Looking Before Leaping onto Technology Bandwagons

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QAD

Table of Contents

Introduction: Too Much Information About Innovation

Do you feel overwhelmed by the endless stream of technology innovation? You are not alone. It is easy to become confused about which new technologies or trends are useful and which are passing fads or too immature.

At QAD, we constantly sift through emerging technologies to determine and eventually deploy innovations that benefit customers. Our tech investment decision-making challenge is of particular importance because many thousands of manufacturing sites depend on us being right. It also directly impacts QAD because we support our customers' mission critical ERP in our QAD Cloud; in essence we have become our own largest customer.

Our tech decision-making challenge is further complicated by the solutions we offer, which includes full-featured ERP and several related solutions. When you implement QAD Enterprise Applications in the QAD Cloud, known as QAD Cloud ERP, you deploy an entire solution stack, including hardware, network and software, supported by cloud services. Our scope of technology trend watching, therefore, covers a full spectrum of possibilities.

What drives QAD's technology choices? The goal of this paper is to share our approach for discovering technology innovation, making technology investment decisions and to shed light on some recent technology innovations most pertinent to manufacturing ERP.

Searching for Innovation and the Balance Point

QAD discovers emerging trends by closely watching technology media, bloggers, industry analysts, universities and the startup community for ideas. Not all new technologies, however, eventually reach customers. Just because, for example, an analyst thinks a new technology is cool does not qualify the technology for use in the highly regulated manufacturing industry.

We also do not only keep our eye only on enterprise technologies. Before the rise of the internet and mobile computing, enterprise technologies often influenced innovations for consumers. Today, however, consumer technologies typically drive innovations for enterprises.

QAD's viewpoint is that technology trends act like a swinging pendulum. The extremes of the swing represent technology hype. Predicting and driving toward the balance point in the middle is the best way to service our customers – by protecting them from misleading hype and low ROI technology.

Though we obtain early innovation ideas from media, analysts, universities and startups, we also watch open technology and industry bodies which act as predictors of technology maturation. Organizations like the IEEE, ISO, NIST, the Object Management Group, OpenStack and the W3C not only set standards but tend to work on standards reaching wide market acceptance.

Finally, QAD pays close attention to the often overlooked human behavioral aspect of technology adoption. We try to spot situations where people and organizations face common problems and watch how and why they are investing to solve the problems. Often this surfaces in social oriented systems like open source development and standards committees – they tend to be groups of people spending their own time on something they feel is important. There is an element of natural selection in technology innovation where people will invest time if they believe in the value of the outcome.

Decision Factors for Adopting Emerging Technologies

No single factor outweighs all other factors when QAD decides whether to add or replace technology in its solutions. For every emerging technology that ends up on QAD's short list, we consider all the following areas in the risk, cost and benefit analysis:

Business Outcomes

The first question QAD asks when considering new technologies is always, "How can this emerging technology help customers improve business outcomes?" QAD's stated goal is, "to help manufacturers achieve a future where your business processes are operating at peak efficiency and perfectly aligned with your strategic goals." QAD refers to this goal as the Effective Enterprise, a vision that is never attained but underscores a commitment to continuous improvement.

Given the business outcome framework, we ask questions like: Does this new technology increase a manufacturer's insight into its business process performance? Does it improve collaboration in a business context to produce more accurate supply chain and production plans? Does it help better ensure compliance? Does it help a manufacturer focus more on its business and less on the systems that the business runs on? Does it, overall, improve customer experience, product quality, operational efficiency and decision making?

At QAD, adopting technology for the sake of technology does not work for our manufacturing customers. QAD invests in innovation only when we see the technology resulting clearly in better business outcomes.

Dependability at Scale

Assuming a new technology shows promise, when does promise turn into reality? QAD needs to see that a technology has reached a high level of dependability before implementing it around the world for several thousand global manufacturers.

QAD may test the new technology in our labs, and eventually pilot it with a few select customers or partners, but it must approach flawless execution for full distribution.

The technology must also scale up and down in order to support our largest and most globally diverse customers and, for example, early stage, single site life sciences manufacturers. Not only must the technology be reliable, it must run successfully in the full variety of customer implementations.

Cost

QAD has received many awards for customer experience and our 35 years in the manufacturing ERP software business serves as a testament to our focus on our customers' success – we believe and hope that is what sets us apart. Nonetheless, QAD is a for profit business and the cost of new technology, to develop or acquire, is naturally passed on to customers in some fashion. QAD, therefore, typically limits emerging technology adoption to technologies that have already passed the early adopter, and exceptionally high price, stage of the maturity curve.

Security

Customers depend on QAD for secure solutions that protect data privacy, support audits, meet technology related compliance requirements and address ever-changing cybersecurity challenges. If a newer technology requires too much special handling to fit into QAD's current and evolving security scheme, it does not qualify for becoming part of the production stack of QAD solutions. Any evolving enterprise class technology must take into full account the ongoing security challenge, in its design and implementation.

Multiple Technology Sources and Availability

Is the new technology available from only a single source? A technology poses a greater risk of failure at the earliest stage of its adoption. We evaluate that risk for the benefit of our customers. Usually, QAD shies away from technology until it becomes available from multiple sources. If, however, the benefits of the technology are obvious and the likelihood is strong that the technology supplier community will expand rapidly, QAD might adopt an early stage technology. An example was our early support of Linux and virtualization. In the situation where there are only one or a few suppliers, QAD looks closely at the supplier(s) service levels, commitment to support and roadmap before investing.

Lifecycle

New technologies are not simply developed and deployed, they must also improve, integrate with other technologies and have a clear lifecycle ahead of them for QAD to adopt them on behalf of our customers. Some specific areas of lifecycle we concentrate on include:

- **Release compatibility**: we observe the compatibility of technology versions from release to release. Release compatibility is very important for keeping our customers as current as possible with as little disruption as possible.

- **Cross platform support**: we prefer technology that matches the diversity of our customers' operating infrastructure.

- **Supportability and Security**: inevitably there are issues from the beginning to the end of a technology's lifecycle. Can we quickly obtain answers and fixes on behalf of our customers? Is the technology provider keeping abreast of vulnerabilities and releasing security patches promptly?

Ecosystem and Learning

Even when emerging technologies spread to multiple primary suppliers, the technology may lack a strong enough ecosystem for global consumption. QAD prefers to see consultancies, integrators and even other application providers offering training, implementation and related professional services before choosing that technology.

Recent Technology Reviews

Though QAD constantly tracks and considers newer technologies, there are some relatively recent technologies and trends closely associated with ERP solutions. What follows is a review of the more well-known trends impacting the ERP space in terms of QAD's level of commitment to each trend and an explanation of why.

Cloud

QAD was an early mover on cloud compared to most of its established on premise competitors. In fact, QAD was doing cloud before it became a popular term. With our first cloud offering, QAD Supplier Portal available in 2003, and a full ERP solution available in the cloud in 2007, QAD has remained ahead of most of its peers. Why did QAD invest early? There were three primary reasons:

1. **Creative solutions**: It was clear to QAD that the collaboration afforded by the internet provided an opportunity to create entirely new solutions. For example, with QAD Supplier Portal we could use the internet, or cloud, to enable suppliers and customers to share information to improve supply chain effectiveness. Using a universally accessible system like the internet, even then, seemed an obvious choice – one which has been validated to this day.

2. **Alleviate pressure on IT**: IT departments, regardless of the economic cycle, have been required to do more with less. Cloud offers an option to shift some of the burden from a manufacturer's IT staff to the ERP vendor and cloud service provider (CSP).

3. **Keeping ERP current**: QAD continuously enhances and adds capabilities to its

solutions, but on premise customers that lag in upgrading to the latest ERP versions are not able to take advantage of enhancements. QAD Cloud ERP makes it easier for customers to stay current.

Eventually QAD believes there will be a blurring of the boundaries between cloud and on premise. Data centers, whether public or private, will increasing look like cloud systems. In the near term there remains, as estimated by several industry analyst firms, strong upside for cloud.

Multitenancy

In 2003, before the term "multitenancy" was widely used in the industry, QAD implemented the QAD Supplier Portal as a web application that fits the definition of a SaaS multitenant application. Our subsequent experience taught us that multitenancy is not always the best option for certain types of businesses, despite it being convenient for the SaaS vendor who enjoys reduced deployment complexity.

Running a full-featured global manufacturing ERP operation is highly complex. Providing a system that includes customer version independence, security isolation and even FDA qualification cannot be serviced effectively in a multitenant environment.

Based on our experience, with QAD Cloud ERP, first deployed in 2007, we addressed the challenge – how to provide a single instance system without sacrificing the cost saving associated with multitenancy. QAD achieved this through an extensive set of DevOps best practices, automation and comprehensive monitoring. This differentiating approach and innovation has resulted in QAD winning a number of awards in the areas of security and cloud, most recently winning the Stratus Award for 2016 Cloud Company of the Year.

Although QAD does not consolidate customers on a single instance, the QAD approach is designed to consolidate multiple instances of a single global customer system on a single instance.

Leveraging our domain technology, introduced in the early 2000s, and our ability to define the scope of shared data across those domain instances, we are able to give our global customers the ability to model their business in an extremely flexible manner. It also gave customers the ability to deploy using what QAD refers to as a "blended" approach where customers may run some sites on premise and some in the cloud without sacrificing data consistency.

QAD has invested so much in automation to effectively manage thousands of customer instances from a single pane of glass that the QAD Cloud solution is now technically agnostic to Cloud Service Providers (CSPs). This gives QAD the agility to rapidly add new CSPs and adopt technology improvements as the cloud space evolves.

QAD was a very early implementer of virtualization for its cloud-based solutions and internally for development, demo, training and support systems. We fully automate our lifecycle leveraging virtualization and have increased our use of technologies like OpenStack and Docker.

Cloud Service Providers

When QAD started looking for partners to provision cloud services a decade ago, there were few options. Today there are dozens of global CSPs and the competition is fierce. This is great for QAD's cloud customers. It controls costs and forces the many CSPs to simultaneously invest in technology in pursuit of delivering excellent service levels.

QAD, unlike several other ERP vendors, has decided not to work exclusively with only one CSP, although choosing one would have simplified our daily operations and support footprint. We decided, however that a single CSP was not the best approach for our customers for the following reasons:

- **Geography**: some CSPs provide better service levels at different locations. QAD wants its customers to enjoy the best possible service levels regardless of manufacturing site location.

- **Compliance**: some CSPs more readily meet compliance requirements, such as country-specific data residency, than others. QAD wants to simplify the meeting of infrastructure validation and compliance matters for its customers.

- **Lock-in**: just as QAD wants to avoid single sourcing technology if possible on our customers' behalf, our philosophy is the same about cloud provisioning.

Currently QAD works with three global CSPs, for example IBM Cloud, and has certified three local CSPs including one for China.

Using advanced automation, monitoring and big data analytics, QAD has developed its own preventative management layer that is CSP-agnostic. The cloud services arena is experiencing rapid innovation and QAD's own management layer will make it easier for cloud customers to take rapid advantage of advancements.

HTML5

The user interface (UI) and more importantly the user experience (UX) of an application is essential to the effectiveness of users and therefore manufacturers. The UI is like the clothing of the application: it must be fit for purpose, give a particular message style and constantly change to stay in fashion.

In QAD's experience, UI technologies change every three to five years. QAD's application UIs have evolved from character (i.e., Telnet), to GUI, to early browser, to .NET and now to modern browser and mobile. QAD has adapted to each trend and exploited the latest usability capabilities as they have come into fashion.

Given the changing nature of UIs, we understand how to adapt quickly to new UIs with minimal development. In our latest UX technology initiative called Channel Islands, we have incorporated the latest web and mobile UI technology referred to as HTML5, providing the most compelling UX to date.

The Channel Islands based UX is data driven allowing QAD to adapt to industry changes without major rework to underlying ERP

capabilities. The approach protects our customers' investment for the future.

In-memory Database

As mentioned earlier, QAD is committed to protecting customers from overhyped technologies. In-memory databases is a clear recent example of such hype.

Given all the hype, it is easy to overlook the business purpose of offering an in-memory database or a database running on a solid state drive (SSD) – that is to deliver real-time transactional data or related analytics as quickly and cost effectively as possible.

Once you think in terms of business purpose you find that there are many technology approaches. Examples include storage solutions like SSD, technologies for handling large data volumes like Logstash and cache technologies that optimize schema structure – all of which QAD has implemented. In fact, QAD DSCP (Demand and Supply Chain Planning) uses our own proprietary in-memory database technology. Our approach is to choose technologies that best address a particular business and/or technology objective, measured by real world results and cost effectiveness for our customers.

Recently QAD has implemented a number of technologies to offer real-time transactional analytics as part of our Channel Islands initiative. A careful balance between in-memory data cache, optimized data structures and an advanced analytics engine come together to address the true insight and decision-making goals of our customers.

Interoperability and the API Economy

Interoperability technologies have swung in and out of favor over the last few years. The most recent trend has been fueled by the proliferation of APIs from cloud-based products coupled with the simplification of the methods used to call application programming interfaces, APIs, called REST APIs. REST stands for "representational state transfer."

7

REST APIs have grown in popularity due to the massive growth of mobile computing. Mobile operating systems like iOS and Android did not originally support complex data structures and protocols like XML and SOAP. As a result, simpler structures for passing data back and forth have become popular, particularly REST APIs and JSON (JavaScript Object Notation). Due to the growth of cloud, mobile and the Internet of Things (IoT), there has been an explosion in available APIs.

Many ERP providers have jumped on the API bandwagon and are at various points of implementation. QAD has offered APIs for its business functions for many years under the banner of a service-oriented architecture or SOA. More recently, however, with our Channel Islands initiative, we now use REST API's to service the new UX and to create a highly open system that readily supports integration, application extension and innovation. This approach simplifies cloud application integration, which QAD achieves through a combination of its own technology and with partner Dell Boomi.

REST APIs, however, still need to be managed, like any software source. There are best and worst practices for REST API design and security. QAD, therefore, primarily views REST APIs as a best practice for interoperability. The interoperability afforded by REST APIs significantly reduces the volume of customizations required for an ERP implementation and lowers the hurdle for future ERP upgrades. Most importantly, the QAD API approach offers flexible options for ERP upgrades, such as by module rather than the entire application.

IoT, Robotics and 3D Printing

These three rapidly evolving technologies are changing manufacturing and will continue doing so for the foreseeable future.

Starting with IoT, QAD started offering QAD Automation Solutions, a shop floor data collection and label printing set of capabilities and services, in 2015. QAD made this investment because the shop floor and the supply chain are becoming highly automated and integrated – primarily through robotics and IoT. QAD Automation Solutions acts as a foundational IoT backbone for customers.

3D Printing, also known as additive manufacturing, will obviously change production processing for many manufactures, but will also transform supply chains. While the material needs of a manufacturer might change due to 3D, there are other powerful impacts.

For example, with 3D Printing a manufacturer's intellectual property shifts from managing physical objects to controlling design media. This is analogous to what has happened in industries like software, music and movies.

As a result, concepts like digital rights and media management, similar to those used by Apple, Amazon and Google, will become important aspects of managing data in the ERP world. QAD is observing these trends closely and waiting for this inevitable trend to become a real-world business need.

QAD will continue investing in R&D to stay abreast of these important emerging technologies that will all require ERP and related supply chain solutions to enable manufacturing business processes transformation.

Summary

One of the key activities of the CTO's office at QAD is to keep up with innovation. Another key activity includes filtering the endless stream of tech innovation into specific technologies that add value to QAD customers' experience.

Often, I get asked the question, "Is QAD an early adopter, a fast follower or maybe a late adopter?" The answer is "all of the above." Our own R&D that developed the predictive management layer across all our CSPs is something few other vendors have undertaken – early adopter. Our cloud

customers enjoy very high cloud availability, higher than 99.9 percent so far this year, as a result. For an on premise vendor, we were early to cloud, though we have opted to a single tenant approach that we believe best fits the needs of our manufacturing customer base – fast follower. We are selective about our use of in memory computing. We are bullish on IoT, robotics and 3D printing.

QAD looks before it leaps onto technology bandwagons. All this new technology must be applied for the obvious benefit of customers. QAD looks for technology that produces positive business outcomes for manufacturers at an acceptable risk and cost.