

NAVIGATING THE INTERNET OF EVERYTHING: ROADMAP OF CHALLENGES

INSIGHTS AND OPTIONS
FOR DIGITAL BUSINESSES

SEPTEMBER 2016

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EXECUTIVE SUMMARY

If you are a business or technology leader trying to understand the implications and opportunities presented by the emerging world of the Internet of Everything (IoE), you are not alone. This ebook is aimed at leaders developing strategies to navigate uncharted IoE territory.

Unlike other whitepapers about IoE that provide a snapshot of challenges within a specific industry vertical, this one catalogs the common challenges encountered across multiple industry sectors. It is designed to provide you with insights and options, and to map the challenges to existing best practices to help you translate challenges into actionable steps.

The content is based on input from leading IoE industry experts from operators and suppliers working across multiple sectors. Using this input as a basis for the research, we compiled and explained the 20 common challenges covering three logical areas of interest:

- Markets and customers
- Business
- Technology

We aim to help you look at the emerging IoE world through a different lens and from new perspectives, so we can all learn to adapt to our changing environment together.

If you are a leader seeking to answer these questions, then this paper is for you:

1. What are the most common challenges?
2. How can TM Forum help?

“ The greatest obstacle to discovering the shape of the earth, the continents, and the oceans was not ignorance but the illusion of knowledge.”

Daniel J. Boorstin,
Historian



INTRODUCTION

The Internet of Everything (IoE) promises to create a technology-enabled series of business and societal changes which will affect every organization and individual on the planet.

“IoE is a vision based on the belief that great value can be achieved if we can connect anything to any other thing. If this vision is realized it changes

For organizations to prosper, they will need to create and maintain an exceptional level of situational awareness, grasp the changing landscape at speed, and be able to respond appropriately. The ubiquitous scope and complexity of IoE will favor organizations that can quickly grasp and adapt – requiring new tools, and organizational and business models. Many are struggling to understand the implications and opportunities, but some of the leading digital players have blazed a trail that others can follow.

We are now past a tipping point in the IoE, and it is certain that we are in for a large-scale change.

What's different about IoE?

IoE is the connecting of anything and anyone in a dynamic complex network – covering everything from devices, data and networks to processes and people. It promises to penetrate every aspect of society: private and public sectors, consumers and businesses. As the physical world merges with the digital, new capabilities will lead to new ways of doing business. This change is unprecedented in human history, comparable to the impact of the Internet itself, but potentially IoE is much bigger.

In this context of a massively networked world, organizations need to think about their place in the bigger scheme of things. Products and services will no longer exist in isolation. Instead, they will work with others in partnerships to create exciting new offerings. These new scenarios require us to embrace different ways of thinking, using concepts such as dynamic systems, platforms and ecosystems. This is a huge change and it is moving at high speed.

IoE drivers and enablers

IoE is being made viable by advances in devices, wireless connectivity and the cloud, together with economic enablers such as the decreasing costs of hardware, computing and bandwidth. Other key factors include the globalization of information and the digitalization of our societies. With these enablers in place, IoE appears to be driven (at least initially) by those organizations seeking to improve efficiency more than by those seeking to increase their market share.

According to Cisco, IoE creates \$14.4 trillion in value, with the top five drivers that fuel IoE development being:



Reduce costs



Increase efficiencies



Eliminate waste

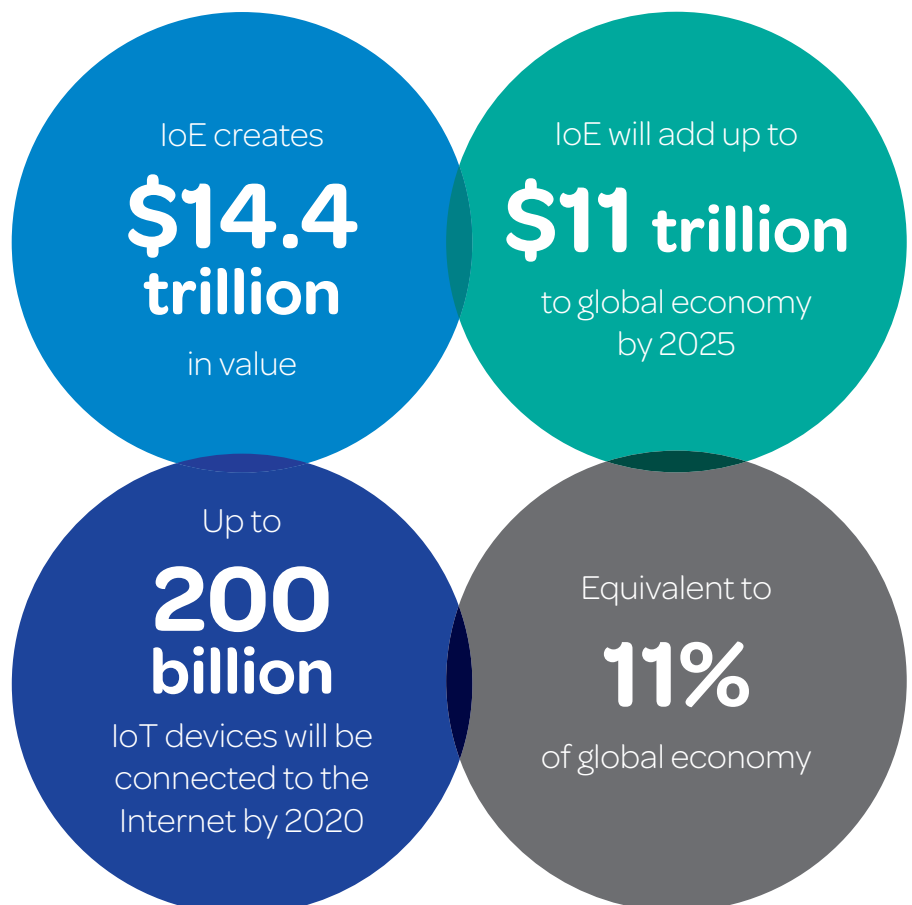


Add customers



Reduce time to market

Analysts predict that 20 to 200 billion IoT devices will be connected to the Internet by 2020. This explosion of connected devices is predicted to add between \$4 trillion and \$11 trillion to the global economy by 2025. These are impressive figures. If market growth for IoE were to happen in line with such industry predictions, it would equate to 11 percent of the global economy.



EMERGING INDUSTRY CHALLENGES

The TM Forum [Open Digital](#) and IoE Program Steering Group is committed to leading the work of defining, analyzing and identifying common patterns. This includes linking the Forum's efforts to industry best practices to build value for the Forum's members. Recognizing the changing landscape, the steering group decided to investigate emerging challenges across the industry sectors covered by TM

“ Human systems grow toward what they persistently ask questions about!”

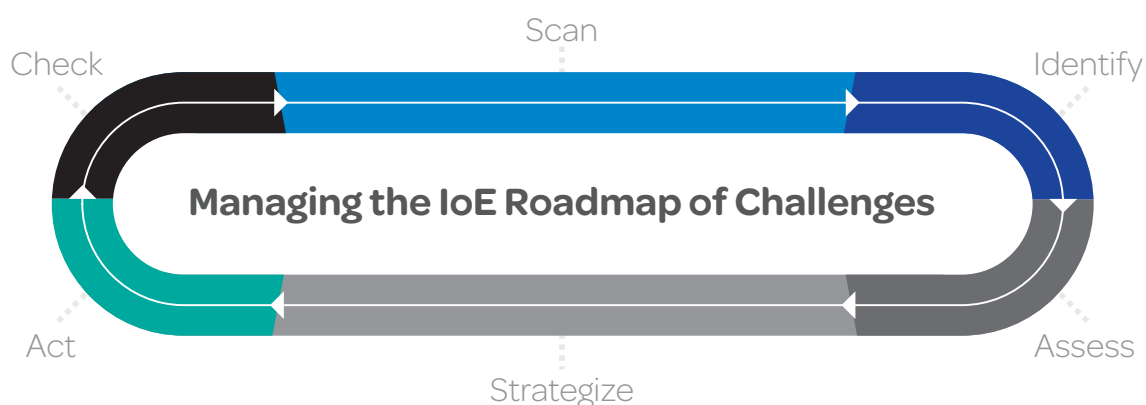
(Cooperrider & Whitney)

We define a challenge as any issue that prevents an organization from reaching its key strategic goals. Challenges can illuminate constraints that limit our ability to achieve a desired performance. They can also represent a potential for growth, for example, an underserved market need. Whatever their nature, they can be viewed as a significant opportunity.

The dynamic and emerging nature of the IoE landscape means that the challenges described in the following sections can be described as a “working set of challenges” that will inevitably evolve over time and will need to be monitored in the light of the changing situation.

The challenges management lifecycle includes the following:

1. **Scan (Landscape)** – Based on goals and scope, e.g. industry sectors and geography.
2. **Identify** – Via indicators/symptoms. Map and record key information.
3. **Assess** – Analyze and understand the nature of the challenge. Capture who, what, where, when and why.
4. **Strategize** – Define options, current best practices and common solutions. Decide the best course of action.
5. **Act** – Plan/execute.
6. **Check** – Continuous improvement helps the Forum inspect and adapt.



The top 20 challenges

The following list presents 20 priority topics captured during interviews with members working at the forefront of IoE. Although many of the challenges impact across domains, to ease readability we have placed each challenge in one of three logical areas of interest:

- Markets and customers
- Business
- Technology

Market & Customer Challenges

1. Enabling IoE monetization
2. Brand management in an IoE world
3. Mindsets & culture
4. Communicating IoE (Selling the IoE vision)
5. Customer trust (Security & privacy)
6. Business vocabulary

Business Challenges

7. Business model innovation
8. Business transformation
9. Partnering
10. Scaling proven solutions
11. Discovering ecosystems
12. Unlocking the value in data
13. Data ownership
14. Real-time business systems
15. Skills gap

Technology Challenges

16. End-to-end automation and management
17. Legacy systems and processes
18. Standardization and interoperability
19. Architecting IoE
20. Delivering the IoE network

The interviews produced a lot of useful data, but for the sake of brevity in this ebook, we will attempt to convey the essence of each challenge using the following format:

- Title – title as above
- Description – basic description/overview
- Statement – summarizes the statement in the form of a key question. Asking different questions will lead to a different focus, thus leading to different outcomes.

Market and customer challenges



1. Enabling IoE monetization

Challenge: How can businesses quickly identify revenue-generating opportunities and execute on them?

Although there are many initiatives across most sectors, often in the form of hackathons and proof-of-concepts, these are generally not translating into real revenue-generating opportunities. IoE still appears to be in the early stages of growth. The conceptual IoE is still some distance from realizing a full deployment of converged IoE services. We believe that TM Forum members will step up to the challenge with innovative approaches to monetization.



2. Brand management in an IoE world

Challenge: How do businesses protect and develop their brand value in an IoE world?

Customers have historically had a relatively straightforward relationship with suppliers – but IoE is likely to create complex customer relationship scenarios, for example, a mash-up of services from multiple brands combined to create an outcome. Furthermore, they have been used to long cycle times between product updates. As the effects of IoE filter through to customers, they will experience new dynamics. Established suppliers will begin to offer new and surprising services as they develop new insights into customer behaviors. New suppliers will emerge to challenge existing suppliers



3. Mindsets and culture

Challenge: How do businesses 'think outside the box' about the possibilities, and adjust/adapt quickly enough to ensure their long-term survival and success?

The merging of physical and digital worlds brings new possibilities. Boundaries are being disrupted and change is accelerating. Many businesses lack the knowledge to exploit the opportunities presented by IoE and are unwilling to tackle the emerging situation, for example, the move to a hyper-connected world. If the customer isn't able to grasp the fundamental concepts, threats and opportunities posed by IoE, then suppliers will be unable to convince them to complete commercial deals. Similarly, they won't be able to adapt their value proposition to meet changing customer expectations. Furthermore, they will struggle to evolve their relationships from customer-supplier to partnerships and sharing value. This is true for B2C, B2B and B2B2X scenarios.



4. Communicating IoE (selling the IoE vision)

Challenge: How do we effectively communicate IoE to create a compelling and trusted vision to help to drive demand?

IoE is still emerging and likely will impact every aspect of our lives. To fully embrace the promise of IoE many stakeholders need to work together to achieve the vision. While there are an abundance of IoE use cases, the successes have largely occurred in silos. Are there enough compelling success stories that 'sell' the IoE vision and create sufficient cross-vertical demand to help IoE reach a tipping point?



5. Customer trust (security and privacy)

Challenge: How can we reduce the security and privacy risks to an acceptable level so that they no longer present an obstacle to large-scale IoE adoption?

We are likely to become increasingly dependent on the IoE to safely and securely manage day-to-day transactions. This connectivity will generate detailed knowledge of the actions of individuals and organizations. The scope for vulnerabilities is immense. When customers engage with a service provider they are often presented with information that is complex and difficult to grasp. This makes it difficult for them to understand the underlying business intent and the implications for their personally identifiable information (PPI). To help establish trust, organizations should provide transparency/openness with regard to the intended use. Overcoming these fears remains a challenge in delivering IoE market growth.



6. Business vocabulary (communications)

Challenge: How can businesses effectively communicate (translate) across industry sectors (short-term and longer-term) in order to identify and capitalize on new market opportunities?

With the blurring of boundaries between long-established market sectors, many businesses and industries are starting to talk to each other. However, they find that they often speak a different business language, have different mental models and rules, and communicate using long-established channels within their own industry silos. This can lead to missed opportunities when they don't communicate, and a breakdown in relationships when they do.

Business challenges



7. Business model innovation

Challenge: How can businesses develop business models that succeed in capturing emerging IoE opportunities at Internet pace?

With IoE still in its early stages, there is a lack of proven business models across industry sectors. Traditional business models are difficult enough, but the complexity increases if the strategy is to become a platform or participate in one or more ecosystems. When you take this and combine it with having to determine: the best partners; what the value exchange and revenue share might be; and how you could establish such a complex contract at pace, then we begin to see some of the non-traditional IoE challenges facing traditional business model development. The absence of published and proven models, while definitely a challenge, is also an opportunity for pioneering businesses to innovate.



8. Business (operating model) transformation

Challenge: How can organizations configure themselves to embrace dynamic IoE conditions to become agile, lean, real-time, data-driven business machines?

While many businesses are already digitizing, IoE brings a new set of challenges. On the front end highly connected products and services will introduce a real-time (or near real-time) feedback loop with the customer. On the backend businesses will increasingly work with a diverse set of partners, sometimes in a dynamic (short lifecycle) situation. Increasing market dynamics will require organizations to continually adapt and investigate approaches such as design thinking, system thinking, and problem solving. Historically business transformation has proved problematic and costly - but for the IoE this is likely to become normal business practice.



9. Partnering

Challenge: How can businesses quickly establish partnerships while minimizing the risks in complex IoE business scenarios?

IoE will create complex and confusing business scenarios. Increasingly businesses will need to work together to reach their goals, including some that would have previously seen them as competitors. Organizations that become really good at partnering are likely to achieve a much greater degree of influence due to their ability to adapt rapidly, and to dictate the rules and results of any engagement. The ability to create safe, rapid, robust and scalable relationships becomes a key business capability.

Long-established partners will have trust and respect. But in the race to capture IoE market share businesses may be tempted to take on responsibilities beyond their capabilities.

For example, consider the revenue assurance risks of launching a product without everything in place to collect all the revenues generated by it. One advantage of participating in high-quality ecosystems is that members could benefit from a collaborative risk management approach. In addition to trust and risk management there is also the question of the capabilities. All partners need to be able to establish effective granular and scalable monetization relationships so that everyone is appropriately compensated for their contributions. Otherwise there's a risk of loss-making situations that result in failures for one or more partners. Fortunately, many of these partnering relationships will follow the B2B2X patterns that are already well covered by existing TM Forum scenarios.

Lastly, this raises the prospect of value assurance in addition to revenue assurance.



10. Scaling proven solutions

Challenge: How can we maximize the investment in proven solutions by effectively deploying them at scale to capitalize on emerging market opportunities?

Many solutions are being created to solve problems in a specific context. Often these solutions are not being successfully deployed across the market, leading to inefficient reuse of proven solutions to problems. Point solutions are notoriously difficult to scale up to meet mass-market adoption needs, meaning many early products will fall by the wayside, even though they solve important problems.



11. Discovering ecosystems

Challenge: How do businesses create, find, assess, join (and leave) ecosystems?

One route to delivering IoE value is to engage in ecosystems. Ecosystems are a new and emerging concept created to address complex business scenarios. They are forming both within and across industry verticals. But what defines an ecosystem? What ecosystems exist? What state are they in? What capabilities do they have? What value can we add? Who 'owns' them?



12. Unlocking the value in data

Challenge: If data is the new oil, how do businesses identify, access, expose, share and unlock the value in the data to be found across the expanding IoE space?

Data is widely seen as a new currency and businesses will trade based on the value of insights data can provide. Accessing and storing data is one challenge; extracting actionable insights

of value from it is another. Some of the biggest gains will be from the mash-up of data from multiple sources outside the businesses that consume it. Often this data is not accessible or perhaps not even appreciated. Building apps is still the focus for a majority of businesses, with data still a secondary consideration. When consuming data, it is important to remember that not all data is created equal. When making decisions based on data, how do you determine that the data is accurate? Timing is another crucial factor. The freshness and uniqueness of data will determine its value. Whether selling or consuming, the ability to determine the real value of the data will be key to success.



13. Data ownership

Challenge: How can businesses operate in complex data ownership scenarios while increasing their ability to create value by monetizing data?

There could be multiple partners involved in providing different services or even different components of the same service to the customer. In this case, the service data may be distributed across multiple partners and it is reasonable to expect a dispute over the actual data ownership. As we increase our ability to monetize IoE data, this issue becomes more prominent.

Additionally, since multiple partners may be privy to accessing customer information in the course of providing the service, the ownership of the customer relationship becomes less obvious too. Traditionally, this issue is contractually addressed better than data ownership, but the open digital ecosystem is likely to pose new challenges. Furthermore, customers may increasingly choose to maintain ownership of their data, choosing when to share it and with whom. They may even require tracking of their data's usage in any given context.



14. Real-time business systems

Challenge: How do businesses achieve real-time (always-on) intelligent decision-making capabilities?

IoE capabilities can create an always-on real-time feedback loop between businesses and their customers. This introduces a new set of business dynamics as the customer demands increasingly quicker and improved data-driven decision-making. This will create new opportunities for proactive and predictive capabilities that deliver quicker outcomes to customers. Business scenarios will be even more complex/critical if the business is not only sensing but also controlling devices based on data. Manual processes will not be able to respond to such conditions as things scale, thus moving the business to look at more intelligent (automated) decision-making approaches.



15. Skills gap

Challenge: How do organizations ensure they have the right people, with the right capabilities, at the right time, to deliver the IoE vision?

The complexity and global scale of IoE will create significant demand for a highly skilled workforce able to both understand and develop the IoE promise. It will require people who can understand the problem, make effective decisions, and develop effective solutions while continually adapting to changing business conditions.

Examples of areas of growing demand include:

- Fast idea generation and quick concept testing in the market
- Complex business model development (multi-sided platforms and ecosystem models)
- Agile commercial contracting and partner risk management
- Internet-scale and platform/ecosystem architecture designers and more 'jobs' that have yet to be invented.

Technology challenges



16. End-to-end automation and management

Challenge: How do we automate and manage different components so that they can be integrated into a coherent functioning end-to-end whole without any obvious centralized control?

With the number of devices and relationships to be managed in IoE scenarios, there will be increasing pressure to eliminate manual processes which are costly, time-consuming, error-prone and difficult to scale. Furthermore, complex partnering arrangements will need careful management to ensure the expected outcomes are delivered. Orchestration of relationships, service construction, pricing, offer management and delivery through partners across the IoE will be a key capability.



17. Legacy systems and processes

Challenge: How can organizations use legacy systems to maximize their return on investment while developing new capabilities to support new business opportunities?

Many large enterprises have made significant investments in systems to support established business processes. These assets could become liabilities if they constrain or hinder the organization's ability to support IoE requirements, for example, integrating IoE applications or non-linear requirements.



18. Standardization and interoperability

Challenge: How can we develop the minimum standards necessary quickly enough to maximize the interoperability between 'things' to meet emerging IoE market demands in a timely manner?

For IoE to achieve its goals, anything should be able to seamlessly connect to any other thing, both vertically and horizontally across domains. Historically, standards have been key to enabling interoperability, driving down costs and stimulating growth. But generally standards processes are complex and take a long time to evolve and be adopted – we are not yet seeing mature, stable standards dominating, so suppliers and buyers are having to over-invest in multiple standards.



19. Architecting IoE (building modular building blocks)

Challenge: How do businesses architect their solutions to use, and also create, modular reusable building blocks in a complex IoE world?

The complexity of IoE is driving new ways of creating solutions by coupling together smaller, discrete, composable building blocks. These blocks can come from many different sources, including open source communities. While this presents new opportunities it also creates new risks. For example, a service may rely on a range of complex third-party dependencies, some of which may be poorly managed. The industry should consider the importance of a microservices architecture to this challenge.

One example of third-party dependency is location management. Many devices will be both sensors and actuators. Every device has a location at a point in time. Accurate location management is critical to effective IoE operation and must be

fully considered and managed throughout the IoE stack. Capability may change given different location/presence characteristics – a challenge for many service implementations.



20. Delivering the IoE network

Challenge: How do we ensure the right infrastructure is built to support IoE requirements (and what will be the revenue model)?

Everyone likes a free ride. Over-the-top services have gained great success riding on top of high quality networks. IoE requires even more network coverage and will include a mix of licensed and unlicensed networks. These networks all need to be of sufficient quality to ensure quality of service for complex applications that span such networks. They will also need to be able to be configured quickly to meet new business scenarios.

Analysis of challenges

TM Forum operates in a highly collaborative R&D environment at the core of the organization. Having captured an initial set of challenges, we conducted further analysis with a goal of understanding:

- **Domains** – Impact to high-level business domains (markets and customer, business, technology).
- **Relationships** – Dependencies and linkages between challenges.
- **Composition** – Key info/details covering who, what, how, why, where, when.
- **Priority** – How important are they and how should they be prioritized?
- **Options** – Divergent thinking on how to tackle the challenges.
- **Best practices and common solutions** – TM Forum asset gap analysis/mapping.

The analysis and mapping led to many observations and insights, including:

1. Appreciation of the broad range of different organizations from diverse industries, with historically different approaches and goals that are becoming increasingly connected.
2. The emergent nature of IoE with business outcomes that are highly unpredictable.
3. The lack of any dominant players or ecosystems that are (currently) dictating or controlling IoE direction or state.
4. Emerging TM Forum solutions continue to be valid and highly applicable for the majority of digital businesses given the current (emerging) status of IoE.
5. Emerging TM Forum solutions, proven for linear (ordered) systems, could be extended to address the challenges presented by emerging non-linear systems likely to dominate the IoE in the future.
6. As organizations become increasingly networked, they may benefit from approaching IoE through a different strategic lens for example, Complex Systems Theory (panel below).
7. IoE-capable businesses may benefit from joining (or creating) digital ecosystems.
8. TM Forum, being a long-established ecosystem organization itself, has many of the foundations necessary to help members design the next generation of frameworks to support advanced digital ecosystems.
9. The roadmap of challenges approach produces interesting shifts of perspective that help to build bridges across key business domains (markets and customers, business, and technology) and help align strategy with emerging industry needs.

“...organizations which design systems... are constrained to produce designs which are copies of the communication structures of these organizations”

(M. Conway 1967, Conway's Law)

Complex Systems Theory and the IoE challenges

Many businesses are comfortable operating highly predictable (ordered) systems, often tightly bounded within a fixed operating environment to serve a specific set of customer needs. But IoE is enabling digital businesses to join together in complex ways to provide outcomes that are much greater than the sum of their parts.

As organizations become increasingly exposed and connected to these highly networked operating environments, an understanding of Complex Systems Theory could prove useful.

What is it?

Complex Systems Theory is a scientific framework for attempting to understand the behavior and evolution of systems composed of a large number of networked independent actors, interacting with each other in multiple ways to deliver functions greater than the sum of their parts. They tend to have the following characteristics:



Highly connected: Many actors, many relationships



Non-linear: Small changes can result in large effects



Adaptive: Able to maximize the benefits within the operating environment



Nested: The whole is a complex composition of systems within systems



Self-organizing: No obvious central control – the parts form new structures as they learn and adapt

Why is it important?

Complex Systems Theory offers decision-makers a fresh new lens and a different perspective on the challenges in the context of the wider IoE landscape. It can be applied to all areas of the business to help make sense of the observations and patterns that emerge from business interaction. Complex systems are often governed by simple rules that help identify a hidden order to behaviour. If you can identify and understand these rules, you can identify the factors that may influence the whole. This level of understanding can deliver key insights that can help deliver better decision-making.

A dive into Complex Systems Theory applied to IoE is beyond the scope of this paper. However, it does lead to one of the key areas where Complex Systems Theory is highly relevant – digital ecosystems, a topic covered in the next section.

HOW TM FORUM CAN HELP

SOLUTIONS FOR DIGITAL BUSINESSES

TM Forum's collaborative environment is powered by its highly skilled and trusted member ecosystem, and collaboration is crucial in addressing IoE's challenges.

TM Forum has options to support a broad range of businesses, depending on their operating environment and strategic choices. The current suite of options includes:

1. Digital ecosystems management (Digital Services Reference Architecture)
2. Digital Services Toolkit
3. TM Forum Catalysts
4. Collaboration
5. TM Forum Framework
6. Business scenarios
7. B2B2X Partnering Guide

Digital ecosystems management

What is a digital ecosystem?

A digital ecosystem:

- Is an open socio-technical digital environment with properties of self-organization.
- Aims to build digital services in order to create value and revenue streams among networking partners.
- Provides access to resources, and supports collaboration, knowledge sharing and development of open and adaptive technologies and evolutionary business models, in an open environment which can span across different enterprise boundaries and different parties (operators, social networks).

- Clearly extends the traditional value chain beyond the evolutionary horizontal and vertical value chain paradigms to a full digital value fabric.

Digital ecosystem enablers

A digital ecosystem is enabled by a federation of platforms that implement the Digital Service Reference Architecture (DSRA), and delivers three key value propositions:

1. **A great user experience:** Users are able to access digital products, assembled from diverse building blocks, in the manner they expect.
2. **Robust operations:** Ecosystem participants, including partners, service providers and enterprises, are able to conduct rich commerce as well as create and deploy those products and manage end-to-end performance.

3. A robust developer environment: Developers – both providers of component services and end-to-end product developers – have the tools and infrastructure to support both the above goals.

Digital Services Reference Architecture (DSRA)

As more new products are assembled out of building blocks provided by a range of digital service providers, there is great opportunity and growing complexity to be managed.

The opportunity comes from placing a wide range of capabilities at a product designer’s fingertips. The complexity comes from the distributed nature of those very capabilities – for example, my product may rely on the performance of your building block. Those building blocks may come from a third enterprise delivered over a set of network capabilities, provided by yet another enterprise – a network provider.

This digital economy needs a set of standards and functions that allow product composers to learn about these capabilities, configure and fulfil them, monitor them, understand dependencies, and execute what may be multidimensional commercial and

revenue-sharing models among end users, component service suppliers and advertisers etc.

The Digital Services Reference Architecture (DSRA) is TM Forum’s proposal to enable richer and yet open, distributed digital collaboration with the essential tools to support increasingly demanding technical and commercial models.

It will enable collaboration and product composition from a broad set of building-block services spanning multiple companies, industries, clouds, networks and devices. And it will allow this composition to be accomplished with (if desired) commercial-grade quality, accountability, business models and operational efficiencies. Finally, it will be as simple as possible, maximizing “loose coupling” and minimizing impacts on existing investments. It aims to enable, not replace.

Digital Services Toolkit

The Digital Services Toolkit enables users to rapidly address business problems using existing TM Forum assets, by linking business problems directly to the assets required for their solution.

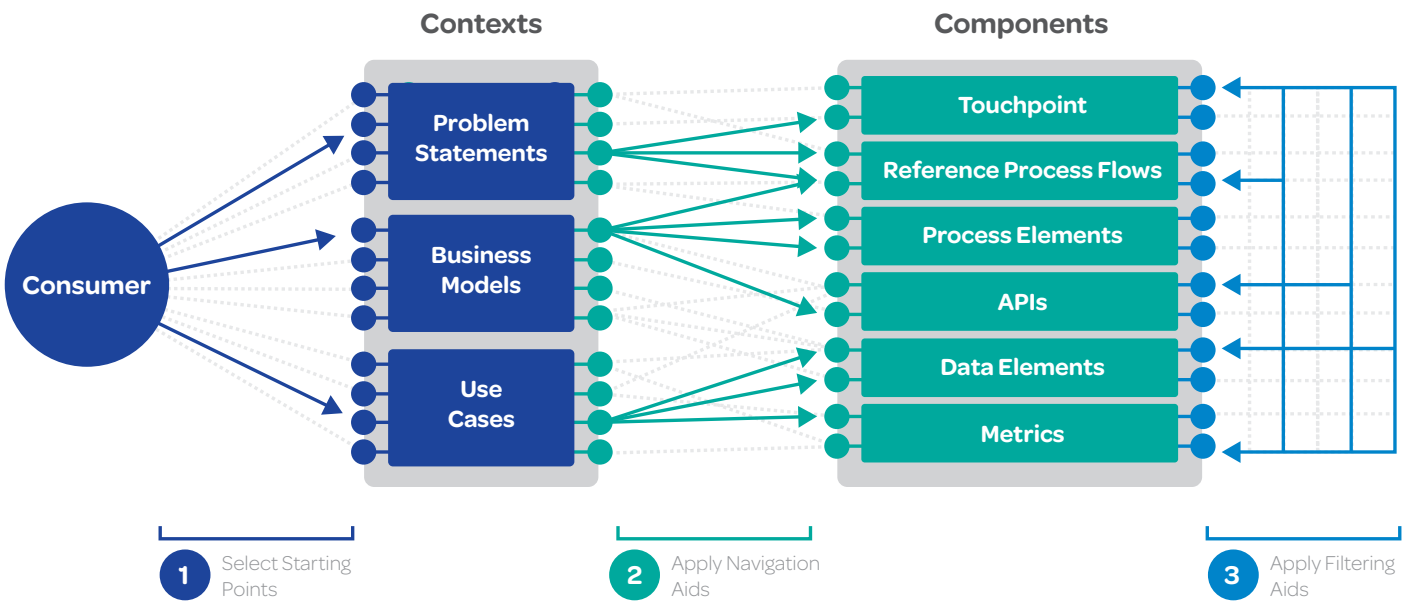
The Digital Services Toolkit is a collection of interlinked assets based on existing Framework, divided into two broad categories of Contexts and Components. These assets are named and described using a common vocabulary, and linked to define relationships.

■ A **Context** describes a specific business problem in terms of user stories, business model canvases and collections of use cases. A Context encompasses the viewpoints, goals and business model of each of the primary parties in the business situation.

■ **Components** include use case sequences, reference process flows, process elements, information model elements, touchpoints, interfaces, metrics and other existing TM Forum assets.

A consumer of the Toolkit will be able to search for Contexts that are relevant to their own business, and then to trace the paths from a Context to the specific Components that relate to that Context.

The initial release of the Digital Services Toolkit is focused on Contexts that involve interaction between partners.



Catalysts

Catalyst projects are traditionally rapid-fire proof-of-concept projects bringing together companies large and small to create innovative solutions to common challenges. Catalysts both leverage and inform key TM Forum best practices and standards, ensuring scalability, reuse and reduced costs and risk.

Catalyst participants gain extensive benefit, both business and technical, through their participation. The short-term duration and common goals of the project lead to close working relationships being formed – relationships that often blossom into long-term business relationships.

There are two types of roles in a Catalyst:

1. A **champion** is an organization seeking a solution to problem.
2. A **participant** is an organization contributing to solving the problem.

Catalyst projects are aligned with the strategic ambitions of TM Forum. They bring the best practices and standards of strategic programs to life in real-world scenarios, ensuring the value of these assets is proven in complex partnership scenarios.

Catalyst projects kick-off at our Action Week events. From there, the teams work together over a period of 4 to 6 months. They demonstrate the solutions they have developed at TM Forum flagship events. These flagship events are held twice a year and a new set of Catalysts presents at each event. One of the key purposes of a Catalyst is to highlight the use of TM Forum assets in solving real-world problems.

A Catalyst example

An example that illustrates the role of TM Forum assets in an IoE context can be seen in the *Smart industrial manufacturing Catalyst* presented at TM Forum Live! in May 2016.

The premise of the Catalyst is that the manufacturing industry could save billions of dollars by significantly improving capital utilization of industrial robots. The lost capital utilization of industrial robots is primarily due to extended downtime for reconfiguration and preventative maintenance, caused by disconnected manual processes. The solution demonstrated coordination of factory floor machines using cloud-based systems and people in dynamically connected solutions.

The Catalyst used an array of TM Forum assets to implement the solution, including:

■ TM Forum APIs

- Catalog: Provides available product offerings to customer
- Ordering: Manages customer choices, validation and robot cell configuration
- Ticketing: To track and manage problem with robot cells

■ Elements of the Application Framework

- The Product Lifecycle Management, Product Catalog Management, Customer Order Management, Service Catalog Management, Service Order Management, Resource Lifecycle Management, Resource Inventory Management, Resource Order Management, Resource Performance Management and Fault Management applications provided high-level views of the required functionality

■ Elements of the Business Process Framework

- Selling, Product Configuration, Order Handling, Service Configuration & Activation, Resource Provisioning, Resource Trouble Management, Resource Performance Management and Party Order Handling

■ Elements of the Information Framework

- Product ABE, Product Configuration ABE, Product Offering ABE, Product Specification ABE, Product Test ABE, Customer ABE, Customer Order ABE, Customer Service Level Agreement ABE, Service ABE, Service Specification ABE, Service Configuration ABE, Resource ABE, Resource Specification ABE, Resource Performance ABE, Resource Trouble ABE, Resource Configuration ABE, Party Order ABE, Catalog ABE, Event ABE, Trouble or Problem ABE

■ TM Forum Metrics

- F-CE-2b - # Hours per Installation Committed, Between Customer Required and Committed Dates
- A-CE-5 - Service Availability

Collaboration

TM Forum Collaboration is focused on delivering rapid pragmatic solutions to the top technology challenges, driven and validated by the business needs of key industry influencers.

This is delivered through highly structured agile collaborative techniques, such as agile workshops, online collaborative working sessions, continuous validation with industry and practical demonstrations of solutions at industry events.

“Sharing in areas that are non-differentiating areas for us is mandatory in an industry ecosystem environment. We believe that participation in collaboration accelerates our R&D and enables us to work with key business stakeholders. We also consider participation in Catalyst projects a very efficient way to showcase new initiatives,” says Laurent Leboucher, Vice President, APIs and Digital Ecosystems, Orange.



TM Forum Framework

TM Forum Framework is a suite of best practices and standards that provides the blueprint for effective, efficient business operations. It enables you to assess and optimize performance using a proven, service-oriented approach to operations and integration. The components that make up TM Forum Framework include:

1. **Business Process Framework (eTOM)**
2. **Information Framework (SID)**
3. **Application Framework (TAM)**
4. **Business metrics**
5. **Best practices**

The practical tools available in Framework help improve end-to-end management of services across complex, multi-partner environments. For example, Framework provides hundreds of standardized business metrics that have been embraced by the industry and allow for benchmarking, as well as a suite of interfaces and APIs that enable integration across systems and platforms.

Framework has been widely adopted and proven to significantly improve agility in digital business operations, resulting in increased margins, lower costs, and optimal customer experience. Framework is created and evolved by TM Forum members who participate in the Forum's collaboration community.

“Participation in Catalyst projects is a very efficient way to showcase new initiatives”

(Laurent Leboucher, Vice President, APIs and Digital Ecosystems, Orange)



CONCLUSIONS

Since its formation in 1988, TM Forum has developed a substantial body of knowledge delivered through de facto standards. These standards provide a business governance framework that has been used for large-scale technology deployments globally.

The collection of standards are combined into the Frameworkx suite of standards-based tools and best practices. Frameworkx has been successfully used to address a number of challenges encountered by digital service operators worldwide through nearly 30 years of change. Hence, the TM Forum community has a long and proven history of being able to successfully adapt to changing market conditions.

Key to this adaptability has been the powerful collaborative environment powered by its highly skilled and trusted member ecosystem. This collaboration capability, agility and adaptability are important assets in addressing the emerging IoE world.

Like any collaborative approach, the keys to success are based on trust and respect. You could say that IoE reinforces the basic rules of good business.

It is through these collaboration capabilities that TM Forum is able to recognize and adapt to the scope of change being driven by IoE – a change from complicated (linear) business operating environments to highly complex (non-linear) ecosystem approaches.

In a relatively short time frame, these changes will transform how business is done.

The good news is that the majority of the Forum's existing assets stand up well to many of the challenges, and where gaps do occur these are being addressed.

Through its increasingly global industry ecosystem for digital business, its ability to connect talented individuals from more than 900 market-leading organizations, and its mission to accelerate successful digital business transformation, TM Forum is well placed to successfully navigate the emerging IoE roadmap of challenges.

Interested in participating in IoE collaboration?

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GLOSSARY

- **Business model:** The value proposition (the why, what, who for, when) and how it is created and delivered
- **Digital service:** An umbrella term for any kind of virtual service based on technology capabilities such as cloud storage, cloud processing, and networking.
- **Ecosystem:** A complex digital or connected set of systems which share common properties, such as a distributed, adaptive, open socio-technical systems with properties of competition and collaboration among diverse entities, self-organization, and complex nonlinear behavior.
- **Internet of Everything (IoE):** The term given to networks of people, processes, data and things that together interact to deliver new capabilities.
- **Internet of Things (IoT):** A network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment.
- **Operating model:** The business engine that implements the business model (the 'how').
- **Outcomes:** A product or service wrapped in a measurable promise. "We sell promises" delivered through our products/services.
- **Outcome economy:** A term used to describe how value is perceived by customers.
- **Platforms:** A technology or software platform that forms a digital layer which allows business partners to connect and interact from multiple applications or devices.

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