Viewpoints and Perspectives Reference Card

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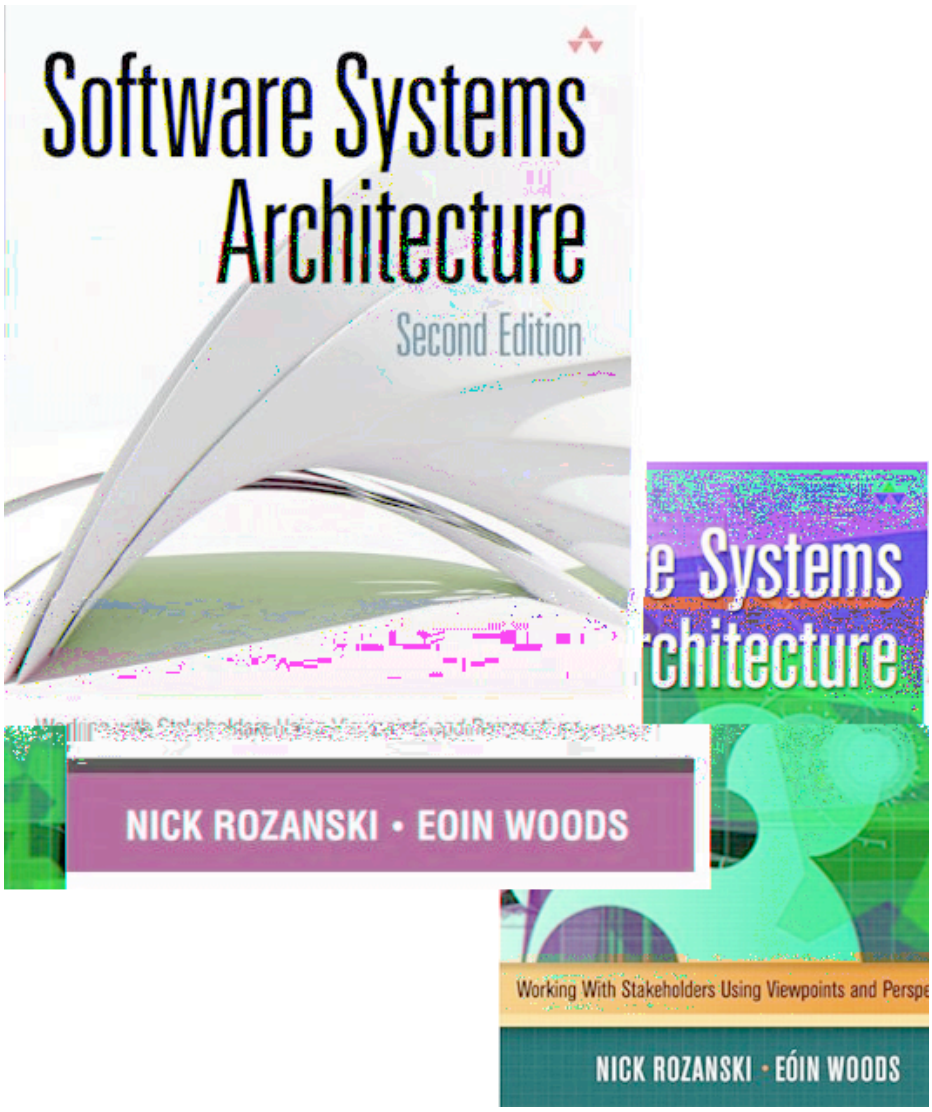

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The book is available from Amazon.com and Amazon.co.uk and other booksellers that carry Addison-Wesley books.

Contents

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Our book is based around four key concepts: ***a*** , , and . The definition of each is reproduced below.

Definition:

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The sets of viewpoints and perspectives that we have developed for information systems architecture are illustrated by the diagram in Figure 1.

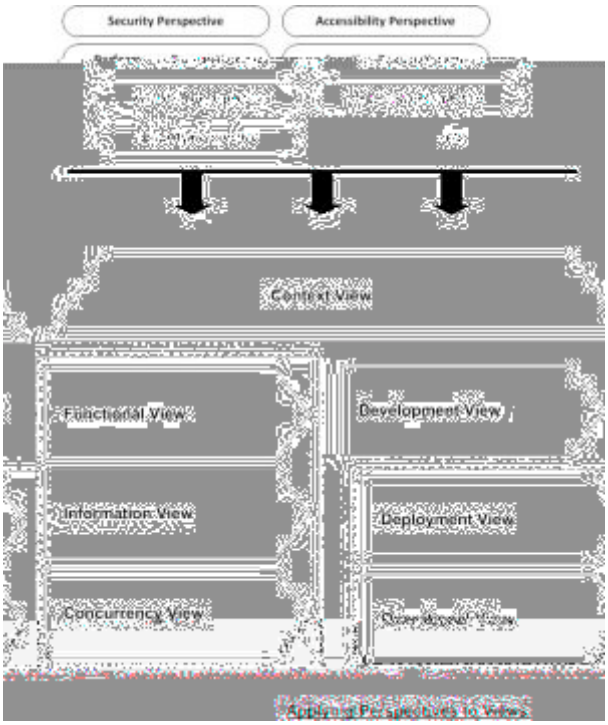


Figure 1 - Vie points and Perspectives

In this document, we provide a summary of each of our viewpoints and perspectives.

V S a

- ***C :*** Describes the relationships, dependencies, and interactions between the system and its environment (the people, systems, and external entities with which it interacts). Includes the system's runtime context and its scope and requirements.
- ***F a*** : Describes the system's functional elements, their responsibilities, interfaces, and primary interactions; drives the shape of other system structures such as the information structure, concurrency structure, deployment structure, and so on.
- ***I a*** : Describes the way that the architecture stores, manipulates, manages, and distributes information. This viewpoint develops a complete but high-level view of static data structure and information flow to answer the big questions around content, structure, ownership, latency, references, and data migration.
- ***C*** : Describes the concurrency structure of the system and maps functional elements to concurrency units to clearly identify the parts of the system that can execute concurrently and how this is coordinated and controlled.
- ***D*** : Describes the architecture that supports the software development process. Development views communicate the aspects of the architecture of interest to those stakeholders involved in building, testing, maintaining, and enhancing the system.
- ***D*** : Describes the environment into which the system will be deployed, and the dependencies the system has on its runtime environment. Deployment views capture the system's hardware environment, technical environment requirements, and the mapping of the software to hardware elements.
- ***O a a*** : Describes how the system will be operated, administered, and supported when it is running in its production environment, by identifying system-wide strategies for addressing operational concerns and identifying solutions that address these.

Q a P A b P

- ***A b*** : The ability of the system to be used by people with disabilities
- ***A a ab a R*** : The ability of the system to be fully or partly operational as and when required and to effectively handle failures that could affect system availability
- ***D R*** : The ability of the system to be designed, built, deployed, and operated within known constraints around people, budget, time, and materials
- ***E*** : The ability of the system to be flexible in the face of the inevitable change that all systems experience after deployment, balanced against the costs of providing such flexibility
- ***I a a a*** : The ability of the system to be independent from any particular language, country, or cultural group
- ***L a*** : The ability of the system to overcome problems brought about by the absolute location of its elements and the distances between them
- ***P a a S a ab*** : The ability of the system to predictably execute within its mandated performance profile and to handle increased processing volumes
- ***R a*** : The ability of the system to conform to local and international laws, quasi-legal regulations, company policies, and other rules and standards
- ***S*** : The ability of the system to reliably control, monitor, and audit who can perform what actions on what resources and to detect and recover from failures in security mechanisms
- ***U ab*** : The ease with which people who interact with the system can work effectively

S a

Stakeholder groups important to the development of most information systems include the following.

- ***A*** : Oversee the procurement of the system or product
- ***A*** : Oversee the system's conformance to standards and legal regulation
- ***C a*** : Explain the system to other stakeholders via its documentation and training materials
- ***D*** : Construct and deploy the system from specifications (or lead the teams that do this)
- ***Ma a*** : Manage the evolution of the system once it is operational
- ***P E*** : Design, deploy and manage the hardware and software environments in which the system will be built, tested and run
- ***S*** : Build and/or supply the hardware, software, or infrastructure on which the system will run
- ***S a*** : Provide support to users for the product or system when it is running
- ***S a a*** : Run the system once it has been deployed
- ***T*** : Test the system to ensure that it is suitable for use
- ***U*** : Define the system's functionality and ultimately make use of it

The characteristics of a good stakeholder can be summarised as follows.

- ***I*** : Do your stakeholders have the information, the experience, and the understanding needed to make the right decisions?
- ***C*** : Are your stakeholders willing and able to make themselves available to participate in the process, and are they prepared to make some possibly difficult decisions?
- ***A*** : Can you be sure that decisions made now by your stakeholders will not be reversed later (at potentially high cost)?
- ***R a*** : If a stakeholder is a group rather than a person, have suitable representatives been selected from the group? Do those representatives meet the above criteria for individual stakeholders?

C V

The Context view of a system defines the relationships, dependencies, and interactions between the system and its environment—the people, systems, and external entities with which it interacts. It defines what the system does and does not do; where the boundaries are between it and the outside world; and how the system interacts with other systems, organizations, and people across these boundaries.

D	Describes the relationships, dependencies and interactions between the system and its environment (the people, systems and external entities that it interacts with)
C	System scope and responsibilities, system quality objectives, identity of external entities and services and data used, nature and characteristics of external entities, identity and responsibilities of external interfaces, nature and characteristics of external interfaces, other external interdependencies, impact of the system on its environment, overall completeness consistency and coherence
M	Context model, scope definition, interaction scenarios
P L a P a	Missing or incorrect context model elements, uneven focus, inappropriate level of detail, scope creep, implicit or assumed scope or requirements, missing implicit dependencies, loose or inaccurate interface descriptions, overcomplicated interactions, overuse of jargon
A ab	All systems

Stakeholders and Concerns

A	System scope and responsibilities, system quality objectives, identity of external entities, and services and data used, impact of the system on its environment
A	All concerns
C a	System scope and responsibilities, identity and responsibilities of external entities, identity and responsibilities of external interfaces
D	All concerns
P E	System quality objectives, nature and characteristics of external interfaces, impact of the system on its environment
S a a	All concerns
T	All concerns
U	System scope and responsibilities, identity of external entities, and services and data used, overall completeness, consistency and coherence

Checklist

- Have you consulted with all of the stakeholders who are interested in the Context View?
- Have you identified all of the external entities that the system needs to interact with, and their relevant responsibilities?
- Have you got a good understanding of the nature of every interface with each external entity, and is this documented to an appropriate level of detail?
- Have you considered possible dependencies between the external entities that you have to interact with? Are these implicit dependencies documented in the AD?
- Does the context diagram adequately illustrate all the interfaces from the system to its environment, with sufficient definition underpinning the diagram?
- Have you identified all of the key capabilities or requirements of the system, and are they documented to an appropriate level of detail?
- Does the scope identify any important technology constraints, such as mandated platforms?
- Is the scope specified at an appropriate level of detail, balancing brevity with clarity and completeness?
- Has the context model been formally agreed by all key stakeholders? Is this documented somewhere?
- Has the context model been placed under formal change control?
- Do the main business processes appear to have adequate coverage, either by systems or defined manual processes?
- Does the overall solution hang together in a coherent way?

F a V

The Functional view of a system defines the architectural elements that deliver the system's functionality. The view documents the system's functional structure—including the key functional elements, their responsibilities, the interfaces they expose, and the interactions between them. Taken together, this demonstrates how the system will perform the functions required of it.

D	Describes the system's runtime functional elements and their responsibilities, interfaces, and primary interactions
C	Functional capabilities, external interfaces, internal structure, and design philosophy
M	Functional structure model
P b a P a	Poorly defined interfaces, poorly understood responsibilities, infrastructure modeled as functional elements, overloaded view, diagrams without element definitions, difficulty in reconciling the needs of multiple stakeholders, wrong level of detail, "God elements," and too many dependencies
A ab	All systems

Stakeholders and Concerns

A	Primarily functional capabilities and external interfaces
A	All concerns
C a	All concerns, to some extent
D	Primarily design philosophy and internal structure, but also functional capabilities and external interfaces
S a a	Primarily design philosophy and internal structure
T	Primarily design philosophy and internal structure, but also functional capabilities and external interfaces
U	Primarily functional capabilities and external interfaces

Checklist

- Do you have fewer than 15–20 top-level elements?
- Do all elements have a name, clear responsibilities, and clearly defined interfaces?
- Do all element interactions take place via well-defined interfaces and connectors that link the interfaces?
- Do your elements exhibit an appropriate level of cohesion and coupling?
- Have you identified the important usage scenarios and used these to validate the system's functional structure?
- Have you checked the functional coverage of your architecture to ensure it meets its functional requirements?
- Have you considered how the architecture is likely to cope with possible change scenarios in the future?
- Does the presentation of the view take into account the concerns and capabilities of all interested stakeholder groups? Will the view act as an effective communication vehicle for all of these groups?

I a V

The ultimate purpose of any information system is to manipulate data in some form. This data may be stored persistently, as in a database management system, or it may be transiently manipulated in memory while a program executes. You use the Information view to answer questions about how your system will store, manipulate, manage, and distribute information

D	Describes the way that the architecture stores, manipulates, manages, and distributes information
C	Information structure and content; information purpose and usage; information ownership; enterprise-owned information; identifiers and mappings; transaction management and recovery; volatility of data semantics; information storage models; information flow; information consistency; information quality; timeliness, latency, and age; and archiving and information retention
M	Static information structure models, information flow models, information lifecycle models, information ownership models, information quality analysis, metadata models, and volumetric models
P a P a	Representation incompatibilities, unavoidable multiple updaters, key-matching deficiencies, interface complexity, overloaded central database, inconsistent distributed databases, poor information quality, excessive information latency, and inadequate volumetrics
A ab	Any system that has more than trivial information management needs

Stakeholders and Concerns

A	Concerned with preserving and safeguarding the value of the organization's information assets, so the following are key: information quality and archiving; reference data; information retention
A	Interested in all aspects, with a focus on information structure and flow, identifiers and mappings, and information quality
C a	Rarely focus on detail on the information architecture, but may find a background understanding of the key principles and strategies helpful
D	Focus on how the models will map to real databases and interfaces
S a a	Interested in how these real-world system components will be managed and supported
T	Interested in the main database structures, how they are affected by the operation of the system, the data flow through the system, and how to create realistic test data sets
U	Concerned with functional aspects of the information architecture (e.g., information ownership and regulation) and user-visible qualities such as timeliness, latency, and age; and information quality

Checklist

- Do you have an appropriate level of detail in your models (no more than 20 entities)?
- Are keys clearly identified for all important entities?
- Have you defined mappings between keys, where required, and defined processes for maintaining these mappings when data items are created and removed?
- Have you defined strategies for resolving data ownership conflicts, particularly where there are multiple creators or updaters?
- Are latency requirements clearly identified, and are mechanisms in place to ensure these are achieved?
- Do you have clear strategies for transactional consistency across distributed data stores, balanced against their cost in terms of performance and complexity?
- Do you have mechanisms in place for validating migrated data and dealing appropriately with errors?
- Have you defined sufficient storage and processing capacity for archiving and restore?
- Has a data quality assessment been done? Have you created strategies for dealing with poor-quality data?

C V

The Concurrency view is used to describe the system's concurrency and state-related structure and constraints. This involves defining the parts of the system that can run at the same time and how this is to be controlled, by defining how the system's functional elements are packaged into operating system processes and how the processes coordinate their execution.

D	Describes the concurrency structure of the system, mapping functional elements to concurrency units to clearly identify the parts of the system that can execute concurrently, and shows how this is coordinated and controlled
C	Task structure, mapping of functional elements to tasks, interprocess communication, state management, synchronization and integrity, startup and shutdown, task failure, and reentrancy
M	System-level concurrency models and state models
P b a P a	Modeling of the wrong concurrency, excessive complexity, resource contention, deadlock, and race conditions
A a	All information systems with a number of concurrent threads of execution

Stakeholders and Concerns

A a	Task structure, startup and shutdown, and task failure
C a	Task structure, startup and shutdown, and task failure
D	All concerns
T	Task structure, mapping of functional elements to tasks, startup and shutdown, task failure, and reentrancy

Checklist

- Is there a clear system-level concurrency model?
- Are your models at the right level of abstraction? Have you focused on the architecturally significant aspects?
- Can you simplify your concurrency design?
- Do all interested parties understand the overall concurrency strategy?
- Have you mapped all functional elements to a process (and thread if necessary)?
- Do you have a state model for at least one functional element in each process and thread? If not, are you sure the processes and threads will interact safely?
- Have you defined a suitable set of interprocess communication mechanisms to support the interelement interactions defined in the Functional view?
- Are all shared resources protected from corruption?
- Have you minimized the intertask communication and synchronization required?
- Do you have any resource hot spots in your system? If so, have you estimated the likely throughput, and is it high enough? Do you know how you would reduce contention at these points if forced to later?
- Can the system possibly deadlock? If so, do you have a strategy for recognizing and dealing with this when it occurs?

D V

A considerable amount of planning and design of the development environment is often required to support the design and build of software for complex systems. Things to think about include code structure and dependencies, build and configuration management of deliverables, system-wide design constraints, and system-wide standards to ensure technical integrity. It is the role of the Development view to address these aspects of the system development process.

D	Describes the architecture that supports the software development process
C	Module organization, common processing, standardization of design, standardization of testing, instrumentation, and codeline organization
M	Module structure models, common design models, and codeline models
P b a P a	Too much detail, overburdening the AD, uneven focus, lack of developer focus, lack of precision, and problems with the specified environment
A ab	All systems with significant software development involved in their creation

Stakeholders and Concerns

D	All concerns
P E	May be involved in or have responsibility for provisioning development and test environments, and mechanisms and controls over the system's transition into production
T	Common processing, instrumentation, test standardisation and possibly codeline organization

Checklist

- Have you defined a clear strategy for organizing the source code modules in your system?
- Have you defined a general set of rules governing the dependencies that can exist between code modules at different abstraction levels?
- Have you identified all of the aspects of element implementation that need to be standardized across the system?
- Have you clearly defined how any standard processing should be performed?
- Have you identified any standard approaches to design that you need all element designers and implementers to follow? If so, do your software developers accept and understand these approaches?
- Will a clear set of standard third-party software elements be used across all element implementations? Have you defined the way they should be used?
- Is this view as minimal as possible?
- Is the presentation of this view in the AD appropriate?

D V

The Deployment view focuses on aspects of the system that are important after the system has been tested and is ready to go into live operation. This view defines the physical environment in which the system is intended to run, including the hardware environment your system needs (e.g., processing nodes, network interconnections, and disk storage facilities), the technical environment requirements for each node (or node type) in the system, and the mapping of your software elements to the runtime environment that will execute them.

D	Describes the environment into which the system will be deployed, including the dependencies the system has on its runtime environment
C	Types of hardware required, specification and quantity of hardware required, third-party software requirements, technology compatibility, network requirements, network capacity required, and physical constraints
M	Runtime platform models, network models, and technology dependency models
P b a P a	Unclear or inaccurate dependencies, unproven technology, lack of specialist technical knowledge, late consideration of the deployment environment, inappropriate headroom and not specifying a disaster recovery environment
A ab	Systems with complex or unfamiliar deployment environments

Stakeholders and Concerns

A	Types of hardware required, technology compatibility, and network requirements
C a	Types and specification of hardware required, third-party software requirements, and network requirements (particularly topology)
D	Types and (general) specification of hardware required, third-party software requirements, technology compatibility, and network requirements (particularly topology)
S a a	Types, specification, and quantity of hardware required; third-party software requirements; technology compatibility; network requirements; network capacity required; and physical constraints
T	Types, specification, and quantity of hardware required; third-party software requirements, and network requirements

Checklist

- Have you mapped all of the system's functional elements to a type of hardware device? Have you mapped them to specific hardware devices if appropriate?
- Is the role of each hardware element in the system fully understood? Is the specified hardware suitable for the role?
- Have you established detailed specifications for the system's hardware devices? Do you know exactly how many of each device are required?
- Have you identified all required third-party software and documented all the dependencies between system elements and third-party software?
- Is the network topology required by the system understood and documented?
- Have you estimated and validated the required network capacity? Can the proposed network topology be built to support this capacity?
- Have network specialists validated that the required network can be built?
- Have you performed compatibility testing when evaluating your architectural options to ensure that the elements of the proposed deployment environment can be combined as desired?
- Have you used enough prototypes, benchmarks, and other practical tests when evaluating your architectural options to validate the critical aspects of the proposed deployment environment?
- Can you create a realistic test environment that is representative of the proposed deployment environment?
- Are you confident that the deployment environment will work as designed? Have you obtained external review to validate this opinion?
- Are the assessors satisfied that the deployment environment meets their requirements in terms of standards, risks, and costs?
- Have you checked that the physical constraints (such as floor space, power, cooling, and so on) implied by your required deployment environment can be met?

O a a V

The aim of the Operational viewpoint is to identify a system-wide strategy for addressing the operational concerns of the system's stakeholders and to identify solutions that address these. The Operational view focuses on concerns that help ensure that the system is a reliable and effective part of commissioning enterprise's information technology environment. For a product development project, the Operational view illustrates the types of concerns that customers of the product are likely to encounter, rather than the concerns of a specific site.

D	Describes how the system will be operated, administered, and supported when it is running in its production environment
C	Installation and upgrade, functional migration, data migration, operational monitoring and control, alerting, configuration management, performance monitoring, support, and backup and restore
M	Installation models, migration models, configuration management models, administration models, and support models
P b a P a	Lack of engagement with the operational staff, lack of backout planning, lack of migration planning, insufficient migration window, missing management tools, lack of integration into the production environment, inadequate backup models, and inappropriate alerting
A ab	Any system being deployed into a complex or critical operational environment

Stakeholders and Concerns

A	Functional migration, data migration, and support
C a	Installation and upgrade, functional migration, and operational monitoring and control
D	Operational monitoring and control and performance monitoring
P E	Installation and upgrade, operational monitoring and control, configuration management, performance monitoring
S a	Functional migration, data migration, and support
S a a	All concerns
T	Installation and upgrade, functional migration, data migration, monitoring and control, and performance monitoring
U	Support

Checklist

- Do you know what it takes to install your system?
- Do you have a plan for backing out a failed installation?
- Can you upgrade an existing version of the system (if required)?
- How will information be moved from the existing environment into the new system?
- Do you have a clear migration strategy to move workload to the new system? Can you reverse the migration if you need to? How will you deal with data synchronization?
- How will the system be backed up? Is restore possible in an acceptable time period?
- Are the administrators confident that they can monitor and control the system and do they have a clear understanding of operational procedures?
- How will performance metrics be captured for the system's elements?
- Can you manage the configuration of all of the system's elements?
- Do you know how support will be provided for the system? Is the support provided suitable for the stakeholders it is being provided for?
- Have you cross-referenced the requirements of the administration model back to the Development view to ensure that they will be implemented consistently?

A b P

Accessibility should take into account not only the direct users of the system—i.e., those sitting at terminals—but the indirect users as well. For example, a financial system may need to provide bank statements in Braille for blind customers. Consideration of disability aside, addressing accessibility concerns brings benefits in many cases by making systems more usable and efficient in their operation.

D Q a	The ability of the system to be used by people with disabilities
A ab	Any system that may be used or operated by people with disabilities or may be subject to legislation regarding disabilities
C	Types of disability, functional availability, and disability regulation
A	Identification of system touch points, device independence, and content equivalence
Ta	Assistive technologies, specialist input devices, and voice recognition
P & P a	Ignoring these needs until too late, lack of knowledge about regulation and legislation, and lack of knowledge about suitable solutions

Applicabilit to Vie s

C	There may be a requirement for the system to interface with specialist devices for use by people with disabilities, such as voice---controlled input devices.
F a	In theory, the functional structure should not really be affected by accessibility considerations. In practice, functional compromises may need to be made.
I a	The information structure is unlikely to be significantly affected.
C	The impact on this view is minimal.
D	The Development view needs to raise awareness that accessibility issues are important. And, of course, you may need to accommodate disabled developers, too.
D	The deployment environment is likely to be the most affected by this perspective. Special hardware may be needed to support disabled users.
O a a	The Operational view may have to take into account the needs of disabled users requiring support or the needs of disabled support staff themselves.

Checklist for Requirements Capture

- Have you identified and obtained stakeholder approval of the extent to which the system must support the needs of disabled users?
- Have you provided for the needs of indirect disabled users, such as customers who need paperwork provided in Braille format?
- Have you identified the disability legislation that affects the system and assessed the system against it?
- Have you ensured that the system meets any internal accessibility standards?
- Have you considered all points at which the system has any human interaction? For example, have you considered operational management and monitoring of the system, or printed forms that are sent to customers to be filled in?

Checklist for Architecture Definition

- How confident are you that your architectural assumptions are correct? Where you are not, are mitigating activities in place (such as a proof-of-concept)?
- Do the interactive elements of your architecture sufficiently separate presentation and content to meet the system's accessibility objectives?
- Are the interfaces between components (particularly those leading in and out of presentation devices) sufficiently generic to be able to take on board new devices without (much) rework?
- Does the architecture allow for presentation alternatives to convey meaning (e.g., text, pictures, and/or sound in a user interface)?
- Do standards for user interface design emphasize simplicity, consistency, and clarity in place? Does the architecture adhere to them?

A a ab a R P

This perspective allows you to identify the availability and resilience needs of your system and identify solutions that take into account the costs that providing these properties incur.

D Q a	The ability of the system to be fully or partly operational as and when required and to effectively handle failures that could affect system availability
A ab	Any system that has complex or extended availability requirements, complex recovery processes, or a high profile (e.g., is visible to the public)
C	Classes of service, planned downtime, unplanned downtime, time to repair, and disaster recovery
A	Capture the availability requirements, produce the availability schedule, estimate platform availability, estimate functional availability, assess against the requirements, and rework the architecture
Ta	Select fault-tolerant hardware, use high-availability clustering and load balancing, log transactions, apply software availability solutions, select or create fault-tolerant software, design for failure, allow for component replication, relax transactional consistency and identify backup and disaster recovery solutions
P & P a	Single point of failure, cascading failure, unavailability through overload, overambitious availability requirements, ineffective error detection, over-estimation of component resilience, overlooked global availability requirements, and incompatible technologies

Applicabilit to Vie s

C	Unlikely to result in many changes to the Context view.
F a	Functional changes may sometimes be needed to support availability requirements, such as the ability to operate in an offline mode a network is unavailable.
I a	A key availability consideration is the set of processes and systems for backup and recovery.
C	Features such as hardware replication and failover in your system may imply changes or enhancements to your concurrency model.
D	Your approach to achieving availability may impose design constraints on the software modules that need captured in this view.
D	Availability and resilience can have a big impact on the deployment environment such as fault-tolerant hardware, disaster recovery sites, redundancy & clustering.
O a a	May need to capture processes to allow the identification and recovery of problems in the production environment and handle failure appropriately (e.g. failover & DR).

Checklist for Requirements Capture

- Are availability requirements defined, documented, and approved?
- Are availability requirements driven by business needs?
- Do availability requirements consider different classes of service, if appropriate?
- Do availability requirements strike a realistic balance between cost and need?
- Do availability requirements consider online and batch availability?
- Do availability requirements take into account variations such as period end?
- Do availability requirements take into account future changes a longer online day?
- Can availability requirements be met by the chosen hardware and software platform?
- Have you defined strategies for disaster recovery and business continuity?
- Do stakeholders have realistic expectations around unplanned downtime?

Checklist for Architecture Definition

- Does the proposed architectural solution meet the availability requirements? Can this be demonstrated, either theoretically or based on previous practical experience?
- Does the solution consider the time taken to recover from failure?
- Does the backup solution provide for the transactional integrity of restored data?
- Has consideration been given to restoring data from corrupt or incomplete backups?
- Have you defined a suitable standby site in the architecture, if appropriate?
- Have you assessed the impact of availability on functionality and performance?
- Have you assessed the architecture for single points of failure and other weaknesses?
- If you developed a fault-tolerant model, does this extend to all vulnerable components?

D R P

All software projects are primarily constrained by time and cost. IT budgets are never unlimited, and although technology capabilities improve from year to year, so do the costs of building, deployment, and support. This perspective allows you to consider whether your architecture can be created, given development resource constraints.

D Q a	The ability of the system to be designed, built, deployed, and operated within known constraints related to people, budget, time, and materials
A ab	Any system for which development time is limited, technical skills for development or operations are hard to find, or unusual or unfamiliar hardware or software is required
C	Time constraints, cost constraints, required skill sets, available resources, budgets, and external dependencies
A	Cost estimation, development time estimation, development planning, dependency management, scoping, prototyping, and expectation management
Ta	Incremental and iterative development, expectation management, descoping, prototyping and piloting, and fitness for purpose
P b & P a	Overly ambitious timescales, failure to consider lead times, failure to consider physical constraints, underbudgeting, failure to provide staff training and consider familiarization needs, insufficient resource allocation for testing and rollout, insufficient time for likely rework, overallocation of staff, and difficulty getting access to knowledgeable business stakeholders

Applicabilit to Vie s

C	Resource constraints such as short timescales or limitations on available skills may impose constraints on system scope.
F a	Resource constraints often impose restrictions on functionality and on functional qualities such as generality.
I a	Complex or particularly sophisticated information models may require a large staff of specialists to implement; and so may impose restrictions on your options.
C	Concurrent architectures are often complex to implement, so you will need to consider the development skills and testing time available to you.
D	Cost constraints may limit the number of separate development and test environments available to you.
D	Again, cost constraints may limit your options for deployment, particularly where redundancy and resilience are concerned.
O a a	You need to be aware of the cost implications of your proposed operational and support architecture.

Checklist for Requirements Capture

- Have you understood the project's key constraints in terms of time and budget, as well as the room for manoeuvring if your architecture mandates extra resources?
- Have you considered physical constraints such as existing capacity and office space?
- Have you balanced the benefits of unfamiliar technologies against their costs and risks?
- Which compromises are more likely to be accepted where resource constraints necessitate this? To what extent could you limit scope, functionality, or even quality? Are you confident that savings would be realized by making such compromises?
- To what extent is there scope for deferring features until future releases of software?
- Do you understand which functional and operational principles absolutely cannot be compromised, no matter what the resource impact?

Checklist for Architecture Definition

- Is your architecture based on technologies already familiar to the developer community?
- Is your architecture based on proven technologies as opposed to innovative ones?
- Have you included in plans the costs of additional infrastructures for disaster recovery, support, acceptance, and training?
- Where unfamiliar technologies are used, have you considered staff training & support?
- Is your architecture simple enough to be built and supported by development/operations staff who have only recently been trained?

E P

The Evolution perspective addresses the concerns related to dealing with evolution during the lifetime of a system and thus is relevant to most large-scale information systems because of the amount of change that most systems need to handle.

D Q a	The ability of the system to be flexible in the face of the inevitable change that all systems experience after deployment, balanced against the costs of providing such flexibility
A ab	Important for all systems to some extent; more important for longer lived and more widely used systems
C	Product management, magnitude of change, dimensions of change, likelihood of change, timescale for change, when to pay for change, changes driven by external factors, development complexity, preservation of knowledge, and reliability of change
A	Characterize the evolution needs, assess the current ease of evolution, consider the evolution tradeoffs, and rework the architecture
Ta	Contain change, create extensible interfaces, apply design techniques which facilitate change, apply metamodel-based architectural styles, build variation points into the software, use standard extension points, achieve reliable change, and preserve development environments
P b & P a	Prioritization of the wrong dimensions, changes that never happen, impacts of evolution on critical quality properties, over-reliance on specific hardware or software, lost development environments, and ad hoc release management

Applicabilit to Vie s

C	May need to s

I a a a P

The Internationalization perspective is important for any system that will have users who speak different languages or come from different countries. If systems are aimed at a specific locale with no plans to move it into a wider area, this perspective has limited relevance.

D Q a	The ability of the system to be independent from any particular language, country, or cultural group
A ab	Any system that may need to be accessed by users or operational staff from different cultures or parts of the world, or in multiple languages, either now or in the future
C	Character sets, text presentation and orientation, specific language needs, cultural norms, automatic translation, currency conversions and exchange rates, and cultural neutrality
A	Identification of system touch points, identification of regions of concern, internationalization of code, and localization of resources
Ta	Separation of presentation and content, use of message catalogs, system---wide use of suitable character sets (e.g., Unicode), specialized display and presentation hardware, and currency conversion mechanisms
P & P a	Platforms not available in required locales, initial consideration of similar languages only, internationalization performed late in the development process, incompatibilities between locales on servers, insufficient consideration to currency exchange

Applicabilit to Vie s

C	Specialist display and data entry hardware may be required for non---Western languages.
F a	The functional structure may need to reflect how presentation is separated from content. General functionality should be independent of location.
I a	The Information view defines which stored information needs to be internationalized and how this will be achieved.
C	This perspective has minimal impact on the Concurrency view.
D	The Development view will need to reflect the impact of these factors on the development environment. (e.g. internationalized test data or user message catalogues).
D	The deployment environment may need to take into consideration such items as internationalized input and presentation devices.
O a a	The Operational view may need to consider what functionality is provided to support the maintenance and administration of localized information and services, and how support will be provided to different locations.

Checklist for Requirements Capture

- Have you agreed with stakeholders on the extent to which systems must be operable in different languages or countries, either now or in the future?
- Have you considered all points at which the system has any human interaction? For example, have you considered operational management and monitoring of the system or printed forms sent to customers to be filled in?
- Have you identified whether there is a requirement for non-Western character sets such as Kanji, which have special requirements for entry and presentation of data?
- Does your analysis consider all types of interaction—screens, keyboards, printed reports, and so on?

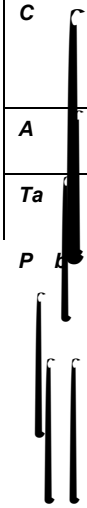
Checklist for Architecture Definition

- How confident are you that the architecture will meet all the requirements? Where you are not, are mitigating activities in place (such as a proof-of-concept)?
- Do the interactive elements of your architecture sufficiently separate presentation and content to meet the system's internationalization objectives?
- If non-Western character sets such as Kanji must be supported, do your input and output devices accommodate these?
- If standard text must be presented in multiple languages, have you designed facilities for maintaining such information?

L a P

The Location perspective addresses the problems that arise when systems or system elements are physically distant from one another. If all elements are located in the same place, you can usually disregard this perspective.

D Q a	The ability of the system to overcome problems brought about by the absolute location of its elements and the distances between them
A ab	Any system whose elements (or other systems with which it interacts) are or may be physically far from one another
C	Time zones of operation, network link characteristics, resiliency to link failures, wide-area interoperability, high-volume operations, intercountry concerns (political, locations
A	Geographical mapping, estimation of link quality, estimation of latency, benchmarking, and modeling of geographical characteristics
Ta	Avoidance of widely distributed transactions, architectural plans for wide-area link failure, and allowance for offline operation
P & P a	



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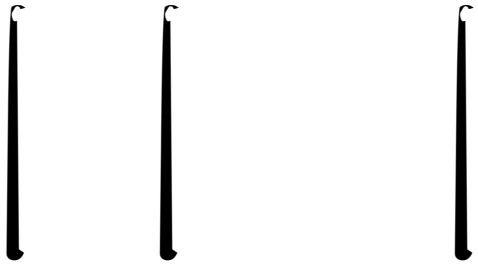
P a a S a ab P

This perspective helps you to address the two related quality properties of performance and scalability. These properties are important because, in large systems, they can cause more



R a P

Unlike other system qualities, compliance with the law is an area where you cannot make compromises. Although you may be able to live with a system that is slow, occasionally unreliable, or potentially insecure, a system that does not comply with legal regulations may be prevented from going into production or may expose the organization to risk of prosecution.

D Q a	The ability of the system to conform to local and international laws, quasi-legal regulations, company policies, and other rules and standards
A ab	Any system that may be subject to laws or regulations
C	Statutory industry regulation, privacy and data protection, cross-border legal restrictions, data retention and accountability, and organizational policy compliance
A	Compliance auditing
Ta	Assessment of architecture against regulatory and legislative requirements
P b & P a	Not understanding regulations or resulting obligations, and being unaware of statutory regulations

Applicabilit to Vie s

C	May unearth requirements to internal or external auditing or regulatory reporting systems.
F a	Regulations can have a significant impact on what the system does and how it works.
I a	Especially in Europe, there is a great deal of legislation related to the retention, use, and manipulation of personal information. The impact on the Information view may include privacy, access control, retention and archive, audit, availability, and distribution.
C	This perspective has little or no impact on the Concurrency view.
D	This perspective has little or no impact on the Development view, although if production (live) test data is to be used, there may be restrictions on this.
D	This perspective has little or no impact on the Deployment view, although health and safety legislation could have an impact on the hardware deployed.
O a a	Specific operational tools and processes are often required to manage and oversee regulatory reporting activities (e.g. monitor conformance to reporting SLAs).

Checklist for Requirements Capture

- Have you identified all legislation that applies to the functionality the system supports (e.g., employment law for a human resources system, or company law for a financial system) and assessed the architecture for compliance with these?
- Have you identified the generic legislation that applies to software systems (e.g., health and safety, the environment, data protection) and assessed the architecture for compliance with these?
- Have you determined whether the system can be considered as touching on other countries in any way, and if so, what legislation it may be subject to as a result?
- Have you considered international law such as technology export restrictions?
- Have you identified the relevant internal business and technology regulations and standards? Have you assessed the architecture for compliance with these?
- If legislation requires registration with governmental agencies (e.g., the Data Protection Registrar in the United Kingdom), have you applied for this registration, or do you have plans to make this happen?
- Do your archive and retention plans conform to all applicable legislation?

Checklist for Architecture Definition

- Does your architecture accommodate any required automated interfaces to regulatory bodies (e.g., automatic upload of accounting or taxation information)? Do these interfaces conform to prescribed business and technical standards?
- Does the architecture conform to any mandated technical standards?

S P

The security perspective guides you as you consider the set of processes and technologies that allow the owners of resources in the system to reliably control who can perform what actions on particular resources.

D Q a	The ability of the system to reliably control, monitor, and audit who can perform what actions on which resources & the ability to detect and recover from security breaches
A ab	Any systems with publicly accessible interfaces, with multiple users where the identity of the user is significant, or where access to operations or information needs to be controlled
C	Resources, principals, policies, threats, confidentiality, integrity, availability, accountability, security mechanisms, and detection and recovery
A	Identify sensitive resources, define the security policy, identify threats to the system, design the security implementation, and assess the security risks
Ta	Apply recognized security principles, authenticate the principals, authorize access, ensure information secrecy, ensure information integrity, ensure accountability, protect availability, integrate security technologies, provide security administration, and use third-party security infrastructure
P b & P a	Complex security policies, unproven security technologies, system not designed for failure, lack of administration facilities, technology-driven approach, failure to consider time sources, overreliance on technology, no clear requirements or models, security as an afterthought, ignoring the insider threat, assuming the client is secure, security in the application code, piecemeal security, ad hoc security technology

Applicabilit to Vie s

C	Allows you to clearly identify external connections and consider how they could become system vulnerabilities and how they will need to be protected from malicious use.
F a	Reveals which functional elements need to be protected. Functional structure may be impacted by the need to implement your security policies.
I a	Reveals what data needs to be protected. Information models are often modified as a result of security design (e.g., partitioning information by sensitivity).
C	Security design may indicate the need to isolate different pieces of the system into different runtime elements, so affecting the system's concurrency structure.
D	Captures security related development guidelines and constraints.
D	May need major changes to accommodate security-oriented hardware or software, or to address security risks.
O a a	Needs to make the security assumptions and responsibilities clear, so that these aspects of the security implementation can be reflected in operational processes.

Checklist for Requirements Capture

- Have you identified the sensitive resources contained in the system?
- Have you identified the sets of principals that need access to the resources?
- Have you identified the system's needs for information integrity guarantees?
- Have you identified the system's availability needs?
- Is there a security policy, including access control and information integrity needs?
- Is the security policy as simple as possible?
- Have you worked through a formal threat model to identify security risks?
- Have you reviewed your security requirements with external experts?

Checklist for Architecture Definition

- Have you addressed each threat identified in the threat model to the extent required?
- Have you used as much third-party security technology as possible?
- Have you produced an integrated overall design for the security solution?
- Have you considered all standard security principles when designing the infrastructure?
- Is your security infrastructure as simple as possible?
- Have you defined how to identify and recover from security breaches?
- Have you applied the results of the Security perspective to all of the affected views?
- Have external experts reviewed your security design?

U ab P

Applying the Usability perspective ensures that the system allows those who interact with it to do so effectively. This perspective tends to focus on the end users of the system but should also address the concerns of any others who interact with it directly or indirectly, such as maintainers and support personnel.

D Q a	The ease with which people who interact with the system can work effectively
A ab	Any system that has significant interaction with humans (users, operational staff, and so on) or that is exposed to members of the public
C	User interface usability, business process flow, information quality, alignment of the human–computer interface (HCI) with working practices, alignment of the HCI with users' skills, maximization of the perceived usability, and ease of changing user interfaces
A	User interface design, participatory design, interface evaluation, and prototyping
Ta	Separation of user interface from functional processing
P b & P a	Failure to consider user capabilities, failure to use human-computer interaction specialists, failure to consider how concerns from other perspectives affect usability, overly complex interfaces, assumption of a single type of user access, design based on technology rather than needs, inconsistent interfaces, disregard for organizational standards, and failure to separate interface and processing implementations

Applicabilit to Vie s

C	Does not typically have much of an impact on the Context view.
F a	The functional structure indicates where the system's external interfaces are and thus where usability needs to be considered. It may be impacted by usability needs (e.g., the addition of interface services to support certain interaction styles) but is unlikely to be changed significantly.
I a	Information quality (the provision of accurate, relevant, consistent, and timely data) can have a large impact on usability.
C	This perspective typically has little or no impact on the Concurrency view.
D	The results of applying the Usability perspective impact the Development view in terms of the guidelines, standards, and patterns that ensure the creation of a consistent and appropriate set of user interfaces for the system.
D	This perspective has little or no impact on the Deployment view, although usability concerns could require changes to element deployment (e.g., due to response time requirements).
O a a	The Usability perspective should consider the usability needs of the system's administrators.

Checklist for Requirements Capture

- Have you identified all of the system's key touch points?
- Have you identified all of the different types of users who will interact with the system?
- Do you understand the type of usage (occasional, regular, transactional, unstructured) for each of the touch points?
- Have you taken into account the needs of support and maintenance staff and other second-line users?
- Do you understand the capabilities, experience, and expertise of the system's users? Have you correctly mapped these into requirements for presentation and support?
- Have you taken into account any corporate standards for presentation and interaction, particularly for systems exposed to the public?

Checklist for Architecture Definition

- For Web and mobile platforms, have you considered the variation in bandwidth, hardware capabilities (screen resolution), and rendering software?
- Do the interface designs align in a sensible way with the business processes they are automating?
- If your system is exposed to the general public, have you obtained any necessary approvals from your marketing department for the use of company logos and so on?