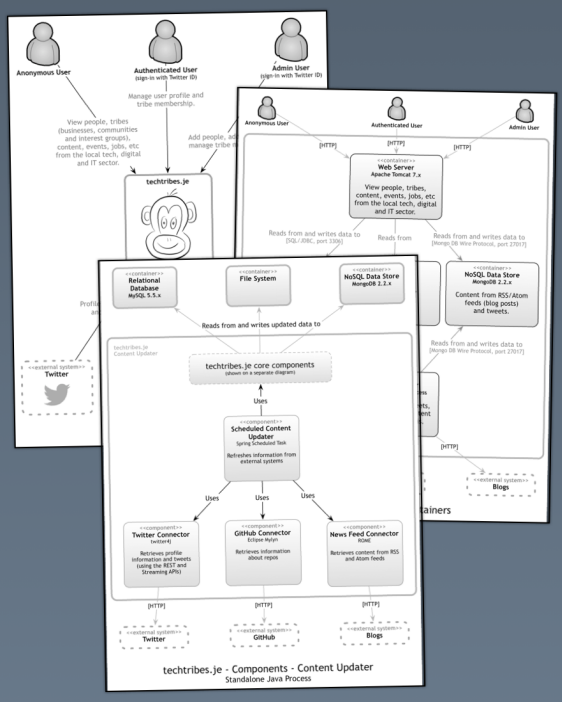
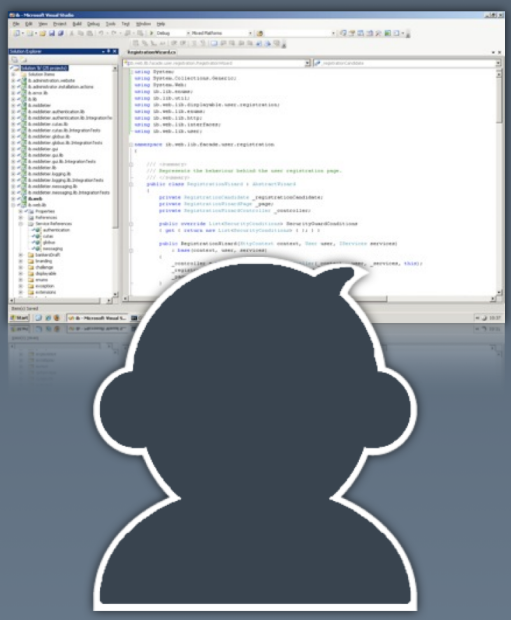
coding {the} architecture

Software Architecture for Developers

A developer-friendly guide to software architecture, technical leadership and the balance with agility





Coding, coaching, collaboration, sketching and just enough up front design

Simon Brown

Software Architecture for Developers

A developer-friendly guide to software architecture, technical leadership and the balance with agility

Simon Brown

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For Kirstie, Matthew and Oliver

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Software Design & Development Conference 2014

This extract is brought to you by the SDD conference, an annual event which takes place at the Barbican Centre in London. Simon Brown is presenting the keynote session at SDD 2014 in May, on the subject of Software Architecture vs. Code.

For more information about the conference, please visit the website or follow @sddconf on Twitter.

To buy the full version of this book at a reduced price, please use this URL: http://leanpub.com/software-architecture-for-developers/c/53h5OOobSLNk

Preface

The IT industry is either taking giant leaps ahead or it's in deep turmoil. On the one hand we're pushing forward, reinventing the way that we build software and striving for craftsmanship at every turn. On the other though, we're continually forgetting the good of the past and software teams are still screwing up on an alarmingly regular basis.

Software architecture plays a pivotal role in the delivery of successful software yet it's frustratingly neglected by many teams. Whether performed by one person or shared amongst the team, the software architecture role exists on even the most agile of teams yet the balance of up front and evolutionary thinking often reflects aspiration rather than reality.

Software architecture has a bad reputation

I tend to get one of two responses if I introduce myself as a software architect. Either people think it's really cool and want to know more or they give me a look that says "I want to talk to somebody that actually writes software, not a box drawing hand-waver". The software architecture role has a bad reputation within the IT industry and it's not hard to see where this has come from.

The thought of "software architecture" conjures up visions of ivory tower architects doing big design up front and handing over huge UML (Unified Modeling Language) models or 200 page Microsoft Word documents to an unsuspecting development team as if they were the second leg of a relay race. And that's assuming the architect actually gets involved in designing software of course. Many people seem to think that creating a Microsoft PowerPoint presentation with a slide containing a big box labelled "Enterprise Service Bus" *is* software design. Oh, and we mustn't forget the obligatory narrative about "ROI" (return on investment) and "TCO" (total cost of ownership) that will undoubtedly accompany the presentation.

Many organisations have an interesting take on software development as a whole too. For example, they've seen the potential cost savings that offshoring can bring and therefore see the coding part of the software development process as being something of a commodity. The result tends to be that local developers are pushed into the "higher value" software architecture jobs with an expectation that all coding will be undertaken by somebody else. In many cases this only exaggerates the disconnect between software architecture and software development, with people often being pushed into a role that they are not prepared for. These same organisations often tend to see software architecture as a rank rather than a *role* too.

Agile aspirations

"Agile" might be over ten years old, but it's still the shiny new kid in town and many software teams have aspirations of "becoming agile". Agile undoubtedly has a number of benefits but it

isn't necessarily the silver bullet that everybody wants you to believe it is. As with everything in the IT industry, there's a large degree of evangelism and hype surrounding it. Start a new software project today and it's all about self-organising teams, automated acceptance testing, continuous delivery, retrospectives, Kanban boards, emergent design and a whole host of other buzzwords that you've probably heard of. This is fantastic but often teams tend to throw the baby out with the bath water in their haste to adopt all of these cool practices. "Non-functional requirements" not sounding cool isn't a reason to neglect them.

What's all this old-fashioned software architecture stuff anyway? Many software teams seem to think that they don't need software architects, throwing around terms like "self-organising team", "YAGNI" (you aren't going to need it), "evolutionary architecture" and "last responsible moment" instead. If they do need an architect, they'll probably be on the lookout for an "agile architect". I'm not entirely sure what this term actually means, but I assume that it has something to do with using post-it notes instead of UML or doing TDD (test-driven development) instead of drawing pictures. That is, assuming they get past the notion of only using a very high level system metaphor and don't use "emergent design" as an excuse for foolishly hoping for the best.

So you think you're an architect?

It also turns out there are a number of people in the industry claiming to be software architects whereas they're actually doing something else entirely. I can forgive people misrepresenting themselves as an "Enterprise Architect" when they're actually doing hands-on software architecture within a large enterprise. The terminology in our industry *is* often confusing after all.

But what about those people that tend to exaggerate the truth about the role they play on software teams? Such irresponsible architects are usually tasked with being the technical leader yet fail to cover the basics. I've seen public facing websites go into a user acceptance testing environment with a number of basic security problems, a lack of basic performance testing, basic functionality problems, broken hyperlinks and a complete lack of documentation. And that was just my external view of the software, who knows what the code looked like. If you're undertaking the software architecture role and you're delivering stuff like this, you're doing it wrong. This *isn't* software architecture, it's also foolishly hoping for the best.

The frustrated architect

Admittedly not all software teams are like this but what I've presented here isn't a "straw man" either. Unfortunately many organisations do actually work this way so the reputation that software architecture has shouldn't come as any surprise.

If we really do want to succeed as an industry, we need to get over our fascination with shiny new things and starting asking some questions. Does agile need architecture or does architecture actually need agile? Have we forgotten more about good software design than we've learnt in recent years? Is foolishly hoping for the best sufficient for the demanding software systems we're building today? Does any of this matter if we're not fostering the software architects of tomorrow? How do we move from frustration to serenity?

About the book

This book is a practical, pragmatic and lightweight guide to software architecture for developers. You'll learn:

- The essence of software architecture.
- Why the software architecture role should include coding, coaching and collaboration.
- The things that you *really* need to think about before coding.
- How to visualise your software architecture using simple sketches.
- A lightweight approach to documenting your software.
- Why there is *no* conflict between agile and architecture.
- What "just enough" up front design means.
- How to identify risks with risk-storming.

This collection of essays knocks down traditional ivory towers, blurring the line between software development and software architecture in the process. It will teach you about software architecture, technical leadership and the balance with agility.

Why did I write the book?

Like many people, I started my career as a software developer, taking instruction from my seniors and working with teams to deliver software systems. Over time, I started designing smaller pieces of software systems and eventually evolved into a position where I was performing what I now consider to be the software architecture role.

I've worked for IT consulting organisations for the majority of my career, and this means that most of the projects that I've been involved with have resulted in software systems being built either *for* or *with* our customers. In order to scale an IT consulting organisation, you need more people and more teams. And to create more teams, you need more software architects. And this leads me to why I wrote this book:

1. **Software architecture needs to be more accessible**: Despite having some fantastic mentors, I didn't find it easy to understand what was expected of me when I was moving into my first software architecture roles. Sure, there are lots of software architecture books out there, but they seem to be written from a different perspective. I found most of them very research oriented or academic in nature, yet I was a software developer looking for real-world advice. I wanted to write the type of book that I would have found useful at that stage in my career - a book about software architecture aimed at software developers.

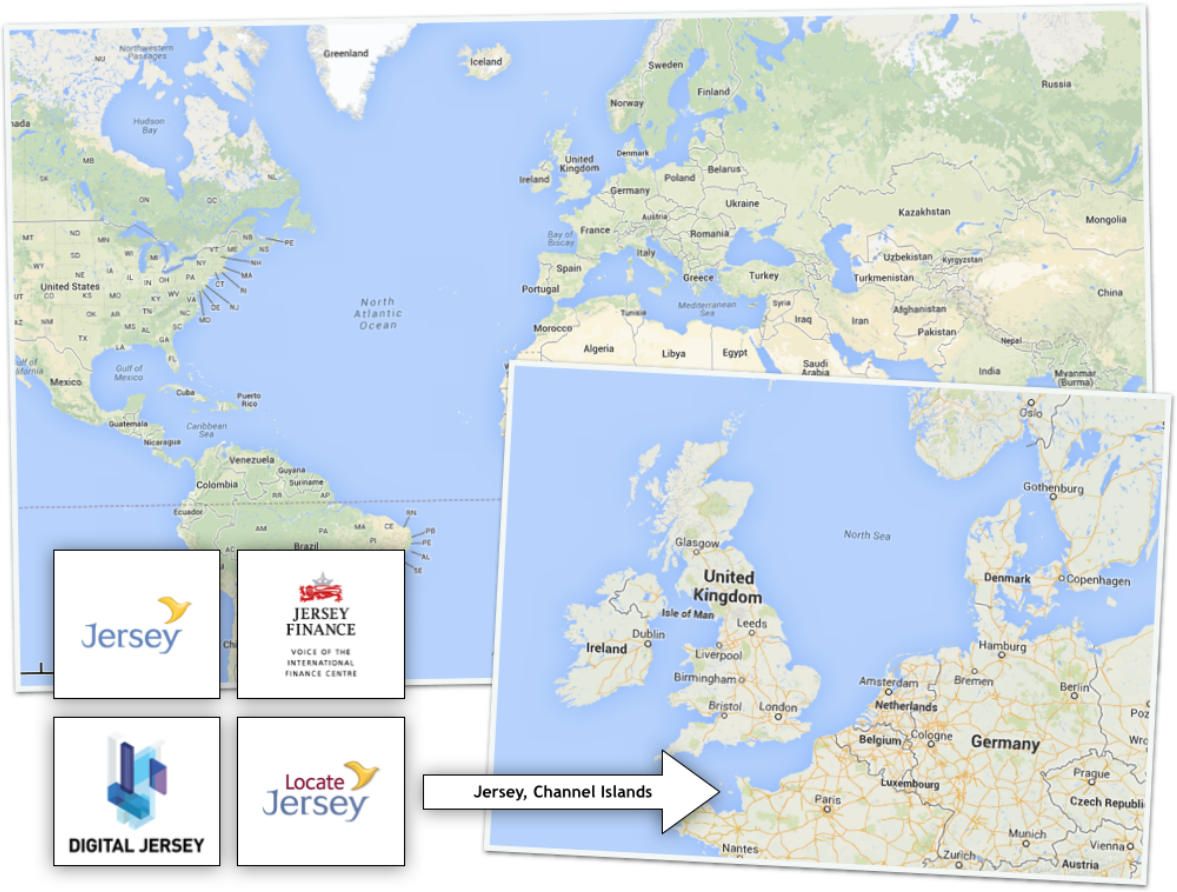
2. **All software projects need software architecture**: I like agile approaches, I really do, but the lack of explicit regard for software architecture in many of the approaches doesn't sit well with me. Agile approaches don't say that you shouldn't do any up front design, but they often don't explicitly talk about it either. I've found that this causes people to jump to the wrong conclusion and I've seen the consequences that a lack of any up front thinking can have. I also fully appreciate that big design up front isn't the answer either. I've always felt that there's a happy medium to be found where *some* up front thinking is done, particularly when working with a team that has a mix of experiences and backgrounds. I favour a lightweight approach to software architecture that allows me to put *some* building blocks in place as early as possible, to stack the odds of success in my favour.
3. **Lightweight software architecture practices**: I've learnt and evolved a number of practices over the years, which I've always felt have helped me to perform the software architecture role. These relate to the software design process and identifying technical risks through to communicating and documenting software architecture. I've always assumed that these practices are just common sense, but I've discovered that this isn't the case. I've taught these practices to thousands of people over the past few years and I've seen the difference they can make. A book helps me to spread these ideas further, with the hope that other people will find them useful too.

A new approach to software development?

This book *isn't* about creating a new approach to software development, but it does seek to find a happy mid-point between the excessive up front thinking typical of traditional methods and the lack of any architecture thinking that often happens in software teams who are new to agile approaches. There **is** room for up front design and evolutionary architecture to coexist.

About the author

Simon lives in Jersey (the largest of the Channel Islands) and works as an independent consultant, specialising in software architecture, technical leadership and the balance with agility. Simon is an award-winning speaker on the topic of software architecture and provides consulting/training to software teams at organisations across Europe, ranging from small startups through to global blue chip companies. He is the founder of Coding the Architecture, which is a website for hands-on software architects. He still codes too.



Simon has a website at http://www.simonbrown.je and can be found on Twitter at simonbrown.

Software architecture training

Designing software given a vague set of requirements and a blank sheet of paper is a great skill to have, although not many people get to do this on a daily basis. However, with agile methods encouraging collective ownership of the code, it's really important that everybody on the team understands the big picture. And in order to do this, you need to understand why you've arrived at the design that you have. In a nutshell, everybody on the team needs to understand software architecture.

This book is also available as a one or two day training course where we'll show you what "just enough" up front design is, how it can be applied to your software projects and how to communicate the big picture through a collection of simple effective sketches. Aimed at software developers, it fills the gap between software development and high-level architecture that probably seems a little "enterprisey" for most developers. You'll find it useful if any of the following scenarios sound familiar:

- I'm not sure what software architecture is about and how it's any different from design.
- I don't understand why we need "software architecture".
- My manager has told me that I'm the software architect on our new project, but I'm not sure what that actually means.
- I want to get involved in designing software but I'm not sure what I should learn.
- I've been given some requirements and asked to design some software, but I'm not sure where to start.
- I need to make some major enhancements to my system, but I'm not sure where to start.
- I've been asked to write a software architecture document but I'm not sure what to include in it.
- I'm not sure who to talk to in my organisation about how best to integrate what we're building.
- I understand what software architecture is all about, but I'm not sure how to tackle it on my project.
- My project seems like a chaotic mess; everybody is doing their own thing and there's no shared vision. Help!

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I What is software architecture?

In this part of the book we'll look at what software architecture is about, the difference between architecture and design, what it means for an architecture to be agile and why thinking about software architecture is important.

1 What is architecture?

The word “architecture” means many different things to many different people and there are many different definitions floating around the Internet. I’ve asked hundreds of people over the past few years what “architecture” means to them and a summary of their answers is as follows. In no particular order…

- Modules, connections, dependencies and interfaces
- The big picture
- The things that are expensive to change
- The things that are difficult to change
- Design with the bigger picture in mind
- Interfaces rather than implementation
- Aesthetics (e.g. as an art form, clean code)
- A conceptual model
- Satisfying non-functional requirements/quality attributes
- Everything has an “architecture”
- Ability to communicate (abstractions, language, vocabulary)
- A plan
- A degree of rigidity and solidity
- A blueprint
- Systems, subsystems, interactions and interfaces
- Governance
- The outcome of strategic decisions
- Necessary constraints
- Structure (components and interactions)
- Technical direction
- Strategy and vision
- Building blocks
- The process to achieve a goal
- Standards and guidelines
- The system as a whole
- Tools and methods
- A path from requirements to the end-product
- Guiding principles
- Technical leadership
- The relationship between the elements that make up the product
- Awareness of environmental constraints and restrictions
- Foundations

- An abstract view
- The decomposition of the problem into smaller implementable elements
- The skeleton/backbone of the product

No wonder it's hard to find a single definition! Thankfully there are two common themes here … architecture as a noun and architecture as a verb, with both being applicable regardless of whether we're talking about constructing a physical building or a software system.

As a noun

As a noun then, architecture can be summarised as being about structure. It's about the decomposition of a product into a collection of components/modules and interactions. This needs to take into account the whole of the product, including the foundations and infrastructure services that deal with cross-cutting concerns such as power/water/air conditioning (for a building) or security/configuration/error handling (for a piece of software).

As a verb

As a verb, architecture (i.e. the process, architecting) is about understanding what you need to build, creating a vision for building it and making the appropriate design decisions. All of this needs to be based upon requirements because **requirements drive architecture**. Crucially, it's also about communicating that vision and introducing technical leadership so that everybody involved with the construction of the product understands the vision and is able to contribute in a positive way to its success.

2 Types of architecture

There are many different types of architecture and architects within the IT industry alone. Here, in no particular order, is a list of those that people most commonly identify when asked…

- Infrastructure
- Security
- Technical
- Solution
- Network
- Data
- Hardware
- Enterprise
- Application
- System
- Integration
- IT
- Database
- Information
- Process
- Business
- Software

The unfortunate thing about this list is that some of the terms are easier to define than others, particularly those that refer to or depend upon each other for their definition. For example, what does "solution architecture" actually mean? For some organisations "solution architect" is simply a synonym for "software architect" whereas others have a specific role that focusses on designing an overall "solution" to a problem, but stopping before the level at which implementation details are discussed. Similarly, "technical architecture" is vague enough to refer to software, hardware or a combination of the two.

Interestingly, "software architecture" typically appears near the bottom of the list when I ask people to list the types of IT architecture they've come across. Perhaps this reflects the confusion that surrounds the term.

What do they all have in common?

What do all of these terms have in common then? Well, aside from suffixing each of the terms with "architecture" or "architect", all of these types of architecture have structure and vision in common.

Take "infrastructure architecture" as an example and imagine that you need to create a network between two offices at different ends of the country. One option is to find the largest reel of network cable that you can and start heading from one office to the other in a straight line. Assuming that you had enough cable, this could potentially work, but in reality there are a number of environmental constraints and non-functional characteristics that you need to consider in order to actually deliver something that satisfies the original goal. This is where the process of architecting and having a vision to achieve the goal is important.

One single long piece of cable is *an* approach, but it's not a very good one because of real-world constraints. For this reason, networks are typically much more complex and require a collection of components collaborating together in order to satisfy the goal. From an infrastructure perspective then, we can talk about structure in terms of the common components that you'd expect to see within this domain; things like routers, firewalls, packet shapers, switches, etc.

Regardless of whether you're building a software system, a network or a database; a successful solution requires you to understand the problem and create a vision that can be communicated to everybody involved with the construction of the end-product. Architecture, regardless of the domain, is about structure and vision.

3 What is software architecture?

At first glance, "software architecture" seems like an easy thing to define. It's about the architecture of a piece of software, right? Well, yes, but it's about more than just software.

Application architecture

Application architecture is what we as software developers are probably most familiar with, especially if you think of an "application" as typically being written in a single technology (e.g. a Java web application, a desktop application on Windows, etc). It puts the application in focus and normally includes things such as decomposing the application into its constituent classes and components, making sure design patterns are used in the right way, building or using frameworks, etc. In essence, application architecture is inherently about the lower-level aspects of software design and is usually only concerned with a single technology stack (e.g. Java, Microsoft .NET, etc).

The building blocks are predominantly software based and include things like programming languages and constructs, libraries, frameworks, APIs, etc. It's described in terms of classes, components, modules, functions, design patterns, etc. Application architecture is predominantly about software and the organisation of the code.

System architecture

I like to think of system architecture as one step up in scale from application architecture. If you look at most software systems, they're actually composed of multiple applications across a number of different tiers and technologies. As an example, you might have a software system comprised of a .NET Silverlight client accessing web services on a Java EE middle-tier, which itself consumes data from an Oracle database. Each of these will have their own application architecture.

For the overall software system to function, thought needs to be put into bringing all of those separate applications together. In other words, you also have the overall structure of the end-to-end software system at a high-level. Additionally, most software systems don't live in isolation, so system architecture also includes the concerns around interoperability and integration with other systems within the environment.

The building blocks are a mix of software and hardware, including things like programming languages and software frameworks through to servers and infrastructure. Compared to application architecture, system architecture is described in terms of higher levels of abstraction; from components and services through to sub-systems. Most definitions of system architecture include references to software *and* hardware. After all, you can't have a successful software system without hardware, even if that hardware is virtualised somewhere out there on the cloud.

Software architecture

Unlike application and system architecture, which are relatively well understood, the term "software architecture" has many different meanings to many different people. Rather than getting tied up in the complexities and nuances of the many definitions of software architecture, I like to keep the definition as simple as possible. For me, software architecture is simply the combination of application and system architecture.

In other words, it's anything and everything related to the significant elements of a software system; from the structure and foundations of the code through to the successful deployment of that code into a live environment. When we're thinking about software development as software developers, most of our focus is placed on the code. Here, we're thinking about things like object oriented principles, classes, interfaces, inversion of control, refactoring, automated unit testing, clean code and the countless other technical practices that help us build better software. If your team consists of people who are *only* thinking about this, then who is thinking about the other stuff?

- Cross-cutting concerns such as logging and exception handling.
- Security; including authentication, authorisation and confidentiality of sensitive data.
- Performance, scalability, availability and other quality attributes.
- Audit and other regulatory requirements.
- Real-world constraints of the environment.
- Interoperability/integration with other software systems.
- Operational, support and maintenance requirements.
- Consistency of structure and approach to solving problems/implementing features across the codebase.
- Evaluating that the foundations you're building will allow you to deliver what you set out to deliver.

Sometimes you need to step back, away from the code and away from your development tools. This doesn't mean that the lower-level detail isn't important because working software is ultimately about delivering working code. No, the detail is equally as important, but the big picture is about having a holistic view across your software to ensure that your code is working toward your overall vision rather than against it.

Enterprise architecture - strategy rather than code

Enterprise architecture generally refers to the sort of work that happens centrally and across an organisation. It looks at how to organise and utilise people, process and technology to make an organisation work effectively and efficiently. In other words, it's about how an enterprise is broken up into groups/departments, how business processes are layered on top and how technology underpins everything. This is in very stark contrast to software architecture because it doesn't necessarily look at technology in any detail. Instead, enterprise architecture might look

at how best to use technology across the organisation without actually getting into detail about how that technology works.

While some developers and software architects do see enterprise architecture as the next logical step up the career ladder, most probably don't. The mindset required to undertake enterprise architecture is very different to software architecture, taking a very different view of technology and its application across an organisation. Enterprise architecture requires a higher level of abstraction. It's about breadth rather than depth and strategy rather than code.

4 What is agile software architecture?

In my experience, people tend to use the word "agile" to refer to a couple of things. The first is when talking about agile approaches to software development; moving fast, embracing change, releasing often, getting feedback and so on. The second use of the word relates to the agile mindset and how people work together in agile environments. This is usually about team dynamics, systems thinking, psychology and other things you might associate with creating high performing teams.

Leaving the latter "fluffy stuff" aside, for me, labelling a software architecture as being "agile" means that it can react to change within its environment, adapting to the ever changing requirements that people throw at it. This isn't necessarily the same as the software architecture that an agile team will create. Delivering software in an agile way doesn't guarantee that the resulting software architecture will be agile. In fact, in my experience, the opposite typically happens because teams are more focussed on delivering functionality rather than looking after their architecture.

Understanding "agility"

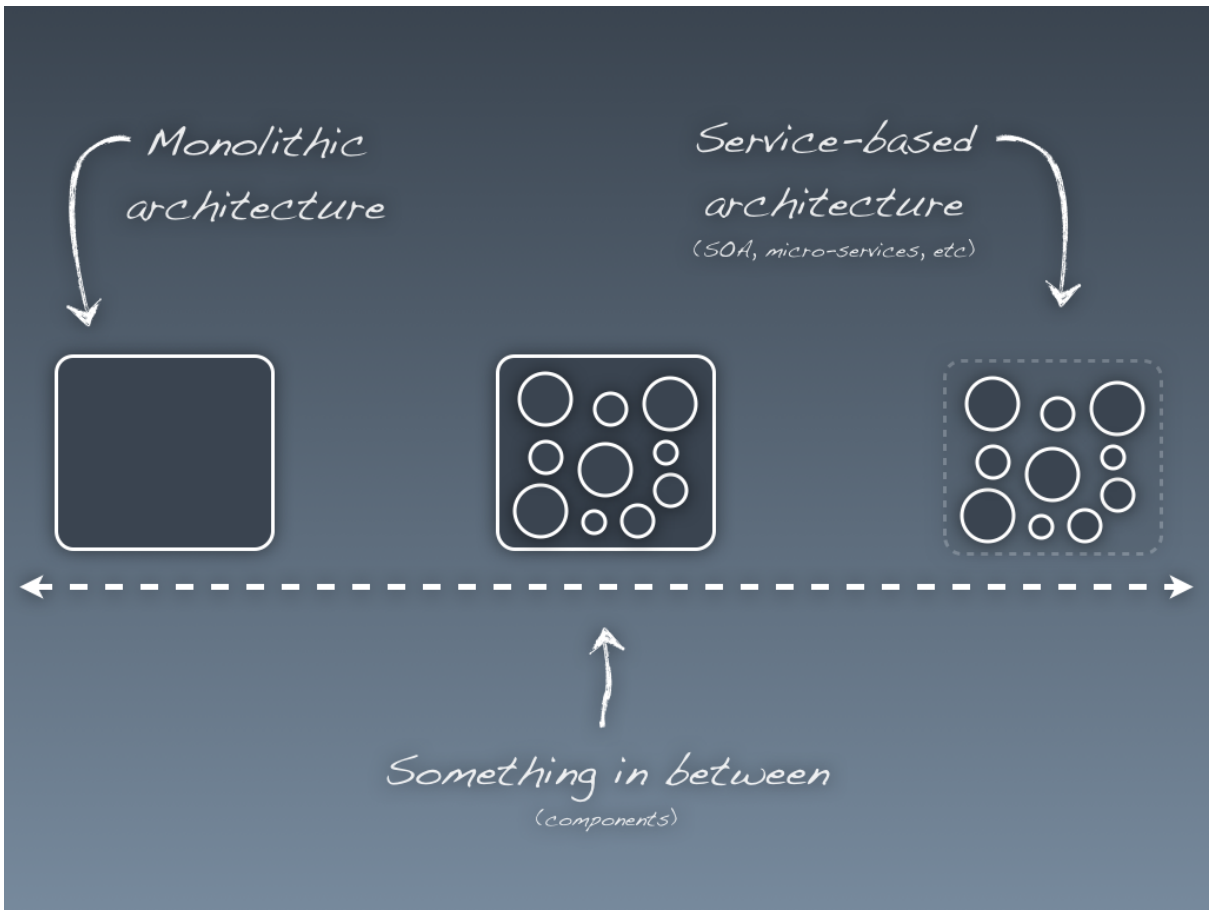
To understand how much agility you need from your software architecture, it's worth looking at what agility means. John Boyd, a fighter pilot in the US Air Force, came up with a concept that he called the OODA loop - Observe, Orient, Decide and Act. In essence, this loop forms the basis for the decision making process. Imagine that you are a fighter pilot in a dogfight with an adversary. In order to outwit your opponent in this situation, you need to observe what's happening, orient yourself (e.g. do some analysis), decide what to do and then act. In the heat of the battle, this loop needs to be executed as fast as possible to avoid being shot down by your opponent. Boyd then says that you can confuse and disorient your opponent if you can get inside their OODA loop, by which he means execute it faster than they can. If you're more agile than your opponent, you're the one that will come out on top.

In a paper titled "What Lessons Can the Agile Community Learn from A Maverick Fighter Pilot?", Steve Adolph, from the University of British Columbia, takes Boyd's concept and applies it to software development. The conclusion drawn is that agility is relative and time-based. If your software team can't deliver software and keep pace with changes in the environment, your team is not agile. If you're working in a large, slow moving organisation that rarely changes, you can probably take months to deliver software and still be considered "agile" by the organisation. In a lean startup, that's likely to not be the case.

A good architecture enables agility

The driver for having this discussion is that a good software architecture enables agility. Although Service-Oriented Architecture (SOA) is seen as a dirty term within some organisations due to over-complex, bloated and bodged implementations, there's a growing trend of software systems being made up of tiny micro-services, where each service only does one thing but does that thing very well. A micro-service may typically be less than one hundred lines of code. If change is needed, services can be rewritten from scratch, potentially in a different programming language. This style of architecture provides agility in a number of ways. Small, loosely coupled components/services can be built, modified and tested in isolation, or even ripped out and replaced depending on how requirements change. This style of architecture also lends itself well to a very flexible and adaptable deployment model, since new components/services can be added and scaled if needed.

However, nothing in life is ever free. Building a software system like this takes time, effort and discipline. Many people don't need this level of adaptability and agility either, which is why you see so many teams building software systems that are much more monolithic in nature, where everything is bundled together and deployed as a single unit. Although simpler to build, this style of architecture usually takes more effort to adapt in the face of changing requirements because functionality is often interwoven across the codebase.



Different software architectures provide differing levels of agility

In my view, both architectural styles have their advantages and disadvantages, with the decision to build a monolithic system vs one composed of micro-systems coming back to the trade-offs that you are willing to make. As with all things in the IT industry, there's a middle ground between these extremes. With pragmatism in mind, you can always opt to build a software system that consists of a number of small well-defined components yet is still deployed as a single unit. This potentially allows you to migrate to a micro-service architecture more easily at a later date.

How much agility to do you need?

Understanding the speed at which your organisation or business changes is important because it can help you decide upon the style of architecture to adopt; whether that's a monolithic architecture, a micro-services architecture or something in between. You need to understand the trade-offs and make your choices accordingly. You don't get agility for free.

5 Architecture vs design

If architecture is about structure and vision, then what's design about? If you're creating a solution to solve a problem, isn't this just design? And if this is the case, what's the difference between design and architecture?

Making a distinction

Grady Booch has a well cited definition of the difference between architecture and design that really helps to answer this question. In On Design, he says that

> As a noun, design is the named (although sometimes unnameable) structure or behavior of an system whose presence resolves or contributes to the resolution of a force or forces on that system. A design thus represents one point in a potential decision space.

If you think about any problem that you've needed to solve, there are probably a hundred and one ways in which you could have solved it. Take your current software project for example. There are probably a number of different technologies, deployment platforms and design approaches that are also viable options for achieving the same goal. In designing your software system though, your team chose just one of the many points in the potential decision space.

Grady then goes on to say that…

> All architecture is design but not all design is architecture.

This makes sense because creating a solution is essentially a design exercise. However, for some reason, there's a distinction being made about not all design being "architecture", which he clarifies with the following statement.

> Architecture represents the significant design decisions that shape a system, where significance is measured by cost of change.

Essentially, he's saying that the significant decisions are "architecture" and that everything else is "design". In the real world, the distinction between architecture and design isn't as clear-cut, but this definition does provide us with a basis to think about what might be significant (i.e. "architectural") in our own software systems. For example, this could include:

- The shape of the system (e.g. client-server, web-based, native mobile client, distributed, asynchronous, etc)

- The structure of the software system (e.g. components, layers, interactions, etc)
- The choice of technologies (i.e. programming language, deployment platform, etc)
- The choice of frameworks (e.g. web MVC framework, persistence/ORM framework, etc)
- The choice of design approach/patterns (e.g. the approach to performance, scalability, availability, etc)

The architectural decisions are those that you can't reverse without some degree of effort. Or, put simply, they're the things that you'd find hard to refactor an afternoon.

Understanding significance

It's often worth taking a step back and considering what's significant with your own software system. For example, many teams use a relational database, the choice of which might be deemed as significant. In order to reduce the amount of rework required in the event of a change in database technology, many teams use an object-relational mapping (ORM) framework such as Hibernate or Entity Framework. Introducing this additional ORM layer allows the database access to be decoupled from other parts of the code and, in theory, the database can be switched out independently without a large amount of effort.

This decision to introduce additional layers is a classic technique for decoupling distinct parts of a software system; promoting looser coupling, higher cohesion and a better separation of concerns. Additionally, with the ORM in place, the choice of database can probably be switched in an afternoon, so from this perspective it may no longer be deemed as architecturally significant.

However, while the database may no longer be considered a significant decision, the choice to decouple through the introduction of an additional layer should be. If you're wondering why, have a think about how long it would take you to swap out your current ORM or web MVC framework and replace it with another. Of course, you could add another layer over the top of your chosen ORM to further isolate your business logic and provide the ability to easily swap out your ORM but, again, you've made another significant decision. You've introduced additional layering, complexity and cost.

Although you can't necessarily make "significant decisions" disappear entirely, you can use a number of different tactics such as architectural layering to change what those significant decisions are. Part of the process of architecting a software system is about understanding what is significant and why.

6 Is software architecture important?

Software architecture then, is it important? The agile and software craftsmanship movements are helping to push up the quality of the software systems that we build, which is excellent. Together they are helping us to write better software that better meets the needs of the business while carefully managing time and budgetary constraints. But there's still more we can do because even a small amount of software architecture can help prevent many of the problems that projects face. Successful software projects aren't just about good code and sometimes you need to step away from the code for a few moments to see the bigger picture.

A lack of software architecture causes problems

Since software architecture is about structure and vision, you could say that it exists anyway. And I agree, it does. Having said that, it's easy to see how not thinking about software architecture (and the "bigger picture") can lead to a number of common problems that software teams face on a regular basis. Ask yourself the following questions:

- Does your software system have a well defined structure?
- Is everybody on the team implementing features in a consistent way?
- Is there a consistent level of quality across the codebase?
- Is there a shared vision for how the software will be built across the team?
- Does everybody on the team have the necessary amount of technical guidance?
- Is there an appropriate amount of technical leadership?

It is possible to successfully deliver a software project by answering "no" to some of these questions, but it does require a very good team and a lot of luck. If nobody thinks about software architecture, the end result is something that typically looks like a big ball of mud. Sure, it has a structure but it's not one that you'd want to work with! Other side effects could include the software system being too slow, insecure, fragile, unstable, hard to deploy, hard to maintain, hard to change, hard to extend, etc. I'm sure you've never seen or worked on software projects like this, right? No, me neither. ;-)

Since software architecture is inherent in every software system, why don't we simply acknowledge this and place some focus on it?

The benefits of software architecture

What benefits can thinking about software architecture provide then? In summary:

- A clear vision and roadmap for the team to follow, regardless of whether that vision is owned by a single person or collectively by the whole team.
- Technical leadership and better coordination.
- A stimulus to talk to people in order to answer questions relating to significant decisions, non-functional requirements, constraints and other cross-cutting concerns.
- A framework for identifying and mitigating risk.
- Consistency of approach and standards, leading to a well structured codebase.
- A set of firm foundations for the product being built.
- A structure with which to communicate the solution at different levels of abstraction to different audiences.

Does every software project need software architecture?

Rather than use the typical consulting answer of "it depends", I'm instead going to say that the answer is undoubtedly "yes", with the caveat that every software project should look at a number of factors in order to assess how much software architecture thinking is necessary. These include the size of the project/product, the complexity of the project/product, the size of the team and the experience of the team. The answer to how much is "just enough" will be explored throughout the rest of this book.

7 Questions

1. Do you know what “architecture” is all about? Does the rest of your team? What about the rest of your organisation?
2. There are a number of different types of architecture within the IT domain. What do they all have in common?
3. Do you and your team have a standard definition of what “software architecture” means? Could you easily explain it to new members of the team? Is this definition common across your organisation?
4. What does it mean if you describe a software architecture as being “agile”? How do you design for “agility”?
5. Can you make a list of the architectural decisions on your current software project? Is it obvious why they were deemed as significant?
6. If you step back from the code, what sort of things are included in *your* software system’s “big picture”?
7. What does the technical career path look like in your organisation? Is enterprise architecture the right path for you?
8. Is software architecture important? Why and what are the benefits? Is there enough software architecture on your software project? Is there too much?

II The software architecture role

This part of the book focusses on the software architecture role; including what it is, what sort of skills you need and why coding, coaching and collaboration are important.

8 Software development is not a relay sport

Software teams that are smaller and/or agile tend to be staffed with people who are generalising specialists; people that have a core specialism along with more general knowledge and experience. In an ideal world, these cross-discipline team members would work together to run and deliver a software project, undertaking everything from requirements capture and architecture through to coding and deployment. Although many software teams strive to be self-organising, in the real world they tend to be larger, more chaotic and staffed only with specialists. Therefore, these teams typically need, and often do have, somebody in the technical leadership role.

"Solution Architects"

There are a lot of people out there, particularly in larger organisations, calling themselves "solution architects" or "technical architects", who design software and document their solutions before throwing them over the wall to a separate development team. With the solution "done", the architect will then move on to do the same somewhere else, often not even taking a cursory glimpse at how the development team is progressing. When you throw "not invented here" syndrome into the mix, there's often a tendency for that receiving team to not take ownership of the solution and the "architecture" initially created becomes detached from reality.

I've met a number of such architects in the past and one particular interview I held epitomises this approach to software development. After the usual "tell me about your role and recent projects" conversation, it became clear to me that this particular architect (who worked for one of the large "blue chip" consulting firms) would create and document a software architecture for a project before moving on elsewhere to repeat the process. After telling me that he had little or no involvement in the project after he handed over the "solution", I asked him how he knew that his software architecture would work. Puzzled by this question, he eventually made the statement that this was "an implementation detail". He confidently viewed his software architecture as correct and it was the development team's problem if they couldn't get it to work. In my view, this was an outrageous thing to say and it made him look like an ass during the interview. His approach was also AaaS … "Architecture as a Service"!

Somebody needs to own the big picture

The software architecture role is a generalising specialist role, and different to your typical software developer. It's certainly about steering the ship at the start of a software project, which includes things like managing the non-functional requirements and putting together a software design that is sensitive to the context and environmental factors. But it's also about *continuously* steering the ship because your chosen path might need some adjustment en-route. After all, agile

approaches have shown us that we don't necessarily have (and need) all of the information up front.

A successful software project requires the initial vision to be created, communicated and potentially evolved throughout the entirety of the software development life cycle. For this reason alone, it doesn't make sense for one person to create that vision and for another team to (try to) deliver it. When this does happen, the set of initial design artefacts is essentially a baton that gets passed between the architect and the development team. This is inefficient, ineffective and exchange of a document means that much of the decision making context associated with creating the vision is also lost. Let's hope that the development team never needs to ask any questions about the design or its intent!

This problem goes away with truly self-organising teams, but most teams haven't yet reached this level of maturity. Somebody needs to take ownership of the big picture throughout the delivery and they also need to take responsibility for ensuring that the software is delivered successfully. Software development is not a relay sport and successful delivery is not an "implementation detail".

9 Questions

1. What's the difference between the software architecture and software developer roles?
2. What does the software architecture role entail? Is this definition based upon your current or ideal team? If it's the latter, what can be done to change your team?
3. Why is it important for anybody undertaking the software architecture role to understand the technologies that they are using? Would you hire a software architect who didn't understand technology?
4. If you're the software architect on your project, how much coding are you doing? Is this too much or too little?
5. If, as a software architect, you're unable to code, how else can you stay engaged in the low-level aspects of the project. And how else can you keep your skills up to date?
6. Why is having a breadth *and* depth of technical knowledge as important?
7. Do you think you have all of the required soft skills to undertake the software architecture role? If not, which would you improve, why and how?
8. Does your current software project have enough guidance and control from a software architecture perspective? Does it have too much?
9. Why is collaboration an important part of the software architecture role? Does your team do enough? If not, why?
10. Is there enough coaching and mentoring happening on your team? Are you providing or receiving it?
11. How does the software architecture role fit into agile projects and self-organising teams?
12. What pitfalls have you fallen into as somebody new to the software architecture role?
13. Is there a well-defined "terms of reference" for the software architecture in your team or organisation? If so, does everybody understand it? If not, is there value in creating one to make an architect's role and responsibilities explicit?

III Designing software

This part of the book is about the overall process of designing software, specifically looking at the things that you should really think about before coding.

10 Architectural drivers

Regardless of the process that you follow (traditional and plan-driven vs lightweight and adaptive), there's a set of common things that really drive, influence and shape the resulting software architecture.

1. Functional requirements

In order to design software, you need to know something about the goals that it needs to satisfy. If this sounds obvious, it's because it is. Having said that, I *have* seen teams designing software (and even building it) without a high-level understanding of the features that the software should provide to the end-users. Some might call this being agile, but I call it foolish. Even a rough, short list of features or user stories is essential. Requirements drive architecture.

2. Quality Attributes

Quality attributes are represented by the non-functional requirements and reflect levels of service such as performance, scalability, availability, security, etc. These are mostly technical in nature and can have a huge influence over the resulting architecture, particularly if you're building "high performance" systems or you have desires to operate at "Google scale". The technical solutions to implementing non-functional requirements are usually cross-cutting and therefore need to be baked into the foundations of the system you're building. Retrofitting high performance, scalability, security, availability, etc into an existing codebase is usually incredibly difficult and time-consuming.

3. Constraints

We live in the real world and the real world has constraints. For example, the organisation that you work for probably has a raft of constraints detailing what you can and can't do with respect to technology choice, deployment platform, etc.

4. Principles

Where constraints are typically imposed upon you, principles are the things that you want to adopt in order to introduce consistency and clarity into the resulting codebase. These may be development principles (e.g. code conventions, use of automated testing, etc) or architecture principles (e.g. layering strategies, architecture patterns, etc).

Understand their influence

Understanding the requirements, constraints and principles at a high-level is essential whenever you start working on a new software system or extend one that exists already. Why? Put simply, this is the basic level of knowledge that you need in order to start making design choices.

First of all, understanding these things can help in reducing the number of options that are open to you, particularly if you find that the drivers include complex non-functional requirements or major constraints such as restrictions over the deployment platform. In the words of T.S.Eliot:

> When forced to work within a strict framework the imagination is taxed to its utmost â€“ and will produce its richest ideas. Given total freedom the work is likely to sprawl.

Secondly, and perhaps most importantly, it's about making "informed" design decisions given your particular set of goals and context. If you started designing a solution to the financial risk system without understanding the requirements related to performance (e.g. calculation complexity), scalability (e.g. data volumes), security and audit, you could potentially design a solution that doesn't meet the goals.

Software architecture is about the significant design decisions, where significance is measured by cost of change. A high-level understanding of the requirements, constraints and principles is a starting point for those significant decisions that will ultimately shape the resulting software architecture. Understanding them early will help to avoid costly rework in the future.

11 Questions

1. What are the major factors that influence the resulting architecture of a software system? Can you list those that are relevant to the software system that you are working on?
2. What are non-functional requirements and why are they important? When should you think about non-functional requirements?
3. Time and budget are the constraints that most people instantly relate to, but can you identify more?
4. Is your software development team working with a well-known set of architectural principles? What are they? Are they clearly understood by everybody on the team?
5. How to *you* approach the software design process? Does your team approach it in the same way? Can it be clearly articulated? Can you help others follow the same approach?

IV Visualising software

This part of the book is about visualising software architecture using a collection of lightweight, yet effective, sketches.

12 We have a failure to communicate

If you're working in an agile software development team at the moment, take a look around at your environment. Whether it's physical or virtual, there's likely to be a story wall or Kanban board visualising the work yet to be started, in progress and done.

Why? Put simply, visualising your software development process is a fantastic way to introduce transparency because anybody can see, at a glance, a high-level snapshot of the current progress. Couple this with techniques like value stream mapping and you can start to design some complex Kanban boards to reflect that way that your team works. As an industry, we've become pretty adept at visualising our software development process.

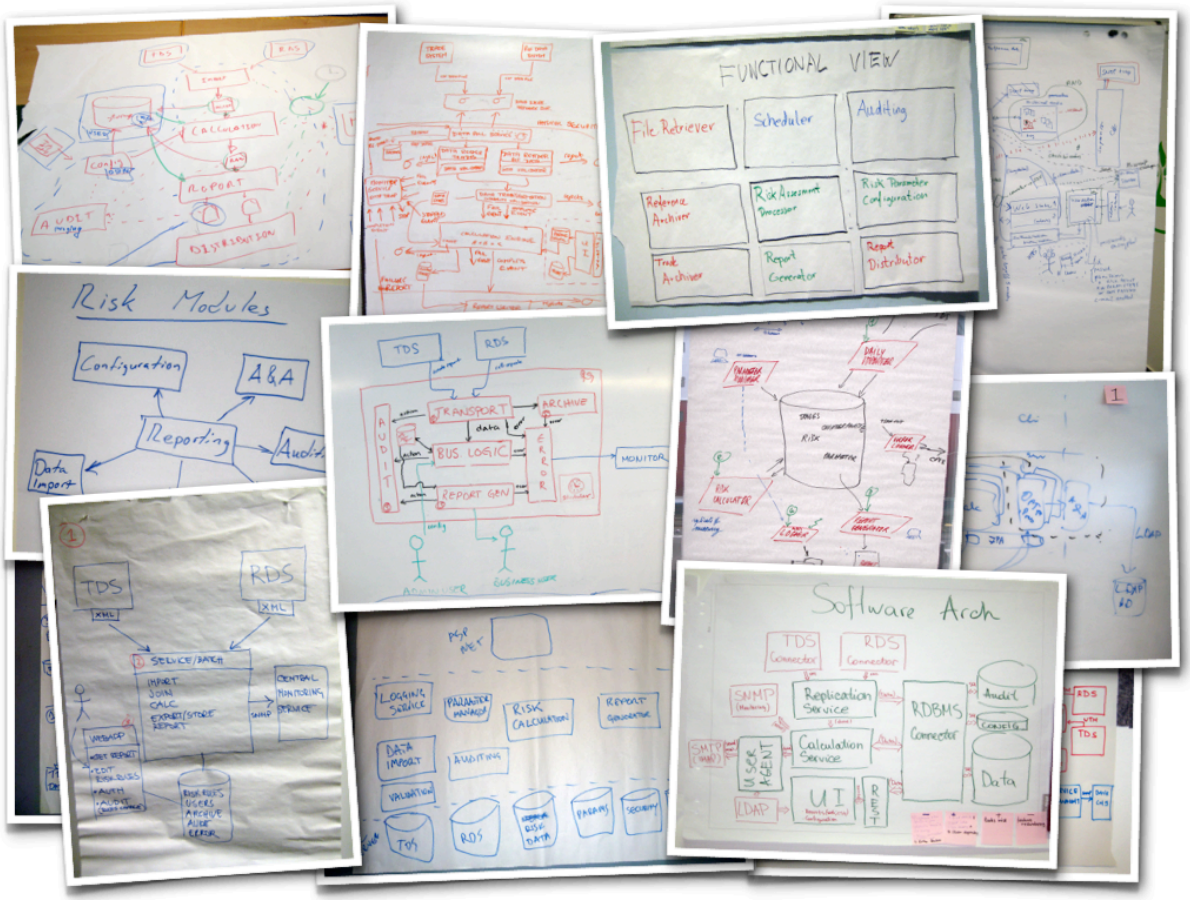
However, it seems we've forgotten how to visualise the actual software that we're building. I'm not just referring to post-project documentation, this also includes communication *during* the software development process.

Understanding software architecture is not the same as being able to communicate it. Those architecture diagrams that you have on the wall of your office; do they reflect the system that is actually being built or are they conceptual abstractions that bear no resemblance to the structure of the code. Having run architecture katas with thousands of people over a number of years, I can say with complete confidence that visualising the architecture of a software system is a skill that very few people have. People can draw diagrams, but those diagrams often leave much to the imagination. Almost nobody uses a formal diagramming notation to describe their solutions too, which is in stark contrast to my experience of working with software teams a decade ago.

Abandoning UML

If you cast your mind back in time, structured processes provided a reference point for both the software design process and how to communicate the resulting designs. Some well-known examples include the Rational Unified Process (RUP) and Structured Systems Analysis And Design Method (SSADM). Although the software development industry has moved on in many ways, we seem to have forgotten some of the good things that these prior approaches gave us.

As an industry, we do have the Unified Modelling Language (UML), which is a formal standardised notation for communicating the design of software systems. However, while you can argue about whether UML offers an effective way to communicate software designs or not, that's often irrelevant because many teams have already thrown out UML or simply don't know it. Such teams typically favour informal boxes and lines style sketches instead but often these diagrams don't make much sense unless they are accompanied by a detailed narrative, which ultimately slows the team down. Next time somebody presents a software design to you focussed around one or more informal sketches, ask yourself whether they are presenting what's on the sketches or whether they are presenting what's in their head instead.



Boxes and lines sketches can work very well, but there are many pitfalls associated with communicating software architecture in this way

Abandoning UML is all very well but, in the race for agility, many software development teams have lost the ability to communicate visually. The example software architecture sketches (pictured) illustrate a number of typical approaches to communicating software architecture and they suffer from the following types of problems:

- Colour coding is usually not explained or is often inconsistent.
- The purpose of diagram elements (i.e. different styles of boxes and lines) is often not explained.
- Key relationships between diagram elements are sometimes missing or ambiguous.
- Generic terms such as "business logic" are often used.
- Technology choices (or options) are usually omitted.
- Levels of abstraction are often mixed.
- Diagrams often try to show too much detail.
- Diagrams often lack context or a logical starting point.

Boxes and lines sketches *can* work very well, but there are many pitfalls associated with communicating software architecture in this way. My approach is to use a collection of simple diagrams each showing a different part of the same overall story, paying close attention to the diagram elements if I'm not using UML.

Agility requires good communication

Why is this important? In today's world of agile delivery and lean startups, many software teams have lost the ability to communicate what it is they are building and it's no surprise that these same teams often seem to lack technical leadership, direction and consistency. If you want to ensure that everybody is contributing to the same end-goal, you need to be able to effectively communicate the vision of what it is you're building. And if you want agility and the ability to move fast, you need to be able to communicate that vision efficiently too.

13 C4: context, containers, components and classes

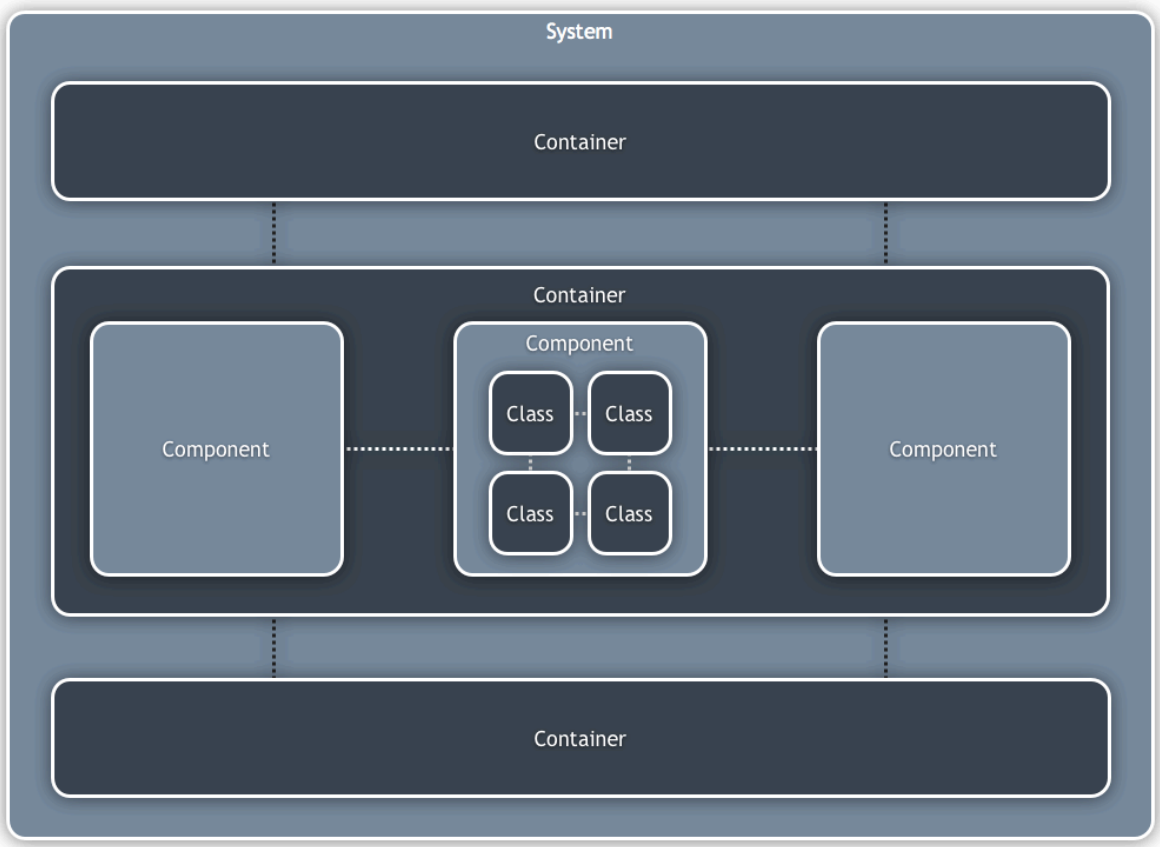
The code for any software system is where most of the focus remains for the majority of the software development life cycle, and this makes sense because the code is the ultimate deliverable. But if you had to explain to somebody how that system worked, would you start with the code?

Unfortunately the code doesn't tell the whole story and, in the absence of documentation, people will typically start drawing boxes and lines on a whiteboard or piece of paper to explain what the major building blocks are and how they are connected. When describing software through pictures, we have a tendency to create a single uber-diagram that includes as much detail as possible at every level of abstraction simultaneously. This may be because we're anticipating questions or because we're a little too focussed on the specifics of how the system works at a code level. Such diagrams are typically cluttered, complex and confusing. Picking up a tool such as Microsoft Visio, Rational Software Architect or Sparx Enterprise Architect usually adds to the complexity rather than making life easier.

A better approach is to create a number of diagrams at varying levels of abstraction. A number of simpler diagrams can describe software in a much more effective way than a single complex diagram that tries to describe *everything*.

A common set of abstractions

If software architecture is about the structure of a software system, it's worth understanding what the major building blocks are and how they fit together at differing levels of abstraction.



A simple model of architectural constructs

Assuming an OO programming language, the way that I like to think about structure is as follows … a software system is made up of a number of containers, which themselves are made up of a number of components, which in turn are implemented by one or more classes. It's a simple hierarchy of logical building blocks that can be used to model most software systems.

- **Classes**: for most of us in an OO world, classes are the smallest building blocks of our software systems.
- **Components**: a component can be thought of as a logical grouping of one or more classes. For example, an audit component or an authentication service that is used by other components to determine whether access is permitted to a specific resource. Components are typically made up of a number of collaborating classes, all sitting behind a higher level contract.
- **Containers**: a container represents something in which components are executed or where data resides. This could be anything from a web or application server through to a rich client application or database. Containers are typically executables that are started as a part of the overall system, but they don't have to be separate processes in their own right. For example, I treat each Java EE web application or .NET website as a separate container regardless of whether they are running in the same physical web server process. The key thing about understanding a software system from a containers perspective is that any inter-container communication is likely to require a remote interface such as a SOAP web service, RESTful interface, Java RMI, Microsoft WCF, messaging, etc.

- **Systems**: a system is the highest level of abstraction and represents something that delivers value to somebody. A system is made up of a number of separate containers. Examples include a financial risk management system, an Internet banking system, a website and so on.

It's easy to see how we could take this further, by putting some very precise definitions behind each of the types of building block and by modelling the specifics of how they're related. But I'm not sure that's particularly useful because it would constrain and complicate what it is we're trying to achieve here, which is to simply understand the structure of a software system and create a simple set of abstractions with which to describe it.

Summarising the static view of your software

With this set of abstractions in mind, I tend to draw the following types of diagrams when summarising the static view of my software:

1. **Context**: A high-level diagram that sets the scene; including key system dependencies and actors.
2. **Container**: A container diagram shows the high-level technology choices, how responsibilities are distributed across them and how the containers communicate.
3. **Component**: For each container, a component diagram lets you see the key logical components and their relationships.
4. **Classes**: This is an *optional* level of detail and I will draw a small number of high-level UML class diagrams if I want to explain how a particular pattern or component will be (or has been) implemented. The factors that prompt me to draw class diagrams for parts of the software system include the complexity of the software plus the size and experience of the team. Any UML diagrams that I do draw tend to be sketches rather than comprehensive models.

Common abstractions over a common notation

This simple sketching approach works for me and many of the software teams that I work with, but it's about providing some organisational ideas and guidelines rather than creating a prescriptive standard. The goal here is to help teams communicate their software designs in an effective and efficient way rather than creating another comprehensive modelling notation.

UML provides both a common set of abstractions **and** a common notation to describe them, but I rarely find teams who use either effectively. I'd rather see teams able to discuss their software systems with a common set of abstractions in mind rather than struggling to understand what the various notational elements are trying to show. For me, a common set of abstractions is more important than a common notation.

Most maps are a great example of this principle in action. They all tend to show roads, rivers, lakes, forests, towns, churches, etc but they often use different notation in terms of colour-coding,

line styles, iconography, etc. The key to understanding them is exactly that - a key/legend tucked away in a corner somewhere. We can do the same with our software architecture diagrams.

It's worth reiterating that informal boxes and lines sketches provide flexibility at the expense of diagram consistency because you're creating your own notation rather than using a standard like UML. My advice here is to be conscious of colour-coding, line style, shapes, etc and let a consistent notation evolve naturally within your team. Including a simple key/legend on each diagram to explain the notation will help. Oh, and if naming really *is* the hardest thing in software development, try to avoid a diagram that is simply a collection of labelled boxes. Annotating those boxes with responsibilities helps to avoid ambiguity while providing a nice "at a glance" view.

Diagrams should be simple and grounded in reality

There seems to be a common misconception that "architecture diagrams" must only present a high-level conceptual view of the world, so it's not surprising that software developers often regard them as pointless. Software architecture diagrams should be grounded in reality, in the same way that the software architecture process should be about coding, coaching and collaboration rather than ivory towers. Including technology choices (or options) is a usually a step in the right direction and will help prevent diagrams looking like an ivory tower architecture where a bunch of conceptual components magically collaborate to form an end-to-end software system.

A single diagram can quickly become cluttered and confused, but a collection of simple diagrams allows you to effectively present the software from a number of different levels of abstraction. This means that illustrating your software can be a quick and easy task that requires little ongoing effort to keep those diagrams up to date. You never know, people might even understand them too.

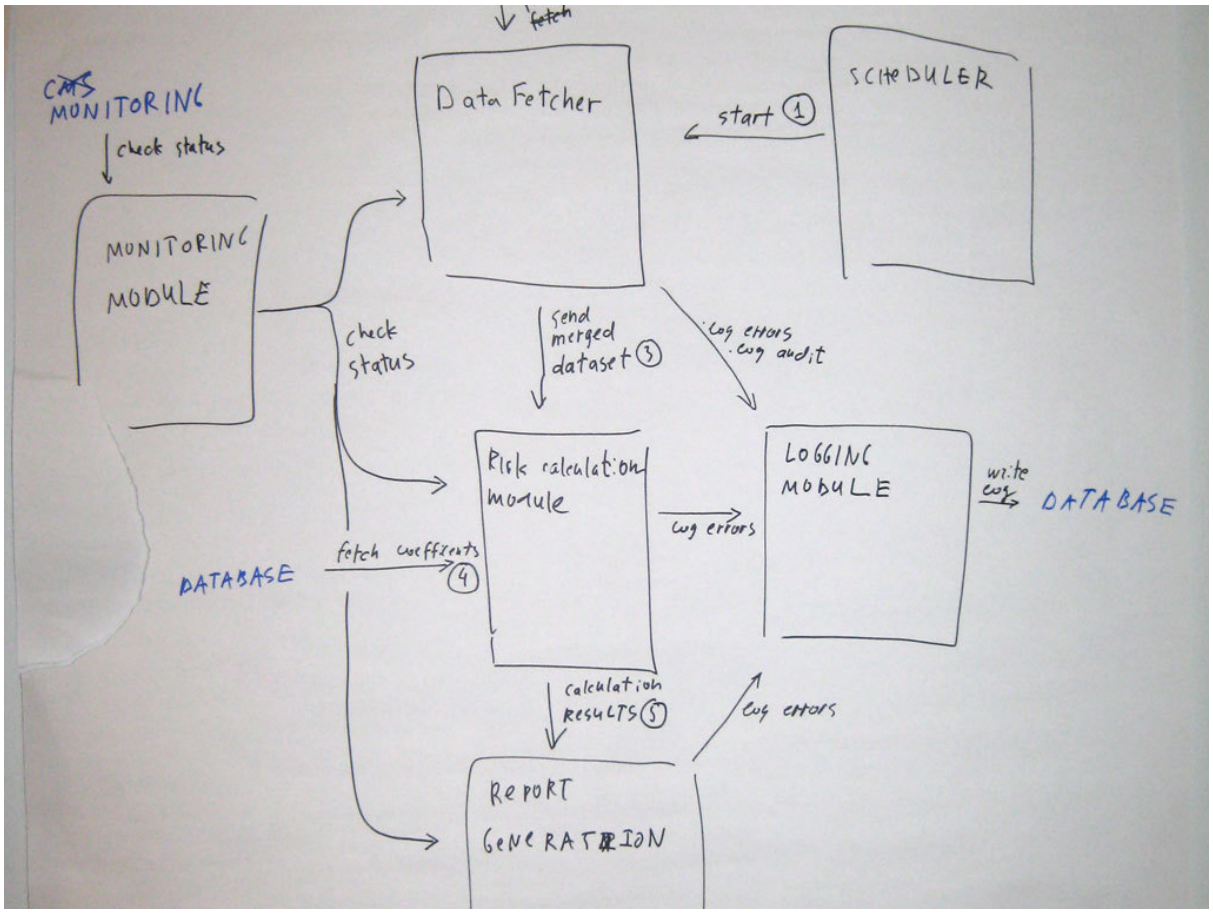
14 Software architecture vs code

Although many software teams find it tricky to visualise the software architecture of their software systems, let's assume that this isn't the case and that you're sketching some ideas related to the software architecture for a new system you've been tasked to build. An important aspect of just enough software architecture is to understand how the significant elements of a software system fit together.

Responsibility-driven design and decomposition into components

For me, this means going down to the level of components, services or modules that each have a specific set of responsibilities. It's worth stressing this isn't about understanding low-level implementation details, it's about performing an initial level of decomposition. The Wikipedia page for Component-based development has a good summary and a "component" might be something like a risk calculator, audit logger, report generator, data importer, etc. The simplest way to think about a component is that it's a set of related behaviours behind an interface, which may be implemented using one or more collaborating classes (assuming an OO language, of course). Good components share a number of characteristics with good classes. They should have high cohesion, low coupling, a well-defined public interface, good encapsulation, etc.

There are a number of benefits to thinking about a software system in terms of components, but essentially it allows us to think and talk about the software as a small number of high-level abstractions rather than the hundreds and thousands of individual classes that make up most enterprise systems. The photo below shows a typical component diagram produced during the training classes we run. Groups are asked to design a simple financial risk system that needs to pull in some data, perform some calculations and generate an Excel report as the output.



We often think in terms of components

This sketch includes the major components you would expect to see for a system that is importing data, performing risk calculations and generating a report. These components provide us with a framework for partitioning the behaviour within the boundary of our system and it should be relatively easy to trace the major use cases/user stories across them. This is a really useful starting point for the software development process and can help to create a shared vision that the team can work towards.

But it's also very dangerous at the same time. Without technology choices (or options), this diagram looks like the sort of thing an ivory tower architect might produce and it can seem very "conceptual" (or "fluffy", depending on your point of view) for many people with a technical background.

We talk about components but write classes

People generally understand the benefit of thinking about software as a small number of high-level building blocks. After all, it's a great way to partition responsibilities across a software system and you'll often hear people talking in terms of components when they're having architecture discussions. This is what component-based development is all about and although many people *talk* about their software systems in terms of components, that structure isn't usually reflected in the code. This is one of the reasons why there is a disconnect between

software architecture and coding as disciplines - the architecture diagrams on the wall say one thing, but the code says another.

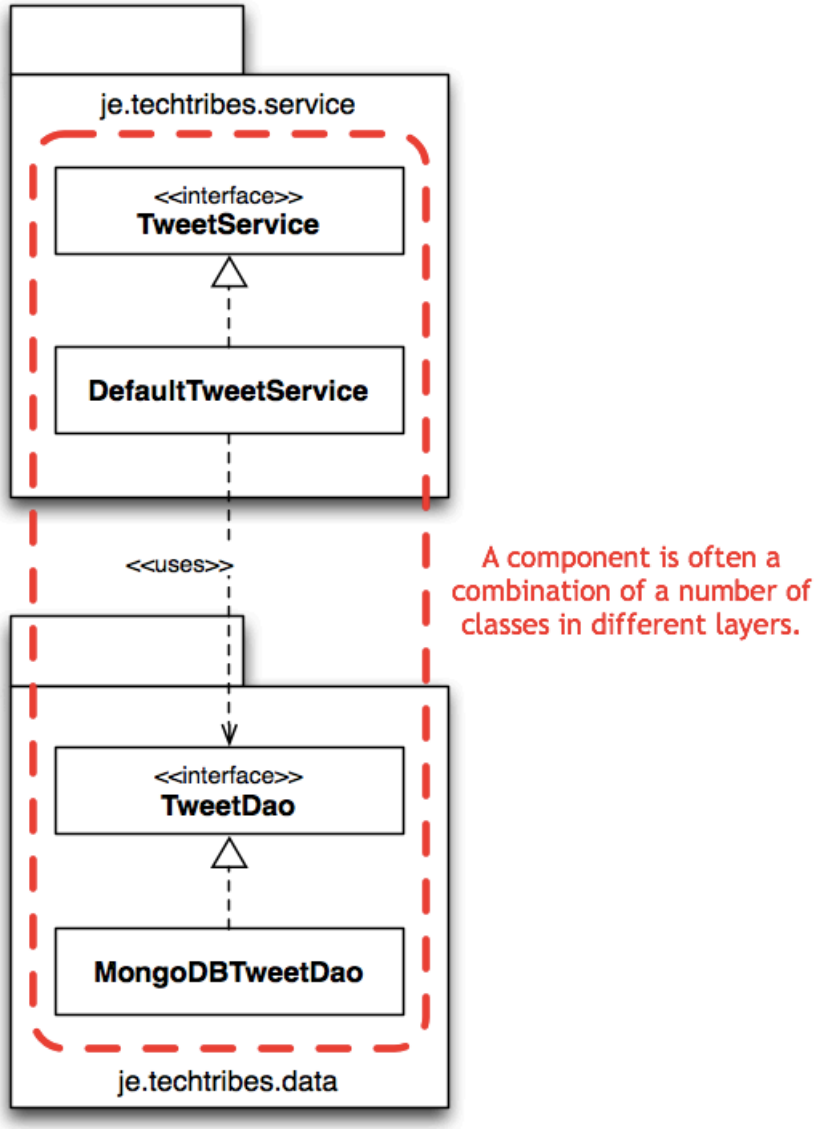
When you open up a codebase, it will often reflect some other structure due to the organisation of the code. The mapping between the architectural view of a software system and the code are often very different. This is sometimes why you'll see people ignore architecture diagrams (or documentation) and say "the code is the only single point of truth". George Fairbanks calls this the "Model-code gap" in his book called Just Enough Software Architecture. The organisation of the codebase can really help or hinder architectural understanding.

Packaging code by layer

Many software teams structure their code by layer. In other words, if you open up a codebase, you'll see a package for domain classes, one for UI stuff, one for "business services", one for data access, another for integration points and so on. I'm using the Java terminology of a "package" here, but the same is applicable to namespaces in C#, etc.

The reason for this is very simple. We know that architectural layering is generally "a good thing" and many of the tutorials out there teach this packaging style as a way to structure code. If you do a Google search for tutorials related to Spring or ASP.NET MVC, for example, you'll see this in the sample code. I spent most of my career building software systems in Java and I too used the same packaging approach for the majority of the projects that I worked on.

Although there's nothing particularly wrong with packaging code in this way, this code structure never quite reflects the abstractions that we think about when we view the system from an architecture perspective. If you're using an OO programming language, do you talk about "objects" when you're having architecture discussions? In my experience, the answer is no. I typically hear people referring to concepts like components and services instead. The result is that a "component" on an architecture diagram is actually implemented by a combination of classes across a number of different layers. For example, you may find *part* of the component in a "services" package and the rest of the component inside the "data access" package.



Packaging by layer

In order to make this possible, the code in the lower layers (e.g. that "data access" package) often has public visibility, which means that it can be called directly from any other layer in the architecture too.

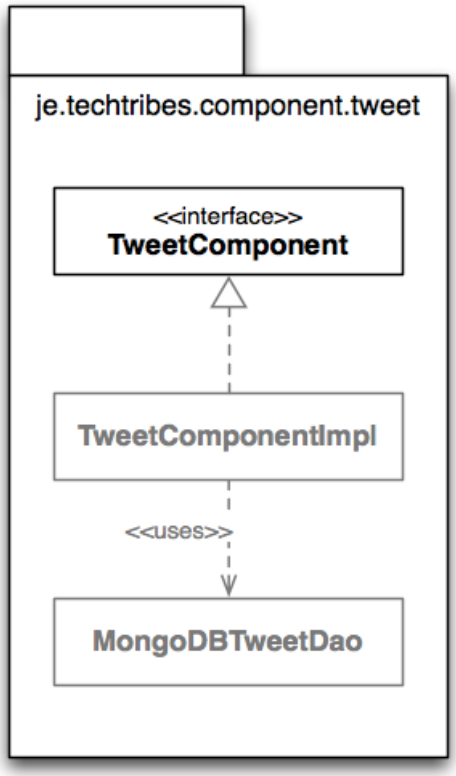
Packaging by feature

Packaging by layer isn't the only answer though and Mark Needham has a great blog post called Coding: Packaging by vertical slice that talks about another approach to code organisation based upon vertical slices of functionality. A Google search for "package by feature vs package by layer" will throw up lots of other discussions on the same topic.

Packaging by component

Organising a codebase by layer makes it easy to see the overall structure of the software but there are trade-offs. For example, you need to delve inside multiple layers (e.g. packages, namespaces, etc) in order to make a change to a feature or user story. Also, many codebases end up looking eerily similar given the fairly standard approach to layering within enterprise systems.

In Screaming Architecture, Uncle Bob Martin says that if you're looking at a codebase, it should scream something about the business domain. Organising your code by feature rather than by layer gives you this, but again there are trade-offs. A slight variation I like is organising code explicitly by component. For example, if you take a look at the je.techtribes.component.tweet package on GitHub, you'll see that it looks something like this.



Packaging by component

This is similar to packaging by feature, but it's more akin to the "micro services" that Mark Needham talks about in his blog post. Each sub-package of je.techtribes.component houses a separate component, complete with it's own *internal* layering and configuration. As far as possible, all of the internals are package scoped. You could potentially pull each component out and put it in it's own project or source code repository to be versioned separately. This approach will likely seem familiar to you if you're building something that has a very explicit loosely coupled architecture such as a distributed messaging system made up of loosely coupled components.

I'm fairly confident that most people are still building something more monolithic in nature though, despite thinking about their system in terms of components. I've certainly packaged

parts of monolithic codebases using a similar approach in the past but it's tended to be fairly ad hoc. Let's be honest, organising code into packages isn't something that gets a lot of brain-time, particularly given the refactoring tools that we have at our disposal. Organising code by component lets you explicitly reflect the concept of "a component" from the architecture into the codebase. If your software architecture diagram screams something about your business domain (and it should), this will be reflected in your codebase too.

Aligning software architecture and code

Software architecture and coding are often seen as mutually exclusive disciplines and there's often very little mapping from the architecture into the code and back again. Effectively and efficiently visualising a software architecture can help to create a good shared vision within the team, which can help it go faster. Having a **simple and explicit mapping** from the architecture to the code can help even further, particularly when you start looking at collaborative design and collective code ownership. Furthermore, it helps bring software architecture firmly back into the domain of the development team, which is ultimately where it belongs. Don't forget though, the style of architecture you're using needs to be reflected on your software architecture diagrams; whether that's layers, components, micro-services or something else entirely.

Designing a software system based around components isn't "the one true way" but if you *are* building monolithic software systems and think of them as being made up of a number of smaller components, ensure that your codebase reflects this. Consider organising your code by component (rather than by layer or feature) to make the mapping between software architecture and code explicit. If it's hard to explain the structure of your software system, change it.

15 Questions

1. Are you able to explain how your software system works at various levels of abstraction? What concepts and levels of abstraction would you use to do this?
2. Do you use UML to visualise the design of your software? If so, is it effective? If not, what notation do you use?
3. Are you able to visualise the software system that you're working on? Would everybody on the team understand the notation that you use and the diagrams that you draw?
4. Should technology choices be included or omitted from "architecture" diagrams?
5. Do you understand the software architecture diagrams for your software system (e.g. on the office wall, a wiki, etc)? If not, what could make them more effective?
6. Do the software architecture diagrams that you have for your software system reflect the abstractions that are present in the codebase? If not, why not? How can you change this?

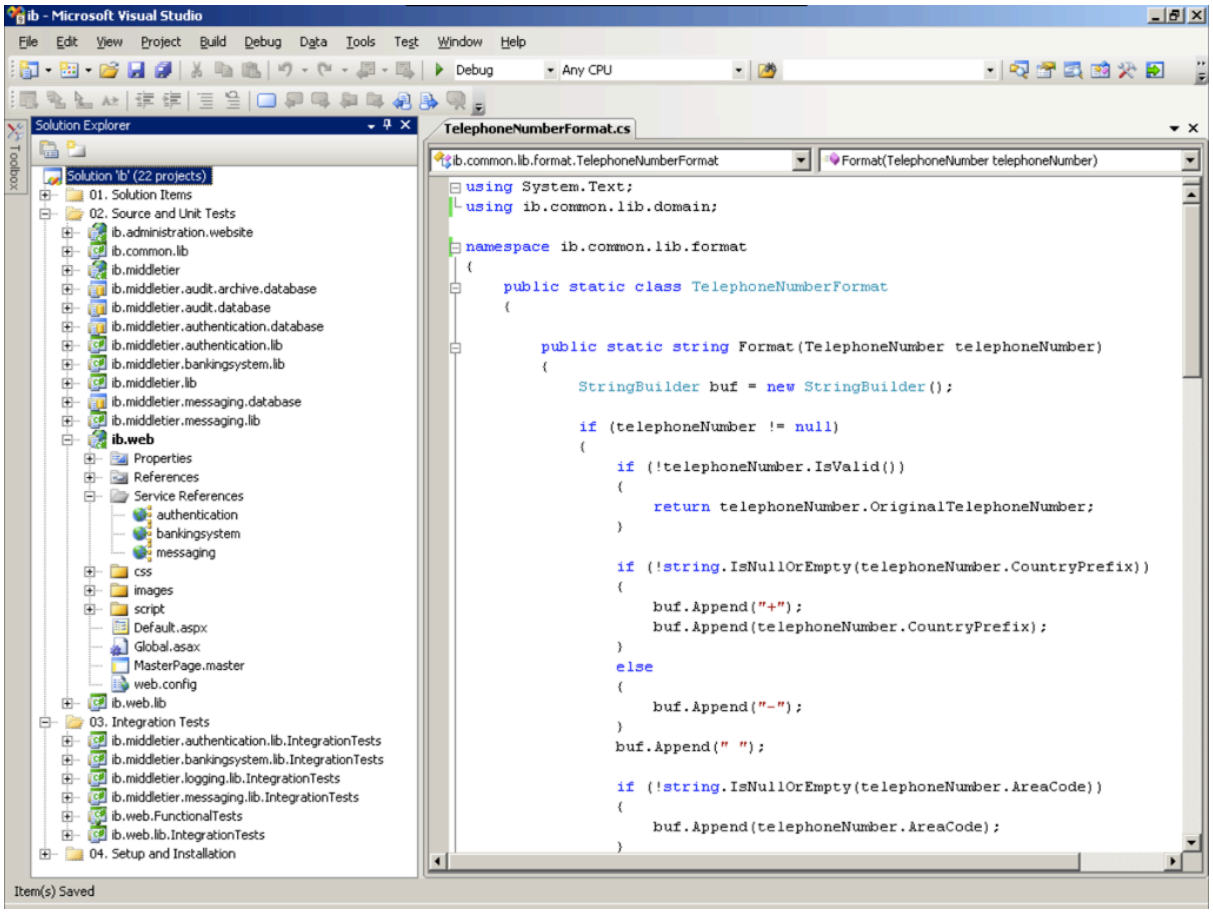
V Documenting software

This part of the book is about that essential topic we love to hate - writing documentation!

16 The code doesn't tell the whole story

We all know that writing good code is important and refactoring forces us to think about making methods smaller, more reusable and self-documenting. Some people say that comments are bad and that self-commenting code is what we should strive for. However you do it, everybody *should* strive for good code that's easy to read, understand and maintain. But the code doesn't tell the whole story.

Let's imagine that you've started work on a new software project that's already underway. The major building blocks are in place and some of the functionality has already been delivered. You start up your development machine, download the code from the source code control system and load it up into your development environment. What do you do next and how do you start being productive?



Where do you start?

If nobody has the time to walk you through the codebase, you can start to make your own assumptions based upon the limited knowledge you have about the project, the business domain,

your expectations of how the team builds software and your knowledge of the technologies in use.

For example, you might be able to determine something about the overall architecture of the software system through how the codebase has been broken up into sub-projects, directories, packages, namespaces, etc. Perhaps there are some naming conventions in use. Even from the previous static screenshot of Microsoft Visual Studio, we can determine a number of characteristics about the software, which in this case is an (anonymised) Internet banking system.

- The system has been written in C# on the Microsoft .NET platform.
- The overall .NET solution has been broken down into a number of Visual Studio projects and there's a .NET web application called "ib.web", which you'd expect since this is an Internet banking system ("ib" = "Internet Banking").
- The system appears to be made up of a number of architectural tiers. There's "ib.web" and "ib.middletier", but I don't know if these are physical or logical tiers.
- There looks to be a naming convention for projects. For example, "ib.middletier.authentication.lib", "ib.middletier.messaging.lib" and "ib.middletier.bankingsystem.lib" are class libraries that seem to relate to the middle-tier. Are these simply a logical grouping for classes or something more significant such as higher level components and services?
- With some knowledge of the technology, I can see a "Service References" folder lurking underneath the "ib.web" project. These are Windows Communication Foundation (WCF) service references that, in the case of this example, are essentially web service clients. The naming of them seems to correspond to the class libraries within the middle-tier, so I think we actually have a distributed system with a middle-tier that exposes a number of well-defined services.

The code doesn't portray the intent of the design

A further deep-dive through the code will help to prove your initial assumptions right or wrong, but it's also likely to leave you with a whole host of questions. Perhaps you understand what the system *does* at a high level, but you don't understand things like:

- How the software system fits into the existing system landscape.
- Why the technologies in use were chosen.
- The overall structure of the software system.
- Where the various components are deployed at runtime and how they communicate.
- How the web-tier "knows" where to find the middle-tier.
- What approach to logging/configuration/error handling/etc has been adopted and whether it is consistent across the codebase.
- Whether any common patterns and principles are in use across the codebase.
- How and where to add new functionality.
- How security has been implemented across the stack.
- How scalability is achieved.
- How the interfaces with other systems work.

- etc

I've been asked to review and work on systems where there has been no documentation. You can certainly gauge the answers to most of these questions from the code but it can be hard work. Reading the code will get you so far but you'll probably need to ask questions to the rest of the team at some point. And if you don't ask the right questions, you won't get the right answers - you don't know what you don't know.

Supplementary information

With any software system, there's another layer of information sitting above the code that provides answers to these types of questions and more.

There's an additional layer of information above the code

This type of information is complementary to the code and should be captured somewhere, for example in lightweight supplementary documentation to describe what the code itself doesn't. The code tells *a* story, but it doesn't tell the whole story.

17 Software documentation as a guidebook

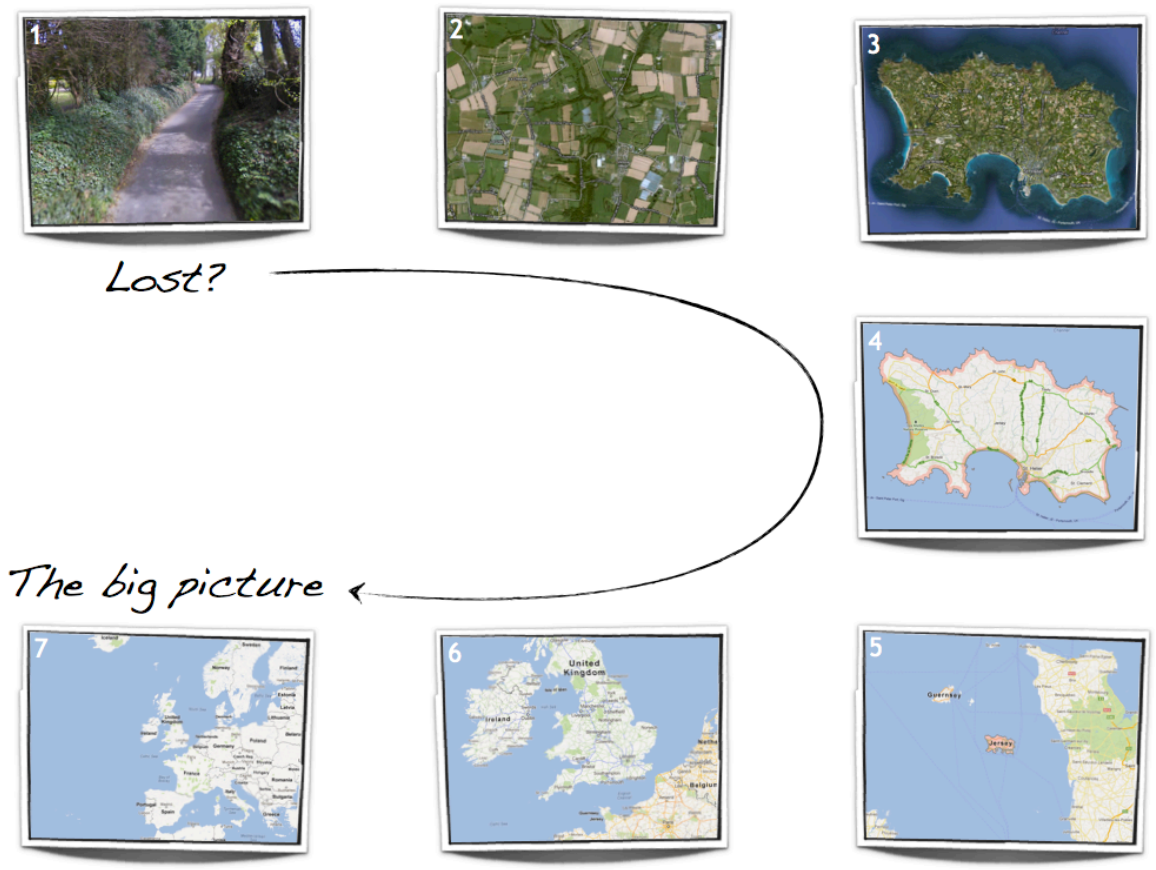
"Working software over comprehensive documentation" is what the Manifesto for Agile Software Development says and it's incredible to see how many software teams have interpreted those five words as "don't write *any* documentation". The underlying principle here is that real working software is much more valuable to end-users than a stack of comprehensive documentation but many teams use this line in the agile manifesto as an excuse to not write any documentation at all. Unfortunately the code doesn't tell the whole story and not having a source of supplementary information about a complex software system can slow a team down as they struggle to navigate the codebase.

I'm also a firm believer that many software teams have a duty to deliver some supplementary documentation along with the codebase, especially those that are building the software under an outsourcing and/or offshoring contract. I've seen IT consulting organisations deliver highly complex software systems to their customers without a single piece of supporting documentation, often because the team doesn't *have* any documentation. If the original software developers leave the consulting organisation, will the new team be able to understand what the software is all about, how it's been built and how to enhance it in a way that is sympathetic to the original architecture? And what about the poor customer? Is it right that they should *only* be delivered a working codebase?

The problem is that when software teams think about documentation, they usually think of huge Microsoft Word documents based upon a software architecture document template from the 1990's that includes sections where they need to draw Unified Modeling Language (UML) class diagrams for every use case that their software supports. Few people enjoy reading this type of document, let alone writing it! A different approach is needed. We should think about supplementary documentation as an ever-changing travel guidebook rather than a comprehensive static piece of history. But what goes into a such a guidebook?

1. Maps

Let's imagine that I teleported you away from where you are now and dropped you in a quiet, leafy country lane somewhere in the world (picture 1). Where are you and how do you figure out the answer to this question? You could shout for help, but this will only work if there are other people in the vicinity. Or you could simply start walking until you recognised something or encountered some civilisation, who you could then ask for help. As geeks though, we would probably fire up the maps application on our smartphone and use the GPS to pinpoint our location (picture 2).



From the detail to the big picture

The problem with picture 2 is that although it may show our location, we're a little too "zoomed in" to potentially make sense of it. If we zoom out further, eventually we'll get to see that I teleported you to a country lane in Jersey (picture 3).

The next issue is that the satellite imagery is showing a lot of detail, which makes it hard to see where we are relative to some of the significant features of the island, such as the major roads and places. To counter this, we can remove the satellite imagery (picture 4). Although not as detailed, this abstraction allows us to see some of the major structural elements of the island along with some of the place names, which were perviously getting obscured by the detail. With our simplified view of the island, we can zoom out further until we get to a big picture showing exactly where Jersey is in Europe (pictures 5, 6 and 7). All of these images show the same location from different levels of abstraction, each of which can help you to answer different questions.

If I were to open up the codebase of a complex software system and highlight a random line of code, exploring is fun but it would take a while for you to understand where you were and how the code fitted into the software system as a whole. Most integrated development environments have a way to navigate the code by namespace, package or folder but often the physical structure of the codebase is different to the logical structure. For example, you may have many classes that make up a single component, and many of those components may make up a single deployable unit.

Diagrams can act as maps to help people navigate a complex codebase and this is one of the

most important parts of supplementary software documentation. Ideally there should be a small number of simple diagrams, each showing a different part of the software system or level of abstraction. My C4 approach is how *I* summarise the static structure of a software system but there are others including the use of UML.

2. Sights

If you ever visit Jersey, and you should because it's beautiful, you'll probably want a map. There are visitor maps available at the ports and these present a simplified view of what Jersey looks like. Essentially the visitor maps are detailed sketches of the island and, rather than showing every single building, they show an abstract view. Although Jersey is small, once unfolded, these maps can look daunting if you've not visited before, so what you ideally need is a list of the major points of interest and sights to see. This is one of the main reasons that people take a travel guidebook on holiday with them. Regardless of whether it's physical or virtual (e.g. an e-book on your smartphone), the guidebook will undoubtedly list out the top sights that you should make a visit to.

A codebase is no different. Although we *could* spend a long time diagramming and describing every single piece of code, there's really little value in doing that. What we really need is something that lists out the points of interest so that we can focus our energy on understanding the major elements of the software without getting bogged down in all of the detail. Many web applications, for example, are actually fairly boring and rather than understanding how each of the 200+ pages work, I'd rather see the points of interest. These may include things like the patterns that are used to implement web pages and data access strategies along with how security and scalability are handled.

3. History and culture

If you do ever visit Jersey, and you really should because it *is* beautiful, you may see some things that look out of kilter with their surroundings. For example, we have a lovely granite stone castle on the south coast of the island called Elizabeth Castle that was built in the 16th century. As you walk around admiring the architecture, eventually you'll reach the top where it looks like somebody has dumped a large concrete cylinder, which is not in keeping with the intricate granite stonework generally seen elsewhere around the castle. As you explore further, you'll see signs explaining that the castle was refortified during the German occupation in the second world war. Here, the history helps explain why the castle is the way that it is.

Again, a codebase is no different and some knowledge of the history, culture and rationale can go a long way in helping you understand why a software system has been designed in the way it was. This is particularly useful for people who are new to an existing team.

4. Practical information

The final thing that travel guidebooks tend to include is practical information. You know, all the useful bits and pieces about currency, electricity supplies, immigration, local laws, local customs, how to get around, etc.

If we think about a software system, the practical information might include where the source code can be found, how to build it, how to deploy it, the principles that the team follow, etc. It's all of the stuff that can help the development team do their job effectively.

Keep it short, keep it simple

Exploring is great fun but ultimately it takes time, which we often don't have. Since the code doesn't tell the whole story, *some* supplementary documentation can be very useful, especially if you're handing over the software to somebody else or people are leaving and joining the team on a regular basis. My advice is to think about this supplementary documentation as a guidebook, which should give people enough information to get started and help them accelerate the exploration process. Do resist the temptation to go into too much technical detail though because the technical people that will understand that level of detail will know how to find it in the codebase anyway. As with everything, there's a happy mid-point somewhere.

The following headings describe what you might want to include in a software guidebook:

1. Context
2. Functional Overview
3. Quality Attributes
4. Constraints
5. Principles
6. Software Architecture
7. External Interfaces
8. Code
9. Data
10. Infrastructure Architecture
11. Deployment
12. Operation and Support
13. Decision Log

Product vs project documentation

As a final note, the style of documentation that I'm referring to here is related to the *product* being built rather than the *project* that is creating/changing the product. A number of organisations I've worked with have software systems approaching twenty years old and, although they have varying amounts of *project-level* documentation, there's often nothing that tells the story of how the product works and how it's evolved. Often these organisations have a single product (software system) and every major change is managed as a separate project. This results in a huge amount of change over the course of twenty years and a considerable amount of project documentation to digest in order to understand the current state of the software. New joiners in such environments are often expected to simply read the code and fill in the blanks by tracking down documentation produced by various project teams, which is time-consuming to say the least!

I recommend that software teams create a single software guidebook for every software system that they build. This doesn't mean that teams shouldn't create project-level documentation, but there should be a single place where somebody can find information about how the product works and how it's evolved over time. Once a single software guidebook is in place, every project/change-stream/timebox to change that system is exactly that - a small delta. A single software guidebook per product makes it much easier to understand the current state and provides a great starting point for future exploration.

18 Questions

1. We should all strive for self-documenting code, but does this tell the whole story? If not, what is missing?
2. Do you document your software systems? If so, why? If not, why not?
3. If you have lots of project-level documentation but very little product-level documentation, how do new joiners to your team understand your software system(s)? What could make their job easier?
4. What would you consider to be a minimum level of supplementary software documentation within your own environment?
5. Where do you store your supplementary documentation? (e.g. source control system, network file share, SharePoint, wiki, etc). Is this the best solution given your intended audience?

VI Software architecture in the development life cycle

This, the final part of the book, is about how everything else covered in the book fits into the day-to-day world of software development. We'll also answer the question of how much software architecture (and therefore, up front design) you should do.

19 The conflict between agile and architecture - myth or reality?

The words "agile" and "architecture" are often seen as mutually exclusive but the real world often tells a different story. Some software teams see architecture as an unnecessary evil whereas others have reached the conclusion that they do need to think about architecture once again.

Architecture can be summarised as being about structure and vision, with a key part of the process focussed on understanding the significant design decisions. Unless you're running the leanest of startups and you genuinely don't know which direction you're heading in, even the most agile of software projects will have some architectural concerns and these things really should be thought about up front. Agile software projects therefore do need "architecture", but this seems to contradict with how agile has been evangelised for the past 10+ years. Put simply, there is no conflict between agile and architecture because agile projects need architecture. So, where is the conflict then?

Conflict 1: Team structure

The first conflict between architecture and agile software development approaches is related to team structure. Traditional approaches to software architecture usually result in a dedicated software architect, triggering thoughts of ivory tower dictators who are a long way removed from the process of building software. This unfortunate stereotype of "solution architects" delivering large design documents to the development team before running away to cause havoc elsewhere has resulted in a backlash against having a dedicated architect on a software development team.

One of the things that agile software development teams strive towards is reducing the amount of overhead associated with communication via document hand-offs. It's rightly about increasing collaboration and reducing waste, with organisations often preferring to create small teams of generalising specialists who can turn their hand to almost any task. Indeed, because of the way in which agile approaches have been evangelised, there is often a perception that agile teams must consist of cross-discipline team members and simply left to self-organise. The result? Many agile teams will tell you that they "don't need no stinkin' architects"!

Conflict 2: Process and outputs

The second conflict is between the process and the desired outputs of agile versus those of big up front design, which is what people usually refer to when they talk about architecture. One of the key goals of agile approaches is to deliver customer value, frequently and in small chunks. It's about moving fast, getting feedback and embracing change. The goal of big design up front is to settle on an understanding of everything that needs to be delivered before putting a blueprint (and usually a plan) in place.

The agile manifesto values "responding to change" over "following a plan", but of course this doesn't mean you shouldn't do any planning and it seems that some agile teams are afraid of doing any "analysis" at all. The result is that in trying to avoid big up front design, agile teams often do no design up front and instead use terms like "emergent design" or "evolutionary architecture" to justify their approach. I've even heard teams claim that their adoption of test-driven development (TDD) negates the need for "architecture", but these are often the same teams that get trapped in a constant refactoring cycle at some point in the future.

Separating architecture from ivory towers and big up front design

These conflicts, in many cases, lead to chaotic teams that lack an appropriate amount of technical leadership. The result? Software systems that look like big balls of mud and/or don't satisfy key architectural drivers such as non-functional requirements.

Architecture is about the stuff that's hard or costly to change. It's about the big or "significant" decisions, the sort of decisions that you can't easily refactor in an afternoon. This includes, for example, the core technology choices, the overall high-level structure (the big picture) and an understanding of how you're going to solve any complex/risky/significant problems. Software architecture is important.

Big up front design typically covers these architectural concerns but it also tends to go much further, often unnecessarily so. The trick here is to differentiate what's important from what's not. Defining a high-level structure to put a vision in place is important. Drawing a countless number of detailed class diagrams before writing the code most likely isn't. Understanding how you're going to solve a tricky performance requirement is important, understanding the length of every database column most likely isn't.

Agile and architecture aren't in conflict. Rather than blindly following what others say, software teams need to cut through the hype and understand the technical leadership style and quantity of up front design that they need given their own unique context.

20 Introducing software architecture

A little software architecture discipline has a huge potential to improve the success of software teams, essentially through the introduction of technical leadership. With this in mind, the final question that we need to address is how to get software teams to adopt a just enough approach to software architecture, to ensure they build well-structured software systems that satisfy the goals, particularly with respect to any complex non-functional requirements and constraints. Often, this question becomes how to we *reintroduce* software architecture back into the way that software teams work.

In my view, the big problem that software architecture has as a discipline is that it's competing with all of the shiny new things created in the software industry on a seemingly daily basis. I've met thousands of software developers from around the world and, in my experience, there's a large number of them that don't think about software architecture as much as they should. Despite the volume of educational material out there, teams lack knowledge about what software architecture really is.

People have limited time and energy for learning but a lack of time isn't often the reason that teams don't understand what software architecture is all about. When I was moving into my early software architecture roles, I, like others I've spoken to, struggled to understand how much of what I read about in the software architecture books related to what I should doing on a daily basis. This lack of understanding is made worse because most software developers don't get to practice architecting software on a regular basis. How many software systems have you architected during your own career?

Simply saying that all software teams need to think about software architecture isn't enough to make it happen though. So, how *do* we get software teams to reintroduce software architecture?

Software architecture needs to be accessible

As experienced practitioners, *we* have a duty to educate others but we do need to take it one step at a time. We need to remember that many people are being introduced to software architecture with potentially no knowledge of the related research that has been conducted in the past. Think about the terminology that you see and hear in relation to software architecture. How would you explain to a typical software developer what a "logical view" is? When we refer to the "physical view", is this about the code or the physical infrastructure? Everybody on the development team needs to understand the essence of software architecture and the consequences of not thinking about it before we start talking about things like architecture description languages and evaluation methods. Information about software architecture needs to be accessible and grounded in reality.

This may seem an odd thing to say, but the people who manage software teams also need to understand the essence of software architecture and why it's a necessary discipline. Some of the teams I've worked with over the years have been told by their management to "stop doing software architecture and get on with the coding". In many cases, the reason behind this is a misunderstanding that all up front design activities need to be dropped when adopting agile approaches. Such software development teams are usually put under immense pressure to deliver and some up front thinking usually helps rather than hinders.

Some practical suggestions

Here are some practical suggestions for introducing software architecture.

1. Educate people

Simply run some workshops where people can learn about and understand what software architecture is all about. This can be aimed at developers or non-developers, and it will help to make sure that everybody is talking the same language. At a minimum, you should look to cover:

- What software architecture is.
- Why software architecture is important.
- The practices you want to adopt.

2. Talk about architecture in retrospectives

If you have regular retrospectives to reflect on how your team is performing, why not simply include software architecture on the list of topics that you talk about? If you don't think that enough consideration is being given to software architecture, perhaps because you're constantly refactoring the architecture of your software or you're having issues with some non-functional characteristics, then think about the software architecture practices that you can adopt to help. On the flip side, if you're spending too much time thinking about software architecture or up front design, perhaps it's time to look at the value of this work and whether any practices can be dropped or substituted.

3. Definition of done

If you have a "definition of done" for work items, add software architecture to the list. This will help ensure that you consider architectural implications of the work item and conformance of the implementation with any desired architectural patterns/rules or non-functional goals.

4. Allocate the software architecture role to somebody

If you have a software team that doesn't think about software architecture, simply allocating the software architecture role to somebody appropriate on the team may kickstart this because you're explicitly giving ownership and responsibility for the software architecture to somebody. Allocating the role to more than one person does work with some teams, but I find it better that one person takes ownership initially, with a view to sharing it with others as the team gains more experience. Some teams dislike the term "software architect" and use the term architecture owner instead. Whatever you call it, coaching and collaboration are key.

5. Architecture katas

Words alone are not enough and the skeptics need to see that architecture is not about big design up front. This is why I run short architecture katas where small teams collaboratively architect a software solution for a simple set of requirements, producing one or more diagrams to visualise and communicate their solutions to others. This allows people to experience that up front design doesn't necessarily mean designing everything to a very low level of abstraction and it provides a way to practice communicating software architecture.

Making change happen

Here's a relatively common question from people that understand why software architecture is good, but don't know how to introduce it into their projects.

> "I understand the need for software architecture but our team just doesn't have the time to do it because we're so busy coding our product. Having said that, we don't have consistent approaches to solving problems, etc. Our managers won't give us time to do architecture. If we're doing architecture, we're not coding. How do we introduce architecture?"

It's worth asking a few questions to understand the need for actively thinking about software architecture:

1. What problems is the lack of software architecture causing now?
2. What problems is the lack of software architecture likely to cause in the future?
3. Is there a risk that these problems will lead to more serious consequences (e.g. loss of reputation, business, customers, money, etc)?
4. Has something already gone wrong?

One of the things that I tell people new to the architecture role is that they do need to dedicate some time to doing architecture work (the big picture stuff) but a balance needs to be struck between this and the regular day-to-day development activities. If you're coding all of the time then that big picture stuff doesn't get done. On the flip-side, spending too much time on

"software architecture" means that you don't ever get any coding done, and we all know that pretty diagrams are no use to end-users!

"How do we introduce software architecture?" is one of those questions that doesn't have a straightforward answer because it requires changes to the way that a software team works, and these can only really be made when you understand the full context of the team. On a more general note though, there are two ways that teams tend to change the way that they work.

1. **Reactively**: The majority of teams will only change the way that they work based upon bad things happening. In other words, they'll change if and only if there's a catalyst. This could be anything from a continuous string of failed system deployments or maybe something like a serious system failure. In these cases, the team knows something is wrong, probably because their management is giving them a hard time, and they know that something needs to be done to fix the situation. This approach unfortunately appears to be in the majority across the software industry.
2. **Proactively**: Some teams proactively seek to improve the way that they work. Nothing bad might have happened yet, but they can see that there's room for improvement to prevent the sort of situations mentioned previously. These teams are, ironically, usually the better ones that don't *need* to change, but they do understand the benefits associated with striving for continouous improvement.

Back to the original question and in essence the team was asking permission to spend some time doing the architecture stuff but they weren't getting buy-in from their management. Perhaps their management didn't clearly understand the benefits of doing it or the consequences of not doing it. Either way, the team didn't achieve the desired result. Whenever I've been in this situation myself, I've either taken one of two approaches.

1. Present in a very clear and concise way what the current situation is and what the issues, risks and consequences are if behaviours aren't changed. Typically this is something that you present to key decision makers, project sponsors or management. Once they understand the risks, they can decide whether mitigating those risks is worth the effort required to change behaviours. This requires influencing skills and it can be a hard sell sometimes, particularly if you're new to a team that you think is dysfunctional!
2. Lead by example by finding a problem and addressing it. This could include, for example, a lack of technical documentation, inconsistent approaches to solving problems, too many architectural layers, inconsistent component configuration, etc. Sometimes the initial seeds of change need to be put in place before everybody understands the benefits in return for the effort. A little like the reaction that occurs when most people see automated unit testing for the first time.

Each approach tends to favour different situations, and again it depends on a number of factors. Coming back to the original question, it's possible that the first approach was used but either the message was weak or the management didn't think that mitigating the risks of not having any dedicated "architecture time" was worth the financial outlay. In this particular case, I would introduce software architecture through being proactive and leading by example. Simply find a

problem (e.g. multiple approaches to dealing with configuration, no high-level documentation, a confusing component structure, etc) and just start to fix it. I'm not talking about downing tools and taking a few weeks out because we all know that trying to sell a three month refactoring effort to your management is a tough proposition. I'm talking about baby steps where you evolve the situation by breaking the problem down and addressing it a piece at a time. Take a few minutes out from your day to focus on these sort of tasks and before you know it you've probably started to make a world of difference. "It's easier to ask forgiveness than it is to get permission".

The essence of software architecture

Many software teams are already using agile/lean approaches and more are following in their footsteps. For this reason, any software architecture practices adopted need to add real value otherwise the team is simply wasting time and effort. Only you can decide how much software architecture is just enough and only you can decide how best to lead the change that you want to see in your team. Good luck with your journey!

21 Questions

1. Despite how agile approaches have been evangelised, are “agile” and “architecture” really in conflict with one another?
2. If you’re currently working on an agile software team, have the architectural concerns been thought about?
3. Do you feel that you have the right amount of technical leadership in your current software development team? If so, why? If not, why not?
4. How much up front design is enough? How do you know when you stop? Is this view understood and shared by the whole team?
5. Many software developers undertake coding katas to hone their skills. How can you do the same for your software architecture skills? (e.g. take some requirements plus a blank sheet of paper and come up with the design for a software solution)
6. What is a risk? Are all risks equal?
7. Who identifies the technical risks in your team?
8. Who looks after the technical risks in your team? If it’s the (typically non-technical) project manager or ScrumMaster, is this a good idea?
9. What happens if you ignore technical risks?
10. How can you proactively deal with technical risks?
11. Do you need to introduce software architecture into the way that your team works? If so, how might you do this?

VII Appendix A: Financial Risk System

This is the financial risk system case study that is referred to throughout the book. It is also used during my Software Architecture for Developers training course and "Agile software architecture sketches" workshop.

VIII Appendix B: Software Guidebook for techtribes.je

This is a sample software guidebook for the techtribes.je website, which is a side-project of mine to provide a focal point for the tech, IT and digital sector in Jersey.

The code behind the techtribes.je website has been open sourced and is available on GitHub.

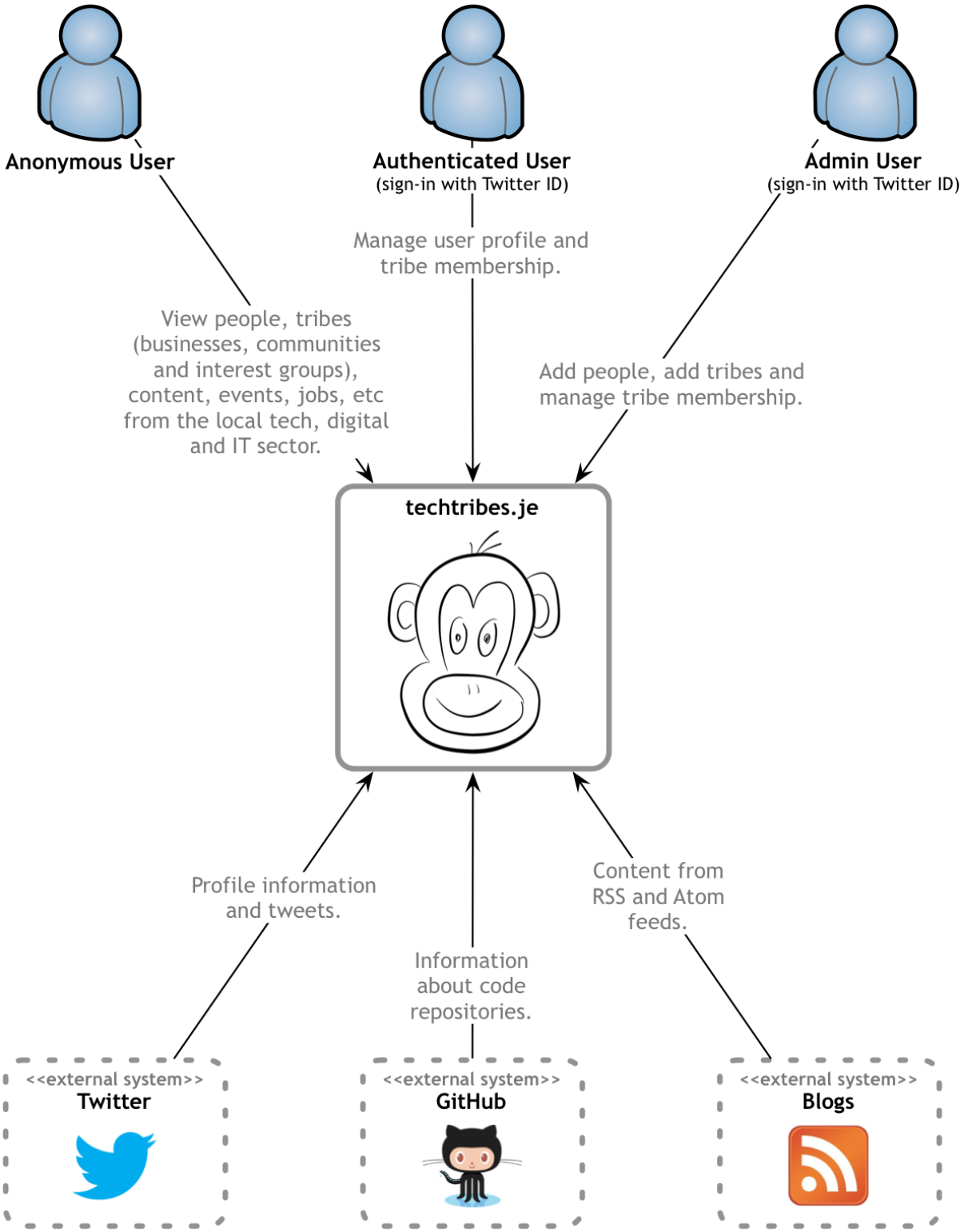
22 Introduction

This software guidebook provides an overview of the techtribes.je website. It includes a summary of the following:

1. The requirements, constraints and principles behind the website.
2. The software architecture, including the high-level technology choices and structure of the software.
3. The infrastructure architecture and how the software is deployed.
4. Operational and support aspects of the website.

23 Context

The techtribes.je website provides a way to find people, tribes (businesses, communities, interest groups, etc) and content related to the tech, IT and digital sector in Jersey and Guernsey. At the most basic level, it's a content aggregator for local tweets, news, blog posts, events, talks, jobs and more. Here's a context diagram that provides a visual summary of this:



techtribes.je - Context

The purpose of the website is to:

1. Consolidate and share local content, helping to promote it inside and outside of the local

community.
2. Encourage an open, sharing and learning culture within the local community.

Users

The techtribes.je website has three types of user:

1. **Anonymous**: anybody with a web browser can view content on the site.
2. **Authenticated**: people/tribes who have content aggregated into the website can sign-in to the website using their registered Twitter ID (if they have one) to modify some of their basic profile information.
3. **Admin**: people with administrative (super-user) access to the website can manage the people, tribes and content that is aggregated into the website.

External Systems

There are three types of systems that techtribes.je integrates with. These are represented by dashed grey boxes on the context diagram.

1. **Twitter**: profile information and tweets from people/tribes are retrieved from Twitter for aggregation into the website. Twitter is also used to allow people/tribes to sign-in to techtribes.je with their Twitter ID.
2. **GitHub**: summary information about code repositories is retrieved from GitHub if people/tribes have registered a GitHub ID.
3. **Blogs**: content from blogs written by people/tribes is retrieved via RSS or Atom feeds for aggregation into the website.