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Building your IoT All-Star Engineering team

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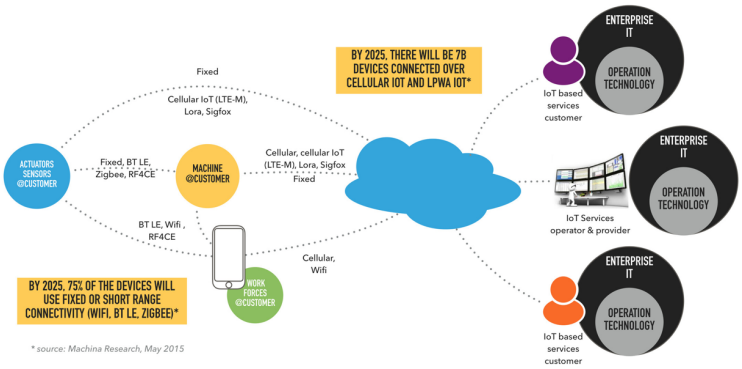
IoT (Internet of Things) projects can be very challenging for an organisation due to the large scope of competencies required. In the past, companies often focus either on HW products, or SW products, or services delivery. But in order to build IoT solutions c**ompanies need to acquire and assemble an incredible set of talent**. In this post, I describe the **main competencies** required in order to **design, industrialise, and operate an IoT solution**.

IoT refers to different architecture typologies. So the set of competencies you need to assemble depend on the architecture(s) **you selected and the place in the value chain / ecosystem you want to hold**. For this list, I considered the most complex situation where you would like to offer a full end-to-end solution (multi-devices to cloud). This is the most challenging from an engineering / operation point of view but it is the most rewarding in terms of value creation.



If you are the founder of an IoT start-up, the engineering head of a MNC, or the HR leader supporting them **then this list of 20 competencies could quickly become your nightmare**. So I would recommend to first evaluate the competencies that already exist in your organisation, the IoT architecture(s) you aim at, the latent value associated with IoT for your

business, the expected number of connected devices, your budget, and your timeline. Scoping and selecting your first IoT projects is very important and these should lay a progressive learning path in front of your engineering team.

> **If you are starting your IoT journey then you should be obsessed with the search of the MVP (minimum IoT viable product) in order to manage correctly the risk for your organisation.**

This list comes on top of **the critical APPLICATION knowledge** that would be specific to your industry, to the problem you want to solve, to the application you have in mind for the IoT technology, and to your targeted customers. **Building application knowledge in your engineering team should be one of your top priorities**. It is indeed the best way to ensure that the creativity of your team is put to the best interests of your customers and so ensure the best practical use of technology.

Top 5 competencies to build the right IoT solutions

Design Thinking / UI-UX design: Helps you to focus on customer's job-t0-be-done and customer experience, seek for minimum viable product, creative and practical use of technology. There is something magical that happens when you build something beautiful and easy to use! This is relevant in both industrial and consumer IoT applications. It is very important to bring the designers at very early stage in the ideation process and to give them a strong mandate. They will need a good support to stand for their values in front of the engineers!

System design: End- to-end IoT solution is composed of several HW and SW components. Designing a reliable, scalable, maintainable solution requires upstream analysis and thinking to understand and define how each of these blocks will interact or interfere with each other. You don't need all detailed requirements to start working on system design and a lot of work should be done once you have a macro view of what you want to build.

M2M (telecom, network, device management): Choice of the technology(ies) for the connectivity is strategic and will depend on various technical, geographical, and business factors. There are many different technologies /standards (Fixed, LoRa, Sigfox, Cellular IoT, Cellular) and providers to choose from. Connectivity is a core part of any IoT solution and it includes for example topic like: device management, messaging technologies, SIM card management, authentication, and encryption, etc.. You will need to select and manage the right technology providers.

Cyber security: Security principles and mechanisms shall be built-in. Design for security is the best way to achieve high level of protection while reducing the cost of security features. While having competencies allow you to embed security mechanisms in your design, it is best to hire security experts to perform security assessment, intrusion tests, and destructive tests. By putting your design at test you will achieve good level of security!

Data protection and privacy legislation: While cybersecurity concepts are global, ; data protection and privacy legislation vary from country to country. It is important to identify the different regulations you have to comply with and how to integrate them in your system design (EULA, user profile & access rights, data base structuration, data anonymization).

Top 5 competencies to build IoT solutions right

Agile methodology: when the direction is fogy, when the path is unknown, when you are learning on the go, there is no better way to work than Agile. Agile methodology is an alternative to traditional project management (waterfall, or traditional sequential development) typically used in software development. It helps teams respond to unpredictability through incremental, iterative work cadences, known as sprints. Agile developments work best when it is also adopted by other functions (marketing, sales) as it ensure quick market feedback to the team (fail fast, keep learning and experimenting) and really improve the speed of implementation. If you are starting your IoT journey then this is the (only) way to go!

Design-to-cost: Typically sixty to seventy percent of a product's cost or life cycle cost is committed based on decisions made during concept or architecture development. That is the best way to maximise the ROI for your IoT investments and to favour a market pull approach vs a technology pull one.

Failure Mode and Effect Analysis (FMEA): End-to-end solution require the collaboration of multiple components and sub-systems. Even world-class engineering and manufacturing teams make mistakes. Your design and your architecture will minimise the impact of unplanned events on your operations and customers. FMEA is powerful tool to build-in quality and robustness. Good engineers always think about degraded modes, about self-recovery mechanisms, about maintainability, about data integrity, and about edges cases. This is a big part of the system design work.

Configuration management / Test automation / Continuous integration: If you are developing an end-to-end IoT solution then this will reach a completely new level. Make sure that your basic quality / development tools are in place to ease the work of your SW engineering team. You will increase your velocity and reduce your non-quality costs in the long run by making sure these foundations are solid. Provide your engineering team with development tools in which Agile methodology concepts are built-in.

Vendors / suppliers management: IoT solutions are the combination / integration of multiple technology bricks available. Selecting, forming, and managing these technology partnerships are a very important part of building your IoT solutions. Select carefully what you will do in-house versus what you buy as putting all these pieces together is already massive work!

Top 5 competencies to build IoT devices

Sensing technologies / actuators: This is the reason you build your own things. This is a major area for research and innovation. They play a key role in the value creation for any IoT solution.

Electronic / PCBA / Mechanical design: Smart Things are made of electronics. End customers don't buy PCBA, everybody loves cool and good-looking things.

Embedded software: You would be amazed by the computing power of some micro-devices and by the level of logic you will end-up embedding in your end devices (sensors / actuators) or machines (gateways, controllers) . Power consumption is always a concern and requires a constant care from both HW and SW developers. For machines ARM, Linux, Java, and OSGI are a popular combo.

Wireless: Local connectivity is often a requirement for multi-devices systems. Here also many technologies are available (Zigbee, Bluetooth,

EnOcean, Wifi, and /or other proprietary technologies) and their selection will be a strategic step. Security, antenna design, power consumption, self-recovery, certifications, and stack tuning are some of the typical hurdles you will have to go through during implementation.

HW industrialisation (manufacturing, tooling, supply chain): What is the point of building and selling great products if quality is not here? Here lies the difference between a proof of concept / value and a real product / business.

Top 5 competencies to build IoT services

Cloud architecture / Cloud database: With different cloud strategy available (public, private, hybrid) there is a cloud solution for all businesses. You will need some in-house expertise to select and manage the right providers (Amazon, Rackspace, Azure, Google, HP) and so harvest the benefits of cloud technology (scalability, lower OPEX, flexibility, glocal).

Data scientist / Big data processing: So you spend million dollars to build an end-to-end IoT solution. You finally get data about your installed base, your customers, and the application of your technologies. What's next? How to extract maximum value based on these data? A data scientist will help you, working with the business team he/she will identify new way to process your data to create value for your existing customers or for new ones.

Mobility / Mobile APP: Both in B2B or B2C, mobile devices shall be your prime area of research to enhance the UX-UI of your solution. Different technologies and different frameworks are available and they all present some unique features. You will need to master iOS platform and a large amount of Android ones. There is no end to this work as the devices and platforms keep evolving and customers expect to receive updates on regular basis.

API design / management: When it comes to B2B business, APIs play a key role to enable collaboration with other technology companies. They are also an efficient way to enable third parties to build on your solutions in order to increase its market value or attractiveness. APIs should be thought through as they are defining the limit / scope of your solution. If you decide to publish them they you will have to manage them like a SW product.

IT Service Management (ITSM): IoT solutions are very often associated with services oriented business models. It is rarely a Sell and Forget model. You will have to create an customer service /operation team with the responsibility to ensure your IoT solution is running according to the (SLA) Service Level Agreement you committed to. ITIL (Information Technology Infrastructure Library) is a widely accepted approach to IT Service Management (ITSM), which has been adopted by individuals and organizations across the world.

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Good list. Because IOT deployments are very TCO sensitive especially in network connectivity and data management, i would probably prioritize analytics/ business value hur core team.

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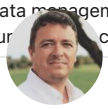

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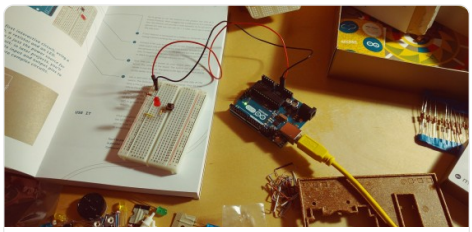

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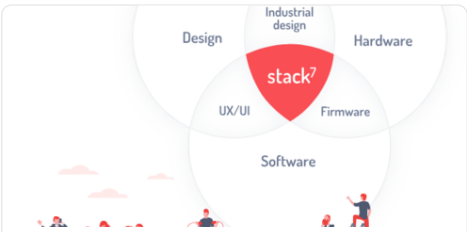

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