IOT Brief with Integration and Implementation Insights

Delivered by

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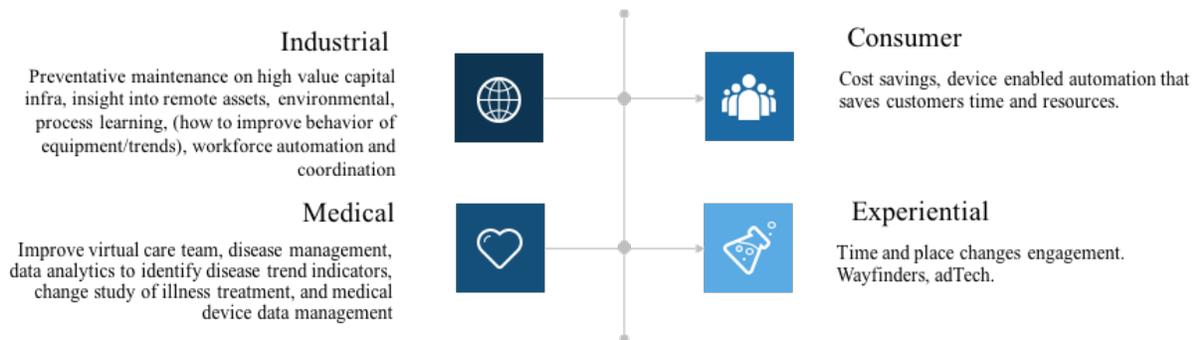North Little Rock, AR 72114

1) <u>Executive Summary:</u>

Much has been written about IoT, including the number of connected devices in the near future and the implications to changes regarding business processes. Elyxor agrees that IoT has great potential, but we also understand that there is a great amount of noise and confusion in the marketplace and will attempt to cut through the clutter in this white paper.

IoT can cover many aspects of interactions between machines, humans and systems. Some well-known groupings are listed in Figure 1.

Figure 1: Applied uses by solution type

Industrial

Preventative maintenance on high value capital infra, insight into remote assets, environmental, process learning, (how to improve behavior of equipment/trends), workforce automation and coordination

Consumer

Cost savings, device enabled automation that saves customers time and resources.

Medical

Improve virtual care team, disease management, data analytics to identify disease trend indicators, change study of illness treatment, and medical device data management

Experiential

Time and place changes engagement. Wayfinders, adTech.

Our view is the Industrial and Medical space has created applied solutions that have reduced waste and improved efficiency, but the consumer space appears nascent, with a lot of experimentation. In our view and our focus, we believe that IoT solutions can allow our clients to impact:

- Elimination of Process Waste/Saving Time/Saving Cost – Improve access to information in support of a business process and automating workforce tasks, which can eliminate manual steps or accelerate process velocity. In addition to process velocity improvements, clients may experience improvements in stability, dynamic load balancing and automated fail-over.
- Improved Data Insights to your business – More sophisticated and relevant data is regularly emitted from devices to better inform your business. You can capture **real** consumption, event and usage information at a level of detail previously impossible. This will allow organizations to utilize predictive analytics and trends proactively. Some of these views were not previously available.
- Changing Experiences – Engage people in different ways connected to their context, and according to changing preferences. The UX is undergoing constant innovation (visually and voice).

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- Changing Communication with Customers – "Customers do not buy IoT."[1] The implication is the user does not care or understand the IoT elements, but they do perceive a seamless and improved interaction with a particular process. Customers will engage with changes that save money and frees up time. Business and consumer automation will be massive in the coming years and will be driven by IoT.

Elyxor's view point is that IoT is potentially hugely disruptive in retail, healthcare, supply chain and service for high cost infrastructure. It can and will impact your business's top line growth by creating new sources of revenue and bottom line by allowing you to react faster and with better information.

IoT also provides a global view in real-time. Cloud infrastructures provide the opportunity to monitor ALL devices and ALL customers in real-time potentially with no limitation. Recent innovations in serverless provisioning, real-time processing architectures and micro services driven by DevOps processes and tools provide massive scale without the traditional barrier of cost of entry.

Elyxor believes many firms are seeking to improve IoT capabilities to improve competitive advantage. We believe that firms need to begin building capabilities, but we also believe firms can benefit from some initial inspection of where value will be created and then selecting an objective with manageable scope so they can establish their IoT framework and learn quickly. Managing millions of sensors, hundreds of thousands of collection end points in a highly-distributed architecture without proper controls and processes is a recipe for disaster. Elyxor believes that IoT development needs to be coupled with strong DevOps and Test Automation practices so they can deliver new capabilities with high velocity and confidence as they learn what external or internal stakeholders indicate is adding value.

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[1] "The Internet of Things Needs Design, Not Just Technology", Harvard Business Review, Scott A. Nelson and Paul Metaxatos, April 29, 2016

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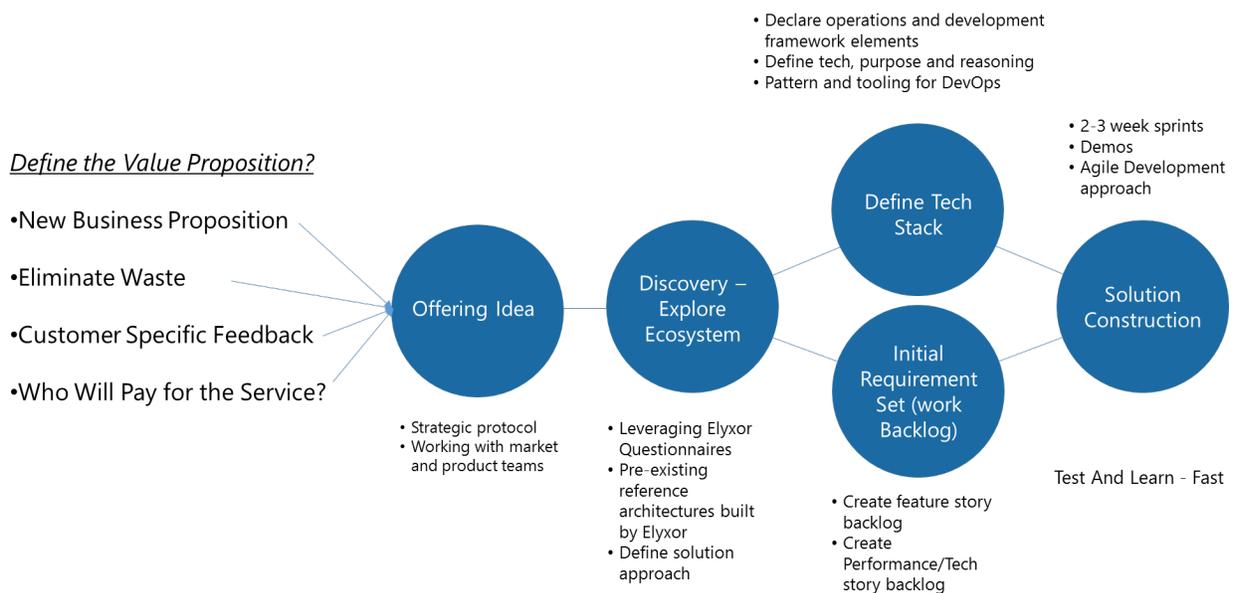401 Main Street, Suite 203
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2) **Viewpoint & Approach:**

Elyxor believes that firms who begin building IoT capabilities encounter three common issues. Firstly, they overwhelm their process with various measure points and data, believing too simply that machine learning or other techniques will extract the right signals from the data noise. Secondly, they don't consider the actual business process and how end users engage with devices, how they are onboarded onto the network and where value is added in the business process. Thirdly they don't consider the environmentals which impact things like power, bandwidth, and accessibility which inform the architecture design.

In effect an IoT engagement is an opportunity to revise and rethink both operations and also how customers engage with products. New products and revenue streams can be created from data, but you need the data. Potential exists to revitalize internal systems and approach, **_and_** excite customers.

Elyxor has learned how to solve problems like this through many implementations. As a result, we now believe the following diagram describes the best approach to advance an IoT project.

Figure 2: Elyxor Engagement Approach IoT

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3) Principles of Engagement Success:

Elyxor has found that a successful engagement is greater than simply the IoT technology and components. It is strongly connected to the business process being enabled, environmentals and development practices for future innovation. We have inventoried the highest priority principles below.

- o Understand the operating ecosystem
- o Understand the business process including human factors - Technology needs to fit to the delivery model. Design is perhaps even more important since engineers become enamored with technology. The IoT technology should be "hidden".
- o Focus on solution architecture first and narrow features – start small, validate and iterate.
- o IoT systems collect lots of data most of which may be redundant or not actionable. Spend time confirming signals and representation of insights – The data may never have been seen in this form with other datasets.
- o Invest in DevOps and Test Automation upfront – Learn quickly and change when needed. These solutions need to have development velocity to sustain market advantage.
- o Understand security paradigm for the offering. Invest time and encourage scrutiny in this area.
- o Consider the right processing environment (i.e. private/In-house versus cloud providers) and know how to migrate between with strong DevOps.
- o Stay on top of technology – It is evolving quickly.

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o Focus on reducing friction regarding user experience. Simplicity is difficult but vital. It can take many iterations to get there and requires specialist help with regard to interface design and software architectures. Cloud-based IoT gives you 1000watts+ of processing power fully operational on a 1-watt device.

During an Elyxor engagement, our approach as defined in Figure 2 above will lead our clients through a protocol that will address each of these items above. We have worked with clients whose diverse solutions have had to overcome items such as remoteness, unusual connectivity, sensitive & regulated data, consumer user experiences, and rapidly changing market requirements. We build upon those experiences to accelerate your IoT enablement using Elyxor frameworks and tools.

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4) Logical Architecture:

Through our engagements, we have seen a common solution footprint, with refinements related to the tech stack and process related to the operational environment of our clients' solutions. Logically the solution approach is reflected in Figure 3.
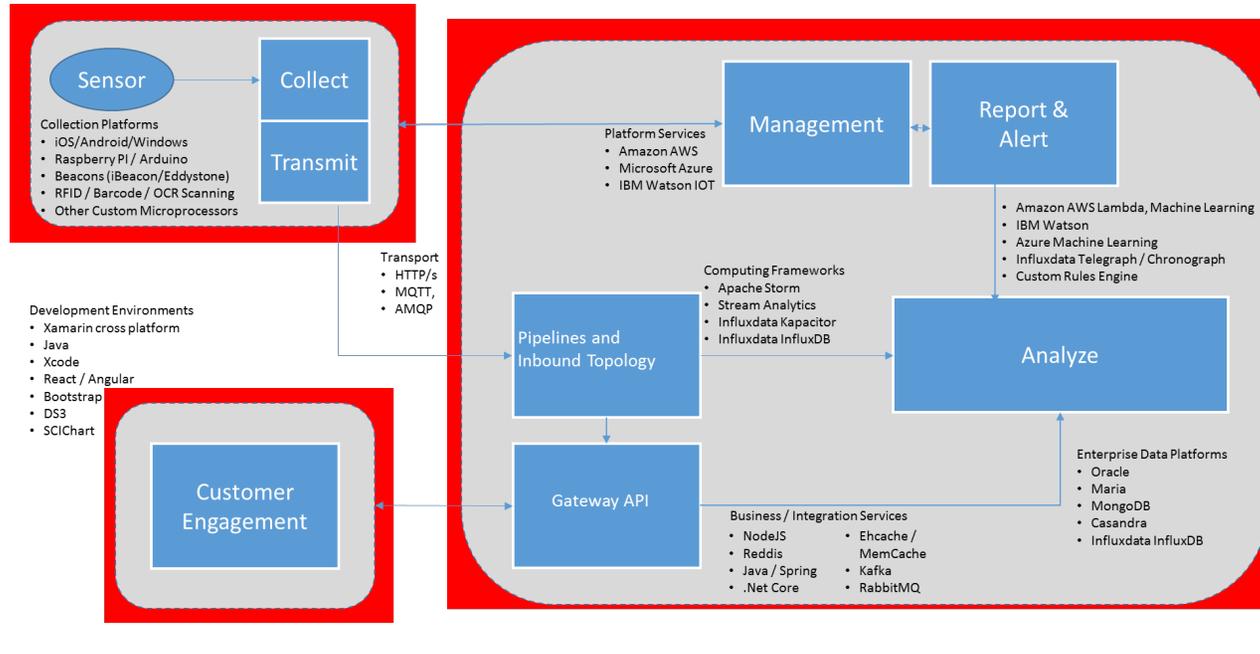
Figure 3: Concept Logical Architecture
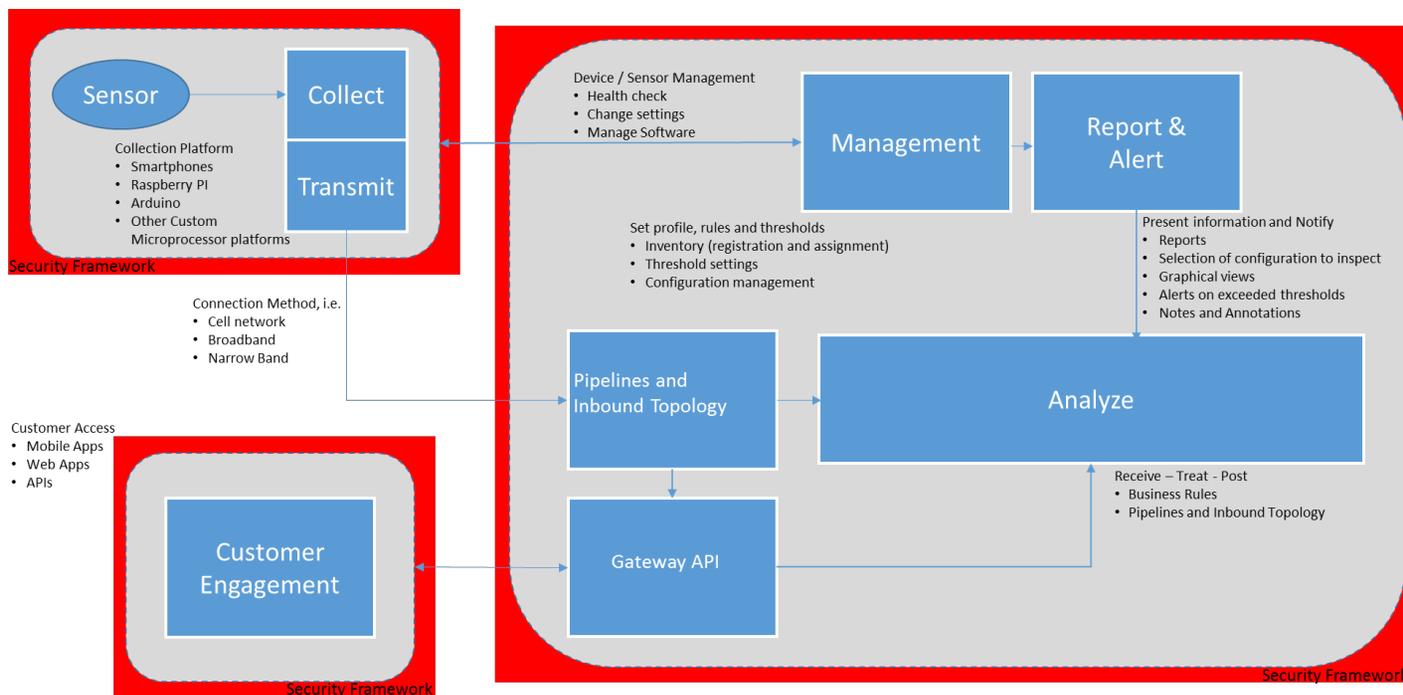
5) Enabling Technology Stack:

To enable an IoT architecture a modern technology stack is required with consideration given to integration into existing legacy application investments that support the business today. Figure 4 below is a sample tech stack to highlight some key technologies that may be relevant for a solution architecture. While representative of today's IOT ecosystem this is a rapidly changing landscape and requirements will drive specific recommendations.

Figure 4: Sample Technology Stack

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1) **Appendix A – Mini Cases of IoT Samples**

Mini Case 1: Inpatient/Outpatient Dialysis Provider – Dialysis Clinic Inventory Management

This service provider was manually tracking clinic drug inventory and updating its core SAP inventory and order management with its main supplier. The firm contracted Elyxor and its partner BarCodeDirect to automate data collection and integrate directly to the drug suppliers and eliminating any supplier dependencies.

Elyxor designed and built a mobile based application and back end solution that allows this firm to collect both inbound and outbound inventory as part of the back-office process within the clinics. The clinics scan and check in receipts against POs, verify inventory counts (cycle counting) and inventory use when pulled from the supply room. The server processes allow the clinics to report in inventory status, upload inventory to SAP and upload inventory orders to supplier systems for auto replenishment. This allows the firm to improve management of lot/expiration tracking of very expensive drugs and allows for alternative suppliers to be used reducing costs and improving patient care.

In the next phase of work, the system will be improved to handle perpetual inventory management and integrate new features to manage patient drug use in real-time. This will allow the firm to improve patient care and inventory management in real-time.

Mini Case 2: Mobile Phlebotomists Management

Elyxor was engaged to build a mobile application using hardened Android device with mobile bar code printers for its field phlebotomists. The application replaced the existing paper-based work flow for home and clinical visits to improve productivity

Elyxor delivered a simple to use application that connects wirelessly and in real-time to a custom backend utilizing hardened mobile devices. Orders are downloaded to the devices in the morning for the technicians to start their day. They receive turn-by-turn directions, custom workflow to process the orders eliminating cumbersome paperwork, dynamically print labels for samples collected and upload completed orders for the day integrating with existing back office applications. Management can track the status of all work orders in near real-time and new orders can be inserted to a technician's work queue by supervisors who can select the nearest technician from a real-time graphical mapping module.

The system enabled Apex to increase the number of daily visits, improve the quality of work and reduce costs per work order. This was accomplished by giving management real-time visibility into the mobile workforce and mobile workforce better tools to accomplish their job.

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Mini Case 3: Medical Blood Product Manufacturer – MES Bridge System

An Elyxor client manufactures blood testing products in its facility. The ingredients used to produce a blood testing product are both costly and have a finite shelf life. The objective of the MES Bridge system is to employ machine readable coding plus automated verification procedures and equipment for incoming raw materials and track work in progress (WIP) to systemically reduce potential for common errors in the production of blood testing products.

Elyxor designed and built the MES Bridge system on an Android platform using hardened device for hash environments. The technicians responsible for production of the final product using bar code scanning to tie the end final product with all the ingredients (by serial/lot number and expiration date) used in the manufacturing process. The system warns the technician if an incorrect ingredient or expired ingredient was selected before being used. The MES Bridge System saves time and money in the process by preventing waste and bad product from being produced. It also allows this firm to efficiently track the production steps for each end product that is produced for audit purposes.

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2) **Appendix B – Reinventing Virtual Care Teams – Medical Device Manufacturer**

Overview: Advancing health care with patient connected devices and professional care team applications with an innovative approach to data analysis. This enables differentiation in a crowded marketplace.

Objectives and Challenges
- Innovation of accessories to improve healthcare is key differentiator in healthcare market.
- New models of engaging patients through telemonitoring are emerging.
- Doctors and patients are seeking better ways of sharing information while lowering the cost to provide care.
- Improved information insights have the ability to improve therapeutic care process for illnesses.
- The reimbursement landscape for medical practitioners is changing.
- Patients and doctors are seeking to have access to medical information from anywhere and everywhere.
- The device manufacturer was seeking to have their communication enabled devices be able to connect to a single information hub across all their products. The device maker wanted a solution to surround the entire arc of their devices which extended from lifestyle to life-support devices.

Elyxor Approach and Solution
- Elyxor participated in a discovery project with the device manufacturer to define next generation functionality.
- We then developed and designed the architectural approach for the new solution, including close coordination with the device development teams. The 'final mile' of IoT is the most complex.
- Leveraged UX design expertise to change how patients and doctors access data.
- Led the application development of the new product, building a multi-platform solution set.
- Elyxor used an Agile Development approach and leveraged DevOps practices to rapidly deliver functionality.

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Results Achieved

- Tens of thousands of devices are now enabled to synchronize data and treatment history, improving care for the patient.
- Multiple applications that worked in coordination with each other were developed, including real-time monitoring solutions for clinics, web enabled physician applications for post analysis, and web, iOS, & Android patient applications.
- The concept of a care team surrounding a patient was created, allowing medical staff and caregivers to see information about the patient in question based on roles, accessing data from a centralized repository in the cloud.
- The platform is providing the most sophisticated clinical data in a cloud offering within the market but in a User Experience that is modern and intuitive.
- The patient can set goals for their use of the device to encourage better health.
- The physician can annotate treatment information, share information with doctors in the care team, and set thresholds for alerts as they monitor patient health.
- Future capabilities will allow instructions to be sent to the device to change settings based on a doctor's recommendation.
- Treatment is transitioning from a monthly doctor visit to a daily exchange of information.

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3) <u>**Appendix C – Innovation in an Old Industry – Industrial Machine Manufacturer**</u>

Overview: Elyxor specializes in building forward facing technology in the IoT space. We have helped to shape the future of the hospitality business working with the manufacturer of a laundry machine that uses 80% less water, fewer chemicals, and is more efficient in cleaning articles than competitive machines. This machine is the first real advance in laundry machine technology in 50 years.

Objectives and Challenges
- Our client manufactures a revolutionary new laundry machine that uses 80% less water, fewer chemicals, and is more efficient in cleaning articles than competitive machines. This machine is the first real advance in laundry machine technology in 50 years.
- To accelerate sales opportunities, they needed a way to measure the utilization and performance of competitor machines and the ability to compare with promised services levels against their proprietary machine.
- To complicate the design challenge, no modifications to the competitor machine could be done.
- The total solution installed, including labor, had to be less than $1000.
- Required a simple, self-service website design to graph, at various levels of details, the comparison against theoretical and actual results based on the type of laundry (formula) being processed.
- The sensor package, data acquisition equipment, and cloud integration had to be simple to install and remove. It also had to run unattended, require no extra operator intervention, and reliably send data to the cloud-based back-end systems for analysis.
- For the proprietary machine, operational measurements and dashboards were needed to improve visibility into machine usage and service.

Elyxor Approach and Solution
- Elyxor, working with its hardware partners, led the R&D effort to design and patent, for our client, passive sensors and a data acquisition device to measure input from laundry machine relays, valves, and utility meters.
- The sensors, data acquisition hardware, and cloud integration software were designed and developed by Elyxor to be pre-configured and installed on location by a technician with simple instructions and minimal training. Configuration and setup is designed so that it can be completed remotely by an administrator once connected to the Internet.
- Elyxor designed a simple machine learning tool that interpreted the sensor data and determined the classification of the formula the machines are processing.

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- Elyxor's UX design team created an easy to use web reporting application and dashboard for laundry management, operations, and Client service teams.
- Elyxor sourced and managed the initial manufacturing of the sensors and data acquisition hardware.

Results Achieved

- A simple, very cost effective, and scalable solution for the field technicians to install at prospect and customer sites.
- Passive sensors can be installed and removed from competitive machines with no modifications to the machine, eliminating any liability issues.
- Simple to use admin tools to configure the learning engine. This properly interprets what the machine is processing and how it compares to competitive machines and SLAs.
- An easy, intuitive web application and reports that can be used to demonstrate to a sales prospect the benefits of this radically new laundry technology.
- Accurate data collection and analysis to be used for municipal and utility rebate programs that save our clients customers thousands of dollars when purchasing their machines.
- Proactive service management by our client's technicians and third party service personnel.