AUTOMATE Everything

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Contents

1. Abstract

JFDI comes from ancient roots, in computing terms.

We've seen a lot of technology bubbles come and go: islands of tech which come along in a blaze of marketing and PR, promising to revolutionise everything, and then disappear into obscurity when they fail to deliver.

Some of these islands of tech return years or decades later, when the technology exists to enable the realisation of the early promise. Some resurgent technologies get incorporated into something altogether bigger, better, more all-encompassing.

We think this is happening again.

But this time, it's going to change the human world in profound ways, and forever.

2. Automate Everything

2.1. Background

At the birth of the microcomputer revolution, back in the late 1970s and early 1980s, when people still routinely programmed in machine code or assembly language, JFDI's founders began to dream of being able to automate everything using electronics and computing technologies. Early achievements included a concept for a smart intruder-management system, a pioneering, barcode-driven electronic point-of-sale system, and later, in the 1990s, even a concept for a mobile PDA forerunner of Apple's Siri or Amazon's Alexa.

The trouble was, in its infancy, microcomputing simply hadn't evolved the platforms to be able to springboard to this grand plan to automate everything. Forty years later, emerging and mature technologies converge to make possible what we could once only dream of. But it hasn't all happened at once. And the road to full automation hasn't been a smooth one. There has been a succession of advancements which were hailed at the time as game-changers, but often they've failed to deliver on their early promise. Frequently this failure is a failure to integrate with other systems. Gradually the foundations of systems integration have become broader, deeper and more solid.

The Internet linked up first our PCs, then our WAP phones. The web provided everyone with the ability to quickly and easily publish and access information. Artificial Intelligence got us all excited about clever computers and robots, but in the end mostly just won games of chess. Workflow processors changed the way in which information flowed around an organisation but remained isolated inside discrete systems. Business Intelligence, OLAP and data-warehousing made it possible for large corporate entities to collect and analyse vast quantities of data, but rarely made it beyond the management accounts department.

Commented [JJ1]: "Workflow systems" ?

2.2. 21st Century

Then, after the turn of the 21st century, some interesting, unifying developments started to appear. A faster, broadband-based Internet and Web 2.0 technologies provided new opportunities for systems to be created with new ways of human interaction, and a more distributed, lighter-weight approach to implementation and deployment – SaaS (Software as a Service).

The Internet of Things (IoT) has developed from early, oft-ridiculed ideas of "Internet fridges" to encompass a wide range of technologies and patterns that can gather vast volumes of data passively, control every physical system, apply intelligent heuristics and natural speech technologies, and truly link the world together.

Glue technologies like REST, JSON and JavaScript have evolved into mature ecosystems like NodeJs and the MEAN technology stack, allowing middleware to be created with unprecedented speed, facilitating the passage of data between systems and making it possible for JFDI's founders to finally realise their early dreams, and for the first time truly to Automate Everything.

Driven by demands from the video and graphics industries, storage became orders of magnitude bigger, and incredibly cheap, making really big databases a commercial reality. Organisations of all kinds have found new markets for the data they collect and sell, and Big Data – the gathering and analysis of huge sets of even seemingly trivial data, often consisting of many millions of datapoints per day - is changing the way we look at the world.

Robotics has matured from the electronic house-slaves promised to us by TV science programmes in the 1970s, to become an essential component of 3D printing, laser cutters and other CNC-based machines. Some of these are even finding their way into our homes to deliver manufacturing and fabrication functions within the reach of hobbyist's budgets.

2.3. Technology, Science, Tools

From earliest beginnings, our species and its forerunners developed and used technology. Technologies drive the creation of tools. Tool usage is one of the most distinctive features of the human lineage. Other animals use tools too: from the chimpanzee with a stick to pick up ants and termites in a tree hole, to the crow snowboarding down a roof using a found coffee cup lid. But no other species has developed such an array of tools, and the science to allow us to create new ones.

From picking up a stone and noticing razor sharp edges where it has been recently broken, to discovering exactly how to break another stone to perfect a cutting edge… ultimately creating a wider range of tools, from an entire technology based upon flint, and gaining the knowledge of materials science to permit the creation of finely nuanced tool-sets: this ability to imagine, discover, define and refine is uniquely human. It's the basis of what we call science. But in the modern era, as technology has become packaged and easily accessible, most people have become increasingly disconnected from the science itself: the tasks of creating and applying technology which were once so vital to our very existence. As a species whose early development was shaped by its ability to create and control fire, it's sobering to discover just how far removed we have become from this ability, at least without resorting to petro-chemical accelerants produced from fossil fuels.

Commented [JJ2]: Can we get Carl Sagan to read this out aloud? It's awesome.

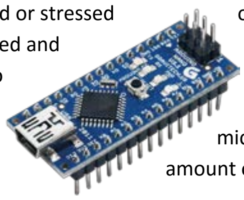
The man in the street sees science as distant from everyday life. Yet everything in that man's life is built and made using the products of science. Science is the process of quest and discovery which leads to the development of technologies. Tools are the product of those technologies and the device which allows us to apply technologies, bringing them to bear to solve problems.

To most of us, the notion of tools normally conjures up mental images of saws, screwdrivers, chisels or even axes. But in reality, our tool-use goes much further than that. Every part of our physical human world is built using components which were made using tools, using materials gathered using tools, by machines which are tools, powered by fuels collected by yet more tools. Computers, microprocessors, and radio frequency communications devices are all tools, created from base technologies.

Most new technologies sit there for a while waiting for us to imagine new use-cases. It probably took us a while to get from injuring a foot on a sharp stone to perfecting the art of flint-knapping, and even then specialised devices created using this technology were developed gradually. Our ability to evolve and repurpose technologies, through imagination and leaps of logic, has been there from the beginning, but is now allowing us to create a homogenous fabric of technology threads which connect everything to everything.

2.4. Why Automate Everything?

Humans are very good at many things. But at some things we're slow; sometimes we make mistakes; boredom and stress make us unwell and unhappy; other times, in a business scenario, we're just too expensive. Computers are great at many of the things we're not good at. They can handle thousands of repetitive tasks at high speed, 24 hours a day, 7 days a week, 365 days a year, with 100% accuracy, never getting bored or stressed or sick. Similarly, they can watch and monitor things without getting fatigued and missing things, picking the right moment using rules and algorithms to automatically adjust something, or to notify a responsible human. When you extend the term "computers" to encompass inexpensive micro-controller devices and cloud-based systems, that's a massive amount of computing power at our disposal.



There are two distinct kinds of automation: fully autonomous systems; and systems which automate everything between human operator decision points. But the distinction between these two categories is really one of scope and extent. Fully autonomous systems typically need either a fairly simple system to run, or they need to engage rules-based or heuristic AI, and possibly machine-learning.

Automating a complex system entirely autonomously, without human intervention, has proven a hard nut to crack, as amply demonstrated by the development of driverless cars. If you opt to only partially automate the driving experience, such as with a smart cruise-control system, things are far simpler. The car can be kept in lane, and cruising along a motorway at high speed without crashing into the car in front. Coming up with the logic to run a system like that is not intrinsically difficult, as long as the hardware sensors and control systems can be made reliable. But ultimately, the entire system can be engaged, disengaged, and rapidly usurped by a human operator qualified to drive the car.

Switch to a full machine-autonomy situation, and things look very different. Suddenly obstacle avoidance becomes more complex, for example. Is it satisfactory to brake and steer around every obstacle? What if it's just an empty plastic bag drifting across the carriageway? Humans are very good at making these judgements, whilst machines, with even the most complex visual and AI systems, frequently get it wrong. Alas driving is one of those scenarios which doesn't sit comfortably with bad decisions. However, AI and machine-learning are constantly improving, developments spurred along by the relentless race between the technology giants to produce the first true driverless car.

Right now, automation can be as simple as synchronising the customer data between your CRM and accounts systems, making an update happen whenever a change occurs, or by regular polling. Automation can be a suite of monitoring, analysis, reporting and alerting mechanisms. Automation can also be workflow: driving a process, moving relevant data around an organisation so it gets to the right people at the right time and ensuring that the right interactions and accumulation of data points occur along the way. We can automate the structured filing of huge volumes of unstructured documents, and create search facilities to allow users to locate rapidly and precisely just the documents they need. In the era of IoT, automation can now interact with the physical world, gathering sensor data or controlling physical systems, and interacting with human operators in new ways. And Big Data can play a part in automation, taking internal or third-party data feeds and analysing them to create new kinds of alerts or reporting.

2.5. Big Data

Big Data is a relatively new, and much misunderstood concept, so it's worth expanding on what it means. Historically, we've commonly stored data representing business information entities, such as address data, sales data, and so on. But there's other data stored with each of the data points making up these data sets. For example, the date when a record was created or modified is frequently stored. Obviously, analysing the differences between these dates, or for another example the frequency of records created in each month, can produce interesting insights into sales trends, or the patterns of acquisition or loss of customers.

Engineering companies like Rolls Royce routinely collect telemetry from operational aircraft engines worldwide. Analysis of this data allows engineers, operating remotely, to spot problems with the engines before they start to affect the performance or safety of the engine. However, on a grander scale, development of future engines can be steered by analysing all the collected data in bulk.

This sort of analysis already has applications in many sectors, from road safety, to medicine, to pharmaceuticals. In each of these areas, however, the introduction of a new breed of low-cost wireless sensors, will produce more data than ever before.

In this way, we can go further in our quest for data, and collect millions of new data points from new sources. We can store them, just because we can, storage being cheap. Then, although the data on their own might mean nothing, and appear to be just noise, smart analysis of the data en masse can yield new and interesting insights. Companies like Apple and Samsung, as well as mobile phone companies, are already able to collect and analyse vast quantities of data from smart phones. This can yield interesting insights into the phone and data use of users, without invading the privacy of individuals.

Modern pioneers of this sort of large-scale data collection and analysis were the supermarket and financial services industries. Spending patterns have been analysed for years on a macro scale, helping to better understand how shoppers shop and spenders spend. But on a micro scale, the data is now used to spot inconsistencies which could point to credit card fraud or identity theft – much to our annoyance when the heuristics yield false-positives and a card is blocked unnecessarily.

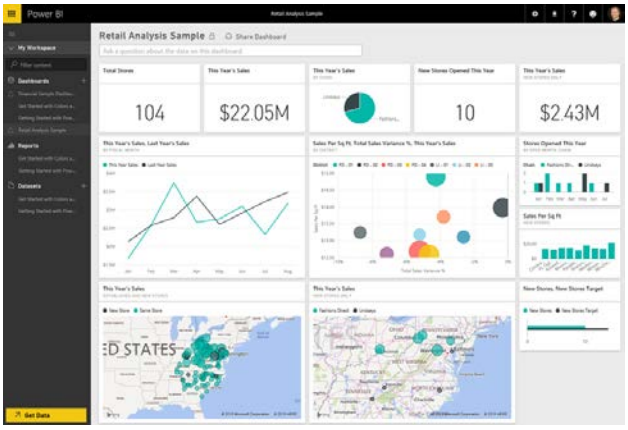
Gaining insights through the analysis of collected data is nothing new. Famously, Henry Ford commanded the large-scale analysis of original, factory-fitted components from scrapped Ford cars, in order to find out what parts were being over-engineered for a reasonable life-span. In another example, Romanian-born mathematician Abraham Wald revolutionised the analysis of damage in bombers returning from missions, and where previously armour had been added to areas showing the most damage, Wald advised that in fact, since the analysis had only looked at bombers which had returned, attention should instead be turned to those areas of the returning aircraft which had suffered no damage, since damage those areas was almost certainly the reason why the lost aircraft hadn't returned at all.

This last case highlights the need for algorithms which apply the correct analysis to collected data, in order to return the correct results and conclusions. If we get the analysis right, we can predict and mitigate against the future with a high degree of accuracy.

2.6. The Best Systems are Ubiquitous

At JFDI, we've come to realise that few of our clients even realise just how much of our novel technology goes into their systems. Most of our clients' staff probably don't really care. And actually, that's the way it should be. Technology doesn't need to shout. The best systems are ones that anticipate your needs and quietly get on with the job of fulfilling those needs, almost before you've realised the need yourself.

Of course when we take the jobs you've done manually, and rapidly implement a complete suite of automation middleware, you'll notice that your life suddenly gets easier, that data turns into information before you ever see the raw data, information becomes fuller, more timely and easier to analyse, and everything just seems a lot more joined up. Systems provide answers instead of merely clues. And the deeper we delve into a client's systems, the more joined up everything can be, including even your physical premises and facilities management.



The Internet of Things (IoT) will allow us to gather more data than ever before. With IoT sensors, connected via wireless communications networks, we can gather millions of data points per sensor per year. By leveraging the current generation of Business Intelligence tools, like Microsoft's Power BI, we can turn this torrent of seemingly useless data into elegant insights into areas of your business for which there was previously no data upon which to make decisions.

For example, how do you decide what your flexi-time policy should look like? It's probably all been based on guesswork and opinions in the past. Your company's parking management, and your staff's impact on the local environment and community could all depend upon your decisions. It's not just a PR matter; the wellbeing of your staff could be affected. But how can you make informed decisions when there's no supporting data? If you could passively track the movements of your staff via occupancy of parking spaces, and combine the resulting volumetric data with intelligence about peaks of traffic activity on local roads, you'd have a better, more concrete basis for making those decisions.

If you could track your staff as they move around your buildings - passively, non-invasively, anonymously – and you could gain insights into over-utilised or under-utilised areas, or perhaps bottlenecks of footfall that could affect fire safety; and you could even save power on lighting and air-conditioning by automatically switching off systems when a building, or part of a building, is unoccupied.

Most of the technology required to do all of these things exists today, is mature enough to use now, and can be remarkably affordable.

2.7. Which Systems can be Automated?

Generally speaking, if a system has an API (Application Programming Interface), a formalised set of methods for talking to the outside world, then we can make everything else talk to it. Events can be raised and acted upon, data can be copied or moved from one place to another, and changes effected.

Most of the modern, cloud-based, SaaS software systems have standards-based APIs, whether they're for CRM, accounting, ERP, human resources or other key business areas. At JFDI we've created many middleware solutions to move or synchronise data between these systems, reliably, securely, and free of the sort of transcription errors which humans are so good at introducing.

Gathering data passively can be done using simple sensors connected to small, low-power microcontrollers, which employ wireless networks to publish raw data, threshold-based events, or summary data, to central data brokers. Databases and control systems can subscribe to those data streams in order to permanently record the data, summarise it, or act upon it. Electronically controlled switches, relays, servos and solenoids can be employed to interact with the physical world. In this manner, a company can now have its own nervous system, sensing its environment and acting upon stimuli autonomously, and providing management with unique insights and statistics in the process.

But suppose you have an older, legacy system which is proprietary, perhaps developed many years ago, possibly using obsolete technologies and tools. Does it have a place in this brave new world? Can it form part of this new fabric of connected systems? The answer is probably yes. If it's based upon off-the-shelf technologies like SQL databases, we can probably build an API for it and link it up to everything else, including more modern cloud-based systems.

2.8. Automation for Business

Should you automate the linkages between legacy systems and other systems? It's all a matter of how important each legacy system is to your core business processes, how much it would cost to replace, and how that weighs against the cost of upgrading it to talk to modern systems.

How much to automate each process, which processes to automate, and whether or not to automate the passage of data between systems?

In business, one thing never changes, and that's the bottom line. Real, tangible, measurable cost savings, or a healthy, quantifiable return on investment – that's what makes investment in information technology systems worthwhile. If it costs too much for the benefit gain over the system lifespan, don't do it. JFDI's ethical approach to consultancy ensures that we will always advise clients to take the path which leads to the maximum return on investment, with minimum costs, and maximum overall savings.

JFDI is actively investing in research and development programmes which incorporate off-the-shelf software platforms, computer science, and even micro-electronics, to discover new ways of automating business systems. Our clients, today and in the future, benefit from this R&D in every consultancy or software development project we take on. Through our many R&D projects, we aim to deliver a new generation of cost-effective automation systems into every area of business.

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