Architecture for the Information Age

Introduction

How are architecture practices changed by digitalization and the Information Age? If you can imagine the scale and complexity of the information your organization deals with every day, then you are starting to grasp the need for more advanced ways to manage, organize and visualize this complexity.

The Information Age challenges that are faced by our clients have led us, at Capgemini, to update our approach to architecture and the way we think about information architecture in particular.

Since 1993, Capgemini has developed its own approach of architecture through the Integrated Architecture Framework (IAF). We have now updated IAF to version 5.1 to address the Information Age challenges we have encountered with our clients.

Capgemini's Integrated Architecture Framework (IAF), is a comprehensive and flexible approach to undertaking Enterprise, Business and IT/Solutions Architecture, and is based on inputs from many of Capgemini's most experienced architects. Its development and use has continued to demonstrate our leadership in the domain and has frequently contributed crucial parts to worldwide standards, notably TOGAF.

Challenges

At Capgemini, we see our clients addressing a number of key challenges:-

- In the digital age, recognizing that mastery of data across the enterprise is the major challenge for profitability and staying competitive
- In an insight-focused revolution, understanding how enterprise information is managed in order to provide the quality of data required by their MI / Analytics / ML
- Struggling or failing to make MDM solutions work and needing to regroup around a better understanding of their enterprise Information
- For information managers, needing a solid architectural foundation (or way of structuring and modelling) to support management of enterprise information and data
- And as the digital age moves forward, recognizing that organically-grown integration landscapes are causing increasing obstacles to implementing new initiatives on time or with sufficient information quality.

At one European client, we estimated that major programs were being delayed by 15% because of a lack of understanding of their enterprise information and its ownership. On a 3 year program, that's an extra 6 months before the expected benefits start to take effect.

As the volume and complexity of information has grown, we know that our clients are finding it harder to mobilize their organizations around the information and data issues that they need to resolve which can be articulated as below:

- I wish I had a view of the flow of information in my organization

- I wish I could resolve the conflict between the data issues my projects want to resolve and the reality of information ownership

- I wish I had enough control of personal data that we hold to satisfy GDPR requirements

- I wish I had confidence that my target application landscape could support my enterprise information needs

- I wish I understood the difference between the information quality I need on the shop floor and what I need for marketing

- I wish my users trusted the data in the applications they used

- I wish I had traceability from my data models and standards to my information ownership and business goals

- I have a BI initiative, but how and where do I get the clean, high quality data that it needs

- I wish I knew how to best organize my Information Governance (IG) to get effective management of my information

- I wish I knew why the data used in my applications doesn't reflect the language used in my organization

Big data is not the new game in town anymore. Gartner removed it from their hype cycle in 2016, and it must now be considered business as normal in the information age. However organizations are still struggling to recognize this in their architecture approaches.

There is still a chasm between how business and IT understand the term "information", how they communicate

about the information needed to run a business, and how this translates into the data processed and shared by IT systems

Brief Case Studies

The following use cases discuss various areas of the IAF 5.1 update, which help with some selected client challenges.

1. Why the difference between information and data matters?

We distinguish clearly between information and data in IAF 5.1, defining information as data in context or for a purpose. This allows both architects and information managers to think more clearly about how they define rules and standards for data.

For example, if you just think about data, you would view the concept of 'address data' as something that probably has a single definition or single set of rules to manage it. However, as soon as you think about putting that data into different business contexts and see it as information, your view immediately changes.

It's possible to see that customer address data used in an order delivery process (Customer Delivery Address Information) is very different from customer address data used by your marketing department (Customer Current Address Information). So for example, if the zip code or post code is put in address line 4, it can still be delivered; but not being in the right field it is useless for marketing insight analysis.

Once these are seen as different kinds of Information, it is easier to understand that they need different standards and rules to govern them, and of course require different levels of information quality.

The IAF 5.1 content framework formalizes this thinking and gives the tools to structure and understand information within the business contexts. Being able to see your information in this way has profound effects on your Information Management (IM) decisions, on your enterprise architecture decisions, and on your solution design decisions.

The dangers of not understanding data in context can cause serious business disruption. One of our retail clients found they had a problem measuring business activity across their global business units, causing much wasted time in management arguments and disputed figures. One of the major causes of this was applying data rules to data flows across global systems. This prevented data from being passed on to their global management function if it didn't reach certain data quality criteria. With an understanding

of an information view, it was apparent that the defined business rules were being applied in an inappropriate situation, i.e. on integration.

2. Effects of Governance on IM and then on IS design

IAF 5.1 provides artefacts and traceability to clearly identify the major governance impacts on the use and treatment of the enterprise's information.

For example, understanding the business reality and constraints on Information Governance (IG), such as who really owns the information in the organization, allows not only appropriate IM decisions to be taken, but also broader IT decisions.

In most cases we find that IG has to follow business governance, and at least, cannot cut across or undermine it. If two parts of your organization can make separate IT buying decisions then they will make separate IM decisions. This can be assessed with artefacts in IAF 5.1 and the boundaries between different IT purchasing organizations can be identified in information sharing between business services. This leads to deeper understanding of the information rules that apply within each organization and which need to apply between the organizations. This has direct implications in say design decisions concerning data integration.

The IAF 5.1 content framework has artefacts that help assess the set of information within each governance domain or organization. It keeps traceability to the business architecture, allows clear assessments of the impact of these governance structures and the implications for Information Systems architecture.

The dangers of not understanding the effects of business and information governance on your treatment of data, or the design of your systems landscape, will directly effect your organization's ability to make decisions and conduct business. We frequently see organizations tryingto apply information or data rules and standards across organizational governance boundaries, with no will within the business to adhere to them. The IT department may try to enforce them, but the business dynamics in the separate organizations often mean exceptions and 'work arounds' are implemented locally as the rules and standards are increasingly ignored and left on the shelf.

IAF 5.1 provides a framework that helps an organization look at its data integration, its issues and effective design.

3. Getting to grips with Data Quality

IAF 5.1 provides a structure for understanding your required data quality within the correct business context, taking both business goals and risks into account.

For example, we worked with an global client who asked us to look at their data quality issues in a large e-commerce program. Architectural analysis showed that there were three different views of data quality: those defined by the e-commerce program; those defined by the global marketing organization; and those defined by the local business.

Because the e-commerce program was driving solution development, it was enforcing its particular view of data quality on other areas. For instance, it required a certain set of mandatory fields in a record, in order to allow that record to be accepted by the e-commerce platform. From the point of view of the local business, its current data quality, although not being perfect, was absolutely good enough for it to run a very profitable business; they certainly didn't need any of the so called "mandatory fields" to be mandatory in all cases.

Additionally, there was a serious consequence for the e-commerce program; in a number of scenarios it meant that a customer who had 'signed up' in the local business area, could not then access the e-commerce capability, unless of course they signed up again on the e-commerce site, thereby creating a duplicate identity - propagating more data issues.

The IAF 5.1 content framework allows traceability of business goals through the Information Architecture. As the Information Architecture is built up, both in terms of "information structure" and "information interaction with the business", we bring focus to six risk areas. These are six separate aspects of information risk that can affect the business. Based on these business goals for a specific business area and the associated risks, appropriate decisions can be made about data rules and the required levels of data quality needed to operate that business area effectively.

The dangers of not understanding the difference in data quality requirements in different parts of your business means that some areas may be forced to operate at higher costs to achieve a level of data quality that is well above that which is needed to run their business area. Conversely some areas of the business could be falling short of data quality needs that are vital to other areas of the business to function properly.

4. Regrouping around Information for improved Master Data Management (MDM)

IAF 5.1 provides techniques to understand how to best to work with semantic issues, conflicting business rules, and quality requirements and to give the necessary design foundation to establish effective MDM solutions.

For example, creating Master Data Management solutions in organizations, which have organically grown their IT systems and data, needs a thorough appreciation of how that data is used and by whom.

Working with one client, we noticed that in the case of product information, that the disparate areas of the organization that used it had very different understandings of that data, or even of what a 'product' was in their

organization. In this situation, the business analysts, working to integrate product data between the product development area of the business and the e-commerce area, couldn't initially establish the basis for communicating what a product or its attributes were, because the business languages used in the two areas were so far removed from each other. The current integrations, which passed data through many interfaces, produced so many issues that only a small proportion of products "got through" to the web store. The causes were not just semantic, but also driven by a series of misunderstandings about business rules, quality rules, formats, and different states of product information.

The IAF 5.1 content framework also allows us to build a view of information, such as product information, from the semantics of the information's use in areas of the business. This can be achieved right down to how that information is most effectively structured according to the principles and goals of the organization, and finally to appropriate business rules and standards in the context of how the data is used.

IAF 5.1 enables this while modeling how that information flows and changes as it passes through the organization and the impact this has on IT systems and system design. This modelling allows us to assess the timeliness, availability of information flows, and through this traceability determine if the data that arrives at a user interface is fit for purpose (or design it to be so).

The dangers of not being able to have a good view of these master data challenges can lead to delayed or paralyzed MDM programs, with the business not being able to realize the vision they have of operating with the "single version of the truth" that they so often need.

5. How to bring the focus onto Data Integration

IAF 5.1 provides a framework that helps an organization look at its data integration, its issues and effective design. By data integration, we mean the flow of data across the organization, which of course includes how that data is exchanged between IT systems. IAF of course deals with other aspects of integration, the technical infrastructure required as well as any functional or orchestration designs. However, IAF 5.1. brings the focus on information, which lets us look at the data exchange issues within the context of how the organization uses and manages its information.

For example, many integration issues arise out of how an organization buys its IT systems or services. We may see instances where the sales department owns the CRM system, while the customer service area owns the call center systems;

also the global organization owns the website, while the local business units their individual CRM systems, etc.

As a result of owning their own systems and having their own P&L, IT governance (if in place) often fails or is too weak to override the immediate business imperatives to upgrade those systems. So, when inevitably they need to upgrade their system, the data often changes; however it is the data exchange with other systems that suffers, because often integration is left out of scope and any complementary updates needed in other systems doesn't happen. Even where IT governance is in place to manage integrations, we often find that the data is not the focus, but treated more as a commodity that just flows "down the integration pipe". As a result, the organization's ability to exchange data effectively around the organization is degraded, bit by bit, month by month.

The IAF 5.1 content framework has artefacts to support these data integration issues:

- The ability to model governance (as indicated earlier). This enables us to build a view of how data is exchanged, with a focus on how the organization's information is governed, no matter how complex or changeable that business governance is. Once it is recognized by an architect, it can be modelled, and its effect on the organization's management of information can also be modelled. With these insights, it is possible to design the best approach to data integration that works for that organization.
- The ability to understand information quality in a structured, traceable way. This answers the question of what the data quality should be in the context of each part of the organization where the data is used. Understanding the differing data quality requirements of separate areas of a business, using the same data, allows design decisions about how data quality is dealt with in integrations to be made - based on some objective assessment.

The dangers of not being able to understand your organization's data integration landscape is an inevitable degradation in data quality as your data moves around systems. We have seen good data being blocked by integration, or feedback loops in integrations where data corrected manually yesterday gets flipped back to yesterday's state - day after day. We've seen uncontrolled growth of duplicates, as well as systems receiving their data, but just in a semantic or syntactic state that they cannot use at all.

The Focus of IAF 5.1

Information Architecture is an essential part of the Capgemini Information Value Chain; the way we see an organization's Information, contributing to business outcomes. Without the in-depth understanding that Information Architecture brings, the whole value chain is weakened and the expected business outcomes are diluted.

Figure 1 - Capgemini's Information Value Chain
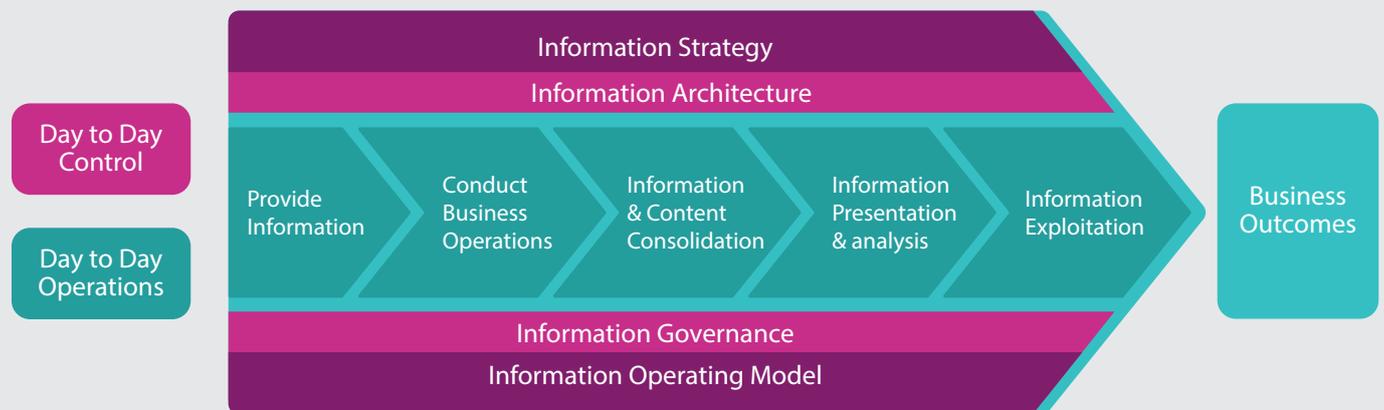
Working on IAF client engagements, we've experienced the reality of our clients' challenges and have applied the underlying principles of IAF to help resolve them. The core abstraction levels of IAF lead to a way of thinking about architecture that is insightful in many aspects of our work, from Information Strategy, Information Governance, Business Information Service Centers, Insight generation, MDM program delivery etc.

Figure 2 - Abstraction Levels of IAF

WHY do we need the Architecture? **Business Drivers, Objectives and Scope**	HOW to address these needs? **Components and Interactions**
WHAT are the needs? **Services and Interfaces**	WITH WHAT to address these needs? **Structures, Standards and Guidelines**

IAF is, in essence, agile so we can use particular aspects of the framework as the situation demands. So when an Information Manager needs to see the flow of information across the whole business, IAF provides a ready **artefact** to support this. When we need to identify how Information Governance should work (i.e. which information is owned by whom, in which part of the business), then IAF has a way of thinking that gives us a clear, crisp and clean view of this.

Over time, we have adapted the framework, made small upgrades, and clarifications within IAF, culminating in IAF 5.1, which makes dealing with these Information Age challenges that much easier.

In upgrading IAF, we needed to find ways of:

1. Baking in data quality, and how data quality is seen in the context of different parts of the organization - in other words an overall view of Information Quality;
2. Providing a link between IAF Information Artifacts and the practice of data architecture;
3. Strengthening data migration approaches - allowing clear definition of data end state quality, alongside business and systems;
4. Adding an 'information-first' approach to sit alongside the business- and systems-first approaches;
5. Recognizing and embedding the language of an organization into an architecture, to allow data and IS designs that are more intuitive and usable, plus improving data quality and data trust issues;
6. Molding the use of Information Domains and Information Interaction models so they would be more useful to Information Managers and the governance of information;
7. Assessing better the risks involved with using information and the traceability between information risk assessment and information quality; and
8. Clarifying the use of the Logical Information Model and the important role it plays in linking Information Security and Governance to Information Policy, Information Standards and Logical Data Models.

All of this allows organizations to build comprehensive views of how they use their information, where and why they use it – no matter how complex or the volume of information they have.

Conclusion

IAF 5.1 is now the Architecture Framework for operating with the digital challenges of the Information Age. This helps us connect digital initiatives with the emphasis on Information Governance and Information Management that our clients need to be successful.

With this development in IAF, we can help our clients to ensure that Information Architecture is a major focus of any Enterprise Architecture or Solution Architecture initiative.

We can deliver information architectures that the business own, that align with governance and that provide traceability to good Information System / Technical Infrastructure design.

IAF 5.1 is a tool that allows us to mine the underlying seam of value in digital - INFORMATION

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