoT?*

Organizations best suited for IoT are those that would benefit from using sensor devices in their business processes.

### 3.1 Manufacturing

Manufacturers can gain a competitive advantage by using production-line monitoring to enable proactive maintenance on equipment when sensors detect an impending failure. Sensors can actually measure when production output is compromised. With the help of sensor alerts, manufacturers can quickly check equipment for accuracy or remove it from production until it is repaired. This allows companies to reduce operating costs, get better uptime, and improve asset performance management.

### 3.2 Automotive

The automotive industry stands to realize significant advantages from the use of IoT applications. In addition to the benefits of applying IoT to production lines, sensors can detect impending equipment failure in vehicles already on the road and can alert the driver with details and recommendations. Thanks to aggregated information gathered by IoT-based applications, automotive manufacturers and suppliers can learn more about how to keep cars running and car owners informed.

### 3.3 Transportation and Logistics

Transportation and logistical systems benefit from a variety of IoT applications. Fleets of cars, trucks, ships, and trains that carry inventory can be rerouted based on weather conditions, vehicle availability, or driver availability, thanks to IoT sensor data. The inventory itself could also be equipped with sensors for track-and-trace and temperature-control monitoring. The food and beverage, flower, and pharmaceutical industries often carry temperature-sensitive inventory that would benefit greatly from IoT monitoring applications that send alerts when temperatures rise or fall to a level that threatens the product.


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### 3.4 Retail

IoT applications allow retail companies to manage inventory, improve customer experience, optimize supply chain, and reduce operational costs. For example, smart shelves fitted with weight sensors can collect RFID-based information and send the data to the IoT platform to automatically monitor inventory and trigger alerts if items are running low. Beacons can push targeted offers and promotions to customers to provide an engaging experience.

### 3.5 Public Sector

The benefits of IoT in the public sector and other service-related environments are similarly wide-ranging. For example, government-owned utilities can use IoT-based applications to notify their users of mass outages and even of smaller interruptions of water, power, or sewer services. IoT applications can collect data concerning the scope of an outage and deploy resources to help utilities recover from outages with greater speed.

### 3.6 Healthcare

IoT asset monitoring provides multiple benefits to the healthcare industry. Doctors, nurses, and orderlies often need to know the exact location of patient-assistance assets such as wheelchairs. When a hospital's wheelchairs are equipped with IoT sensors, they can be tracked from the IoT asset-monitoring application so that anyone looking for one can quickly find the nearest available wheelchair. Many hospital assets can be tracked this way to ensure proper usage as well as financial accounting for the physical assets in each department.

### 3.7 General Safety Across All Industries

In addition to tracking physical assets, IoT can be used to improve worker safety. Employees in hazardous environments such as mines, oil and gas fields, and chemical and power plants, for example, need to know about the occurrence of a hazardous event that might affect them. When they are connected to IoT sensor–based applications, they can be notified of accidents or rescued from them as swiftly as possible. IoT applications are also used for wearables that can monitor human health and environmental conditions. Not only do these types of applications help people better understand their own health, they also permit physicians to monitor patients remotely.


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## 4. Specification of Web Services:

**4.1 SOAP:** SOAP was originally part of the specification that included the Web Services Description Language (WSDL) and Universal Description, Discovery, and Integration (UDDI). It is used now without WSDL and UDDI. Instead of the discovery process described in the History of the Web Services Specification section below, SOAP messages are hard-coded or genereated without the use of a repository. SOAP commonly uses HTTP, but other protocols such as Simple Mail Transfer Protocol (SMTP) may be used. SOAP can be used to exchange complete documents or to call a remote procedure.

**4.2 REST:** REST (Representational state transfer) is an architectural style consisting of a coordinated set of architectural constraints applied to components, connectors, and data elements, within a distributed hypermedia system. REST appeals to developers because it has a simpler style that makes it easier to use than SOAP. It also less verbose so that less volume is sent when communicating. REST ignores the details of component implementation and protocol syntax in order to focus on the roles of components, the constraints upon their interaction with other components, and their interpretation of significant data elements.

**4.3 UDDI:** UDDI is defined as “a set of services supporting the description and discovery of businesses, organizations, and other Web services providers, the web services they make available, and the technical interfaces which may be used to access those services” by OASIS (The Organization for the Advancement of Structured Information Standards) . UDDI is an industry initiative that enables businesses to publish their services and allows potential users to discover these services.

**4.4 WSDL:** The Web Services Description Language (WSDL) forms the basis for the original Web Services specification. The following figure illustrates the use of WSDL. At the left is a service provider. At the right is a service consumer.

## 5. Challenging Aspects:

In the technological corners, it is always amusing to find out how quickly a newly coined term becomes a buzzword. And in no time, it passes through different stages of development and a handy product or service is made available for the consumers.


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The easiest example in this context is eCommerce websites. Amazon.com was the first eCommerce website launched in 1994 and within 10-15 years, almost all large and medium scale enterprises started selling their products over the Internet. So is in the case of Smartphone. First Smartphone that was marketed to the consumers was also launched in 1994 by BellSouth, and now it has become a modern-day lifeline.

From the consumers' perspective, if the product meets the convenience, cost, and social factors, it quickly gets adopted on large scale. Here, two critical factors i.e. security and privacy are often ignored at the beginning by consumers and sometimes willingly by tech-leaders, mainly because of lack of effective solution, but gradually before these become a real threat, a shield, may not be strong enough, is developed to keep the technology functional.

One such term, IOT (Internet of Things) was first coined by Kevin Ashton in 1999, but interestingly, it has never became a buzzword, rather it silently revolutionized the industrial sector and gradually paving its way in the consumer market.

Even, Accenture's latest Industrial Internet of Things trend study confirms that *60% of the companies are already engaged in IoT projects*, more than 30% are at an early stage of deployment though. And 69% of these companies' IoT intitivaties are focused on reducing operational cost.

The growing advancement in sensor technology with respect to range, sensitivity, and resolution, and the network in terms of speed and coverage led to this revolution. The "connected" can help businesses generate insight and provide valued services to their customers, at a reduced operational cost. Despite the availability of resources and advancements in key IOT components: Sensors and Networks, many companies have not been able to make substantial benefit out of their IoT project.

According to a data released by Cisco, *74% of surveyed organizations have failed with their IoT initiatives.* This is mainly because there are several human factors involved in IoT implementation, beyond the functional elements of sensors and networks.

An effective collaboration and integration among all the components of IoT, along with creating a culture of technology within the organization is required to succeed.


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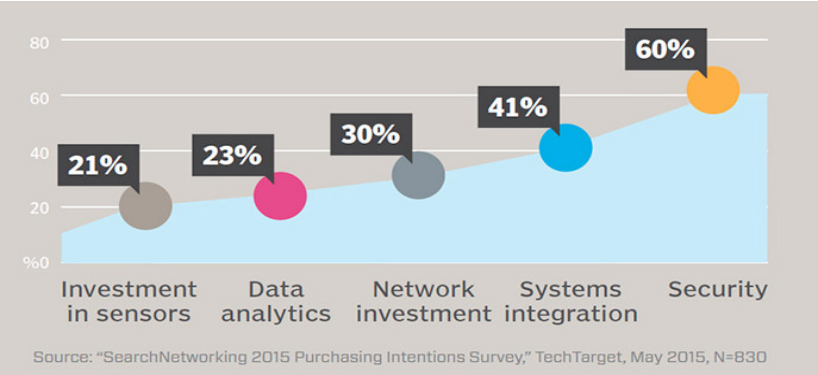
But in doing so, many companies face critical challenges related to security network investment and data analysis. Here is a brief on the areas where the companies face challenges:




Where most of the companies are often prepared to handle Sensors and Data Analytics, they fail to bring the same level of expertise into Network Investment, System Integration, and Security. Besides, on the occasion of IoT World Forum 2017, Cisco released a survey that highlights a perception gap between the IT executives and business executives.

**35% of surveyed IT executive's percieved their IoT project as successful, but only 15% of business executives believe that the initiative was a success.**

The percentage gap highlights a rift between technology and value delivered, where IT department is sure of bringing the technology required for a successful IoT project, it is the lack of value delivered, which makes business executives consider the project unsuccessful. Capturing invaluable data that lead to false insight could also be the reason many business executives consider their IoT projects unsuccessful.

A list of 10 common challenges faced by enterprises that cause quality issues, leading to the project failure, including budget overruns and long completion times.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### 5.1 Compatibility and interoperability of Different IoT systems

As per the market analysts at McKinsey, 40% to 60% of the total values lies on our ability to achieve interoperability between different IoT systems. With numerous vendors, OEMs, and service providers, it becomes really difficult to maintain interoperability between different IoT systems. Sensors and Networking are the integral components of IoT. But not every machine is equipped with advanced sensors and networking capabilities to effectively communicate and share data. Besides, sensors of different power consumption capabilities and security standards inbuilt in legacy machines may not be capable to provide the same results.

A quick workaround could be to add external sensors, but this is also challenging because determining which function and which part will communicate and share data with the network is complex.

### 5.2 Identification and Authentication of Technologies

According to a report, there are around 20 billion connected devices at present, and to connect all the devices involves a lot of security risks and not just complexity. Bringing along a large number of connected devices on one platform needs formalization and system architecture that can identify and authenticate those devices.

### 5.3 Integration of IoT Products with IoT Platforms

For the successful implementation of IoT application, enterprises need to integrate various IoT connected products with right IoT platforms. Lack of proper integration could lead to abnormalities in functions and efficiency to deliver value to the customers.Research vice president at Gartner, Benoit Lheureux, says “Through 2018, half the cost of implementing IoT solutions will be spent integrating various IoT components with each other and back-end systems. It is vital to understand integration is a crucial IoT competency.”

The major challenge here is too many IoT endpoints and asserts that need to be connected to aggregate the sensor data and transmit it to an IoT platform. Only with deep integration, companies can mine the huge data through Big Data technique to generate insight and to predict the outcomes.


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### 5.4 Connectivity

It is the part of networking challenges, as the Internet is still not available everywhere at the same speed. A global mobile satellite company Inmarsat revealed that 24% finds connectivity issue as the one of the biggest challenges in IoT deployment.

Specifically, Logistics and Oil & Gas companies engaged in remote operations require robust communication networks to collect data in tough conditions and transmit back to the centre for analysis. The quality of signals collected by the sensors and to transmit over to the Networks largely depend upon the routers, LAN, MAN, and WAN.

These networks have to be well-connected through different technologies to facilitate quick and quality communication. But the number of connected devices is growing at a much higher rate than the network coverage, which creates monitoring and tracking problems.

### 5.5 Handling Unstructured Data

Growing connected devices will increase the challenges of handling unstructured data on the parameters of volume, velocity, and variety. However, the real challenge for the organizations is to determine which data is valuable, as only quality data is actionable data.

According to a survey, 80% of today's data is unstructured data and so the data cannot be stored in SQL format. The unstructured data is stored in NoSQL format makes retrieval of data a bit complex.
With the launch of Big Data frameworks such as Hadoop and Cassandra, the problem and complexity of handling unstructured data has somewhat reduced, but the Big Data in itself is so massive that combining it with IoT possess a great challenge. Besides, there are no standard guidelines for retention and use of data as well as metadata.

### 5.6 Data Capturing Capabilities

The purpose of capturing data is to transform the information collected from various sources in a standard format that can be analyzed and automated.According to Hubspot report, sponsored by ParStream, out of 86% of business stakeholders who claim that data is integral to their IoT project, only 8% are able to capture and analyze IoT data in a consistent manner.


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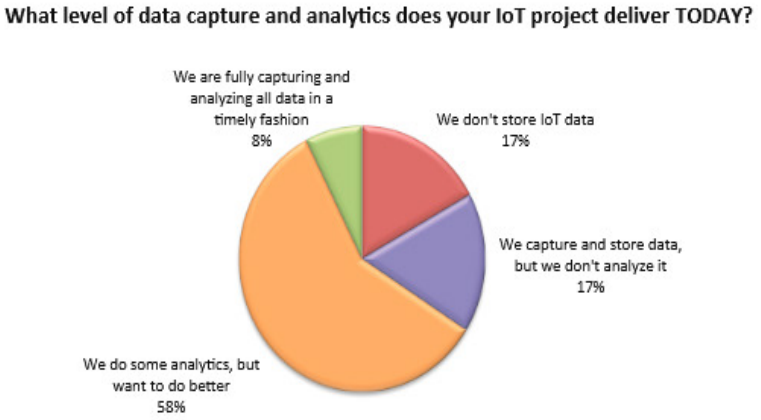
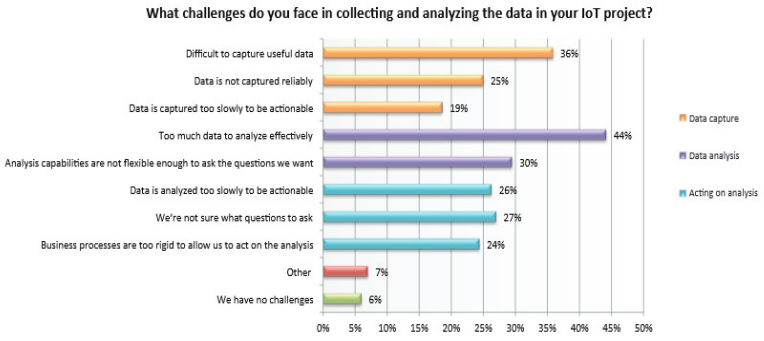



Image Source: Dimensional Research

As IoT is mainly about dependence on sensors for signals and networks for the distribution, chances are that due to certain anomalies in runtime, such as a shutdown of power, incorrect data may get recorded.

### 5.7 Intelligent Analytics

At this stage, we are at the very purpose of IoT i.e. translating data into meaningful information. A flaw in data or data model could lead to false positives and false negatives. We have to understand the data in itself is not an insight, rather right questions have to be asked from the precise data to gain the insight. Based on this report by Hubspot, it is apparent that 44% of IoT stakeholders face difficulty in capturing data and 30% confirms that their analytics capabilities are not strong and flexible.

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Legacy systems such as traditional analytics software where not all data can be loaded at a time can limit the capabilities to manage real-time data.

Here's the list of challenges that deter intelligent analytics:

- Unpredictable action of the machine during an incident
- Traditional analytics software
- Slow adoption of the latest technology due to the high cost
- Lack of skilled professionals in data mining, algorithms, machine learning, and complex event processing

### 5.8 Data Security and Privacy Issues

Even top companies like Apple, known for big security claims, and visionaries like Elon Musk have not been spared by hackers. Recent cases of ransomware attacks have also challenged the confidence of corporate.

- A latest research claims that by 2020, 25% of cyber attacks will target IoT devices.
- Malware infiltration: 24%
- Phishing attacks: 24%
- Social engineering attacks: 18%
- Device misconfiguration issues: 11%
- Privilege escalation: 9%
- Credential theft:6%

When it comes to cyber security, lapses could be from both company and consumer side, so it is essential for each party to take necessary measures to improve security.

A study revealed that 54% IoT device owners do not use any third party security tool and 35% out of these do not even change default password on their devices.

Here, it should be a collaborative effort between companies and customers to plan and implement collaborative data security policies for successful IoT implementation.


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### 5.9 Consumer Awareness

Many people are not aware of IoT, but they understand the dependence on Smart Apps like news apps, stocks applications, and entertainment applications. It is not actually important for the consumers to how things work technically, but lack of basic awareness can create a fear of security and cost, which could lead to the slow adoption of technology.

According to a survey of 3,000 U.S. and Canadian consumers conducted by Cisco, 53% consumers would not prefer to get their data collected, irrespective of the device. This shows the fear among users to share their data, which can act as a deterrent to the IoT .

### 5.10 Delivering Value

According to Forbes Insights Survey, 29% executives feel major challenge in building IoT capabilities is the quality of IoT technology.

This data reveals the struggle of IoT application development companies in bringing the value for their consumers. So, before plunging into the development of IoT applications, an enterprise must clearly define what value they are going to deliver through what capabilities. And how their solution will enhance the efficiency and productivity, while also generating customer-satisfaction.

As the IoT is all about “connected things”, the IoT projects also require a high level of assistance throughout the way. Around 50% of companies with IoT intitivaties are strongly involved with IT service providers or consulting firms, relying on them to help across solution delivery and provide business advice.

Connect with an IoT Development Company that thinks engineering beyond design and work on integrating all the components of IoT in a manner that is focused on connectivity, gaining insight, and maintaining accuracy at all the stages.

## 6. Conclusion:

As the Internet Of Things (IoT) continues to steer operations in the 21$^{st}$ century, numerous challenges are coming to light . While the IoT still has the potential to transform business for owners, employees and customers alike, those who already embrace this next-gen network still have some work to do. Not only are they trying to make the most of IoT integration to benefit their own company, but they’re also


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treading new ground and serving as role models for those who have yet to take the plunge. Despite the challenges and bottlenecks of the IoT in its current state, it still has many benefits in today's business world. It's useful enough that some are willing to throw caution to the wind and make the transition to the IoT — despite all the challenges it provides — to get a jumpstart on their competition before it becomes the next big thing.

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