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From the Editor – About this Issue

Leonard Fehskens

First, my sincerest apologies for our having missed a few issues. But we're back now, we have taken measures to ensure that we will publish regularly, on a quarterly basis, and we've done some things that we believe will significantly decrease the time from material submission to publication.

We're also adding some new kinds of content. We'll be including reports from AEA Chapters, and republishing material from other sources that we think will be of value to the JEA readership. We've resurrected the "Architect in the Spotlight", but in two different ways that we think you'll find more interesting. The first is "Four Questions", where a practicing Enterprise Architect can ask and answer four questions, related or unrelated, of their own choosing. The second is "Talking Shop", which is an open-ended conversation between myself and an active member of the EA community – practitioners, researchers, managers, whatever.

This issue opens with reports from the Bangalore and New York Metro Chapters of the AEA on recent events they held. It continues with two "Four Questions" self-interviews, and then "Talking Shop" with Alan Hakimi of Microsoft®. Then a short subject by Mark Perry on the importance of the "big picture perspective". In addition to the "About this Issue" column and frequent book reviews, I'll be contributing a regular series of articles ("Len's Lens") about subjects that are "off the beaten track", and this issue contains an introduction and overview of the series. We have two peer-reviewed articles on subjects of perennial interest to the community, on how to demonstrate that EA actually delivers value, and how to connect EA to the business. Finally I review the source of one of the most frequently cited quotes from the literature of (building) architecture, the "utilitas, firmitas, venustas" of Vitruvius.

As always, I urge you to consider contributing to the JEA. You don't have to write something to do so – you can suggest something you've seen published elsewhere that you think would be of value to the EA community if it were featured in the JEA. If you do want to write something original, we're now accepting non-peer-reviewed short subjects (a few pages) as well as the traditional peer-reviewed longer articles.

We're especially interested in business and other forms of enterprise-related material, as well as technological topics. Finally, you can always send us your own "Four Questions", suggest someone you'd like to have submit their "Four Questions", volunteer to "Talk Shop" with me, or suggest someone you'd like me to "Talk Shop" with.



Visit the AEA website at www.globalaea.org



The screenshot shows the AEA website homepage. At the top left is the AEA logo with the text "Association of Enterprise Architects". To the right is a "Translate this page" widget set to Spanish. Below the logo is a navigation menu with items like Home, About Us, Community Blogs, AEA Webinars, Get Involved, Groups, Find a Group, Forums, Career Center, AEA Membership, Join a Chapter, Journal of EA, and Who's Online Now?. The main content area features a large photo of a group of people at a conference, with the heading "Welcome to our Association of Enterprise Architects Online Community!". Below this is a welcome message and a sign-in form with fields for Username and Password, a "Remember Me" checkbox, and a "SIGN IN" button. There are also links for "Forgot your password?" and "Haven't joined yet?". On the right side, there are sections for "Latest News" and "AEA Events", each with a "more" link. At the bottom left, there is a "Tweets" section with a "Follow" button.

Call for Papers

The Journal of Enterprise Architecture is accepting article submissions for its future issues. Research and best practice articles are sought on Enterprise Architecture-related topics, including:

- Case Studies, Configuration Management, Culture, Documentation
- Evaluation, Frameworks, Governance, Implementation, Maintenance
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Chapter Spotlight

AEA Bangalore Chapter

Satish K. Sreenivasaiah

Keywords

AEA, Chapter, Bangalore

The idea of pursuing and re-kindling the AEA Bangalore Chapter event germinated at The Open Group event in Bangalore during the third week of February 2015. By the end of two days of insightful sessions on Enterprise Architecture (EA), its challenges, and the opportunities that lie ahead for Enterprise Architects in the digital economy, the local architecture community wanted to connect, share, and collaborate more to keep abreast of the latest happenings in the EA space.

This thought paved the way for subsequent meetings with the AEA Bangalore Chapter Lead, Sreekanth Iyer and the core AEA team to discuss the agenda, venue, and relevant logistics for the event. After deliberating on the plan ahead, the team quickly got into action and finalized the date of April 9, 2015 for the meet.

Topics to be covered and the speakers for the meet were crowdsourced from the AEA community and finally zeroed in on the following exciting EA talks.

- M2M Platform – Architecture & Realization by Prakash Shivappa, Solutions Architect – Happiestminds
- Web Application Hosting – Cloud Architecture & Realization by Sreekanth Iyer, Executive IT Architect, IBM
- Introduction to ArchiMate® 2.1 by Parameswaran Seshan, Principal Consultant, CC&C Solutions

It was decided that the venue would be at the TCS office in the heart of Bangalore. (Thanks to TCS for the venue.) The event kicked off as planned at 4.00pm with the enthusiastic crowd eager to share and learn the latest happenings in the Internet of Things (IoT), its case study, cloud architecture realization, and the EA modeling language.

Satish Sreenivasaiah from TCS Product Trustworthy CoE welcomed the AEA members, delivered the opening speech, and invited Mr. Kishore Banavar, TCS Head – Banking Technologies Group, North America to deliver the keynote address.

Kishore did touch upon all the key actions that EA as a community needs to adopt to be relevant for our

stakeholders – like bridging the gap between business and technology and owning the digital strategy for enterprises. He emphasized that the future of EA does not confine itself to the boundaries of an enterprise but goes beyond to the industry, and hence Enterprise Architects should gear themselves to solve the EA challenges by sharing and building industry-level patterns. He also stressed the need to have prescriptive architecture to deliver the new age solutions at the pace that clients are expecting.

In the subsequent sessions, Prakash Shivappa from Happiestminds presented an IoT case study and explained the M2M platform architecture adopted, using simple analogies. He explained the differences between a conventional publish/subscribe pattern-based architecture and the IoT architecture implemented. The multiple layers of the architecture were detailed such as the device/sensor layer, preparation layer where a message gets appended with an IP address, the aggregator, big data analytics layer, and finally the subscriber layer. The growing field of M2M communication and IoT was reinforced in the session.

The second session planned was cloud architecture realization in the context of web application hosting by Sreekanth Iyer from IBM. He talked about the Cloud Standards Customer Council (CSCC) and containers based on Docker™. It helped the audience to understand the concept of leveraging the Docker capabilities to deploy a container. Being a new area for most of the participants, the session provided insights into this upcoming technology space.

Lastly, Parameswaran Seshan from CC&C Solutions talked about the need of Enterprise Architects adopting the right modeling language for capturing business requirements and depicting it visually addressing multiple stakeholders' perspectives. He also talked about various open source and COTS tools for EA modeling, the differences between UML® and ArchiMate, and explained that “no one tool fits all” and hence adoption of the right tools for the right purpose was extremely critical.



All the talks were followed by Q&A from enthusiastic participants. It was a great two hours spent understanding the trends in the EA space and networking with like-minded EA professionals. A brief plan was charted for the next AEA meeting in May 2015.

The event ended by the host thanking all participants and the speakers for delivering top-class presentations at short notice.

ABOUT THE AUTHOR

Satish K. Sreenivasaiah is a consultant in Tata Consultancy Services based in Bangalore. He is part of the Product Trustworthy Centre of Excellence that is responsible for ensuring software security and performance. He has 16 years of experience in the IT industry and has held various positions including Solutions Architect, Lead Architect, Practice Manager, and Relationship Manager across different geographies. He is also an Open Group Master Certified IT Architect and a Certified Ethical Hacker. He has authored technical articles for external and internal publications and has been a regular speaker at national and international technology forums.

REFERENCES

Cloud Standards Customer Council (CSCC): Web Application Hosting Cloud Architecture; refer to: www.cloud-council.org/web-app-hosting-wp/index.htm.

Chapter Spotlight

New York Metro Chapter

Joe Maissel

Keywords

AEA, Chapter, New York Metro

The New York Metro Chapter of the AEA has over 40 members and is growing fast. We've held three lively, engaging, and informative meetings. We are currently planning our next meeting and are hoping to hold a large-scale event in the Fall. Our Chapter is moving forward nicely.

But it wasn't always so.

In early 2014 I was changing jobs. I wanted to meet Enterprise Architects in the New York region. I looked for a New York Chapter of the AEA and was surprised to learn that while both Boston and DC had active chapters, there was nothing in New York. How could this be? I contacted the AEA and learned that, sure enough, no one had been able to get a chapter off the ground in New York.

I wondered what it would take to get a chapter started myself. Why not take the opportunity if no one else had? It wouldn't be long before I found out why it was not so simple in New York.

When I called the AEA, it was Birgit Hartje who answered the phone and explained the situation in New York. She also talked me through what it would take to get a chapter going. I would need to appoint officers: a Chair (me), a Vice-Chair, and a Secretary or Treasurer. That much I figured I could do. I called a couple of my former colleagues from Western Union, Sarose Dass and Jan Stobbe, and they stepped up to the plate. Sarose became Vice-Chair and Jan our Secretary.

Birgit recommended that I connect with other AEA Chairs that had started their own chapters. She put me in touch with EA luminary Mike Walker. Mike is the Chair of the Texas Chapter and had built it from the ground up to the point where they were holding large events. I had met Mike at an Open Group event in 2013. When I reached him, he generously offered to mentor me on running a chapter. He met with me on two different occasions and took me through his overall approach, possible pitfalls, and listened patiently as I bounced ideas off him. It was a huge help.

But we would, of course, need a place to meet.

Meeting space in Manhattan is hard to come by. OK, that's not quite true, FREE meeting space in Manhattan is hard to come by (that isn't in a public park!). It was a bit of a catch 22. We were a non-entity with no members to provide space (I did not have an employer that could help), and without space we could not get established. My former employer, Western Union, does not have a strong office footprint in Manhattan, and so it was unclear how to proceed. I turned to my co-founders, Sarose and Jan, for suggestions.

Sarose was still working for Western Union, spending many days in Western Union's Lower Manhattan office. That particular office did have a very small conference room (max capacity 12), and initially we considered it just too small for an AEA meeting. But it was all we had. It was now early Fall and we wanted to get something on the calendar. So Sarose went ahead and reserved the small room for Friday, November 14, 2014.

At AEA headquarters, Birgit put together a list of all AEA members in New York, Connecticut, New Jersey, and Pennsylvania. I composed a chapter kick-off announcement and Birgit sent it out. AEA membership lists are not freely distributed so Birgit has to be the one to send out email broadcasts. The email directed anyone who was interested in the chapter to contact me directly.

The response was great. I received over a dozen emails from people expressing interest. I now had a chapter mailing list. I sent out information confirming our meeting time and location and a proposed agenda. We were on our way! Or so I thought. Just two weeks before the meeting, Sarose called to tell me that Western Union HR would not approve the use of the conference room for our meeting! What to do? I thought for sure we were sunk.

Sharon and IBM to the rescue.

I sent out an email to the newly formed chapter membership apprising them of the situation, asking (pleading/begging) if anyone had access to meeting space in Manhattan. Right away, Sharon Bowden from IBM came back with an offer of an IBM conference room in Lower Manhattan. Suddenly we had new life!



On the day of our first meeting I was excited but didn't know what to expect. I made my way to the IBM offices and up to the meeting room. About a dozen people showed up. Yay! We had a nice mix of Enterprise Architects representing a variety of organizations – large technology companies, niche EA vendors, independent consultants like myself, and several others working in EA practices inside Fortune 500 companies or universities.

After a round of introductions, handing out copies of the Journal of EA, and explaining how the chapter came to be, we started to explore what our new chapter should focus on. Someone raised the question: "What is the elevator pitch for the value of Enterprise Architecture?" The conversation took off from there. It seemed that this topic was on a lot of people's minds. There was a common concern that Enterprise Architects don't have any easy way to describe the value of what they do to their peers and to executives. The conversation flowed freely, around and across the table, debating how best to describe the value of our profession. After a while we realized that there was a lot more to say about the subject than we could cover in our first meeting. We decided right there that we had the perfect topic for our next meeting.

Now that we had the topic, we needed to come up with an effective format to explore it. Pretty quickly we settled on having chapter members put together short presentations on the topic to be given at the next meeting. We agreed to issue a "Call for Presentations" a month or so in advance of the next session.

Other ideas for chapter activities were explored including holding an executive briefing. We would bring together a group of executives, pitch them on the value of EA, and solicit their feedback. Another idea was to hold a joint session with another AEA chapter such as Boston or DC. There were several more, and we decided to remain open-minded about future possibilities. Our main goal had been met, namely getting the chapter underway.

We also made the decision to keep the officers unchanged, and to not be a dues paying chapter. We wanted, and still want, to make being a chapter member as easy as possible. Not having dues also keeps the administrative overhead to a minimum. We did make a rule that you must be an AEA member to attend more than two meetings.

With a core membership established, I hoped it would be much easier to find a place to meet. Sure enough both Paul Brown from TIBCO and Alan Crosswell from Columbia University offered us meeting space. What a relief! In New York, finding space is the hardest thing and I felt a huge weight lifted off the chapter's proverbial back.

Our second meeting on February 13, 2015 was held at Columbia. The call for presentations was answered by six different members, each giving engaging and thought-provoking talks on the value of EA. We opened the session up to remote users via WebEx (thanks to the AEA for providing a WebEx account!). In fact, four of the six presentations were given remotely. When they were finished, a lively discussion ensued. We ran out of time and a number of us found ourselves hanging out afterwards, continuing the discussion. We kept talking as we walked down the street, then on to the subway, and all the way until we reached our stops and had to part ways.

Our third meeting on May 8, 2015 was held at TIBCO. Once again the call for presentations yielded thoughtful presentations on the meeting theme "Making EA a Reality". And, as before, the conversations they generated spilled out beyond the meeting's boundaries. We talked in the elevator and out onto the street and then had to agree that for future meetings we need to schedule an optional lunch for post-meeting discussions!

For our next meeting the chapter agreed to formalize its by-laws, hold officer elections in the Fall (at our one-year mark), and develop a chapter mission and values statement. We are very excited about the future of the AEA New York Metro Chapter.

If you would like to learn more about us, see meeting notes, and keep up with our activities, please go to our chapter page on the AEA website.

Hope to see you at our next meeting!

SUMMARY

Chapter launch in a box:

- Confirm there are no other chapters in your area
- Pull a couple of other architects together to be your officers
- Fill out the form on the AEA website
- Pick a place and a date
- Have the AEA send out an email blast to AEA members in your region
- Meet, elect officers, establish by-laws, talk EA, hold a big event (if that works!), rinse, repeat

ABOUT THE AUTHOR

Joe Maissel is a recognized expert in Enterprise Architecture tools, and the current Chair of the New York Metro Chapter of the Association of Enterprise Architects. With a long career in many facets of architecture, systems engineering, and education, Joe feels at home teaching TOGAF® courses and providing training on Enterprise Architecture toolsets.

Joe started his career as an entrepreneur. His groundbreaking website work on soundwire.com was featured in numerous books, magazines, and periodicals including Wired Magazine and The New York Times. Joe was a featured speaker at conferences focused on the Internet and entertainment. He parlayed his passion for the web into an IT Infrastructure and Systems Architecture career, building middleware and unified communications systems for investment banks such as Credit Suisse and JP Morgan Chase. He was selected to chair the Financial Services Instant Messaging Association (FIMA), which he led for three years, and became an elected member of the XMPP Standards Foundation (XSF). Joe was the creator and primary instructor for "Web Architecture and Infrastructure" which was offered at NYU from 2001 through 2008. The course became required curriculum for students pursuing certification in web programming. Recently, Joe led Western Union's effort to adopt Enterprise Architecture tools and methodologies. He introduced the use of UML® tools and worked to build a full EA modeling practice based on the TOGAF® and ArchiMate® industry standards.

Four Questions

A Practicing Architect Asks and Answers Four Questions of Their Own Choosing

Jason Uppal

Question 1: You are a Mechanical Engineer and an Economist by training; how did you end up as a Chief Architect, now leading a major transformation program in healthcare?

Engineering education, in my opinion, is one of the best education platforms for an architect because it teaches how to think and how precisely to separate the problem definition and solution development phases. The application of this skill in healthcare is like low hanging fruit. There are only a few problems when it comes to improving the delivery of healthcare, but the solutions we have are so complex, we spend most of our energy and time managing inherent complexity in the solutions, not the problem. For example, inter-professional communication is key to improving healthcare quality and cost, but most Healthcare Information Technology solutions don't address this simple problem head on.

Question 2: From your experience what is the biggest challenge for EA professionals in the market place and what can professional associations like AEA, or consortia like The Open Group and others, do to help?

It always comes down to a supply and demand, chicken and egg scenario. We, as an Enterprise Architecture (EA) industry, have not done a very good job at defining exactly what we do and what we as professionals take responsibility and accountability for. If architecture professionals want to be taken seriously in the enterprise they have to put a stake in the ground. Just like Industrial Engineers were the right-hand person of a Plant Manager, EA professionals need to be the right-hand person of the CIO and every other line of business executive, and then we have to take responsibility for the performance of enterprise capabilities just like the industrial engineer. When we have demand then we can start to create supply. There are lot of people in organizations who are ready to fill this role.

Question 3: Your recent research project – Moving EA beyond Modeling and Advisory – what were you hoping to accomplish with this and where do you expect to take it?

I started this project with two research questions – first, what services should an EA professional provide in order to be considered a direct value generator, and second,

what obstacles do we as an industry need to overcome to help them position these services. The 13-month long journey to share our proposed model with broad EA practitioners revealed remarkable insight. We will be sharing our findings at The Open Group event in Baltimore in July 2015. Looking at all the data we collected, one insight we gleaned is that the market is ready and we just need to step up to the plate.

So far we have gained good insight into the state of EA professionals in enterprises. The next step is to engage more EA professionals to finalize the EA services delivery model with complete guides and examples and hand this material to an organization like the AEA or The Open Group to further develop, manage, and distribute. The challenge will be and often is to communicate broadly and make it self-sustaining.

Question 4: What advice can you give to an aspiring engineer, manager, system developer, or a future Enterprise Architect?

I am not big on advice, as I feel what I know is not enough. But Chris Hadfield, a Canadian astronaut once said: you need three things to succeed in life – 1st become very good at what you do, 2nd become a decision-maker, and 3rd take care of your health. I can add that aspiring EA professionals should build good relationships with their stakeholders, take responsibility for results, and solve the real problem.

ABOUT THE ARCHITECT

Jason Uppal is a P.Eng, Open CA Level 3 Certified Chief Architect. Currently Jason is working on two projects – architect, build, and distribute enterprise capabilities to make Zero Patient Harm a reality, and bring Enterprise Architecture education to Indian higher education institutions.

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Four Questions

A Practicing Architect Asks and Answers Four Questions of Their Own Choosing

Dr. Steve Else PhD

Question 1: What are your overall impressions about the practice of EA in 2015?

The people interested in Enterprise Architecture (EA) are often IT people, very talented ones, but not necessarily the best ones to explain what it is and why it matters. Whereas many IT professionals see the potential of EA in terms of career progression, practically speaking, this is still a gamble.

Business people seem to rally more toward Business Process Management, Program Management, and Business Analysis. There is starting to be more interest in Business Architecture, but, if so in certain companies/organizations, the business wants to own the Business Architects.

Because of the apparent tensions between Business Architecture and Enterprise Architecture, it is more difficult for EA to mature since Business Architecture is actually a key part of the EA paradigm.

In short, the EA discipline is still immature and is facing serious challenges in gaining more maturity – it is difficult to build traction.

Question 2: What do you see as the biggest challenges facing EA as it strives to mature?

The perception of EA as either “ivory tower” philosophy or simply as a variation of IT puts EA in an awkward position and, as a discipline, it doesn’t appear to be learning its lessons very well in this regard.

For example, unfortunately, when many people start to learn EA, they are mesmerized by legacy approaches that have not, in fact, been very successful. This would be apparent if one wanted to analyze the past objectively, but for some reason, objective analysis of legacy failures is hard to come by. It is as if earlier practitioners have cast a spell over many bright people, or maybe Enterprise Architects are just reluctant to be critical about the past.

In any regard, despite the concept of EA having been around for over two decades, there is a lack of consistent buy-in among CIOs, much less CEOs, for investing in EA. Ideally, in my view, being a Chief Enterprise Architect would be a stepping stone to becoming a CIO, but most organizations do not even

have a Chief Enterprise Architect. So we are years away from something like this being realistic. But still we need to see CIOs embrace EA if it is going to ever mature.

Because EA is a young discipline overall, it needs some new, credible champions to make its case. Relying on pioneers from decades ago is a sign of a lack of grounding in the demands of the present while embracing incomplete and obscure approaches from the past. The Open Group has many potential standard bearers for EA, but too few are standing out publicly.

There are a number of challenges related to EA tools. These include the cost and the difficulty of mastering and managing many of them. I think that organizations should place a higher priority on enhancing the knowledge, skills, and maturity of their EA team before they make big investments in EA tool purchases or associated training.

Staffing up an EA practice requires a special kind of architecture in its own right. Because of the difficulty of defining the precise roles and responsibilities unique from Strategic Planning, Program Management, Systems Engineering, and IT, it is often hard to get critical mass with an EA team – it is hard to make the business case for a large and diverse enough team to meet the varied expectations in a responsive and well-orchestrated way. Lacking “critical mass”, many EA programs are doomed from the start.

Question 3: What do you see as the biggest opportunities for EA?

I see four major drivers for EA: its linkage to agile business transformation; disruption and resiliency; complexity management; and performance management. To address these drivers, EA must excel at providing the big picture and at connecting the dots between different frameworks and disciplines, and it must be able to demonstrate that it is in fact adding value in the process.

For example, as much as I would like to see coherency in moving toward business transformation, even the various efforts of the different forums of The Open Group come across as unsynchronized. In short, even in The Open Group, there are numerous silos of EA-related development. I think there needs to be more strategic orchestration among these efforts, but I understand that



this is difficult to achieve among a mostly volunteer set of contributors.

Using The Open Group as an example, what is the dashboard? How is it performing compared to what it has set as goals – what is its “big picture”? I ask this because of the central role The Open Group has assumed for EA through its EA Certification programs. Along these lines, I also see a lot of – as yet – untapped possibilities for the Association of Enterprise Architects. Progress in either of these organizations will not happen by accident, but rather it needs to be architected and led.

Question 4: What are your recommendations for the way ahead for EA?

I think it is important to be realistic and honest about the many EA failures to date, even as the interest in EA is spiking again. Large EA programs were launched in many organizations in the early 2000s, but many were since canceled. That said, some of those same organizations are trying EA again, but in a less dramatic way. To assist more in capitalizing on the resurgence of interest in EA, some new architecture patterns for successful rollouts need to be developed and socialized aggressively, while anti-patterns need to be shared and analyzed as well across the EA community. Earlier, I mentioned the danger of not committing enough resources to EA. Therefore, there has to be a happy medium linked to demonstrated value as an EA program begins and matures.

Architecting an EA career pipeline should be a priority for the EA community. This will not happen overnight, but EAs need to be the champions for this if it is to ever happen. Interestingly enough, the US federal government requires EA, but even so, the approach to defining the roles and maturing the practice is still hollow.

Linking EA to Master's Degree Professional Education programs strikes me as a very promising option, but again, this requires champions from the EA community to engage appropriately for this to occur broadly. I teach for the University of Denver, University College's Master of Applied Science program for Information and Communications Technology (ICT). EA is mandatory in this program and most students I have taught over the past six years say they value EA a lot, but would not have taken the course if they were not required to.

I think the TOGAF® 9.1 standard has been and remains a great stimulant and foundation for the future of EA, but it needs to be streamlined and tailored more for broader buy-in. For example, the eyes of too many students glaze over when being instructed about the Enterprise Continuum and the recommended setup of the Architecture Repository. Instead, the emphasis for the

generic certification should be more practical and linked to topics such as agility for enhanced business capability. I'm seeing some of this in White Papers from The Open Group, but need to see more in the required material for certifications.

In addition, I think a concerted effort to develop Advanced Applied EA Courses – that would include applied modeling and customization (e.g., for certain industries or focused topics) – is essential and my company is already moving out on this front. For example, we now have such a class on EA for the Financial Services Industry and one for the US government. For such courses, I have found there is a wealth of material in The Open Group and other places that can easily be leveraged.

Finally, I think the EA community writ large needs to articulate some overarching business principles and some architecture principles, too, as we move forward. The Open Group could help facilitate such a dialog, as could the AEA.

ABOUT THE ARCHITECT

Steve Else is CEO and Chief Architect of EA Principals. Steve has successfully combined wearing many hats as Enterprise Architect. He was a practitioner as Chief Enterprise Architect at FDIC in 2007 and at the Office of Inspector General, Department of Health and Human Services from 2008 until 2010. He has taught Enterprise Architecture at the graduate level as Adjunct Professor for approximately 6 years (nearly 30 courses). He has also been a consultant/contractor to the United Nations and Fortune 1000 companies for Enterprise Architecture deliverables while also training globally – now in his 10th year. He is the Founder of the Enterprise Architecture Professional Journal and Founder and Chair of the Association of Enterprise Architects Chapter in the Washington, DC area (AEA-DC).

Talking Shop

A Conversation with Alan Hakimi

Alan Hakimi, Leonard (len) Fehskens

Abstract

Two architects talk shop and let the conversation take them wherever it will.

INTRODUCTION

Len:

This wasn't scripted, but it wasn't entirely spontaneous. This is a jointly edited version of a few dozen email messages we exchanged. We did not set out with any more of a goal than to just talk about things of interest to us. Virtually all of what we wrote to one another survived the editing process intact; we moved a few things around when "responses to responses" broke the flow of the conversation, we clarified some points that we didn't "say" as clearly as we'd have preferred, and we cleaned up the grammar a bit. But what follows is an honest and accurate transcript, a sort of "My Dinner with Andre" without the dinner.

I met Alan at The Open Group event in San Francisco in late January 2008, and we've kept in touch ever since, which has usually involved an enjoyable dinner when we happen to be in the same place at the same time.

THE CONVERSATION

Len:

You and I seem to share an interest in exploring ideas about Enterprise Architecture (EA) that are not part of the conventional wisdom, from a perspective that is also unconventional. I have in mind in particular your series of talks on Zen and the Art of Enterprise Architecture. What led you "off the beaten path", or as some might put it, "astray"?

Alan:

That is an interesting question. I started to think differently about EA when I realized that many practitioners and the frameworks and methods that they used were more focused on governing the organization than enabling it. I have always viewed my role as finding the appropriate balance between governance and enablement. What I was witnessing was that many Enterprise Architects were focused on managing control of the IT environment under the guise of architectural governance. This had led many of the consumers or beneficiaries of the discipline of architecture to become disenchanted with the "architecture process", therefore it

was viewed as a barrier for progress. In their eyes, they felt there was a lack of empathy and urgency to what the business needed.

Len:

Do you have any sense of what kinds of organizations or organizational cultures are more likely to implement the EA role in this manner?

Alan:

Culture is a huge factor in whether they can leverage architecture beyond what it is being used for today. Taking the culture into consideration has led me to a more philosophical approach, to examine the nature of architecture itself. Architecture is both a process and an outcome. A key theme in my mind was that architecture exists to serve others, not the architect. What does high quality architecture look like? How can we reduce the "friction" in an architectural process to achieve better outcomes through the realization of an architecture? In architecting a system, how can one achieve the two fundamental goals: things flow and things work together. Or, said differently, form (structure) follows function (behavior).

Len:

I hear what you're saying but I worry about the "well-designed system that does something other than what is needed" syndrome. Do we too easily take for granted the idea that a system must do what we need it to do? This is the "utilitas" aspect of the Vitruvian "firmitas, utilitas, venustas" model. How do we prevent the system from becoming an end in itself? I imagine one could argue that if the scope of "things work together" is broad enough, for the system to "work together" with its context it would have to be fit for purpose, and for us be able to design a system, we have to have some sense of what it is supposed to do, but I wonder if it wouldn't be worth it to be much more explicit about that.

Alan:

I agree. This gets back to the point that architecture has to serve others. If you view architecture through the lens of a "product mindset", it forces you to think of the value

of the product and how it's consumed. Therefore it is critical to understand the purpose of the product. This is where the great intersection of strategy and architecture come together. If you do not understand the product's purpose, then how do you know you have the right means to achieve that purpose? In other words, if you do not understand the organizational strategy then how do you know that you have the right architecture to achieve the desired outcome? I recall early in my career as a software engineer using more classic system engineering approaches where we had better traceability from purpose to outcome. We seem to have gotten lost along the way. Using some of the "system" methods from philosophy, science, engineering, and nature has provided some interesting insight into what a healthy system looks like. What is the composition (architecture) of a healthy system? How does it behave over time? What makes it resilient? What makes it agile? How do you balance flexibility and precision? To use a term from author and Professor Nassim Nicholas Taleb: how do we make a system *antifragile*? In his book titled with the same name, Taleb stresses the point that a system benefits from "stress" and "disorder" in which entropy is actually treated as a vital ingredient for its fitness and evolution. What I had discovered is that the ability to cope and leverage a degree of entropy is required in all healthy systems. If the system is too rigid, the system will only be useful to accomplish a very small number of outcomes, fairly narrowly vertically scoped outcomes, or both. If the system is overly flexible, then one may not achieve any meaningful outcomes as the system is trying to serve too many objectives.

Len:

This reminds me of W. Ross Ashby's "Law of Requisite Variety": *The larger the variety of actions available to a control system, the larger the variety of perturbations it is able to compensate.* Putting an "entropic spin" on it is interesting. If I recall my thermodynamics correctly, entropy is a measure of the randomness or disorder in a system. How does randomness or disorder facilitate adaptability and resilience?

Alan:

This would be a great conversation within itself. ☺ To get a bit geeky for a moment, the laws of thermodynamics apply to a large number of disciplines. They have a sort of universal applicability. They can apply to information theory, cybernetics, informatics, ambient intelligence, ubiquitous computing, statistical mechanics, and machine learning to name a few. Most of the EA frameworks treat the enterprise as a machine. That is the wrong perspective from my point of view – it is not a mechanistic or static system that works within the rules of classical physics. It is more organic, dynamic, and operates more within the rules of quantum mechanics

and non-deterministic probability. Random disorderly things will happen. A good designer will have to account that some are good, and some are bad. I know this notion of complexity freaks people out because many architects view it as the antithesis of simplicity. Simplicity is something we should all strive for and not making things unnecessarily complicated. But sometimes you need entropy for the system to work. Entropy within a mechanistic passenger airliner is not good. Within the context of passenger air travel this "system" behaves more like a living one where entropy is an essential ingredient for it to thrive.

This is where I started on my journey into systems thinking, systems dynamics, and complexity theory. I now have an appreciation for tolerating a degree of entropy in the architectures that I develop and strive to design with the antifragile concepts that are commonly found in healthy adaptive and resilient systems. This does not mean that I am introducing disorder; it means that I have to account for it and understand that some disorder is actually a good thing. It should be treated as a learning event, or in cases can yield an unexpected yet beneficial behavior. I found this system-like thinking allowed me to be more holistic in terms of how architecture can drive value to all beneficiaries of the enterprise.

Len:

Two things. My first reaction to hearing "all beneficiaries of the enterprise" is that you mean "beneficiaries within the enterprise"; i.e., those who benefit directly from the architecture, but I think you might actually literally mean "all beneficiaries of the enterprise"; i.e., those who benefit from the enterprise. Can you elaborate?

Alan:

That is correct Len. All beneficiaries of the enterprise is all-inclusive of those within the enterprise system and the ecosystem in which the enterprise system resides. Therefore the people "beneficiaries" have to be positioned at the center of the architecture conversation. Instead of doing architecture in a modeling tool in some back office, I began to seek opportunities to engage directly with people.

Len:

Which brings me to the second thing. I take every opportunity I get to point out that if you take the people out of an enterprise all you have left is an inert pile of capital assets. But, people are autonomous and their behavior is non-deterministic; they are not like most other "components" of systems. They are probably the primary source of entropy in the systems they play a role in. How do we incorporate people into system models without eliminating everything that makes them people,

which is not only dehumanizing, it makes the model seriously wrong?

Alan:

We agree. People's behavior – especially groups of people – is difficult to predict. The elimination of the people element I believe was done out of engineering convenience, perhaps. They are not part of the system model, because it is difficult to model. I think there is a tendency of many architects to become enamored with their models and show how accurately they reflect the system. When you introduce the human element and seek to understand their interactions with the systems, it forces one to architect with empathy and appreciate that humans do unexpected things. This is where “agent”-based modeling becomes interesting. Agent-based modeling has been used to model social systems where the focus is the nature of interactions amongst agents (people) and how changes in their behavior can often lead to dramatically different outcomes. There is always a risk of overly simplifying people into a persona or through some classification scheme. To mitigate this potential risk is to develop models incrementally and use simulation to verify how things work in the virtual world against the physical world and *vice versa*. Feedback is a powerful element in model development. There is a significant amount of research in the socio-technical systems space, and I think Enterprise Architects would benefit from this significantly.

Len:

So, how then do you engage with people? Do you just listen? Do you lead (take the initiative) or follow? What do you do with what you hear? What is the balance between contribution and facilitation? What is the balance between analysis and synthesis? Is that too many questions? 😊

Alan:

I am not sure I can answer all of them succinctly, but I will try. I have had the privilege of having very meaningful conversations with many professionals including petroleum engineers, legal professionals, human resources staff, aircraft pilots, banking officers, healthcare practitioners, merchandisers, business suppliers, etc. These conversations had a profound impact on my world view. The conversations were dialectic. I enjoyed engaging them in order to better understand their motivations, needs, desires, and actually taking a keen interest in how they accomplish their work. I realized that the old way of “gathering” requirements for architecture was not working. We were solving the wrong problems because we were not asking the right questions. We needed more elicitation techniques to show the art of the possible. One of the interesting lessons learned was to combine aspects of

human digital experiences with business architecture. To your point there was always a collaborative process with the “client” in which we can both synthesize the art of the possible and analyze the feasibility of the desired outcome.

Len:

I find it a bit ironic that so many members of the EA community like to call an enterprise a socio-technical system, when the idea of “socio-technical system” was invented to address the way people interact with technology, and that seems to get the short end of the stick in most thinking about EA. It's almost as if we think that just by using the term we've done all we need to do. I've come to prefer calling an enterprise a “people-intensive system”, which makes it harder to ignore the central role people play in the enterprise.

Alan:

I like the aspect of the socio-technical system thinking, but to your point, we clearly need to do more. A socio-technical system has a series of social/collaborative interactions in which people are involved. When you look at an “enterprise” as a system, the architecture of such a complex system with its dynamic connections and information flows requires a multi-disciplinary approach. Many of those interactions cross knowledge domains and disciplines, and many of these disciplines are not necessarily “technical” or “engineering”-oriented. Unfortunately most of the IT architecture frameworks are designed to develop models for members of their own guild, not the people they are intended to serve. Therefore the nature of developing architecture itself has to evolve and be far more multi-disciplinary in order to understand holistically how we are going to achieve the outcome. Bringing a diverse group of people to “architect” the enterprise requires some simplification of terms, and some common models for communicating the purpose of the organization, the means the organization has to achieve the outcome, how the results are achieved through execution, and finally evaluating and measuring performance.

Len:

Within the small group of people I know who are thinking “far out” thoughts about EA, I find this an increasingly common theme – that as Enterprise Architects we have an inherent responsibility to resist the technological dehumanization of people.

Alan:

I agree, I have never liked the idea that software professionals labeled people as “users”. It really does not teach one empathic design. One thing that I have enjoyed about being a software engineer in my previous life was around the development of personas and scenarios. This is one area that I have enjoyed during

my tenure at Microsoft® – that we strive very hard to get the “experience” right. To get it right, it takes a degree of experimentation in which you develop a persona and determine the scenarios that those personas are interested in. One of the things that has frustrated me in particular is that most Enterprise Architects treat people as a box in some huge diagram that is buried in the far corner of the picture.

Len:

Is this a problem for EA in general? Does the community need to do something about it?

Alan:

Frankly I think we do. I have been spending a lot of time recently thinking about digital transformation and the Internet of Things (IoT). EA has huge potential to help drive successful digital transformation if EA practitioners are willing to get out of their comfort zone.

The pace of change is accelerating, and Enterprise Architects should evaluate their outcomes each calendar quarter to gain a perspective on how the architecture of their enterprises emerges and self-organizes. What is working, what is not working, what new business needs are there, has the market changed, how is the business going to monetize and justify the change, etc. Organizations have a strong desire to move faster, and do more with less. One area that I have been experimenting with on my client engagements is “business scenario-driven EA”. This is an attempt to break down a set of broad enterprise initiatives into digestible scenarios in which the architecture of the enterprise has to evolve including the holistic examination of human, procedural, technological, environmental changes that are defined, introduced, understood, measured, and tested continually. Tied to the scenario is the experience that the architecture wishes to create. Security and privacy are also top-of-mind issues for everyone in the business world. Compartmentalizing the “enterprise question” down to a set of scoped business scenarios at a given time has the potential for us to design and evolve the architecture of the enterprise incrementally. This will make it easier for all EA professionals to balance architecture governance with enactment. In the end that is how I define my job to my children: I create digital experiences for people so they can get their stuff done.

Len:

This has been an enjoyable and fascinating exchange, and I’m sure we could continue more or less forever. To wrap this up though, I’d like to explore this last remark of yours. It seems to me that the EA community has become almost obsessed with the quest for a single universal compelling value proposition for EA, and that members of the community have considerable difficulty

explaining to the uninitiated what they do and why it’s worth doing. I have come to see this as another example of the tendency of the community to position alternatives (for example, different ways stakeholders might find value in EA) in opposition to one another, rather than look for a unifying principle that would include them all. Making it possible for people to “get their stuff done” seems just such a unifying principle. I sense the community believes that if we could just find the “right” (“one true”) value proposition, then EA would be legitimized and enthusiastically accepted. Any closing thoughts on the “magic value proposition contest”?

Alan:

That is the million-dollar question, isn’t it? One axiom that I have relied on is that the perspective of value is from the consumer of the product, not the provider. The second axiom is that value is directly tied to fulfillment of people’s intentions. The third axiom is that architecture (as opposed to engineering) is used to solve multi-context problems, therefore the associated value model is also multi-contextual.

This is why it is essential to have the value conversation with the beneficiaries to get consensus on the appropriate value proposition based on collective intentions. What is valuable to the environment, the marketplace, the individual, team, management, and leadership must be aligned and integrated to unify organizational purpose. The enterprise is a purposeful system to produce a set of outcomes. One can make a compelling argument that value is about meeting expectations of purpose while addressing constraints that prevent the fulfillment of purpose. There is a nice Zen-like duality here, between expectations and constraints. If you have no or too many constraints, the value diminishes. If you have no or too many expectations, to quote Lewis Carroll: “Then it doesn’t matter which way you go.” Again, little value. For EA to get legitimized and enthusiastically accepted, we ironically have to stop preaching about it and start to listen to people and fulfill their needs first, and drive an outcome. If you help people and consistently satisfy them, then they will be interested in knowing how you did it.

Len:

Amen to that! And on that note, thank you for taking the time to talk shop with me.

Alan:

Thank you for the opportunity. It was a pleasure.

THE TALKERS

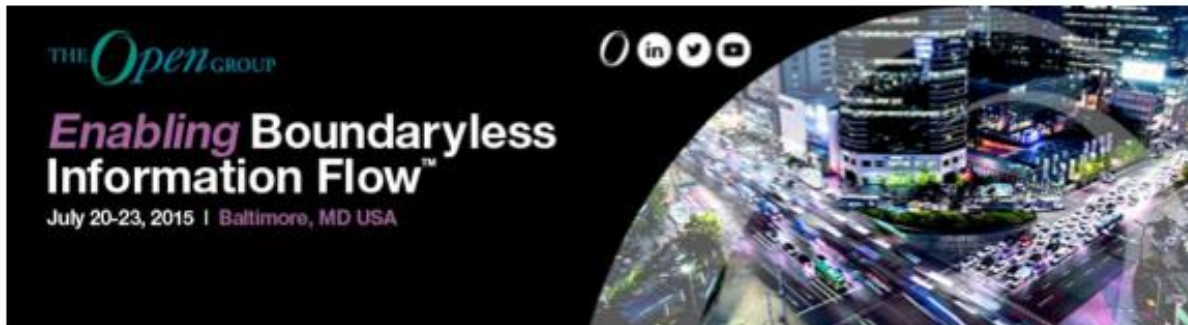
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Alan Hakimi (alan.hakimi@microsoft.com) has over 25 years of experience in the information technology and software industry. He joined Microsoft® in 1996 as a consultant within Microsoft Consulting Services (MCS). During his time within the Microsoft professional services organization, he has advised various industry executives from several Fortune 50 companies, delivering impactful innovative business solutions using strategy, program management, and EA.

His current role is within the Microsoft Enterprise Strategy Practice and he is currently helping Microsoft clients with strategy, architecture, and planning specifically around the Internet of Things, digital transformation, cybersecurity, and enterprise risk management.

Alan also has the role of Microsoft Worldwide Enterprise Architecture Community lead to help advance the discipline, and has architect certifications from Microsoft (MCA-Infrastructure), International Association of Software Architects (CITA-P), and The Open Group as a Distinguished Enterprise Architect.

He is currently a member of the Association of Enterprise Architects (AEA) and sits on certification boards for The Open Group and International Association of Software Architects (IASA). Alan and his wife and two children currently reside in the San Francisco Bay Area. He has a Bachelor of Science degree from the University of California at Davis in Computer Engineering. In his spare time Alan enjoys cycling, running, hiking, yoga, making music, cooking, and studying philosophy. His blog can be found at: blogs.msdn.com/zen.



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Short Subject

How Far up the Tower should Enterprise Architects Climb?

Mark Perry

Abstract

One subject of “friendly” office banter I have sometimes encountered, particularly in larger IT companies, is centered on the view that Enterprise Architects sit in an ivory tower and add little to solution design, development, and deployment. This article aims to address that topic head-on by discussing just how far up the tower Enterprise Architects should climb in order to provide something of real tangible value.

INTRODUCTION

How many of us, when discussing architecture, have encountered the response “Architects? What do they do for us? Just sit in ivory towers drawing diagrams”. Surprisingly this response does not always come from a cynical business community but often from the very individuals or teams who stand to benefit from having access to knowledgeable and experienced architects; i.e., the IT teams themselves!

Over the years I have tried to identify why this is and can only think that their experiences have been ones where people have been happy to use the label “architect” (it sounds much grander than “programmer” or “manager”!) but have not understood, or been prepared to provide, what architecture is really about. Yes, a number of diagrams (or more correctly models) are produced, but in the right environment, following the right approach, and with the appropriate level of engagement with delivery programs, an experienced architect produces what are in fact invaluable frameworks and solution blueprints.

So, my answer to the above is always: “Yes, I do sit in a tower but only because it gives me a wider view of what is going on, how the various solution parts should come together, but I am always careful to ensure that I don’t lose touch with what’s realistic or practical”. It is a conscious decision to get a balanced view; i.e., wide enough to see the business drivers and overall solution context whilst still understanding the development and deployment constraints and possibilities. The architectural frameworks and solution blueprints then produced from this higher viewpoint, particularly when operating in the enterprise role, are much more relevant and effective in:

- Communicating the business solution vision to stakeholders
- Guiding analysis and feasibility studies

- Helping capture requirements and elaborate design principles
- Assessing system impact and risk
- Identifying solution options and making design decisions
- Ensuring the full solution lifecycle is covered

There is another side to taking this elevated position. It is crucial that those who need the day-to-day guidance and governance on development and implementation programs (e.g., analysts, developers, project managers) are readily able to identify you as having the knowledge and perspectives to provide the business drivers, the solution context, and the architectural structure. It is no good trying to operate as an Enterprise Architect if you are “down in the detail” all the time – you will not have the necessary senior stakeholder relationships, the longer-term solution vision, or the system “big picture” – teams in general will not accept you as providing any solution leadership or design authority.

As with so many things the final choice, in this case “how far up the tower” you go, is down to balance and compromise. Hopefully, by considering the following questions you should arrive at something that enables you as an Enterprise Architect to achieve the goals above:

- What is the scope of the solution program(s); e.g., Intra/inter-organization, B2C/B/E?
- What is the impact and lifespan of these programs and which stakeholders need to be kept informed of where the solutions are going?
- How many domains of expertise need to be managed within teams; e.g., applications, channels/integration, information, security, networks, deployment, operations, etc?
- What is the level of architectural and technological risk?



Anything which points to environments and solutions which are departmental in focus, have a small footprint, are short-term, use well-known and familiar technologies, and/or have local resources will tend to need someone operating in more of a Systems/Project Architect role closer down to the program detail. However, environments and solutions which are larger-scale, typically geographically dispersed, are longer-term addressing strategic business needs, are complex with many domains, use new/innovative technology, and/or have dispersed multi-disciplinary teams requiring guidance and governance will need an Enterprise Architect position “higher up the tower”.

Keep your feet on the ground but your head high enough to see where the enterprise needs to go.

ABOUT THE AUTHOR

Mark has 36 years' experience in the IT industry covering information systems strategy and architecture, consulting, technology/service solution & business transformation, systems engineering, technical analysis & design, engineering & technical management, project

team leading, and CTO/Strategist roles – for the last 17 years he has focused specifically on Enterprise Architecture. His experience has been gained in various business and industry areas including: military opto-electronics, avionics and communications; medical equipment; naval command & control; airline baggage management; civil air traffic control; insurance; sea ferry management; local council; container shipping & transportation; global logistics & supply chain management; pharmaceuticals; public services & central government; energy & utilities; retail; defense & civil security, and most recently smart cities. He is a Chartered Engineer (Engineering Council) and a Fellow of the Institution of Engineering and Technology. He has a BSc in Electrical and Electronic Engineering (Bath, UK) and an MSc in Systems Engineering (Surrey, UK).

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Editorial Opinion

Len's Lens – Introduction to an Editor's Series

Leonard Fehskens

Abstract

The conventional wisdom about Enterprise Architecture (EA) goes largely unexamined. As the community's consensus on what we know about EA, it is taken to be more or less axiomatic by most of that community. This article introduces a series of articles exploring alternative, specifically more inclusive, ideas about EA as a way to create the foundation for a professional discipline like law, medicine, or engineering.

Keywords

Editorial opinion, alternate perspective, unconventional, exploratory, conjectural, profession

INTRODUCTION

The conventional wisdom about Enterprise Architecture (EA), while reiterated like a theme and variations, goes largely unexamined. As the community's consensus on what we know about EA, it is taken to be more or less axiomatic by most of that community.

This exploration of the less traveled lanes of thought about EA is not meant to be controversial, but it almost certainly will be. Its intent is not to change anyone's mind, but rather to get members of the community to think about why they believe what they believe about EA, in particular why the way they think about EA is the best way, or must be the only way, to think about EA. I'm going to try to "eat my own dog food" and explain the "why" behind the ideas I expound.

Before I get into this I want to shortstop a fairly common misunderstanding of my position. When I say that EA as understood and practiced today is not all of what EA might be, I'm not saying that EA as understood and practiced today is not EA. Nor am I saying (or implying) that it has no utility or value. This will, I hope, become clearer when I talk about the idea of specializations in professions. I have found it helpful when explaining some of my ideas about EA as a profession to recast the idea as it might be expressed in some other profession, like medicine or law or engineering. No one would bat an eyelash if someone said "neurology is not all there is to medicine", and certainly no one would interpret such a statement as implying that neurology is not medicine, or that neurology is of no utility or value.

Another thing to bear in mind is that I am taking a very long view here. Even if we were to all agree that this is the proper future for a profession of EA, it would still take us a long time to get there.

Finally, please note that these unconventional perspectives should not be construed as official positions of either the Journal of Enterprise Architecture or the Association of Enterprise Architects.

THE "LENS" METAPHOR

In his recent book "How We Got to Now" (Johnson 2014), Steven Johnson describes the discovery of glass, how it enabled the development of the science of optics, and how that in turn affected mankind. Central to his story is the glass lens, which made imaging possible. We use lenses to bring things into focus and to examine small or distant things in detail, something we would not otherwise be able to do with our unaided eyesight.

Certainly one of the most powerful tools we have as architects is asking the question "Why?", and its corollary, "What if ...?". Doing so brings things into focus, and allows us to see things we would not otherwise be able to see. As a community, though, we seem reluctant to ask these questions about what we do as Enterprise Architects; i.e., about EA itself.

In this series of editorial opinions, I'll be applying the lens of "Why?" and "What if ...?" to the conventional wisdom on EA. I expect you will find the places this takes us to be very unconventional.

MY PERSPECTIVE

There is, I hope, a method to my madness. My career has worked out such that for the past 15 years or so, I have had the opportunity to think hard about what EA is, and to pursue that subject with a wide variety of practitioners, as well as draw on my own 40 years of experience. That led me in so many different directions that I began to ask instead "What could EA be?", a process that came to be shaped by a handful of principles that emerged along the way. These principles

will be illustrated repeatedly in the articles that I plan to include in this series, but I think it will be helpful to summarize them here.

Creating a Foundation for an “Umbrella” Profession

I have the impression that a large portion of the EA community considers the diversity of opinion about what EA is, what it is for, how it should be done, all the things we debate so passionately, to be a bad thing.

As a result, discussions that surface alternative opinions about EA tend to become debates about which perspective is “right”, so it can be anointed as the one and only true way of thinking. This is odd, given the value that the community places on the ability to abstract and generalize. One might expect that a community of generalists and abstract thinkers would instead conclude that the diversity of ideas suggests that they each offer value to someone and that rather than set them against one another, it would make more sense to find a way to integrate them under some unifying set of general concepts.

The way existing professions integrate a diversity of applications of basic principles and general concepts is by acknowledging the existence of specializations within the profession.

A profession’s body of knowledge is typically so broadly encompassing that it is usually not possible for a single individual to master all of it. There is a subset of the body of knowledge that the profession requires all practitioners to master, but there are other well-defined subsets of the body of knowledge that are the basis for specializations. Professional specializations are so commonplace that even “general practice” is treated as a specialization.

The idea of specialization is the basis for the professional practices of *referral* (sending a client to another practitioner better suited to the client’s needs) and *consultation* (asking another practitioner with skills relevant to the client’s problem for advice). Practitioners of any given specialization take it for granted that practitioners of other specializations are members of the same profession; they don’t argue with one another about which specialization wholly defines the profession.

A More Inclusive Concept of Enterprise

The origin of the word “enterprise” goes back about 500 years. For most of that time, the word has meant some sort of “ambitious undertaking”, or the quality of character that leads someone to pursue such undertakings. It is only in the past 100 years or so that the word came to mean a business organization. This usage was introduced by economists and academics like

Thorsten Veblen in *The Theory of Business Enterprise* (Veblen 1932) and Alfred Chandler in *Strategy and Structure: Chapters in the History of the American Industrial Enterprise* (Chandler 1962). Note though that they implicitly acknowledged the traditional meaning of the word by qualifying it with modifiers like “business” and “industrial”, to indicate just what kind of ambitious undertakings they were concerned with. It was obviously convenient to drop the explicit qualifiers when they could be taken for granted.

It should not be surprising that this usage took hold within the EA community given EA’s origins. The earliest papers that laid the foundations of EA as we think of it today (PRISM 1986; Zachman 1987) were motivated by the challenge of commercial organizations taking fullest advantage of their large complex distributed computing infrastructure, a technology that was in addition changing very rapidly. “Business/IT alignment”, as the problem came to be called, was where the action was, and it is not surprising that practical considerations strongly influenced the way the emerging discipline was characterized. Over time these ways of thinking became the conventional wisdom on the subject.

Understandable as this is, there is no reason why architectural thinking should not be applied to other forms of human enterprise besides commercial businesses and their information systems. There are numerous examples of the use of EA by non-profit organizations, and by various levels and functions of government. Despite this, the EA community generally frames the challenges of EA from the perspective of “business”. When I point this out, I am invariably told that “business” really means “whatever an organization does”, though it seems that when one looks under the covers, “what an organization does” seems for most of the EA community to be largely about supporting commercial transactions.

Architecture as a Specific Kind of Design

Many members of the EA community have IT backgrounds, and their understanding of the word design usually derives from the idea of a “design phase” as part of a System Development Life Cycle (SDLC). As such, they tend to think of architecture similarly, as something that is done during the “architecture phase” of the SDLC.

Outside the IT community, design is thought of as a very general discipline that entails some form of intent-driven decision-making. From this perspective, the entire SDLC is a “design phase”, and architecture is not different from design; it is a specific kind of design. If architecture deserves its own name, exactly what kind of design it is;

i.e., what makes a design decision “architectural”? The answer to this question remains a subject of debate.

The Primacy of People in EA

Even partisans of a focused view of “enterprise” as a large, complex business organization must admit that without people an enterprise cannot function. The idea of enterprise is meaningless without people; we don’t talk about machines being enterprising, and even if we were to automate the entirety of an enterprise’s operation, it would likely still operate on people’s behalf.

It is a commonplace nowadays to talk about an enterprise as a “socio-technical system”. The idea of socio-technical systems dates to the late 1950s, when it was introduced by the Tavistock Institute in London to address new ways of thinking about how people worked with machines, as the idea of people working like machines didn’t seem to be working out. As I note in my conversation with Alan Hakimi (“Talking Shop”, this issue), the EA community has not found a way to address the real contribution that people make to enterprises, and has instead largely focused on the technology of the enterprise.

The Importance of Language

Like other professions, we communicate amongst ourselves and with clients and other stakeholders by using ordinary language, with all of its shortcomings. Other professions have dealt with these shortcomings by creating professional vocabularies, and being educated as a professional entails becoming proficient with this vocabulary and its usage conventions. These professional languages are generally not used to communicate with clients, but to communicate with other practitioners. The EA community still seems ambivalent about the importance of a professional language, often citing its inappropriateness for communication with stakeholders as a justification for a “simple and clear” style. While such a goal is admirable, it seems incompatible with the notion that the *raison d’être* for EA is the complexity of its concerns.

EA as the Intersection of the Social Sciences and Design

The idea of the primacy of people in EA, and the idea of architecture as a particular kind of design, jointly suggest that EA lives at the intersection of the disciplines of design and the social sciences. This has important implications for how we think of an emerging profession, and especially for a curriculum for educating Enterprise Architects.

FORTHCOMING TOPICS

Different Words Mean Different Things

As noted above, one of the hallmarks of a profession is a professional language that practitioners use to communicate with one another. While the words are important (for example, they should be suggestive of the concepts they denote), it is the concepts they denote that are what really matter. Using different words as if they were synonyms is like building multiple different applications to solve the same problem; more importantly, it makes it much more difficult for us to distinguish concepts worth distinguishing. The vernacular of EA is rife with examples. We have a tendency to start with the words, and assign concepts (“definitions”) to them, rather than start with the necessary concepts and assign words to them, words that are suggestive of the concept they denote.

Why We Can’t Agree

Even within the bounds of the conventional wisdom on EA there is an extraordinary diversity of opinion about the details. James Lapalme has proposed that this diversity reflects three different schools of thinking about EA (Lapalme 2012); my own informal research suggests that the problem is not so simply characterized. I have identified six practices common to discussions about EA that muddy the waters, and 33 areas where members of the community make different and usually unexpressed assumptions about things fundamental to a concept of EA (Fehskens 2013).

Eight Ways we Frame our Concepts of Architecture

People have begun to talk about “EA as a noun” *versus* “EA as a verb”, an inelegant way of distinguishing between EA thought of as the result or outcome of an activity and EA thought of as that activity or process.

Two different frames seems reasonable, but observations and analysis of actual discussions suggest that there are in fact eight distinguishable ways of framing a concept of architecture in general and EA in particular. How can there be eight meaningfully different ways to interpret the word “architecture”?

The best way to illustrate this is by analogy with a common word that is used in a similar diversity of ways: “music”.

What Can We Know about EA?

Enterprises and architectures are artifacts; i.e., they are “made things” that do not occur “naturally”. While some (myself included) have argued that everything has an

architecture, it is the idea of architecture that is a “made thing”. Architectures do not exist in isolation in the wild – we must infer them from observations and analysis of the “things they are the architectures of”. This process of observation and analysis is not deterministic; different people can, and often do, infer different architectures for the same “thing the architecture is of”.

As such, virtually everything we say about our concept of EA is an opinion. Even research into EA is often research into other people’s opinions. There are rare exceptions, like the MIT Sloan Center for Information Systems Research (CISR) empirical research into the correlation between certain enterprise characteristics and an enterprise’s performance, but EA is not, and I will argue cannot be, an experimental science.

Googling epistemology brings up “*epistemology is the investigation of what distinguishes justified belief from opinion*”. One of the greatest challenges a profession of EA faces, and one that the EA community is the least concerned with, if even aware of, is that we do not share an epistemology for EA. Until we do, all we have are opinions.

An Enterprise is Not Like a Building

The words “architect” and “architecture” were once more or less, but more importantly exclusively, used to mean “designer of buildings” and “the design of buildings”. Much to the chagrin of (building) architects the words have become part of our common language. The most extreme example is perhaps the suggestion in a Domino’s (an American pizza chain) commercial that one can “become a pizza architect”.

We need to accept that the use of the word “Architecture” in “Enterprise Architecture” is at best a metaphor rather than an assertion of isomorphism. It is tempting to imagine that the architecture of buildings, and the practice of architecting buildings, can teach us important things about the architecture of enterprises and the practice of architecting enterprises. If we want to argue that “EA is to an enterprise as building architecture is to a building” then we have to be able to argue that “EA is to building architecture as an enterprise is to a building”. Comparing and contrasting enterprises and buildings shows that they have little more in common than that they are both artifacts that are designed, made, and used by people. This suggests to me that we should be looking not for what we can learn from the profession of building architecture, but what we can learn from what is common to the enormous variety of design disciplines.

Profession, Practice, and Specialization

In discussions of the potential professionalization of EA, there are three important concepts that too often are not kept in mind as distinct concepts: profession, practice, and specialization. The diversity of opinions about EA noted earlier suggests that there are specializations even within business information systems architecture, which I consider to be the most widely, if not universally, practiced specialization of a more broadly inclusive profession of EA.

On the Success of Ambitious Endeavors

While there is an enormous diversity of concepts (“definitions”) of EA, they all seem to be variations on a single theme – facilitating the success of an enterprise.

They differ in the assumptions they make about:

- What constitutes an enterprise
- What it means for an enterprise to be successful
- What factors contribute to success
- The means by which these factors are to be addressed

Suppose instead we assumed only that the primary goal of all endeavors is to be successful, in whatever way the endeavor itself defines success, and regardless of the nature of the endeavor. Suppose then that we set aside everything we already “know” about “Enterprise Architecture” and undertook to (re)design it from scratch, based on this single assumption?

What would such a discipline look like?

An Enterprise Architecture Curriculum

While there are several other exploratory journeys I expect to take us on, my ultimate goal is to propose a curriculum for a professional degree program in EA, based on the idea of the intersection of the disciplines of design and the social sciences, with a well-argued justification for its content.

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Peer-Reviewed Article

Enterprise Business Motivation Model (EBMM) TRIADS™ – The Chemistry of Business Architecture Alignment

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Abstract

This article presents an approach that tackles the number one issue faced by most organizations: the Alignment of Business and IT. We do so by presenting a Business Architecture meta-model called the EBMM TRIADS™ and its application to aligning an organization's Business Motivation, Business Strategy, Business Responsibilities, and Business Operation. Each one of the four EBMM TRIADS shares three sets of Relationships with the other TRIADS. The Relationships contained in each one of those sets impose Alignment Constraints on the types of Business Architecture elements hosted by the TRIADS. We posit that each set of Constraints represents a dimension of Alignment between two TRIADS. The number of Relationships contained in each set indicates the Strength of Alignment between the two TRIADS that share the set. Therefore, the EBMM TRIADS can provide a solid reference for a qualitative and quantitative characterization of the Alignment achieved by an organization through its existing and targeted Business Architectures.

Keywords

Business Architecture, Alignment of Business and IT, architecture meta-model, business model reliability, quantitative architecture model, strategic program management, risk management, dynamic business model

INTRODUCTION

Business Architecture (Reynolds 2009) has gained a lot of attention in the Enterprise Architecture (EA) community as a result of a recent shift in the view of EA that strives to expand beyond its IT roots towards more strategic concerns such as business models and organizational change (FEAPO 2013; OMG 2008). In addition, recent research keeps reaffirming the critical role of clearly articulated vision, goals, and objectives from business leaders to increase Business Initiatives and Programs' chances of success (Patanakul et al. 2013; Kurstedt & Thayne 2013).

This article presents theoretical research about a Business Architecture meta-model called the EBMM TRIADS and its application to aligning the following four common views of an organization's Business Architecture: Business Strategy, Business Operation, Business Motivation, and Business Responsibilities. We also demonstrate that the EBMM TRIADS can provide a solid reference for a qualitative and quantitative characterization of the degree of Alignment achieved by an organization through its existing and targeted Business Architectures (Gammoh et al. 2010; Kearns & Lederer 2000; Luftman et al. 1993).

While primarily theoretical, the article also presents a practical application of the EBMM TRIADS as a facilitation instrument for the adoption of the Microsoft®

Connected Health Business Framework (CHF) (Microsoft 2013) by a fictional healthcare organization.

EXAMPLE OF BUSINESS ARCHITECTURE ELEMENTS

In this section we introduce some fundamental Business Architecture elements such as Business Strategies, Business Capabilities, Products and Services, and the Relationships that they entertain with each other.

An organization's success is tied to its customers' satisfaction and loyalty. To ensure that an organization is properly aligned with its customers' expectations, it must have a reliable and comprehensive enough understanding of its Market Segments (Barnes 2014) and Micro-Segments (Galbraith 2012). Clarifying the specific demands or expectations of each Market Segment allows the organization to justify its engagement towards each targeted customer group. Customers' trust and hopefully their long-term loyalty can be effectively secured and nurtured by the organization through its profound understanding and indisputable fulfillment of customers' expectations (Porter et al. 2014; Galbraith 2014).

Influencing Organizations are sources of Influence. Influencing Organizations could be Partners, Competitors, or Regulatory Bodies. In some sense, Partners and Regulatory Bodies are also customers of the organization since they bring specific Constraints or expectations often key to the organization's success.

Competitors' Influence is undeniable as they often cater to the same pool of customers as the ones targeted by an organization. With a clear understanding of Customer Demands and Relationships and the proper consideration of Influences generated by Partners, Competitors, and Regulatory Bodies, Organization Stakeholders are empowered to formulate effective Business Strategies and Objectives that have a high probability of securing a desired Market Position (Howard et al. 2014; Prentice 2013; Kaplan & Norton 2004).

It is important to hold Stakeholders accountable for Business Strategies and Objectives. Stakeholders when held accountable for a given set of Business Strategies and Objectives become advocates for their effective implementation (Kurstedt & Thayne 2013). Some Stakeholders will carry this responsibility further than others by actually driving the Business Strategies and Objectives toward their fulfillment and by being actively involved in, or accountable for, all activities required for their realization (Olding & Fitzgerald 2011). Some Stakeholders play the role of Governance Body by creating and enforcing Business Policies applicable to the entire organization and/or specific Business Units. These Business Policies are meant to support and articulate agreed Directives that contribute to the achievement of the established Business Strategies and Objectives (Cloo et al. 2008).

A Capability Roadmap (Burton 2013) is a well-articulated set of successive changes to the organization's Business Capabilities (Ulrich & Rosen 2011) aimed at progressively transforming the organization from its current state to its desired future states. Capability Roadmaps can be prioritized according to selected Assessment Metrics that highlight the most valuable opportunities for Capability improvements. Therefore, Capability Roadmaps provide a solid foundation upon which Business Initiatives and Programs can be chartered.

The organization's desired future Business Capabilities are the outcome of fulfilling its Business Strategies and achieving its Business Objectives. Business Initiatives and Programs chartered from Capability Roadmaps can drive changes to Business Capabilities in a coordinated and effective manner.

Properly assessed and understood Customer Demands and Relationships along with Influences created by Partners, Competitors, and Regulatory Bodies all come into consideration for the formulation of desired Products and Services offerings that effectively package Business Capabilities specified by Capability Roadmaps (Ulrich & Rosen 2011).

The organization's Value Proposition can be formulated by describing the rationale behind its featured Products

and Services (Barnes et al. 2009). Securing the targeted Market Position mandates Required Competencies through exceptional Business Capabilities included in or contributing to the organization's Products and Services offerings (Porter & Heppelmann 2014; Handler & Maizlish 2005).

Once an organization has defined its Value Proposition and Required Competencies, it can elicit its Assets. Assets are resources employed, possessed, or controlled by the organization in order to deliver its Products and Services. The organization's Governance Body formulates Directives that govern the use of Assets in a way that contributes to the achievement of the established Business Strategies and Objectives (Bittler 2009).

The organization can consolidate its structure by forming or allocating Business Units responsible for each Business Capability. Required Competencies can guide this allocation process (Galbraith 2014; Galbraith 2012; Keinz et al. 2012).

From the elicitation of Assets and their respective Directives, the organization can further refine its structure by designating Business Units responsible for each Asset.

Since Products and Services package Capabilities and since Business Units are mapped to the Capabilities that they are responsible for, it is possible to determine which Business Units provide which Products and Services based on the Capabilities packaged within the Products and Services. Business Units can also consume Products and Services in order to perform their responsibilities.

Typical resulting organizational structures reflect the overall Business Strategy and are listed below (Galbraith 2012):

- Administrative Office structure for a Volume Expansion strategy
- Departmental Headquarters structure for a Geographic Dispersion strategy
- Division Central Office structure for a Vertical Integration strategy
- Multi-divisional General Office structure for a Diversification strategy
- Three-dimensional structure for an International Growth strategy
- Front/Back and Four-dimensional structures for a Customer Focus strategy

Next, we present how a Business Architecture meta-model can be used to effectively capture the essence of a Business Architecture.

THE EBMM-TRIADS

The EBMM TRIADS are a conceptual meta-model (Grigoriu 2006) of a Business Architecture and as such they model the types of elements and their associated Relationships involved in the definition of an actual Business Architecture. The four EBMM TRIADS elegantly break down the complexity found in Nick Malik's initial EBMM (Malik 2001) by showing how its Business Architecture elements participate in four very common inter-dependent and complementary views of any Business Architecture: Strategy, Operations, Motivation, and Responsibilities. Each TRIAD combines three Fundamental Interrogatives taken from the following set: WHY, WHAT, WHO, and HOW. Each Fundamental Interrogative group contains several types of Business Model elements that entertain Relationships with each other (e.g., Success Metrics and Measures [WHY] set Performance Criteria for Business Strategies and Objectives [WHY]). The EBMM TRIADS are an attempt at integrating Fundamental Interrogatives similar to the purpose of the Zachman™ Framework (ZF) Integration Relationships between any two cells of the same perspective (ZF Row) (Doucet et al. 2009; Zachman 2009; Anaya & Ortiz 2005; Sowa & Zachman 1992). Each TRIAD lists relevant types of Business Model elements and their respective Relationships. Those Relationships are between elements that belong to different Fundamental Interrogative groups (e.g., Business Strategies and Objectives [WHY] drive changes to Business Capabilities [WHAT]).

Our model groups the majority of Nick Malik's EBMM Business Model elements into four groups each answering a fundamental question about the business: WHY, WHO, WHAT, and HOW. There are four total possible combinations of three distinct Fundamental Interrogatives. Each one of these four combinations constitutes an EBMM-TRIAD that relates well to a particular view of a Business Architecture, as depicted in Figure 1.

The first TRIAD is Business Strategy. It answers the question: HOW does WHAT fulfill WHY?

The second TRIAD is Business Operation. It answers the question: HOW does WHO do WHAT?

The third TRIAD is Business Motivation. It answers the question: HOW does WHO influence WHY?

The fourth TRIAD is Business Responsibilities. It answers the question: WHY does WHO do WHAT?

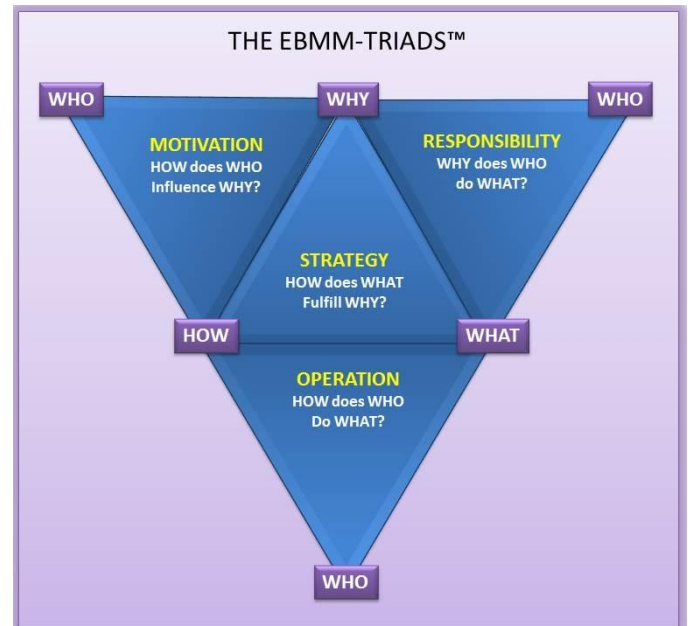


Figure 1: The Four EBMM TRIADS

Rationale Behind the Business Strategy TRIAD

Business Strategy is defined by Wikipedia under the surrogate term "Strategic Management" as:

"Strategic Management analyzes the major initiatives taken by a company's top management on behalf of owners, involving resources and performance in internal and external environments [...]. Strategic Management provides overall direction to the enterprise and is closely related to the field of Organization Studies. In short, it entails specifying the organization's objectives, developing policies and plans designed to achieve these objectives, and then allocating resources to implement the plans."

The EBMM TRIADS capture the essence of Business Strategy by answering the question: "HOW does WHAT fulfill WHY?" and by identifying relevant Relationships among Business Architecture elements classified within the three Fundamental Interrogatives WHY (e.g., Business Strategies and Objectives), WHAT (e.g., Capabilities, Products and Services), and HOW (e.g., Processes, Activities, Applications, and Assessment Metrics).

Rationale Behind the Business Operation TRIAD

Business Operation can be understood through Wikipedia's definition of Operations Management as:

"Operations Management is an area of management concerned with overseeing, designing, and controlling the process of production and redesigning business operations in the production of goods or services. It involves the responsibility of ensuring that business operations are efficient in terms of using as few resources as needed, and effective in

terms of meeting customer requirements. It is concerned with managing the process that converts inputs (in the form of materials, labor, and energy) into outputs (in the form of goods and/or services)."

The EBMM TRIADS capture the essence of Business Operation by answering the question: "HOW does WHO do WHAT?" and by identifying relevant Relationships among Business Architecture elements classified within the three Fundamental Interrogatives WHAT (e.g., Capabilities, Products and Services), HOW (e.g., Applications, Processes, and Assessment Metrics), and WHO (e.g., Business Units).

Rationale Behind the Business Motivation TRIAD

The OMG in their definition of the Business Motivation Model (OMG 2008) states that:

"Specifically, the Business Motivation Model does all of the following:

- *Identifies factors that motivate the establishing of business plans*
- *Identifies and defines the elements of business plans*
- *Indicates how all these factors and elements inter-relate*

Among these elements are those that provide governance for and guidance to the business – Business Policies and Business Rules."

The EBMM TRIADS capture the essence of Business Motivation by answering the question: "HOW does WHO influence WHY?" and by identifying relevant Relationships among Business Architecture elements classified within the three Fundamental Interrogatives WHY (e.g., Business Policies, Business Strategies and Objectives), HOW (e.g., Key Performance Indicators and Assessment Metrics), and WHO (e.g., Governance Body, Stakeholders, and Market Segment).

Rationale Behind the Business Responsibilities TRIAD

Business Responsibilities are often captured in an organizational chart. Wikipedia provides the following definition:

"An organizational chart (often called organization chart, org chart, organigram(me), or organogram(me)) is a diagram that shows the structure of an organization and the relationships and relative ranks of its parts and positions/jobs."

The EBMM TRIADS capture the essence of Business Responsibilities by answering the question: "WHY does WHO do WHAT?" and by identifying relevant Relationships among Business Architecture elements classified within the three Fundamental Interrogatives WHY (e.g., Business Policies and Rules, Business Strategies and Objectives), WHO (e.g., Business Units and Stakeholders), and WHAT (e.g., Capabilities, Products and Services).

BUSINESS ARCHITECTURE ALIGNMENT AND THE EBMM TRIADS

A practical definition of Alignment is given by Henderson and Venkatraman (Henderson & Venkatraman 1992) as:

"Alignment between business and IT is the degree of fit and integration between business strategy, IT strategy, business infrastructure, and IT infrastructure".

We advocate that Alignment of Business and IT can be greatly facilitated for an organization that has a clear and comprehensive Business Architecture that provides unambiguous directions regarding the Business Motivation, its Strategy, its Roles and Responsibilities, and its Operations.

The EBMM TRIADS can effectively guide an organization through the steps required to achieve a strong Alignment between Business Strategy, Business Operation, Business Motivation, and Business Responsibilities.

The EBMM TRIADS are a conceptual meta-model. The meta-model can be understood as a set of Rules that govern the structure and content of a Business Architecture.

The following statement helps understand why this article uses a meta-model as the basis for the definition of six dimensions of Alignment for a Business Architecture:

It does not matter so much how many times you follow a given rule in the Law, it matters more that you follow all the rules in the Law to be compliant with it.

Our approach to Business Architecture Alignment follows this principle. The EBMM TRIADS are a comprehensive set of Rules that govern the structure and content of an actual Business Architecture. They do so by identifying six sets of Relationship types that integrate four fundamental views of any Business Architecture: Strategy, Operation, Motivation, and Responsibilities. Each one of these views is represented by a TRIAD in our model.

Each TRIAD is defined by a set of Relationships that connect Business Model element types found in distinct Fundamental Interrogative groups. We define a Relationship Rule as being composed of three parts:

- A Source Business Model element
- A Destination Business Model element
- The Name and Direction of the link between Source and Destination elements

Relationship Rules that are common to any two TRIADs represent Rules that are applicable to both TRIADs. Therefore, our definition of Alignment can be stated as "Following a common set of Rules".

Two TRIADs are in Alignment with each other if they both follow the same set of Relationship Rules. This also justifies the existence of six dimensions of Alignment or six sets of Relationships among four EBMM TRIADS, as depicted in Figure 2.

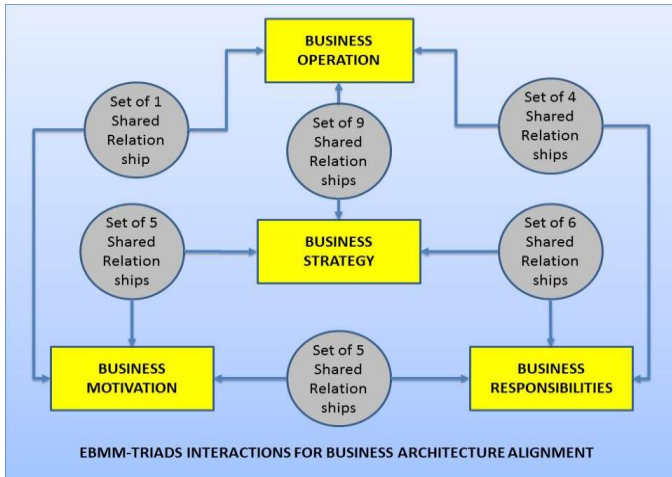


Figure 2: Six Sets of Relationships Among Four EBMM TRIADS

Next, we present the sets of Relationships shared between TRIADs:

HOW to WHAT – Business Strategy and Business Operation shared Relationships:

- Business Processes and Activities **properly manage** Assets.
- Business Processes and Activities **produce and consume** proper Data Objects.
- Assessment Metrics **evaluate** Business Capabilities.
- System Interaction Points **are described in** Use-Cases or User Stories.
- Applications properly **impact** Business Capabilities.
- Applications **are involved in providing** useful Products and Services.

WHAT to HOW – Business Strategy and Business Operation shared Relationships:

- Business Capabilities **are implemented through** Business Processes/Activities.
- Data Objects **are created or used in** Applications.
- Business Requirements **describe** Application Features.

WHY to HOW – Business Strategy and Business Motivation shared Relationships:

- Directives **govern** Business Processes and Activities.
- Success Metrics and Measures **track success of** Business Processes and Activities.

- Value Propositions **are inputs to** Finance and Revenue Models.

HOW to WHY – Business Strategy and Business Motivation shared Relationships

- Assessment Metrics **prioritize** Capability Roadmaps.
- Key Performance Indicators **track** Success Metrics and Measures.

WHY to WHAT – Business Strategy and Business Responsibilities shared Relationships:

- Business Initiatives and Programs **drive changes to** Business Capabilities.
- Business Strategies and Objectives **drive changes to** Business Capabilities.
- Customer Demands and Relationships **drive** Products and Services.
- Value Propositions **drive** Required Competencies.
- Directives **govern use of** Assets.
- Capability Roadmaps **describe changes to** Business Capabilities.

WHO to WHAT – Business Responsibilities and Business Operation shared Relationships:

- Business Units **are responsible for** Assets.
- Business Units **are responsible for** Business Capabilities.
- Business Units **consume** Products and Services.
- Business Units **provide** Products and Services.

WHO to WHY – Business Responsibilities and Business Motivation shared Relationships:

- Governance Body **enforces** all Business Policies.
- Stakeholders **are accountable for** Business Strategies and Objectives.
- Stakeholders **can be a type of** Driver.
- Market Segments **generate** Customer Demands and Relationships.
- Influencing Organizations **are sources of** Influence.

WHO to HOW – Business Motivation and Business Operation shared Relationships:

- Business Units **perform** Business Processes and Activities.

At this point, it is worth explaining why this article defines Alignment as being between TRIADs and not between Fundamental Interrogatives.

- When Alignment is defined between two TRIADs: each Relationship Rule is fully owned by both TRIADs; therefore, each TRIAD has equal stake in the Rule.

- When Alignment is defined between two Fundamental Interrogative groups: the Source part of the Rule is owned by one Interrogative, the Destination part of the Rule is owned by the other, the name of the link is shared by both parties, but the source part of the Rule, by being the subject, gives its Interrogative a higher stake in the Rule than the Interrogative of the destination part which is the object. Passive and Active sentence Rules further complicate this state of affairs.

Each EBMM-TRIAD shares three sets of Relationships with the other TRIADs. The Relationships contained in each one of those sets impose Constraints on Business Architecture elements hosted by the TRIAD. So each set of Constraints represents a dimension of Alignment between two TRIADs. The number of Relationship types contained in each set indicates the Strength of Alignment between the two TRIADs that share the set (Gammoh et al. 2010; Kearns & Lederer 2000; Luftman et al. 1993).

The number of Relationship types contained in each set indicates the Strength of Alignment between two TRIADs that share the set. This is a direct implication of our definition of Alignment as: “Following a common set of Rules”. The more Relationship Rules two TRIADs have in common, the more aligned they become.

This also means that an organization’s Business Architecture that has 100 actual instances of the Relationship type shared between Business Operation and Business Motivation, and ten actual instances for each one of the five Relationship types shared between Business Motivation and Business Responsibilities is more strongly aligned in its Responsibilities-Motivation dimension than its Operation-Motivation dimension.

BUSINESS ARCHITECTURE ALIGNMENT CYCLE

A Business Architecture Alignment effort can be conducted by going through consecutive Alignment cycles. An Alignment cycle is initiated by one of the four TRIADs. For the TRIAD that triggers the Alignment cycle, all the Relationship Rules that it contains are scrutinized to:

- Identify the types of Business Architecture elements that must be addressed; they are the elements at the source and destination of the Relationships
- Identify the types of Constraints that each source Business Architecture element imposes on its destination element; they are the names of the Relationships

The following steps occur during the first cycle:

- First, identify all actual Business Architecture instance elements that belong to the various types

listed; e.g., all Business Processes and Activities taking place in the business under study.

- Then ensure that all actual Business Architecture instance elements are properly linked to each other by means of the appropriate Relationship instances; e.g., a specific Business Process (such as “Generate Customer Invoices”) is linked to all the Data Objects that it produces and all the Data Objects that it consumes. Another example will link a specific Data Object (such as “Customer Billing Address”) to all Business Processes that produce and consume it.

The subsequent Business Architecture Alignment cycles will repeat the above steps for each one of the remaining three TRIADs in a recursive manner to ensure that all actual Business Architecture instance elements are identified and properly linked to each other according to the applicable Relationships of their respective element types.

Let’s illustrate two Business Architecture Alignment cycles initiated by the Business Responsibilities TRIAD. The first Alignment cycle is represented by the red numbers in Figure 3. The Relationships being scrutinized are:

- Five Rules shared between Business Responsibilities and Motivation TRIADs (1)
- Six Rules shared between Business Responsibilities and Strategy TRIADs (2)
- Four Rules shared between Business Responsibilities and Operation TRIADs (3)

The second Alignment cycle is represented by the green numbers in Figure 3. The Relationships being scrutinized are:

- Five Rules shared between Business Strategy and Motivation TRIADs (4)
- Nine Rules shared between Business Strategy and Operation TRIADs (5)
- Six Rules shared between Business Strategy and Responsibilities TRIADs (6)
- One Rule shared between Business Motivation and Operation TRIADs (7)
- Five Rules shared between Business Motivation and Strategy TRIADs (8)
- Five Rules shared between Business Motivation and Responsibilities TRIADs (9)
- Four Rules shared between Business Operation and Responsibilities TRIADs (10)
- Nine Rules shared between Business Operation and Strategy TRIADs (11)
- One Rule shared between Business Operation and Motivation TRIADs (12)

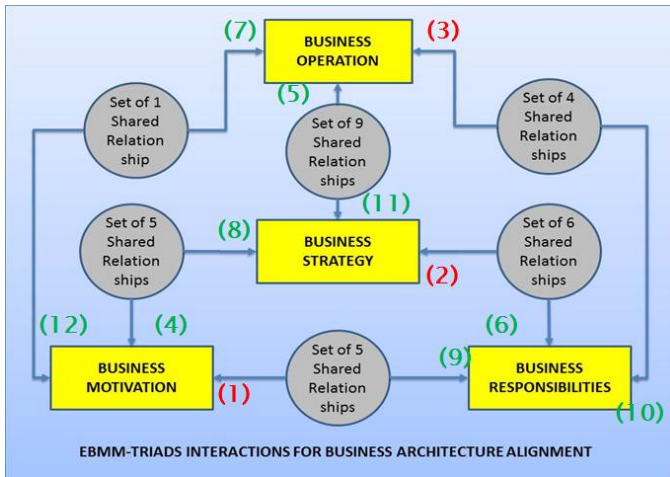


Figure 3: Alignment Cycles Initiated by the Business Responsibilities TRIAD

At the end of an Alignment cycle, each TRIAD has shared with the other TRIADS a number of Relationship Rules to be compliant with. Those Rules are Constraints that are placed on the TRIADS. The relative strength of the Constraints received by a TRIAD reflects the Alignment Strength achieved by that TRIAD.

These strengths are totally dependent upon the number of Relationship Rules found in each shared set regardless of the actual definition of each Relationship Rule. The previous statement highlights a system-level property of the EBMM TRIADS (Adams et al. 2014). Alignment Strengths are only dependent upon the structure of the EBMM TRIADS; i.e., the number of TRIADS (four of them) and the number of Relationship Rules linking the TRIADS (shared Relationship sets between any two TRIADS).

Table 1 summarizes the Alignment Strengths between any two TRIADS regardless of which one initiates an Alignment cycle. Table 1 shows that each TRIAD has a relative Alignment Strength that reflects the total number of Relationship Rules that it shares with other TRIADS. These relative Alignment Strengths are:

- 33% for the Business Strategy TRIAD
- 25% for the Business Responsibilities TRIAD
- 24% for the Business Operation TRIAD
- 18% for the Business Motivation TRIAD

These relative Alignment Strengths are called Steady State Alignment Strengths. They are obtained when all EBMM TRIADS shared Relationship sets are taken into account simultaneously. We also refer to them as Equilibrium Alignment Strength Distributions.

Table 1: Alignment Strengths Between Any Two TRIADS

	STRATEGY	OPERATION	MOTIVATION	RESPONSIBILITIES
STRATEGY	0	9	5	6
OPERATION	9	0	1	4
MOTIVATION	5	1	0	5
RESPONSIBILITIES	6	4	5	0
TOTAL	20	14	11	15
Strength Percentage	20/60 ~ 33%	14/60 ~ 24%	11/60 ~ 18%	15/60 ~ 25%

Table 2 shows a normalized Alignment Strength Matrix derived from Table 1 by dividing the Alignment Strengths found in a TRIAD row by the total of the row strengths.

Table 2: Normalized Alignment Strengths Matrix

	STRATEGY	OPERATION	MOTIVATION	RESPONSIBILITIES
STRATEGY	0	0.45	0.25	0.3
OPERATION	0.643	0	0.071	0.286
MOTIVATION	0.455	0.091	0	0.455
RESPONSIBILITIES	0.4	0.267	0.333	0

It is often not practical to simultaneously consider all shared Relationship sets included in the EBMM TRIADS when conducting a Business Architecture Alignment effort. The more tractable approach is to select subsets of Relationship Rules through consecutive Alignment cycles. Because the first Alignment cycle only includes a subset of Relationship Rules, it introduces Gaps between the EBMM TRIADS Alignment Strength Distributions and their Equilibrium values. These Gaps vary from one Alignment cycle to the next until they finally reach zero when the TRIADS have reached their Equilibrium Alignment Strength Distributions.

The following section uses Markov Chains (Winston & Goldberg 2004) to analyze how the Business Architecture Steady State Alignment Strength distribution is reached based on the TRIAD that triggers the Alignment cycles (Koffi 2010).

The recursive nature of the Alignment cycles carries a computational complexity cost. We will address it by comparing the relative efficiency (performance) of the four possible approaches to conducting Business Architecture Alignment efforts based on the TRIAD that initiates the Alignment cycles.

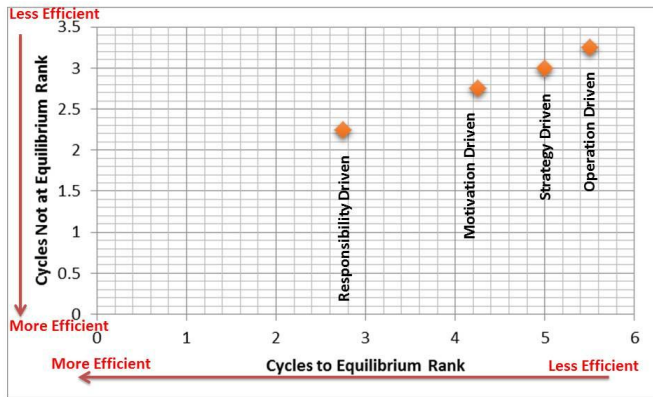
COMPARING BUSINESS ARCHITECTURE ALIGNMENT CYCLES EFFICIENCY PER INITIAL TRIAD

When analyzing the four types of Business Architecture Alignment cycles, it can be noticed that:

- The average number of cycles needed to reach equilibrium ranks varies.

- The average number of cycles during which a TRIAD Alignment Strength ratio is not at its equilibrium rank also varies.

We consider these two variables to be good indicators of the efficiency with which Business Architecture Alignment cycles take place. Figure 3 summarizes our findings.



EBMM-TRIADS: Business Architecture Alignment Cycles Efficiency Per Initial TRIAD

Figure 3: Business Architecture Alignment Cycles Efficiency per Initial TRIAD

In Figure 3, better efficiency is achieved when both the average number of cycles needed to reach equilibrium ranks and the average number of cycles not at equilibrium ranks are lower.

The best performance is achieved when the Business Architecture Alignment cycles are initiated with the Business Responsibilities TRIAD. The second best performance goes to the Business Motivation TRIAD, the third best to the Business Strategy TRIAD, and the worst performance is for the Business Operation TRIAD. Table 3 compares the EBMM TRIADS Business Architecture Alignment cycles efficiency performances.

Table 3: Business Alignment Cycles Efficiency Performances

Performance	Responsibilities	Motivation	Strategy	Operation
Average number of cycles needed to reach equilibrium ranks	2.75	4.25 = 1.55 times as much [55% more]	5 = 1.82 times as much [82% more]	5.5 = 2 times as much [100% more]
Average number of cycles not at Equilibrium ranks	2.25	2.75 = 1.22 times as much [22% more]	3 = 1.33 times as much [33% more]	3.25 = 1.44 times as much [44% more]

COMPARING BUSINESS ARCHITECTURE VIEWS ALIGNMENT GAPS PER INITIAL TRIAD

Table 4 shows how the Alignment Gap of each TRIAD varies throughout Alignment cycles in terms of the distance to the value of its Equilibrium Alignment

Strength Distribution. When a TRIAD Alignment Gap reaches zero, its Alignment Strength distribution equals its equilibrium value. Each TRIAD Alignment Gap follows a different curve based on the TRIAD that initiates the Alignment cycles. Alignment Gap values are between 0 and 1 and are reported for the first five Alignment cycles.

The color coding gradient in Table 4 varies from green to red where green represents lower Alignment Gaps and red higher ones. As predicted in the previous section, the four EBMM TRIADS Alignment Gaps collectively reach zero much faster when the Business Responsibilities TRIAD initiates the Alignment cycles. This suggests that aligning an organization’s Business Architecture can be attained faster when the Business Responsibilities TRIAD is used as the trigger of the Business Architecture Alignment effort. When the Business Responsibilities TRIAD triggers the Business Architecture Alignment, the EBMM TRIADS Alignment Strength Distribution Gaps become small enough at the end of the second Alignment cycle when compared to their equilibrium values:

- The Responsibilities TRIAD (WHY does WHO do WHAT) Alignment reaches 60% of its equilibrium value.
- The Motivation TRIAD (HOW does WHO Influence WHY) Alignment reaches 66% of its equilibrium value.
- The Operation TRIAD (HOW does WHO do WHAT) Alignment reaches 92% of its equilibrium value.
- The Strategy TRIAD (HOW does WHAT fulfill WHY) Alignment reaches 97% of its equilibrium value.

Table 4: EBMM TRIADS Alignment Gaps per Initial TRIAD

Initial TRIAD	TRIAD	Alignment Gap per Cycle				
		1	2	3	4	5
Responsibilities	Responsibilities	0.25	0.1	0.04	0.02	0.01
	Motivation	0.15	0.06	0.03	0.01	0.01
	Operation	0.04	0.02	0.02	0.01	0.01
	Strategy	0.07	0.01	0	0.01	0
Motivation	Responsibilities	0.21	0.09	0.04	0.02	0.01
	Motivation	0.18	0.09	0.04	0.03	0.01
	Operation	0.14	0.09	0.06	0.04	0.02
	Strategy	0.12	0.09	0.07	0.04	0.03
Strategy	Responsibilities	0.05	0.01	0	0.01	0
	Motivation	0.07	0.05	0.04	0.02	0.02
	Operation	0.22	0.13	0.08	0.05	0.03
	Strategy	0.33	0.19	0.11	0.07	0.04
Operation	Responsibilities	0.04	0.02	0.02	0.01	0.01
	Motivation	0.11	0.07	0.04	0.03	0.02
	Operation	0.23	0.14	0.08	0.05	0.03
	Strategy	0.31	0.18	0.11	0.07	0.04

BUSINESS ARCHITECTURE ALIGNMENT RELIABILITY

Another interesting property of the EBMM TRIADS addresses the overall Reliability with which a TRIAD influences another one. For example, while there are nine Relationship Rules between the Business Responsibilities and Business Operation TRIADs, it does not guarantee that the actual Relationship Rule instances are 100% accurate. One of these nine Relationship Rules is “Business Requirements describe Application Features”. It is possible that the accuracy with which actual Business Requirements describe actual Application Features is less than 100%. The same observation can be made for the other eight Relationship Rules found in that particular set.

Therefore, each instance of a TRIAD shared Relationship Rules set identified for a given organization’s Business Architecture can have an accuracy level R with a value between 0% and 100%.

Figure 4 illustrates that observation and it uses the following abbreviations to represent each TRIAD:

- STR for Business Strategy
- OPS for Business Operation
- MOT for Business Motivation
- RSP for Business Responsibilities

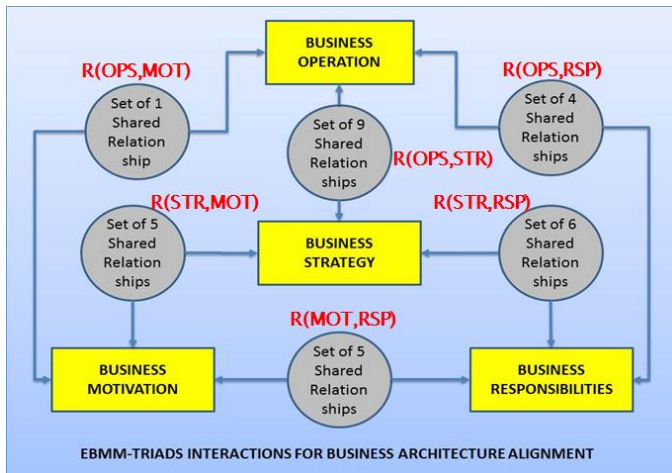


Figure 4: EBMM TRIADS Mutual Influence Reliability

Since each shared Relationship Rules set is a dimension of Alignment between any two TRIADs, the accuracy levels previously defined can be seen as the Reliability with which two TRIADs influence each other:

- $R(OPS,MOT)$ is the Reliability of Business Operation and Business Motivation mutual influence.
- $R(OPS,STR)$ is the Reliability of Business Operation and Business Strategy mutual influence.

- $R(OPS,RSP)$ is the Reliability of Business Operation and Business Responsibilities mutual influence.
- $R(MOT,STR)$ is the Reliability of Business Motivation and Business Strategy mutual influence.
- $R(MOT,RSP)$ is the Reliability of Business Motivation and Business Responsibilities mutual influence.
- $R(RSP,STR)$ is the Reliability of Business Responsibilities and Business Strategy mutual influence.

Let’s say that we are interested in finding out the overall Reliability with which the Business Strategy TRIAD influences the Business Operation TRIAD. The TRIAD influences paths could be:

- Straight from Strategy to Operation
- Or from (Strategy to Motivation) and from (Motivation to Operation)
- Or from (Strategy to Responsibilities) and from (Responsibilities to Operation)
- Or from (Strategy to Motivation) and from (Motivation to Responsibilities) and from (Responsibilities to Operation)
- Or from (Strategy to Responsibilities) and from (Responsibilities to Motivation) and from (Motivation to Operation)

Figure 5 illustrates these possible Influence paths.

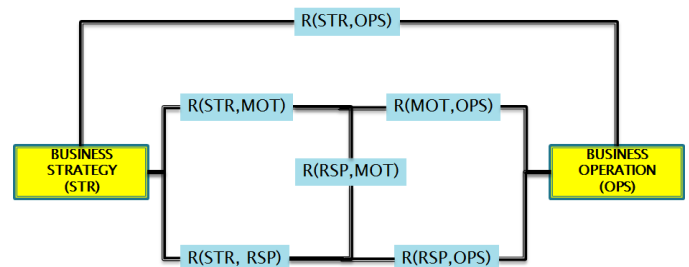


Figure 5: EBMM TRIADS Influence Paths

It is possible to compute the overall Reliability RT with which the Business Strategy TRIAD influences the Business Operation TRIAD (Blanchard & Fabrycky 1998).

Let’s assume, for example, that all shared Relationship Rules sets have the same accuracy or Reliability R . Figures 6 and 7 show the graphs of RT as a function of R and the graph of $(RT-R)$ as a function of R when R varies between 0 and 1.

Figure 7 shows that the overall Reliability RT with which the Business Strategy TRIAD influences the Business Operation TRIAD is higher than the Reliability of Business Operation and Business Strategy mutual influence when R is strictly greater than 0 and strictly

less than 1, with 25% more Reliability achieved when $R = 0.6$.

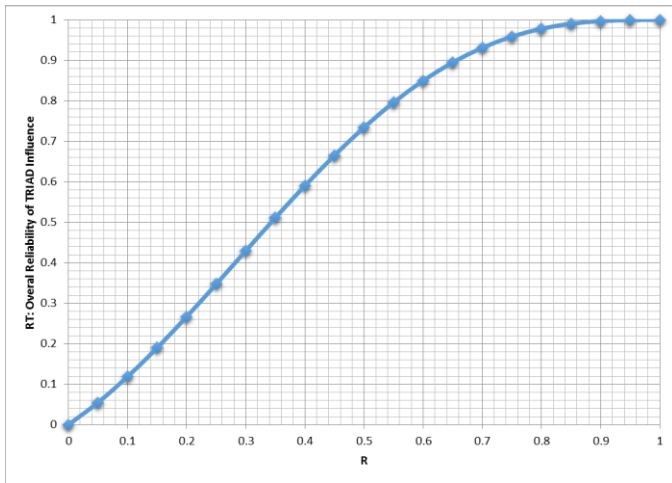


Figure 6: Overall Reliability of a TRIAD Influence as a Function of R

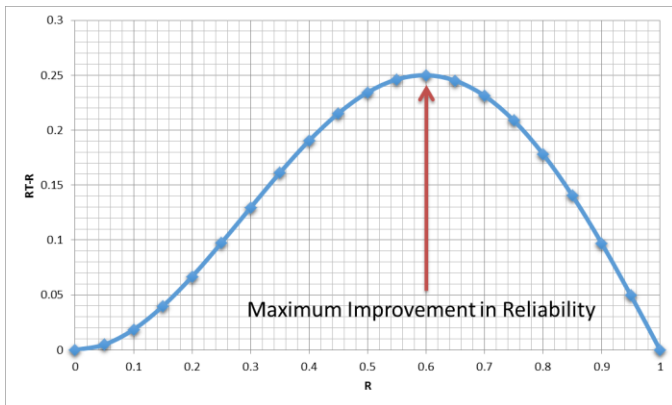


Figure 7: RT-R as a Function of R

APPLYING THE EBMM TRIADS: EXAMPLE OF THE MICROSOFT® CONNECTED HEALTH FRAMEWORK (CHF) BUSINESS ARCHITECTURE

This section illustrates a Responsibilities-driven Business Architecture Alignment effort conducted by a fictional healthcare organization that would like to adopt the Microsoft® Connected Health Framework (CHF) Business Architecture (Microsoft 2013).

Microsoft Corporation defines the CHF as follows:

“The Connected Health Framework (CHF) Architecture and Design Blueprint highlights a series of best practices for service-oriented health information and collaboration architecture. It also enables the development of an ecosystem of solutions based on the guidelines.

The Microsoft Connected Health Framework (CHF) is designed to enable the creation of Health and Social Care systems that are seamless and joined up. It provides the seamless experience through flexible user interfaces, driving dynamic, orchestrated business processes. It provides the “joined-up”

environment by linking applications using open standards for communication, data representation, and process control.”

Part 2 of the CHF Architecture and Design Blueprint addresses its Business Framework. The EBMM TRIADS can be used to assess the Alignment Strength of the CHF Business Architecture and guide an organization to adopt it in an effective manner.

This section shows how the EBMM TRIADS Responsibilities-driven Business Architecture Alignment can facilitate the adoption of the CHF Business Architecture by a fictional healthcare organization. The CHF Business Framework document is used as the primary source of information to conduct the Alignment effort. The document can be used in conjunction with common information gathering techniques between the information gatherers (Analyst) and Subject Matter Experts (Expert) (Gavrilova & Andreeva 2012).

Table 5 shows examples of such techniques. In this context, the EBMM TRIADS facilitate the classification of CHF Business Architecture element instances relevant to the healthcare organization under Fundamental Interrogatives. The EBMM TRIADS Relationship sets help validate that all expected CHF Business Architecture element instances are in Alignment with each other by being properly classified, defined, and connected via relevant Relationship instances. Typically, Business Architects, Enterprise Architects, and other key Stakeholders representing both strategic (i.e., CMO office) and operational (i.e., COO and CTO offices, Program Management Office) Business Units in the organization are involved in the Alignment cycles described earlier in this article. Next, for simplicity’s sake, we only describe the two steps conducted during the first Alignment iteration cycle.

Table 5: Examples of Information Gathering Techniques

Leading Role	Knowledge Elicitation Technics	Variations
Analyst	Interviews	Structured
		Unstructured
	Questionnaires	Face to Face
		E-Quiz
Expert	Individual Focused	Observation
		Storytelling
	Collective	Round Table
		Brainstorming
Expert and Analyst	Role Games	
	Verbal Report	

The first step is to identify and classify the various CHF Business Architecture elements according to the three EBMM TRIADS Fundamental Interrogative groups involved with the Responsibilities TRIAD: WHY, WHO, and WHAT. For example, the following CHF Business Policies element instances are categorized under the WHY Interrogative: Using Cloud Computing, Using

Portals, Using SOA. Another example of a WHY-like CHF Business Architecture element instance is the CHF Maturity Model for e-Health and the e-Care Business Capability Roadmap. 17 CHF Customer Demands and Relationships instances are classified under the WHY Interrogative; they are expressed as business needs among the following six WHO-like CHF Market Segments: Persons (i.e., patients, clients, customers), Care Professionals (i.e., physicians, nurses, allied care professionals), Care Providers (i.e., hospitals, clinics, medical practices, laboratories), Funding Organizations (i.e., national and local health departments, insurance companies), Policy Makers and Legislators (i.e., government departments, professional bodies), Researchers and Analysts (i.e., scientific institutes, medical institutes, statistical institutes).

In the second step, the fictional healthcare organization identifies CHF Business Architecture instances of the 15 Relationship Rules found in the three Relationship sets shared by the Business Responsibilities TRIAD with the other three TRIADs. These Relationship Rules are listed below:

WHO to WHY – Business Responsibilities and Business Motivation shared Relationships:

- Governance Body **enforces** all Business Policies.
- Stakeholders **are accountable for** Business Strategies and Objectives.
- Stakeholders **can be a type of** Driver.
- Market Segments **generate** Customer Demands and Relationships.
- Influencing Organizations **are sources of** Influence.

WHY to WHAT – Business Strategy and Business Responsibilities shared Relationships:

- Business Initiatives and Programs **drive changes to** Business Capabilities.
- Business Strategies and Objectives **drive changes to** Business Capabilities.
- Customer Demands and Relationships **drive** Products and Services.
- Value Propositions **drive** Required Competencies.
- Directives **govern use of** Assets.
- Capability Roadmaps **describe changes to** Business Capabilities.

WHO to WHAT – Business Responsibilities and Business Operation shared Relationships:

- Business Units **are responsible for** Assets.
- Business Units **are responsible for** Business Capabilities.
- Business Units **consume** Products and Services.

- Business Units **provide** Products and Services.

For example in the WHO to WHY set, the Relationship “Market Segments **generate** Customer Demands and Relationships” has many actual instances such as but not limited to:

- Persons **generate** needs for Appointments with Care Providers.
- Persons **generate** needs for Admissions with Care Providers.
- Persons **generate** needs for Discharges with Care Providers.
- Persons **generate** needs for Episodes of Care with Care Professionals.
- Persons **generate** needs for Patient Relationships with Care Providers.
- Policy Makers **generate** needs for Standards of Care applicable to Care Professionals.
- Policy Makers **generate** needs for Audit Standards applicable to Care Providers.
- Policy Makers **generate** needs for Performance Standards applicable to Care Providers.
- Policy Makes **generate** needs for Awareness Programs applicable to Persons.
- Policy Makers **generate** needs for Screening Programs applicable to Persons.

Further details can be added to the Relationship instances previously listed in order to refine their definitions. Similar Relationship instances identification efforts can be conducted for each one of the 15 Relationships found in the three Relationship sets shared by the Business Responsibilities TRIAD with the Strategy, Operation, and Motivation TRIADs. Reporting the full results of these efforts is beyond the scope of this article.

Table 4 shows that relatively good degrees of Business Architecture Alignment can be achieved at the conclusion of the second Responsibilities-driven Alignment cycle. CHF Business Architecture element instances mapped to the EBMM TRIADS also inherit these Alignment degrees when all instances of their Relationship Rules have been properly identified and documented. Quantitative measures of the overall Alignment Reliability achieved between any two TRIADs can also be computed using the methods presented in this article. Reporting these results is beyond the scope of this article.

CONCLUSION

This article has presented the EBMM TRIADS, a Business Architecture meta-model. The EBMM TRIADS have practical applications to the Alignment of an enterprise Business Architecture. Each TRIAD

represents one of four complementary and mutually-dependent views of a Business Architecture.

We have listed the EBMM TRIADS 30 Relationship Rules between Business Architecture elements that belong to different interrogative groups. Each one of the four EBMM TRIADS shares three sets of Relationships with the other TRIADS. The Relationships contained in each one of those sets impose Alignment Constraints on the types of Business Architecture elements hosted by the TRIADS. Each set of Constraints represents a dimension of Alignment between two TRIADS. We have proposed using the number of Relationships contained in each set to compute the relative Alignment Strength between any two TRIADS.

A Business Architecture Alignment effort can be conducted by going through consecutive Alignment cycles. An Alignment cycle is initiated by one of the four TRIADS. Our model reveals that initiating an Alignment cycle with the Business Responsibilities TRIAD reaches in lesser cycles the Equilibrium Alignment Strength Distributions.

We also proposed a measure of the overall Alignment Reliability achieved between any two TRIADS based on the Reliability with which TRIADS influence each other.

We illustrated a possible application of the EBMM TRIADS as a facilitation instrument for the adoption of the Microsoft® Connected Health Framework (CHF) Business Architecture by a fictional healthcare organization.

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Peer-Reviewed Article

Measuring Enterprise Architecture Effectiveness using Key Performance Indicators

Wendy Arianne Günther and Werner Heijstek

Abstract

One of the reasons why measuring Enterprise Architecture (EA) effectiveness is considered difficult, is that it may be challenging to choose the right performance indicators. The aim of this study is to arrive at a clear overview of Key Performance Indicators (KPIs) that can be used to measure EA effectiveness. To arrive at such an overview, we adopted a design science research approach. For data collection prior to the design, we adopted qualitative methods: a semi-structured literature review was done and interviews were held with 18 experts in the field of EA. Prior to each interview, experts were asked to fill out an input survey. The outputs of these methods formed the input for our design phase. Initial versions of our solution have been evaluated through intermediate evaluations, an interactive evaluation session, and an evaluation survey, and have been modified accordingly. In this article, we present the resulting Focus Framework for Enterprise Architecture Measurements (FFEAM), which can be used to measure EA effectiveness by focusing on four areas: the decision-making process, decision-making results, program implementation, and the actual program results. This framework can be implemented through a set of 22 KPIs for EA effectiveness. We believe this framework has the potential to aid organizations in measuring the effectiveness of their EA by shifting the focus of EA measurements to the actual desired results.

Keywords

Enterprise Architecture (EA), effectiveness, evaluate, measurement framework, Key Performance Indicator (KPI)

INTRODUCTION

Any organizational practice should be able to show its “value”, including Enterprise Architecture (EA). Research in the field of EA value measurement includes, for example, studies on assessing EA quality and EA maturity. EA quality is mostly concerned with the quality of EA products and services (Niemi & Pekkola 2013). EA maturity on the other hand (Van Steenberg 2011, p.72), is about:

“The degree of development of the architectural practice; i.e., the whole of activities, responsibilities, and actors involved in the development and application of Enterprise Architecture within the organization.”

Although these strands of research, focusing on the way EA itself is practiced, are considered relevant, we believe that they do not define the value of EA. We believe something is valuable when it leads to certain desired results. Thus, we focus on EA effectiveness; i.e., the degree to which EA is “successful in producing a desired result” (Oxford Dictionaries). In this regard, having a high-quality or very mature EA are means to get to these desired results.

Researchers have already focused on providing complete overviews of claimed EA benefits (e.g., Boucharas et al. 2010; Niemi 2008). As acknowledged

by a Dutch consultancy, however, due to its “(perceived) abstract nature”, it can be difficult in practice to choose the right performance indicators for EA (Van Gils & Van Dijk 2013, p.45). Therefore, the aim of this study is to arrive at a clear overview of Key Performance Indicators (KPIs) that can be used to measure the effectiveness of EA. A KPI differs from regular metrics or indicators (Parmenter 2007, p.3) in that:

“KPIs represent a set of measures focusing on those aspects of organizational performance that are the most critical for the current and future success of the organization.”

We simplified this definition while keeping its essence, and applied it to the field of EA while truly focusing on its effectiveness, thus defining KPIs for EA effectiveness as metrics focusing on those effects of EA that are the most critical for determining its success.

In this article, we will first elaborate on our view of what EA entails. Then, we will briefly discuss some related work with regard to this topic. We will elaborate on how we went about our research, and we will present our proposed solution: the current versions of the Focus Framework for Enterprise Architecture Measurements (FFEAM) and its accompanying set of KPIs for EA effectiveness. Finally, we will discuss the limitations of our research approach, propose possibilities for future

work, and conclude our research. This work is derived from a Master's thesis (Günther 2014).

DEFINING ENTERPRISE ARCHITECTURE

This section deals with our view on what EA entails, as the term seems to represent different things to different people.

Several perspectives on EA exist; e.g., the “*design-oriented perspective*”, the “*regulation-oriented perspective*”, and the “*patterns-oriented perspective*” (Op't Land et al. 2009, p.34). The first two perspectives are considered complementary to each other as the first perspective is focused on gaining:

“... insight into an enterprise's design while also providing guidance to designers of enterprise systems”

whereas the second perspective deals with actually directing the enterprise through principles (Op't Land et al. 2009, p.34). Although the patterns-oriented perspective, focused on “*the use of design patterns*”, may be important as well (Op't Land et al. 2009, p.34), we argue that a solid definition of EA should focus on at least both describing or designing the enterprise through artifacts and actually directing it. Moreover, we argue that a clear distinction should be made between architecture in general and *enterprise* architecture, and that EA roles and processes should explicitly be acknowledged as integral parts of EA. Finally, we think that an accurate definition of EA must be concise and focused on its ability to direct the enterprise as a whole. Although definitions may exist that adhere to most of these requirements (e.g., Jonkers et al. 2006; Josey et al. 2009; Op't Land et al. 2009; Lapkin et al. 2008), to the authors' knowledge, as of yet, no definition adheres to all of them. With this in mind, we consider EA to be a combination of artifacts, principles, roles, and processes, directing the enterprise's design towards an envisioned future state in terms of both business and IT. Brief elaborations on the several aspects that make up this definition (i.e., artifacts, principles, roles, and processes), largely based on Van der Raadt & Van Vliet (2008), are given below.

Enterprise Architecture Artifacts

In our view, EA artifacts are typically EA documents that should provide insight into and oversight of the design of an enterprise's business and IT. In this regard, design could mean the current design of the enterprise, as well as its envisioned design. EA artifacts therefore often include an “as-is” architecture, a “to-be” architecture, and a roadmap describing the transition from the as-is to the to-be state (Van der Raadt & Van Vliet 2008; Tamm et al. 2011). Moreover, *both* business *and* IT are to be taken into consideration. Frameworks guiding the design of artifacts often cover business, information, application,

and infrastructure technology architectures (Dube & Dixit 2011). Thus, in the context of EA artifacts, IT relates to the physical infrastructure, applications, and IT functionalities.

Enterprise Architecture Principles

EA principles can be thought of as “*standards*”, “*rules*”, or “*guidelines*” (Van der Raadt & Van Vliet 2008, p.106), and can be interpreted as “*imposed laws*” or guidance (Op't Land et al. 2009, p.37). Moreover, these principles guide the development processes of, for example, EA artifacts, as well as the actual change processes (Josey et al. 2009). Therefore, these principles could be both input for EA, in terms of development, and part of the output of EA, used to frame certain change implementations.

Enterprise Architecture Roles

By EA roles, we mean those roles fulfilled by one or more persons, providing the functions needed when EA is practiced within an organization. Several EA roles exist at different levels within the enterprise. For example, there is often one Chief Enterprise Architect and several Enterprise Architects for each of the areas of business, information, applications, and infrastructure, who reside at “*enterprise level*” (Van der Raadt & Van Vliet 2008). Moreover, several “EA governance bodies” (e.g., architecture councils) may be part of the EA practice at both enterprise level and “*domain level*” (Van der Raadt & Van Vliet 2008). Roles at higher levels are involved with decision-making and delivery, whereas roles at lower levels (i.e., “*project level*” and “*operational level*”), are more concerned with conforming to EA (Van der Raadt & Van Vliet 2008).

Enterprise Architecture Processes

EA processes are concerned with the development of artifacts and their maintenance, as well as with organizing, decision-making, and implementation (Van der Raadt & Van Vliet 2008; Op't Land et al. 2009, pp.85-112). Therefore, EA processes are not just concerned with setting up EA and delivering artifacts, but also with actually directing the enterprise towards a desired future state. This then includes certain governance processes.

RESEARCH DESIGN

The aim of this study is to arrive at a clear overview of KPIs that can be used in practice to measure EA effectiveness. In order to arrive at such an overview of KPIs for EA effectiveness, we adopted a design science research approach (Peffer et al. 2006; Hevner et al. 2004). Design science, which focuses on the

development of IT artifacts (Hevner et al. 2004), has previously been used in the field of EA evaluation (e.g., Puijitt et al. 2012; Van Steenbergem & Brinkkemper 2008; Meyer et al. 2012). Our approach is “*problem-centered*” (Peffer et al. 2006), aiming for a solution that meets the following four requirements:

1. It should be clear what areas practitioners should focus on when measuring EA effectiveness.
2. It should present KPIs for EA effectiveness.
3. Practitioners should be able to choose which KPIs are applicable for measuring the effectiveness of their EA.
4. The design in general should be clear enough for use in practice.

As part of the data collection prior to the design, we performed a semi-structured literature review, focused on finding existing methods and approaches that can be used to measure EA effectiveness, as well as on finding already existing metrics for EA effectiveness. This literature review was semi-structured in the sense that literature was selected in a rather structured way using the ACM and IEEEExplore digital libraries, but also in an unstructured way using Google and Google Scholar. Relevant literature retrieved from students and experts was included in the final set as well. Moreover, although such so-called “grey literature” (e.g., white papers and reports) is not always peer-reviewed, both academic and grey literature were included in the results as we consider bridging the gap between research and practice an important part of our approach and in line with the objectives of the design science research approach. For the structured part of our literature review, an extensive set of keywords focused on measuring EA was used. For this part, we focused on finding articles rather than books or dissertations. Resulting articles were first judged on being about EA value by their title and abstract. Then, only if a full text version of an interesting article could be obtained, it was scanned and judged on its relevance for achieving our research objectives. If it was deemed relevant at this point, it was read in more detail. Both for the structured and unstructured parts of our literature review, literature was included in the final set if it appeared to touch upon EA effectiveness measurement approaches, metrics, or KPIs.

As part of the data collection as well, we held 17 interviews (both in person and through Skype) with 18 experts in the field of EA. An expert in this regard could be a consultant, a researcher, or a practitioner (or both). Researchers are often up-to-date about new research in the field and about new contexts related to their topic. Practitioners that are, or have been, involved in the field of EA in some way may be more knowledgeable about the way it actually works in practice. Consultants often

obtained experience from multiple organizations. Prior to each interview, experts were asked to fill out an input survey, which functioned as an introduction to the interview. All experts claimed to be involved with EA in some way (e.g., its development, because they use it, provide expertise on it, or, for example, because EA departments report to them or they add a certain perspective to it). During the interviews, generally, experts were asked about their view on measuring EA effectiveness, and especially about metrics and KPIs that could possibly be used to do this. Each interview was recorded, transcribed, and, next to the corresponding surveys, coded using a generic form of open coding derived from our understanding of grounded theory (Corbin & Strauss 2008). As this led to many codes, those occurring in more than 50% of the cases were elaborated on in more detail. Moreover, those codes we felt were relevant for answering the research questions were visualized in a large graph.

The results of the above-mentioned methods formed the input for the design phase. Initial designs were evaluated in three phases: rather informal intermediate evaluations, an interactive evaluation session, mainly focused on evaluating our initial framework, and an evaluation survey, mainly focused on evaluating our established set of draft KPIs for EA effectiveness.

Before the interactive evaluation session, two experts (one of them a member of the Software Improvement Group (SIG),¹ the other an external expert who was approached once), were asked about their opinion on earlier versions of the design. Moreover, an informal presentation was held at the SIG, in order to get timely feedback.

CIO Platform Nederland², a Dutch association for CIOs and IT managers, was approached for an interactive evaluation session during their “CIO Interest Group” meeting on architecture. In this evaluation session, an introduction was given (including the results of a short introductory survey), and parts of the solution were presented. The 12 architecture experts present at this meeting were invited to be active and critical, ask questions, and give constructive feedback.

A survey was sent to each member present at the interactive evaluation session. This survey contained a set of draft KPIs and some questions related to each KPI. Two questions were central to evaluating the draft KPIs:

1. Is KPI x clear enough for use in practice?
2. Is KPI x useful for measuring EA effectiveness?

¹ Refer to: www.sig.eu.

² Refer to: www.cio-platform.nl.

Question 1 was deemed important due to the fact that we adopted a design science approach, which made one of the objectives of the resulting design that it should be clear enough for use in practice. Question 2 was focused on a KPI's *usefulness* for measuring EA effectiveness. Each question was operationalized through a statement that respondents could agree or disagree with. For this, a 5-point Likert scale was used. Participants were given room to comment on each KPI and were, at the end of the survey, asked whether they felt KPIs were missing, or whether they had any general comments. This provided respondents with the possibility to elaborate on their choices. The authors could use this to modify KPIs based on more constructive types of feedback.

EA EFFECTIVENESS MEASUREMENT APPROACHES

In this section, we briefly discuss a subset of the measurement approaches that we found during the semi-structured literature review.

Other researchers have acknowledged the difficulty of assessing EA effectiveness as well. Methods that can be used to measure EA effectiveness include, for example, approaches in line with the Balanced Scorecard

approach (e.g., Plessius et al. 2012; Van Steenberg & Brinkkemper 2008; Schelp & Stutz 2007) and value tree-like approaches (e.g., Rodrigues & Amaral 2010; Van Steenberg & Brinkkemper 2008). Moreover, some approaches focus on more objective or quantitative measurement approaches or metrics (e.g., Slot 2010; Potts 2010), whereas others (e.g., Van der Raadt 2011; Alaeddini & Salekfarid 2013) look at more qualitative, possibly more subjective aspects by basing their indicators on, for example, Luftman's indicators for business-IT alignment (Luftman 2000).

As for actually establishing metrics, some researchers suggest or relate their approach to the "Goal Question Metric" method (e.g., Hämäläinen & Kärkkäinen 2008; Van Steenberg & Brinkkemper 2008). Moreover, quite some metrics for EA effectiveness have already been collected by other researchers (e.g., Cameron & McMillan 2013). To the authors' knowledge, however, no research has focused on establishing a set of true KPIs for EA effectiveness and linking them in a clear framework, such that organizations can use this to measure the effectiveness of their EA.

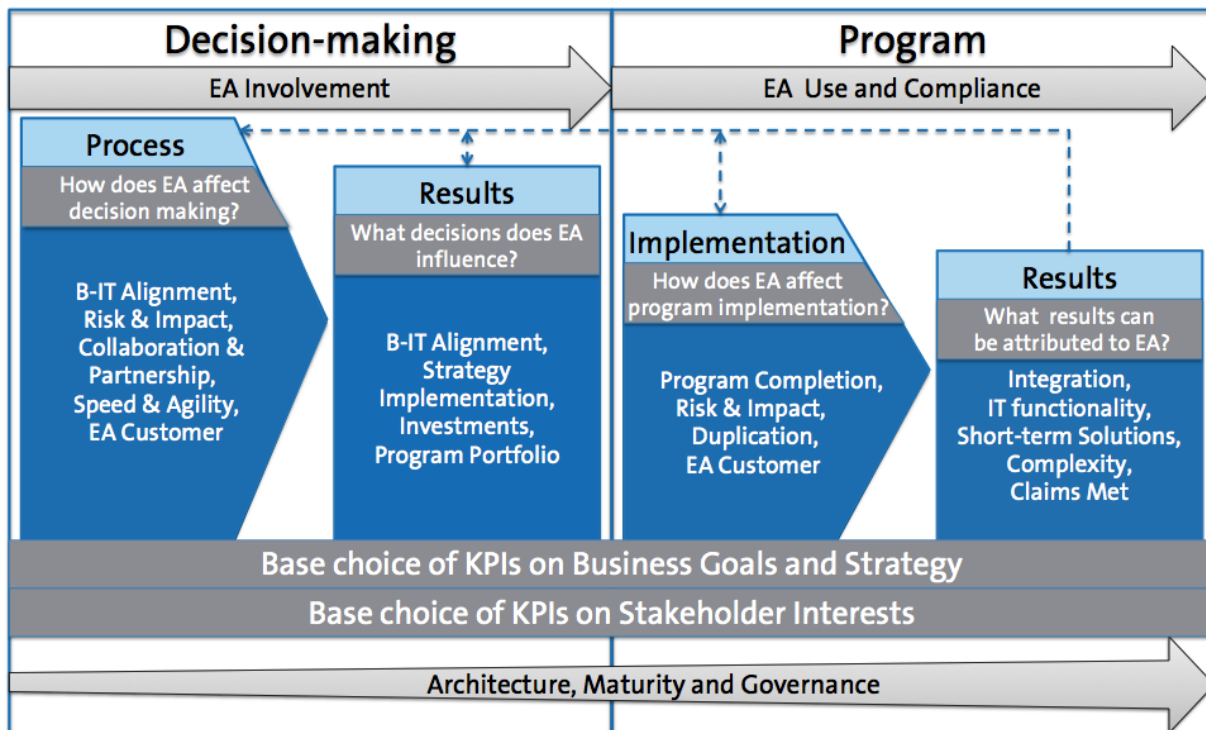


Figure 1: The Focus Framework for Enterprise Architecture Measurements (FFEAM)

FOCUS FRAMEWORK FOR EA MEASUREMENTS

Our research approach led to the establishment of the Focus Framework for Enterprise Architecture Measurements (FFEAM) and an accompanying set of KPIs for EA effectiveness. Figure 1 shows the current version of the FFEAM, which is based on the insights described below.

A benefit of EA that was often found in the interview transcripts is that it generally helps during decision-making. Now, this may not be a new insight in itself as it has been implied by other researchers (e.g., Schelp & Stutz 2007; Van der Raadt & Van Vliet 2008; Slot 2010; Johnson et al. 2004; Tamm et al. 2011; Van den Berg & Van Vliet 2014). However, we found that metrics mentioned by experts at this level could be divided into two *focus areas*: the decision-making process, and decision-making results. The decision-making process is about decision-making at enterprise level and includes building a vision and strategy, formulating and evaluating scenarios, and selecting alternatives and scenarios (Johnson et al. 2004; Van der Raadt & Van Vliet 2008; Slot 2010). Decision-making results then include the actual decisions made; i.e., the goals, strategies, and program plans resulting from the decision-making process.

During the interviews, there seemed to be a recurring discussion whether EA should reside on a strategic level or should be involved with more operational levels as well. This discussion in itself is not new either as researchers have already acknowledged that EA is, in some way, involved at all organizational levels (e.g., Van der Raadt & Van Vliet 2008; Van Steenbergen 2011). However, metrics experts mentioned at program (or in some cases project) level could be divided into two focus areas: implementation and results. We argue that EA should focus on enterprise-wide programs, which could be defined as programs (Van der Raadt & Van Vliet 2008, p.110):

“... in the interest of the enterprise-wide structures, processes, systems, and procedures.”

Program implementation is then about carrying out enterprise-wide program plans and implementing changes through such programs. This leads to certain program results; i.e., program deliveries and subsequent effects in operation.

Some of the metrics retrieved from the literature, the input survey, and the interviews were focused on EA architecture aspects (e.g., quality, content, design), maturity or governance, EA involvement, the use of EA, or EA compliance. We argue that, although these aspects is important for the EA practice and measuring these can lead to valuable insights, they are *requirements* rather than effects. We argue that, in order

for EA to influence decision-making, its involvement is required. Moreover, for EA to be effective at program level, EA use and compliance or conformance are required (Foorthuis et al. 2010; Van der Raadt & Van Vliet 2008). Finally, we believe that certain architectural aspects, maturity, and governance are increasingly required for EA to be effective. For example, EA governance may not need to be defined yet if EA is only involved in decision-making. Once EA gets involved in the actual programs, however, aspects such as principles, more mature processes, more coherent artifacts, and governance may be required in order to direct changes and be accountable for certain results.

Experts seemed to recognize the issue of *causality* during the interviews. This issue has to do with the fact that EA may be just one of multiple causes leading to certain effects (Van Steenbergen & Brinkkemper 2008). The staircase-like structure visible within the FFEAM represents this issue: the further you get from the decision-making process, the harder it may be to measure EA effectiveness. We argue that, because of this causality issue, one should focus on those effects of EA that can *reasonably* be attributed to it when measuring its effectiveness. Therefore, each focus area is assigned one key question that helps focus on such effects.

During evaluations of initial versions of the framework, experts pointed out that the framework needed to be dynamic and that waterfall-style frameworks might not work anymore in this continuously changing world. In the current version of our framework, this is accounted for by feedback loops, visualizing the importance of feedback and reconsideration.

The categories shown within the focus areas of the FFEAM (e.g., “B-IT Alignment” and “Integration”) represent KPI categories. The assignment of such categories to our KPIs makes it easier for practitioners to choose which KPIs are relevant for their organization.

The input survey included a list of options from which experts could choose (multiple answers possible) what they thought were the most important factors influencing the choice of EA effectiveness KPIs. The mode for this question equaled “business goals”. Moreover, more than half of the respondents answered “organization’s strategy” and “stakeholder interests”. Based on these results (and in line with Rosser 2006), we argue that, when choosing KPIs from our set, this choice should eventually be based on the business goals and strategy, as well as on stakeholder interests.

KEY PERFORMANCE INDICATORS FOR EA EFFECTIVENESS

The FFEAM can be implemented through a set of KPIs for EA effectiveness. To arrive at an initial set of KPIs,

we made a selection of the metrics retrieved from the literature, the input survey, and the interviews. As mentioned in the previous section, because of the issue of causality, we focused on those metrics that measure those effects of EA that we thought can reasonably be attributed to it. For example, metrics that are subject to too many influences, or that are generally hard to link back to EA, were not included. Remaining metrics could then be mapped to an initial set of KPIs.

After the intermediate evaluations and the evaluation session, metrics were filtered again using newly gained insights and, again, mapped to a set of KPIs. Eventually, a set of draft KPIs was evaluated through the evaluation survey. Six people who participated in the evaluation session also answered all of the survey questions. A draft KPI was per definition rejected if none of those respondents considered it useful for measuring EA effectiveness; i.e., not one respondent answered agree or strongly agree for the corresponding statement. Remaining draft KPIs could be modified based on comments and feedback. For the right reasons, such a modification could still include the draft KPI being taken out (e.g., if respondents felt the draft KPI was subject to too many influences). These modifications led to our current set of 22 KPIs for EA effectiveness, divided over the four focus areas: decision-making process, decision-making results, program implementation, and program results.

Four KPI types are included in our current set of KPIs for EA effectiveness:

- **Subjective KPIs:** KPIs of this type could be interpreted to be subjective and are operationalized through scaled surveys. Three essential elements are included in their description: the topics asked, the stakeholders of whom questions on these topics are asked, and the way the KPI is operationalized in more detail. The topics asked and the stakeholders who are asked about these topics may differ per KPI. However, all KPIs of this type are operationalized by determining the percentage of stakeholders giving negative ratings for each of the topics. This makes the range for such KPIs equal to [0%, 100%]. For EA to be considered effective then, the percentage of stakeholders giving negative ratings, per topic, should be as low as possible; e.g., <20%.
- **Mapping-based KPIs:** KPIs of this type involve a mapping between two separate items. Therefore, three essential elements are included in their description: a description of the first item, a description of the second item, and the way the KPI is operationalized. The two items can differ, but all KPIs of this type are operationalized by determining the percentages of (1) instances of item 1 not

mapped to or competing with instances of item 2, and (2) instances of item 2 not adequately supported by instances of item 1. Note that it may be difficult to determine whether instances of item 2 are adequately supported by instances of item 1. As suggested during the intermediate evaluations, one could use the Pareto principle for this. As it is about percentages, the range for this type equals [0%, 100%] and, for EA to be considered effective, percentages should be as low as possible; e.g., <20%.

- **Case-based KPIs:** KPIs of this type are case-based, meaning that they are operationalized on a per-case basis; i.e., by looking at the impact and occurrence of certain events. Therefore, two essential elements are included in their description: a description of the kind of cases one should look out for, and the way the KPI is operationalized in more detail. KPIs of this type are operationalized by looking at the number of existing cases in a certain time period, as well as their impact. Theoretically, the range for the number of cases equals [0, ∞]. Of course, in practice this number is finite. The impact of such cases may have to be expressed in monetary values or time. Therefore, although this number is in practice finite as well, the theoretical range for the impact also equals [0, ∞]. Note that the number of cases could say different things about EA effectiveness for different KPIs.
- **Percentage-based KPIs:** KPIs of this type are operationalized by determining the number of occurrences of an unfavorable phenomenon as a percentage of a whole. Determining such percentages allows for easier comparison of improvement over time. Two essential elements are included in their description: what phenomenon to look out for, and as a percentage of what whole it should be operationalized. As it is about percentages, the range for this type equals [0%, 100%]. Moreover, as it is about the occurrence of unfavorable phenomena, this percentage should be as low as possible; e.g., <20%.

All KPIs and their operationalization are outlined in Appendix A. As mentioned in the previous section, each KPI is assigned a more general category and, when choosing KPIs, one should take into account the business goals and strategy, and stakeholder interests. In the sections below, we shortly elaborate on the KPIs in relation to their categories.

How EA Affects Decision-Making

Table 1 links KPI numbers to the categories shown in the FFEAM for the decision-making process focus area.

Table 1: KPI Linkage to Categories for the Decision-Making Process Focus Area

Category	KPI Number
B-IT Alignment	KPI 1, 2, 3
Risk & Impact	KPI 4
Collaboration & Partnership	KPI 5, 6
Speed & Agility	KPI 7
EA Customer	KPI 8

All KPIs related to the decision-making process area are of the subjective type. This may be because the process of decision-making can be considered subjective in itself, and objectively measuring something about the way it is done can be considered difficult. As shown in the FFEAM, EA involvement is required if EA is to be effective during the decision-making process. EA cannot influence any decision-making process if it is not in some form involved, be it through EA roles, artifacts, principles, or processes.

Business-IT alignment during the decision-making process pertains to the subjective alignment of those business and IT stakeholders that are involved in decision-making at the enterprise level. Note that two of the subjective KPIs linked to this category are largely based on two of Luftman’s indicators for business-IT alignment (i.e., “*understanding of business by IT*” and “*understanding of IT by business*” (Luftman 2000)), whereas the third one is focused on one’s understanding of the linkage between IT and business. If EA does not increase IT stakeholders’ understanding of the business direction, or business stakeholders’ understanding of the IT landscape, this could lead to ineffective decision-making. Moreover, as EA is about both business and IT, it should also affect stakeholders’ understanding of the way these are linked through the different layers of EA. EA could influence these kinds of understanding by elaborating on the business direction, the IT landscape, and the linkage between the two more proactively.

The subjective KPI linked to the category of “Risk and Impact” for the decision-making process focus area, is concerned with the extent to which decision-makers gain insight into the consequences and impacts of their decisions through EA. EA could influence stakeholders’ understanding of these risks and impacts by actively explaining them. This then goes beyond the boundaries of just one area of expertise (e.g., IT or business). It is about the risks and impacts for the entire enterprise.

Objectively measuring collaboration in terms of standards or interfaces may be very difficult and hard to link to EA. Collaboration and partnership during the decision-making process, however, is about the

subjective feeling of collaboration, both between internal business and IT stakeholders, and between internal and external stakeholders. It is not only about improving internal collaboration, but also about looking for possibilities to benefit from, for example, shared resources beyond the enterprise’s boundaries. Thus, the two subjective KPIs linked to this category focus on EA’s influence on the ability of business and IT stakeholders to cooperate, and its influence on the ability of internal stakeholders to cooperate with external stakeholders.

Speed and agility with regard to the decision-making process relate to the time needed to reach actual decisions. As one expert noted during the intermediate evaluations, objectively measuring this and linking it to EA’s influence may be very difficult. However, as stakeholders often recognize whether EA is a bottleneck or speeds up the decision-making process, this can be measured using a KPI of the subjective type, focused on the extent to which stakeholders feel EA affects the speed of the decision-making process. Note that, in some cases, slowing down the decision-making process may be necessary if this leads to “better” decisions.

In general, EA should help the EA customer during the decision-making process. At the enterprise level, EA stakeholders (and therefore also customers) are typically the CxOs (Van der Raadt 2011). The subjective KPI linked to the “EA Customer” category for the decision-making process focus area, focuses on the extent to which those involved in the decision-making process feel EA facilitates communication, provides insight and oversight, and provides input and advice during this process.

Decisions EA Influences

Table 2 links KPI numbers to the categories shown in the FFEAM for the decision-making results focus area.

Table 2: KPI Linkage to Categories for the Decision-Making Results Focus Area

Category	KPI Number
B-IT Alignment	KPI 9
Strategy Implementation	KPI 10
Investments	KPI 11
Program Portfolio	KPI 12

For the decision-making results focus area as well, EA involvement is needed if EA is to be effective in this focus area, or for certain results to be attributed to EA.

Business-IT alignment is an important category for the decision-making results focus area as well. In this regard, it is mostly about whether decisions made for IT

are aligned with those made for business. Although these two should be aligned, this may not always be the case and EA plays a crucial role here. The mapping-based KPI linked to this category therefore focuses on the alignment between business and IT strategic goals, largely based on a metric by COBIT® (ISACA 2011):

“... percent enterprise strategic goals and requirements supported by IT strategic goals.”

In practice, one may need to normalize such goals to a certain comparable level, maybe even one or more levels lower than the high-level strategic goals, as long as they stay focused on a longer-term strategic vision.

EA seems to play a crucial role in strategy implementation through programs (Op't Land et al. 2009, pp.25-47). In this regard, programs need to be aligned with business strategic goals as well. The mapping-based KPI linked to this category focuses on whether this is actually the case. If strategies are not adequately implemented through programs, EA may need to re-design its roadmap and portfolio, and re-engage in the decision-making process.

Whether EA actually leads to better investments can be hard to measure. However, in some cases EA's contribution by preventing erroneous decisions may be clear. This can only be determined on a per-case basis, which calls for a case-based KPI.

Whereas program managers are responsible for the implementation of programs in terms of budget and time, EA is responsible for their content (Slot 2010). Therefore, EA has responsibility with regard to whether the established program portfolio sufficiently covers stakeholder goals. The subjective KPI linked to the “Program Portfolio” category thus focuses on stakeholder satisfaction with the scope of this enterprise-wide program portfolio. Both enterprise and domain stakeholder interests are important here. Note that at some point, specific stakeholder interests may have to make way for enterprise-wider goals.

How EA Affects Program Implementation

Table 3 links KPI numbers to the categories shown in the FFEAM for the program implementation focus area.

Table 3: KPI Linkage to Categories for the Program Implementation Focus Area

Category	KPI Number
Program Completion	KPI 13
Risk & Impact	KPI 14
Duplication	KPI 15
EA Customer	KPI 16

As shown in the FFEAM, EA use and compliance are needed for EA to be effective during program implementation. Moreover, this calls for more coherent architectures, certain governance processes, and greater maturity.

Although, as noted during the intermediate evaluations, EA may not be responsible for program completion in terms of budget and time, it could still play a big role here (Slot 2010). Again, it may be difficult to prove EA's influence on budgets and time. One could focus on finding correlations between EA aspects and project success (Slot 2010), or one could focus on stakeholders' views on whether EA helped complete enterprise-wide programs within budget and time. We decided to focus on this last option, as this is easier when certain data points are not available within an organization.

Risks can always occur during program implementation. As EA can be expected to foresee EA-related risks and impacts, it has some stake in the occurrence of such. Therefore, the case-based KPI linked to the category of “Risk and Impact” for the program implementation focus area focuses on the occurrence of those EA-related issues limiting ongoing business operations. Such issues include, for example, domain-integration problems. If domain-specific systems need to be integrated, but this appears to be hardly doable mid-program, this may be something EA should have foreseen. Note that a low occurrence of such issues does not prove EA's effectiveness here. A high occurrence of such issues however, may be an indication of EA's ineffectiveness at identifying and mitigating risks.

As EA crosses domain boundaries, it could provide a good overview of duplication within the enterprise-wide program portfolio. As pointed out by participants during the evaluations, duplication could be intentional. Therefore, the percentage-based KPI linked to the category of “Duplication” focuses on *unintentional* duplication within the enterprise-wide program portfolio. Unintentional duplication of programs or projects can be costly and is very inefficient. Thus, if duplication occurs, programs or projects may need to be terminated or merged. In some situations, continuation may need to be considered, depending on the kind of programs or projects and the state they are in.

In general, as was the case for the decision-making process, EA should help the EA customer during program implementation. EA stakeholders (and therefore EA customers) at this level include, for example, domain owners and domain architects (Van der Raadt 2011). The subjective KPI related to the “EA Customer” category for the program implementation focus area focuses on the extent to which those involved in program implementation feel EA facilitates communication,

provides insight and oversight, provides input and advice, and provides direction during this process.

Program Results that can be Attributed to EA

Table 4 links KPI numbers to the categories shown in the FFEAM for the program results focus area.

Table 4: KPI Linkage to Categories for the Program Results Focus Area

Category	KPI Number
Integration	KPI 17
IT Functionality	KPI 18
Short-term Solutions	KPI 19
Complexity	KPI 20, 21
Claims Met	KPI 22

An important definition for the program results focus area is that of a critical system: a distinct combination of business, information, applications, and infrastructure providing a certain critical service. During the evaluation session, participants rightfully noted that such “systems” should not be just about IT when it comes to EA. Moreover, again, EA use and compliance and increased levels of architecture, governance, and maturity are required for EA to be effective in this focus area, or to be held responsible for certain program results.

One of the key dimensions EA influences is that of integration (Ross et al. 2006, p.27), which:

“... links the efforts of organizational units through shared data.”

Integration in our view is about the extent to which critical systems communicate. Therefore, the percentage-based KPI linked to this category focuses on the identification of critical systems insufficiently communicating with other critical systems. If critical systems are not sufficiently integrated, this may cause business inefficiency. Thus, optimal ways of sharing data need to be found.

In the evaluation survey, participants argued that general stakeholder satisfaction with IT-enabled business capabilities may be hard to link to EA. However, as EA needs to work with program managers and should focus on the content of programs (Slot 2010), it has a stake in whether IT functionality resulting from enterprise-wide program implementations is eventually in line with what the business expected, which can be measured through a subjective KPI. A low level of satisfaction in this area could mean, for example, that the program delivered what it should, but that it did not align with stakeholder

interests. It could, however, also mean that the program did not deliver what it should have.

As became evident from the input interviews, EA is often considered longer-term, but should also be concerned with shorter-term aspects. In essence then, EA should make sure shorter-term solutions do not oppose longer-term strategic goals. Therefore, the percentage-based KPI linked to the category of “Short-term Solutions” focuses on the identification of critical systems posing a serious threat to the achievement of longer-term strategic goals. If this percentage is high, longer-term strategic goals may not be reached.

Complexity could mean different things in different contexts. Forms of complexity EA may influence are duplication and reuse, as EA is about crossing boundaries. Therefore, the percentage-based KPIs linked to this category focus on identifying critical systems unintentionally having similar or closely-related functionalities, and critical systems used by only one domain at most. Having a duplication of services or having services delivered by distinct critical systems that could be jointly delivered by one bigger system could be costly and may result in unnecessary overhead. Therefore, EA may need to look for ways in which such services could be combined. A lack of reuse may indirectly imply duplication. Moreover, a lack of reuse may be an indication of critical systems operating in an isolated manner, which could lead to a complex landscape consisting of individual silos.

Eventually, if EA makes certain claims (e.g., cost reduction due to reusing existing applications), these claims need to be met. In some cases, it can be very clear whether claims are met or not met, and how this impacts the organization. Therefore, the KPI linked to the category of “Claims Met” is a case-based one.

THREATS TO VALIDITY AND RESEARCH LIMITATIONS

Our semi-structured literature review approach may give rise to critique. As for the unstructured part, the use of Google and Google Scholar provides no way for ensuring that all relevant literature has been covered. As for the structured part, the focus was on finding articles as opposed to books or dissertations. Free full-text versions of articles were retrieved through Google, Google Scholar, and Leiden University. These searches were not exhaustive, which may have led to relevant papers being left out.¹ Nevertheless, we believe that our framework is, next to our other data, based on a quite

¹ This was the case, for example, for a paper by Espinosa, Boh, and DeLone (Espinosa et al. 2011), which we found during later stages of our research and which was therefore disregarded.

extensive collection of methods and metrics that can be used to measure EA effectiveness.

Although limited due to the use of a predetermined list of questions, the interviews may have left room for interviewer-bias. Focusing on qualitative methods in general leaves room for variability (Krefting 1991) as:

“... variability is expected in qualitative research.”

Moreover, evaluations of early designs, especially the intermediate evaluations, may be considered to have been informal. The evaluation survey, however, was more formal and structured.

Experts approached for the interviews and evaluations include consultants, researchers, and practitioners involved with EA in some way. As pointed out during the

evaluations, even though these experts may have focused on what is expected from EA, we did not focus specifically on identifying and including EA customers.

The FFEAM and its accompanying set of KPIs for EA effectiveness have not been applied in practice yet. Evaluations were done on a theoretical basis, therefore missing the “*Demonstration*” step that is part of design science research (Peffer, et al. 2006). Moreover, even though responses were limited, only complete answers on the evaluation survey were taken into account. Including a respondent’s incomplete answers as well may have led to different insights regarding the evaluation of the draft KPIs.

APPENDIX A: RESULTING SET OF KPIS FOR EA EFFECTIVENESS

No.	Name	Description
1	EA’s influence on IT stakeholders’ understanding of the business direction	Question: Does EA [Not at all 1 2 3 4 5 Very much] lead to an increased understanding of the business goals and strategy? Ask of: Key IT stakeholders involved in decision-making at enterprise level. KPI operationalization: The percentage of key IT stakeholders giving negative ratings.
2	EA’s influence on business stakeholders’ understanding of the IT landscape	Question: Does EA [Not at all 1 2 3 4 5 Very much] lead to an increased understanding of (1) the IT landscape, (2) IT financial information, and (3) IT innovation possibilities? Ask of: Key business stakeholders involved in decision-making at enterprise level. KPI operationalization: The percentage of key business stakeholders giving negative ratings.
3	EA’s influence on stakeholders’ understanding of the linkage between IT and business	Question: Does EA [Not at all 1 2 3 4 5 Very much] lead to an increased understanding of the way IT is, and can be, linked to business? Ask of: Key stakeholders involved in decision-making at enterprise level. KPI operationalization: The percentage of key stakeholders giving negative ratings.
4	EA’s influence on stakeholders’ understanding of risks and impacts	Question: Does EA [Not at all 1 2 3 4 5 Very much] lead to an increased understanding of the (1) risks, and (2) impacts of certain scenarios and decisions? Ask of: Key stakeholders involved in decision-making at enterprise level. KPI operationalization: The percentage of key stakeholders giving negative ratings.
5	EA’s influence on the ability of business and IT stakeholders to cooperate	Question: Does EA [Not at all 1 2 3 4 5 Very much] (1) facilitate the strategic dialog between business and IT, (2) promote IT as a driver or as “co-adaptive”, and (3) promote IT as a partner in creating value? Ask of: Key business and IT stakeholders involved in decision-making at enterprise level. KPI operationalization: The percentage of key business and IT stakeholders giving negative ratings.
6	EA’s influence on stakeholders’ ability to cooperate with external business partners	Question: Does EA [Not at all 1 2 3 4 5 Very much] (1) lead to an increased understanding of the way external business partners are, and can be, linked to the enterprise, and (2) facilitate communication with external business partners? Ask of: Key stakeholders involved in decision-making at enterprise level. KPI operationalization: The percentage of key stakeholders giving negative ratings.
7	EA’s influence on the speed of decision-making	Question: Does EA affect [Slows down 1 2 3 4 5 Speeds up] the speed of the decision-making process? Ask of: Key stakeholders involved in decision-making at enterprise level. KPI operationalization: The percentage of key stakeholders giving negative ratings.

No.	Name	Description
8	EA's contribution during decision-making	Question: Does EA [Not at all 1 2 3 4 5 Very much] help the EA customer during the decision-making process by (1) facilitating communication, (2) providing insight and oversight, and (3) providing input and advice? Ask of: Key stakeholders involved in decision-making at enterprise level. KPI operationalization: The percentage of key stakeholders giving negative ratings.
9	Mapping between IT strategic goals and business strategic goals	Mapping between: (1) IT strategic goals, and (2) business strategic goals. KPI operationalization: The percentages of (1) IT strategic goals not mapped to or competing with business strategic goals, and (2) business strategic goals not adequately supported by IT strategic goals.
10	Mapping between enterprise-wide programs and business strategic goals	Mapping between: (1) Enterprise-wide programs, both adopted (i.e., budgeted and planned for) and ongoing, and (2) business strategic goals. KPI operationalization: The percentages of (1) enterprise-wide programs not mapped to or competing with business strategic goals, and (2) business strategic goals not adequately supported by enterprise-wide programs.
11	Erroneous decisions prevented thanks to EA	Cases: (1) Inefficient or (2) ineffective decisions clearly prevented by EA (e.g., by suggesting better alternatives). KPI operationalization: (1) The number of cases, and (2) their theoretical impact.
12	Stakeholder satisfaction with the scope of the enterprise-wide program portfolio	Question: Does the scope of the enterprise-wide program portfolio, including both adopted (i.e., budgeted and planned for) and ongoing enterprise-wide programs, sufficiently support [Not at all 1 2 3 4 5 Fully] stakeholder interests? Ask of: Key stakeholders affected by enterprise-wide programs at enterprise and domain levels. KPI operationalization: The percentage of key stakeholders giving negative ratings.
13	EA's contribution to program completion	Question: Did EA [Not at all 1 2 3 4 5 Very much] help complete enterprise-wide programs, within (1) budget, and (2) time? Ask of: Key stakeholders involved in enterprise-wide program implementation. KPI operationalization: The percentage of key stakeholders giving negative ratings.
14	Occurrence of critical to business EA-related issues during enterprise-wide program implementation	Cases: EA-related issues (e.g., domain-integration problems) that limit ongoing business operations during enterprise-wide program implementation. KPI operationalization: (1) The number of cases, and (2) their impact.
15	Unintentional duplication within the enterprise-wide program portfolio	Determine: Number of programs or projects within the enterprise-wide program portfolio unintentionally aiming for something very similar to other programs, projects, or already existing solutions. KPI operationalization: As a percentage of the total number of programs or projects within the enterprise-wide program portfolio.
16	EA's contribution during enterprise-wide program implementation	Question: Does EA [Not at all 1 2 3 4 5 Very much] help the EA customer during enterprise-wide program implementation by (1) facilitating communication, (2) providing insight and oversight, (3) providing input and advice, and (4) providing directions? Ask of: Key stakeholders involved in enterprise-wide program implementation. KPI operationalization: The percentage of key stakeholders giving negative ratings.
17	Integration of critical systems with other critical systems	Determine: Number of critical systems insufficiently communicating with other critical systems. KPI operationalization: As a percentage of the total number of critical systems.
18	Business stakeholder satisfaction with IT functionality resulting from enterprise-wide program implementation	Question: Level of satisfaction [Very dissatisfied 1 2 3 4 5 Very satisfied] with IT functionality resulting from enterprise-wide program implementation? Ask of: Key business stakeholders at enterprise and domain levels. KPI operationalization: The percentage of key business stakeholders giving negative ratings.

No.	Name	Description
19	Existence of short-term focused critical systems	Determine: Number of short-term focused critical systems posing a serious threat to the achievement of longer-term strategic goals. KPI operationalization: As a percentage of the total number of critical systems.
20	Critical systems unintentionally having similar or closely-related functionalities	Determine: Number of critical systems unintentionally providing services similar or closely related to one or more other critical systems. KPI operationalization: As a percentage of the total number of critical systems.
21	Reuse of critical systems	Determine: Number of critical systems used by only one domain at most. KPI operationalization: As a percentage of the total number of critical systems.
22	Enterprise-wide programs meeting EA-related claimed benefits	Cases: Enterprise-wide programs where EA-related claimed benefits (e.g., reduced (IT) costs thanks to reuse, targeted cost savings achieved) are (1) met, or (2) not met. KPI operationalization: (1) The number of cases, and (2) their impact.

FUTURE WORK AND CONCLUSION

Future research could focus on the kind of processes that need to be put in place to be able to execute measurements, thus touching the topic of EA maturity and governance. Moreover, instead of determining EA effectiveness from an architecture point of view, future research could focus on what different groups of EA customers actually expect from EA. Also, as suggested during the evaluations and in line with related approaches (e.g., Plessius et al. 2012), future research could focus on ways to link the proposed KPIs to Balanced Scorecard areas. Finally, the FFEAM and its most recent set of KPIs for EA effectiveness need to be further evaluated, as they have been modified after the evaluation survey. Such an evaluation can be done through, for example, a demonstration in the form of case studies, which would be in line with our adopted design science approach (Peffer, et al. 2006). Such an approach could be focused on determining, in practice, which of the proposed KPIs are more useful or more applicable than others in certain situations. It should also lead to solid examples of how KPIs are eventually linked to several business goals and strategies, and stakeholder interests.

This study focuses on measuring EA effectiveness, something that is generally deemed difficult to do. We argue that focus areas in which EA effectiveness should be measured are: decision-making process, decision-making results, program implementation, and program results. In this article, we presented the current version of the Focus Framework for Enterprise Architecture Measurements (FFEAM) and its accompanying set of KPIs for EA effectiveness. These are based on both literature and expert views, and are the result of several evaluations and subsequent modifications.

The FFEAM truly shifts the focus of EA value measurements to EA effectiveness and its most important focus areas. The KPIs for EA effectiveness,

although they should still be linked to the business goals and strategy, and stakeholder interests, represent those metrics that we deem the most critical for determining EA success.

We argue that, eventually, every EA practice should be able to prove the extent to which it is effective.

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Wendy Günther completed her Bachelor Computer Science at the University of Amsterdam. She conducted this research as part of the Master's program ICT in Business at Leiden University, in collaboration with the Software Improvement Group (SIG), and completed this Master's in 2014. She is currently a PhD candidate at the Vrije Universiteit Amsterdam.

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Book Review

Ten Books on Architecture

By Marcus Vitruvius Pollio

Reviewed by Leonard Fehskens

Keywords

Book Review, Vitruvius, Ten Books on Architecture

INTRODUCTION

“Firmitas, Utilitas, Venustas” is probably one of the most frequently cited architecture-related quotations, especially within the Enterprise Architecture (EA) community. It comes from the Ten Books on Architecture (*De Architectura*, literally “On Architecture”) by Vitruvius, a Roman architect from the first century BCE. My impression is that of the people who quote this passage, almost none of them have actually read the book, or know where in the book the passage comes from (Book 1, Chapter 3, paragraph 2). It being Latin, there are a variety of different translations into modern English, among them “strength, durability, soundness, or firmness; utility, convenience, or commodity; and beauty, attractiveness, or delight”, which should suffice to get the idea across.

A LITTLE BIT ABOUT VITRUVIUS AND DE ARCHITECTURA

The Ten Books on Architecture were probably written around 25 BCE, give or take ten years. Vitruvius was by his own admission an old man at the time, but his birthdate is not accurately known, probably sometime between 90 and 70 BCE.

The importance of *De Architectura* to the (building) architecture community, especially historians of architecture, is a consequence of it being the oldest manuscript on Roman architecture to have survived (Roth 2014):

“He listed 63 Greek and Roman books on architecture that he consulted, some dating back to the fourth century BCE. Sadly, with time and periodic upheavals, both natural and human-caused, all but the treatise by Vitruvius himself have been lost”.

Vitruvius was, as he suggests in Book 1, Chapter 1 all architects should be, what would some 20 centuries later be called a renaissance man or polymath. This is apparent from the variety of subjects his book covers, a summary of which can be gleaned from the chapter headings; see the table of chapters at the end of this review. I will return to this consideration later. He was,

however, considered by his translators to be a merely adequate writer.

AVAILABLE EDITIONS

If you do want to read the book (more on this later), you have many options. This review considered three printed editions:

- Translation by Ingrid D. Rowland, commentary and illustrations by Thomas Noble Howe; Cambridge University Press (1999), paperback edition ISBN 0-521-00292-3, xvi + 333 pages.
- Translation by Morris Hicky Morgan, illustrations and original designs prepared under the direction of Herbert Langford Warren; Dover Publications (1960), paperback edition ISBN 0-486-20645-9, xii + 331 pages. This is “an unabridged and unaltered republication of the first edition of the English translation by Morris Hicky Morgan, originally published by the Harvard University Press in 1914”.
- Translation by Frank Granger; published in two hardbound volumes as part of the Loeb Classical Library (Nos. 251 and 280); Harvard University Press (1931), hardcover edition ISBNs 0-674-99277-6 and 0-674-99309-9, Vol. 1, xxxvi + 330 pages; Vol. 2, xlvi + 396 pages.

The Dover edition is by far the least expensive – the Cambridge and Harvard/Loeb editions are priced at about five times the cost of the Dover edition. The Cambridge edition has much larger pages (21.4 x 27.8cm) than the Dover (13.6cm x 20.1cm) and Harvard/Loeb (11.5cm x 16.7cm) editions. The Cambridge edition has many more illustrations (interspersed throughout its 182 pages of commentary) than the Dover and Harvard/Loeb editions, The Harvard/Loeb edition has more than twice as many pages as the Cambridge and Dover editions because it includes the Latin text and English translation on facing pages. (Note: this Latin text was apparently edited by Granger from the Harleian manuscript in the British Museum. The other translators did not edit the Latin source.) It also has more supplementary text. The

illustrations in the Dover edition are interlinear with the text, while the Cambridge and Harvard/Loeb editions group them at the end of each volume.

There are many resources available online. Among them:

- The Latin text of the book can be found at: <http://penelope.uchicago.edu/Thayer/E/Roman/Texts/Vitruvius/home.html>. This site also includes translations into English (by Joseph Gwilt, 1874) and Italian.
- A PDF of the scanned text of the 1914 Harvard University Press edition (used in the Dover edition) can be found at: http://academics.triton.edu/faculty/fheitzman/Vitruvius_the_Ten_Books_on_Architecture.pdf.
- An OCR'ed re-rendering of that text can be found at: <http://www.gutenberg.org/files/20239/20239-h/29239-h.htm>.
- There is a comprehensive review of the Cambridge edition at: <http://bmcr.brynmawr.edu/2000/2000-03-29.html>.

THE FAMOUS WORDS

Context

The “these” referred to in the translations are enumerated in the previous paragraph of the text. They largely correspond to the chapter headings of the subsequent books; again, see the table of chapters at the end of this review.

The Rowland Translation

All these works should be executed so that they exhibit the principles of soundness, utility, and attractiveness. The principle of soundness will be observed if the foundations have been laid firmly, and if, whatever the building materials may be, they have been chosen with care but not with excessive frugality. The principle of utility will be observed if the design allows faultless unimpeded use through the disposition of the spaces and the allocation of each type of space is properly oriented, appropriate, and comfortable. That of attractiveness will be upheld when the appearance of the work is pleasing and elegant, and the proportions of its elements have properly developed principles of symmetry.

The Morgan Translation

All these must be built with due reference to durability, convenience, and beauty. Durability will be assured when foundations are carried down to solid ground and materials wisely and liberally selected; convenience,

when the arrangement of the apartments is faultless and presents no hindrance to use, and when each class of building is assigned to its suitable and appropriate exposure; and beauty, when the appearance of the work is pleasing and in good taste, and when its members are in due proportion according to correct principles of symmetry.

The Granger Translation

Now these should be so carried out that account is taken of strength, utility, and grace. Account will be taken of strength when the foundations are carried down to the solid ground, and when from each material there is a choice of supplies without parsimony; of utility, when the sites are arranged without mistake and impediment to their use, and a fit and convenient disposition for the aspect of each kind; of grace, when the appearance of the work shall be pleasing and elegant, and the scale of the constituent parts is justly calculated for symmetry.

CONCLUSION: VITRUVIUS AND EA

Should Enterprise Architects read this book? Maybe. Must they? No.

I confess that I'm not sure the famous “firmitas, utilitas, venustas” trio has any real value for Enterprise Architects. Enterprises are not like buildings – about the only things they have in common are that they are artifacts designed, built, and used by people, which is also true of pretty much all artifacts. The ideas that things should be built soundly so that they do not fail, and that they should be useful, are not exactly blinding insights. A discipline that adopted as its fundamental principles the design and building of useless fragile things might make sense only as some ironic form of art.

Furthermore, it is not at all clear to me what “venustas” might mean when applied to an enterprise. One could argue that it would apply in the sense that “elegant” might apply to a mathematical proof, or to a design that exhibits “economy of mechanism”. The problem is that contrary to Vitruvius's apparent intent that architecture delight the ordinary citizen, not just other architects, these properties are generally recognizable only to expert practitioners of the relevant discipline. The rest of what's in the Ten Books has even less direct applicability to EA.

I have argued elsewhere that architecture is a special kind of design, and that because the EA community's use of the term “architecture” is a metaphor, not an assertion of isomorphism, the lessons we can learn from other architectural disciplines are more often actually lessons about design rather than architecture.

So the real reason to read Vitruvius is that, whatever the causal relationship, polymaths seem to make better

architects. I think this is especially true with respect to the variety of different design (including architectural) disciplines an architect is aware of.

It seems to me that the true value of *De Architectura* to an Enterprise Architect lies in its stark depiction of the role of cultural context on design (including architecture), and to a lesser extent, the effect of available implementation technologies. Culture affects design in several ways – it influences the kinds of problems we consider worth designing solutions to; it shapes the way we think about design and thus the approach we take to solving (i.e., designing solutions to) these problems; and finally, in conjunction with the technologies available to us, it determines the nature of the solutions we will

create to solve these problems. *De Architectura* presents these influences, which are often not readily apparent, in “high contrast” because we are separated from the culture of the Roman Empire by two thousand years.

ABOUT THE REVIEWER

Leonard Fehskens is the Chief Editor of the Journal of Enterprise Architecture.

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Table 1: Translation Chapter Headings

Book	Chapter	Dover/Morgan	Cambridge/Rowland	Harvard/Granger
1			First Principles and the Layout of Cities	Architectural Principles
		Preface	Preface	Preface
	1	The Education of the Architect	The Education of the Architect	On the Training of Architects
	2	The Fundamental Principles of Architecture	The Terms of Architecture	Of What Things Architecture Consists
	3	The Departments of Architecture	The Divisions of Architecture	On the Parts of Architecture
	4	The Site of a City	The Choice of a Healthful Site	On the Salubrity of Sites
	5	The City Walls	Construction of City Walls	On the Foundations of Walls and the Establishment of Towns
	6	The Directions of the Streets; with Remarks on the Winds	Orientation	Respecting the Division of the Works which are Inside the Walls and their Arrangement so that the Noxious Breath of the Winds may be Avoided
	7	The Sites for Public Buildings	Allocation of Public Spaces	On the Sites of Public Buildings
2			Building Materials	Evolution of Building: Use of Materials
		Introduction	Preface	Preface
	1	The Origin of the Dwelling House	The Invention of the Arts and of Building	The Origin of Building
	2	On the Primordial Substance according to the Physicists	First Principles	On the Principles of Things
	3	Brick	Mud-Brick Masonry	On Bricks
	4	Sand	Sand for Concrete Masonry	On Sand
	5	Lime	Lime for Concrete Masonry	On Lime
	6	Pozzolana	Pozzolana for Concrete Masonry	On Pozzolana
	7	Stone	Stone for Concrete Masonry	On Stone

Book	Chapter	Dover/Morgan	Cambridge/Rowland	Harvard/Granger
	8	Methods of Building Walls	Styles of Concrete Masonry, Stone Masonry	On Walling
	9	Timber	Timber	On Timber
	10	Highland and Lowland Fir	The Importance of Location in Timber Growth	Highland and Lowland Fir
3			Temples	Ionic Temples
		Introduction	Preface: Judgment of Artistic Skill	Preface
	1	On Symmetry: in Temples and in the Human Body	First Principles of Symmetry	The Planning of Temples
	2	Classification of Temples	Temple Types	On the Kinds of Temples
	3	The Proportions of Intercolumnations and of Columns	The Species of Temples	On the Elevations of Temples
	4	The Foundations and Substructures of Temples	Temple Construction	On the Foundations of Temples
	5	Proportions of the Base, Capitals, and Entablature in the Ionic Order	Ionic Column Bases, Capitals, and Entablatures	On the Ionic Order
4			Corinthian, Doric, and Tuscan Temples	Doric and Corinthian Temples
		Introduction	Preface	Preface
	1	The Origins of the Three Orders, and the Proportions of the Corinthian Capital	The Discovery of Symmetries	On the Corinthian Capital
	2	The Ornaments of the Orders	Architectural Ornament	On the Details of the Orders
	3	Proportions of Doric Temples	Doric Symmetries	On the Doric Order
	4	The Cella and Pronaos	Temple Interiors	On the Interior of the Temple, and the Pronaos
	5	How the Temple should Face	Orientation	On the Aspect of a Temple
	6	The Doorways of Temples	Temple Doors and Doorways	On the Doors of Temples
	7	Tuscan Temples	The Tuscan Temple	On the Tuscan Style
	8	Circular Temples and Other Varieties	Round Temples	On Circular Temples
	9	Altars	Altars	On Altars
5			Public Buildings	Public Buildings: Theatres (and Music), Baths, Harbours
		Introduction	Preface	Preface
	1	The Forum and Basilica	The Forum; Basilicas	On the Forum and Basilica
	2	The Treasury, Prison, and Senate House	Other Features of the Forum	On the Treasury, Prison, and Curia
	3	The Theatre: Its Site, Foundations, and Acoustics	Theaters	On the Site of the Theatre

Book	Chapter	Dover/Morgan	Cambridge/Rowland	Harvard/Granger
	4	Harmonics	Harmonic Principles	On Harmony
	5	Sounding Vessels in the Theatre	The Echea, Sounding Vessels in Theaters	On Sounding Vases in Theatres
	6	Plan of the Theatre	Theater Design	On the Planning of Theatres
	7	Greek Theatres	Greek Theaters	On Greek Theatres
	8	Acoustics of the Site of a Theatre	The Siting of Theaters	On Acoustics
	9	Colonnades and Walks	Porticoes	On Colonnades and Passages behind the Scenes
	10	Baths	Baths	On Baths
	11	The Palaestra	Palaestras	On the Palaestra
	12	Harbours, Breakwaters, and Shipyards	Ports	On Harbours and Shipyards
6			Private Buildings	Town and Country Houses
		Introduction	Preface	Preface
	1	On Climate as Determining the Style of the House	Latitudes and Peoples	The Influence of Climate upon Architecture
	2	Symmetry, and Modifications in it to Suit the Site	The Importance of Proportion and Optics	Proportion in Building
	3	Proportions of the Principal Rooms	Interiors (Cavaedia)	On the Plan of a House
	4	The Proper Exposures of the Different Rooms	Orientation of Rooms	On the Aspect of the Several Apartments
	5	How the Rooms should be Suited to the Station of the Owner	Correctness (Décor)	In Building Suitably for Different Ranks of Society
	6	The Farmhouse	Rural Buildings	On Farm Buildings
	7	The Greek House	Greek Houses	On Greek Mansions
	8	On Foundations and Substructures	Construction: Relieving Arches, Substructures, Retaining Walls	On the Stability of Buildings
7			Finishing	Interior Decoration
		Introduction	Preface	Preface
	1	Floors	Flooring	On Pavements
	2	The Slaking of Lime for Stucco	Plasterwork	On the Preparation of Stucco
	3	Vaultings and Stucco Work	Ceilings	On Stucco
	4	On Stucco Work in Damp Places, and on the Decoration of Dining Rooms	Plasterwork in Damp Locations	On Stucco in Damp Places
	5	The Decadence of Fresco Painting	Correctness in Painting: General Remarks	On Wall-Painting
	6	Marble for Use in Stucco	Marble Powder	On the Use of Marble

Book	Chapter	Dover/Morgan	Cambridge/Rowland	Harvard/Granger
	7	Natural Colours	Pigments	On Natural Colors
	8	Cinnabar and Quicksilver	Cinnabar	On Vermilion and Quicksilver
	9	Cinnabar (<i>continued</i>)	The Processing of Cinnabar	On the Preparation of Minium
	10	Artificial Colours. Black	Compound Pigments	On Black
	11	Blue. Burnt Ochre	Blue	On Blue and Yellow
	12	White Lead, Verdigris, and Artificial Sandarach	White Lead and Verdigris	In White Lead, Verdigris, Red Lead
	13	Purple	Purple	On Purple
	14	Substitutes for Purple, Yellow Ochre, Malachite Green, and Indigo	Substitute Pigments	On Artificial Colors
8			Water	Water-Supply
		Introduction	Preface	Preface
	1	How to find Water	Finding Water	On Finding Water
	2	Rainwater	Rainwater, River Water	On Rain-Water
	3	Various Properties of Different Waters	Springs	On the Nature of Different Waters
	4	Tests of Good Water	Testing Water	On Testing Water
	5	Levelling and Levelling Instruments	Leveling and the Chorobate	On the Method of Levelling
	6	Aqueducts, Wells, and Cisterns	Water Supply	On Aqueducts, Leaden, and Earthen Pipes
9			Sundials and Clocks	Dials and Clocks
		Introduction	Preface	Preface
	1	The Zodiac and the Planets	The Cosmos	On the Universe and the Planets
	2	The Phases of the Moon	The Moon	On the Rising and Waning of the Moon
	3	The Course of the Sun through the Twelve Signs	The Sun	On the Sun's Course through the Signs
	4	The Northern Constellations	Constellations to the Right of the Rising Sun	On the Northern Constellations
	5	The Southern Constellations	Constellations to the Left of the Rising Sun	On the Southern Constellations
	6	Astrology and Weather Prognostics	The History of Astronomy	On Astrology
	7	The Analemma and its Applications	Making the Analemma	On the Principles of Dialling
	8	Sundials and Water Clocks	Sundials and Water Clocks	On Various Dials and their Inventors
10			Machines	Mechanical and Military Engineering
		Introduction	Preface	Preface
	1	Machines and Implements	First Principles	On Machines and Implements

Book	Chapter	Dover/Morgan	Cambridge/Rowland	Harvard/Granger
	2	Hoisting Machines	Cranes and Hoists	On Machines Depending on Equilibrium
	3	The Elements of Motion	All Machines Use Two Types of Motion	On Rectilinear and Circular Traction
	4	Engines for raising Water	Raising Water	On Machines for Raising Water, and First the Tympanum
	5	Water Wheels and Water Mills	An Undershot Water Wheel	On Mill Wheels
	6	The Water Screw	The Water Screw	On the Water Screw
	7	The Pump of Ctesibius	The Water Pump of Ctesibius	On the Water Machine of Ctesibius
	8	The Water Organ	The Water Organ of Ctesibius	On Water Organs
	9	The Hodometer	The Hodometer	On Measuring a Journey
	10	Catapults or Scorpiones	Catapults	On Catapults
	11	Ballistae	Ballistae	On Ballistae
	12	The Stringing and Tuning of Catapults	Tuning War Machines	On the Preparation of Catapults and Ballistae
	13	Siege Machines	Diades and his Siege Engines	On Sieges
	14	The Tortoise	Siege Engines of Vitruvius and his Teachers	On the Tortoise for Filling Ditches
	15	Hegetor's Tortoise	More Siege Engines	On the Tortoise of Hegetor
	16	Measures of Defence	Defensive Stratagems	On Machinery for Defence



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