Architecture Planning and Decision Making in Companies

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Content

1) **This Study**
2) **Decisions and Decision Making**
   - Definitions
   - Rational Decision Making
   - Organizational Decision Making
   - Planning vs. Decision making
3) **Architecture Decisions**
   - Definitions
   - Enterprise Architecture Decisions
   - Information System Architecture Decisions
   - Rational Architecture Decisions
4) **Management of Architecture Decisions**
   - Co-Operation in Decision Making
   - Enterprise Architecture Decision Making Levels
   - Management of Information on Architecture Decisions
5) **Summary and Conclusions**
6) **Implications for Practitioners**
7) **Further Research**

References

Research Questions

- What architecture decisions are?
- What different kind architecture decisions exist?
- In which levels / aspects can these decisions be done?
- How information about decision can be managed?
- How architecture decisions can be done rationally?
- How architecture decisions relate to organization's other decision making situations and related processes?

Research Process

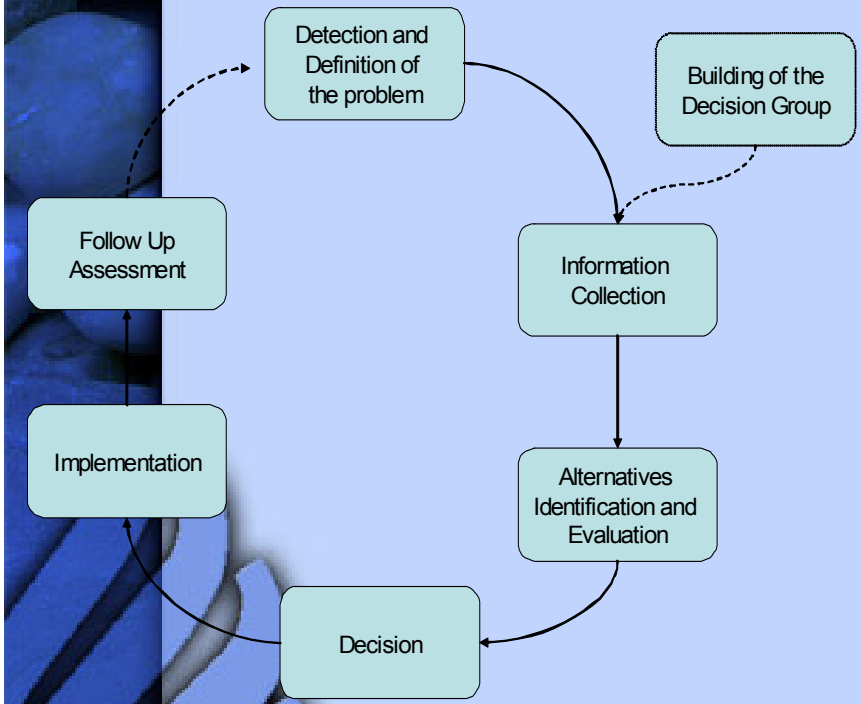
1. Literature review
2. Focus Group Interview
   - Participants: six practitioners from five companies
3. Consolidation and Analysis

Decision and Decision Making

- Commonly, decision making is understood as ***a cognitive process*** leading to the **selection** of a **course of action** among variations
- Begins when a need to do something exists but at the moment it is not known what should be done
- Every decision making process produces a final choice
  - It can be an action or an opinion
- Decision making is a reasoning process
  - can be rational or irrational
  - can be based on explicit assumptions or tacit assumptions
- In practice
  - It is important to consider whether a need to make a decision actually exists
  - It should be noted that decision making involves risk taking

Source: Focus Group Interview.

Decision Making Phases



In practice

- The displayed model depicts a generic decision making process which needs to be contextualized
- There exists iteration between and inside phases, and feedback links (e.g. continuous collection of information)
- Groups both inside and outside the organization may participate in decision making
- Different groups may define alternatives and make the actual decision
- Identifying alternatives is a challenge:
    - Many alternatives may be considered feasible depending on the viewpoint
    - Decision makers may have time to consider only a few alternatives -> selecting them is a decision
    - Insufficient information
- Eliminating non-rational decision criteria is a challenge
- Decision may be outdated at the moment it is made
- Follow-up decisions may arise (a certain decision may set a direction for future decisions) and may be difficult to manage

Source: Power, 2002 (adapted); Focus Group Interview.

Rational Decision Making

A process for making logically sound decisions which features

- Knowledge of alternatives
- Knowledge of consequences
- Consistent preference ordering
- Decision rule

In practice

- Companies make decisions under the constraints of limited knowledge, resources, and time. Rational criteria sometimes need to be skipped and decisions made on intuition/experience
- Perfectly rational decisions require computational resources; for some decisions accurate ROI/NVP calculations are even impossible to calculate
- Rational decision criteria varies depending on the decision maker (e.g. IT vs. business)
- Rational decision criteria should be disclosed when decisions are planned; decision makers should not interfere with the decision planning process
- Twofold nature of time as decision criteria: may lead to competitive advantage or additional costs in the long-term
- Appropriate decision making may be preferable to perfectly rational decision-making; utilizing perfectly rational criteria may lead to “analysis paralysis” and inappropriate decision implementations
- Utilizing a governance model decreases the number of decisions based on subjective criteria

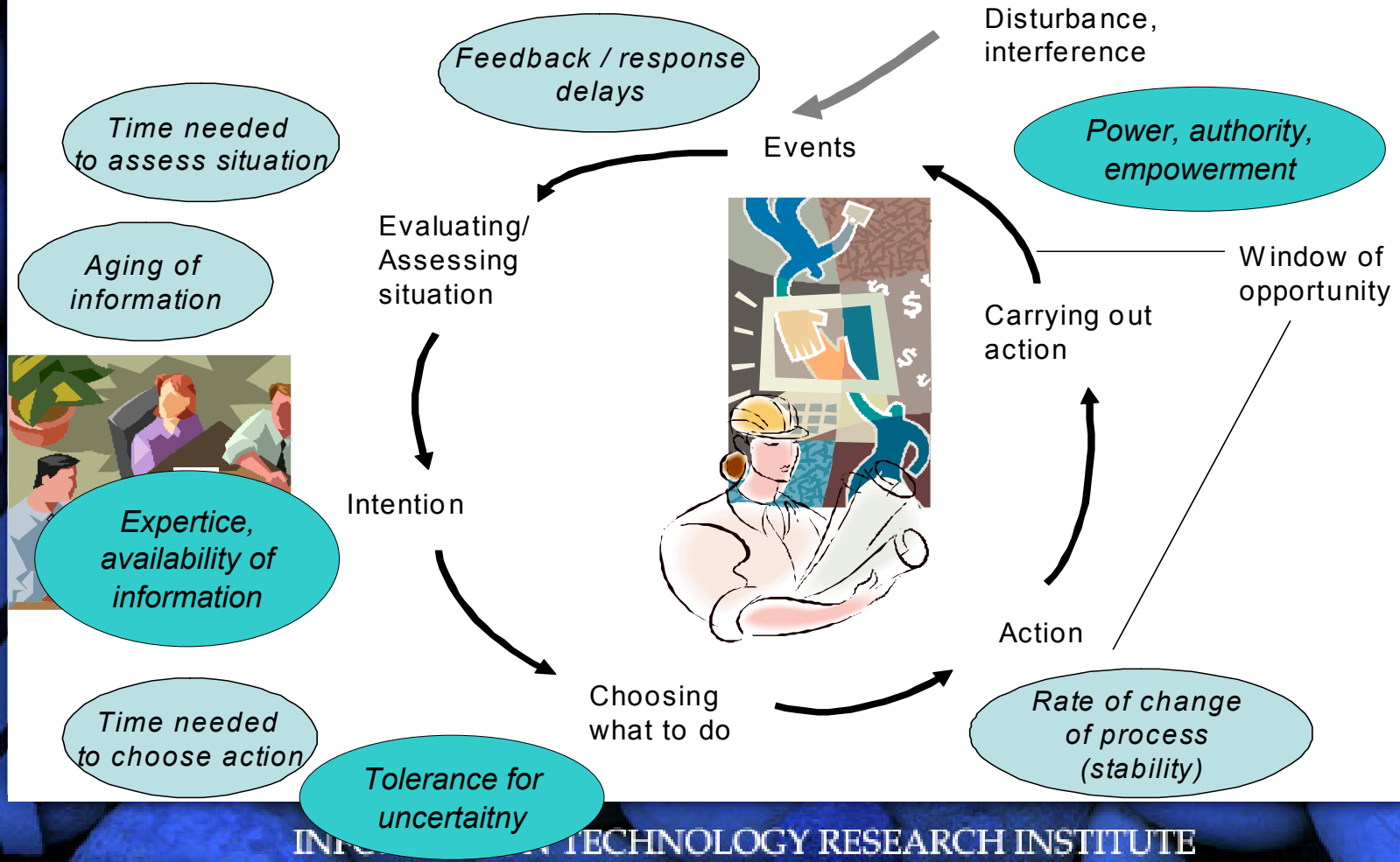
Sources: Cook et al., 2007; Gigerenzer & Selten, 2002; Shapira, 1997; Focus Group Interview.

Challenges in Decision Making

- The information may be uncertain
- All relevant information may not be available or accessible
- Different stakeholders may have different information
- Different interpretations of the information exist
- Different things are important to different stakeholders; power conflicts
- There does not exist a good decision making strategy and it is not clear what to do next to reach a decision.
- The risks associated with each alternative are not understood
- Decision alternative and criteria evolution management
- Decision making structure or organization may be unclear or inappropriate; decision planners and makers have different information
- Getting buy-in on a decision

Source: Ullman, 2006; Focus Group Interview.

Organizational Decision Making



Source: Cook, 2007; Focus Group Interview.

Characteristics of Organizational Decision Making

- Ambiguity
  - information, preferences, interpreting the history of decisions; organizational tolerance for uncertainty
- Decision making in and by organizations is embedded in a longitudinal context
  - Participants in organizational decision making are a part of ongoing processes.
  - Even if they do not take on active roles in all phases of decision making, they are a part of the decision process and its consequences.
  - Decisions in organizations are made in a sequential manner, and commitment may be more important in such processes than judgmental accurary
- Incentives play an important role in organizational decision making
  - Incentives, penalties, and their ramifications are real, salient and may have long-lasting effects.
  - These effects are intensified due to the longitudinal nature of decision-making in organizational settings.
  - Survival is a basic aspect of life in organizations.
- Repeated decisions
  - Many executives may make repeated decisions on similar issues by following rules (rather than by using pure information processing modes)
- Power and Political Issues
  - Power considerations and agenda setting often determine decisions rather than calculations based on the decisions' parameters.
  - Authority relations may have a large impact on the way decisions are made in organizations
  - Predominance of information and empowerment to make decisions are often not connected
  - However, predominance on comprehensive, extensive and holistic information is connected to influence on decisions (c.f. the chief enterprise architect)

Source: Shapira, 2002; Focus Group Interview.

Decision Making Structures in Organizational Decision Making

- Various decision-making structures, organizations or hierarchies are used to reach a decision in organizations
- These include
  - No structure
  - Hierarchy
  - Majority rule / Parliamentary process
  - Consensus
  - Unaminity

However, it should be noted that

- The structure used may vary depending on e.g. the level or type of decision
- The structures are not necessarily related to the organizational structure in question
- Even in the same organization and the same type of decision, the structures used may vary

Source: Schutt, 2001; Focus Group Interview.

Decision Making Levels in Organizations

- **Strategic Management**
  - An ongoing process by which the management of an organization envisions its future and develops the necessary activities to achieve it
  - Involves fitting an organization's internal capabilities to the environment by choosing the best among the possible alternatives
  - Strategy is a coherent, unifying, and integrative pattern of decisions that are based on the environment (e.g. business, industry, competitors) and look to the future
- **Business Unit Management**
- **IT Organization Line Management**
- **IT Portfolio Management**
  - The application of systematic management to large classes of items managed by organization's IT capabilities, enabling the evaluation of their *business value*
  - An enabling technique for the objectives of IT Governance
  - Includes
    - IT project portfolio
    - Application portfolio
- **IT Project Management**
  - Organizing and managing resources in a way that a project is completed within defined scope, quality, time and cost constraints
  - Involves decisions about
    - Activities to be carried out
    - Use of resources
    - Results (e.g. IT solutions)

Sources: Bhushan & Rai, 2004; Goodstein et al., 1993.

Planning vs. Decision making

- Planning is the process of **establishing objectives** and choosing the most suitable **means for achieving these objectives** prior to taking action
- Planning may precede decision making or vice versa
  - Planning is anticipatory decision-making. It is process of deciding before an action is required (e.g. a cyclic process that concludes when enough information is gathered for a final decision)
  - Decision making can involve the selection of a plan to be implemented
  - Company size and maturity level affects the nature of the relationship between planning and decision making (e.g. the need for decision making milestones in the planning process)
- Executing a plan usually requires many *actions*, but may not require any new *decisions*
- A plan may leave open a choice of sub plans at some critical juncture. As a result, there is an additional decision that needs to be made.

Sources: Ackoff, 1981; Krantz & Kunreuther, 2007; Focus Group Interview.

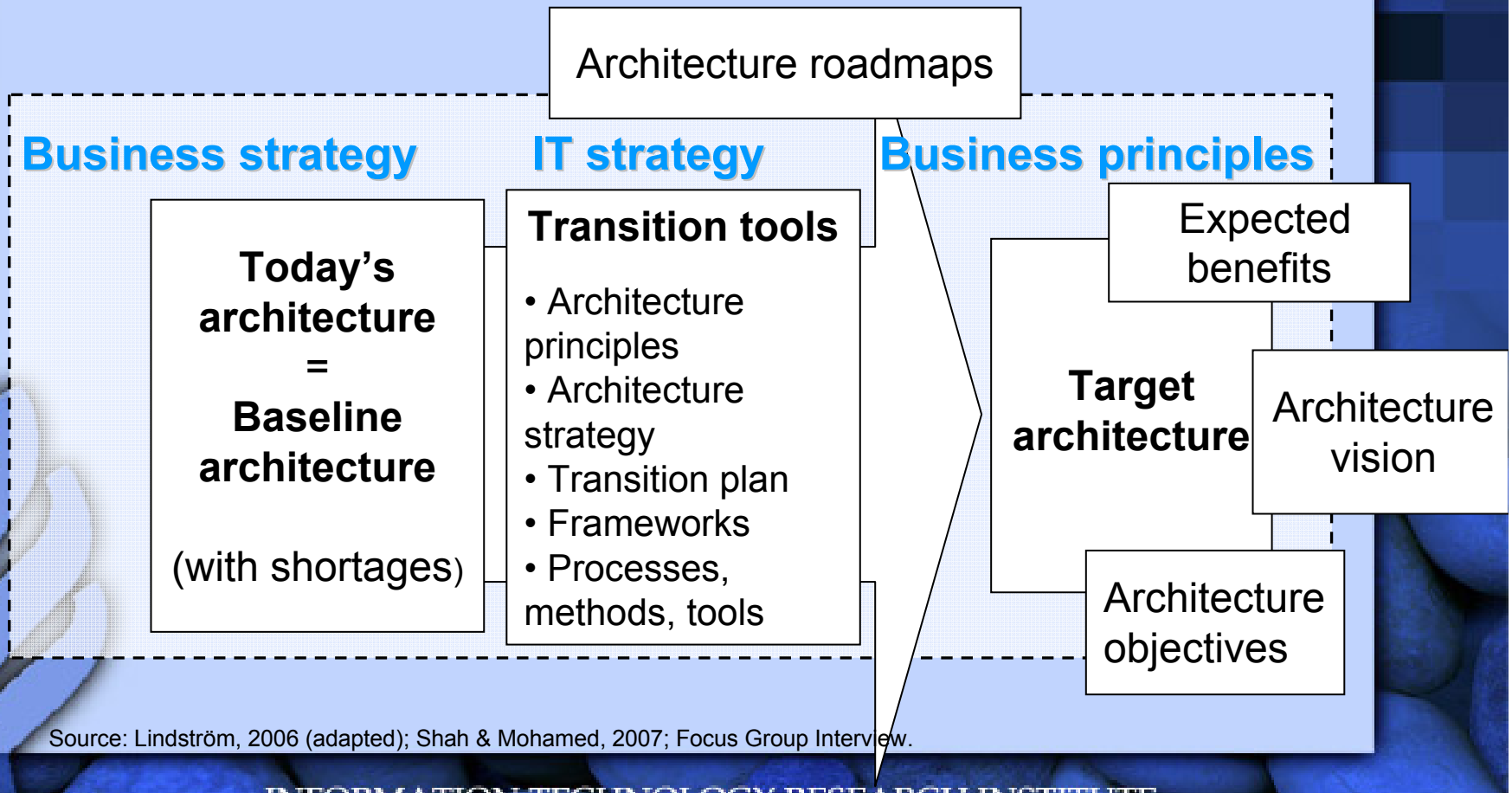
Architecture Decisions in Literature

- A complex architecture can reflect thousands of decisions
- In the software architecture domain, architecture decisions typically define
  - system's key structural elements
  - the externally visible properties of these elements and their relationships
  - how to achieve the architecturally significant needs and requirements
- Architecture decisions relate to different architectural levels (e.g. enterprise, domain, application and component architecture) and should only define elements on that specific level
- Especially on the level of enterprise architecture, planning ahead and setting architecture standards become even more essential and thus architectural decisions may also involve some of the following
  - Selection of an architecture plan (target, transition plan, vision)
  - Decisions relating to the choice of architectural sub plans at some critical juncture
  - Selection of architecture standards, principles and guidelines
  - Decisions about the objectives of architecture work (e.g. by interpreting business goals)

Sources: Tyree & Akerman, 2005; Malan & Bredemeyer, 2002; Bass et al., 1998; Krantz & Kunreuther, 2007 (adapted).

3) Architecture Decisions

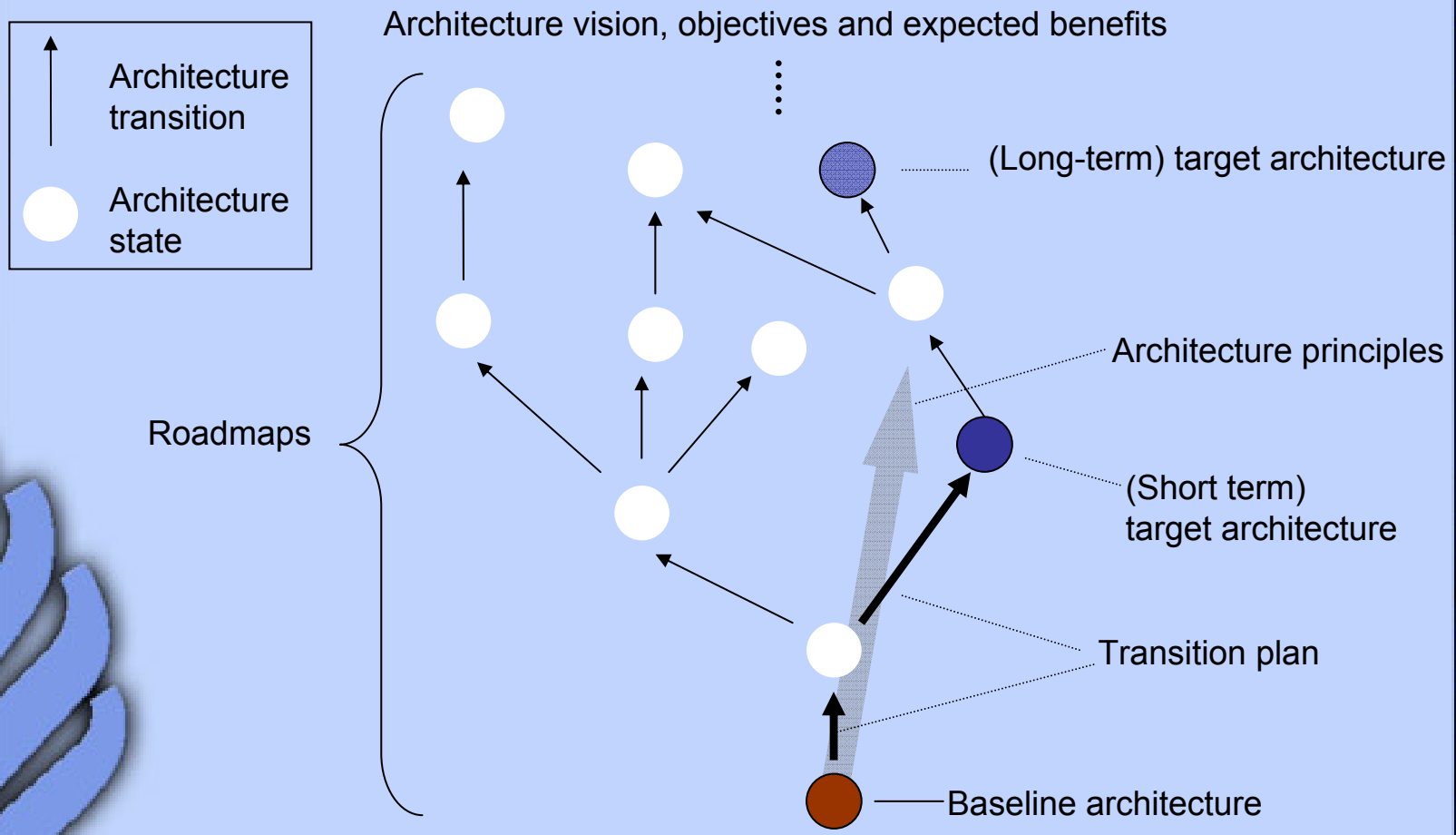
Enterprise Architecture Decision Making Areas



Source: Lindström, 2006 (adapted); Shah & Mohamed, 2007; Focus Group Interview.

3) Architecture Decisions

Enterprise Architecture Transition



Source: Lindström, 2006 (adapted); Shah & Mohamed, 2007; Focus Group Interview.

Baseline Architecture Decisions

- Baseline architecture
  - Contains different layers and existing enterprise architecture components
  - A *starting point* for identifying relationships between components and gaps that should be filled to improve organizational performance
  - Different architectural domains may have different baseline states
- Decisions about ***what*** areas/aspects/components in the enterprise will be developed, improved or changed to improve organizational performance
- The baseline architecture is continuously monitored and necessary decisions are made either
  - officially on higher organizational levels according to the information produced on lower levels
  - on the level in question by setting a new development effort which may be later expanded
- The baseline architecture is monitored by
  - architects and other roles such as controllers and inspectors
  - architecture status evaluations
  - corporate metrics

Source: Shah & Mohamed, 2007 (adapted); Focus Group Interview.

Target Architecture Decisions

- Target architecture
  - Depicts new (or changed) enterprise architecture components
  - Encompasses the strategic initiatives that should be performed to bridge the existing gaps and ensure competitive advantage
  - Different architectural domains may have different target states
  - Should be officially approved and communicated
  - Changes constantly as new target architecture decisions are made and business objectives change
- Decisions about ***how*** the architecture will be developed, improved or changed
  - Choice of target architecture plan (from alternatives)
  - Decisions about
    - new enterprise structures and processes
    - IT resources and infrastructure
    - the strategic initiatives

Source: Shah & Mohamed, 2007 (adapted); Focus Group Interview.

Architecture Roadmap Decisions

- Architectural roadmaps
  - Represent the baseline architecture's *intermediary alternatives* (scenarios) while mitigating the risks and analyzing existing gaps during the shift to the target architecture
  - Highlight the *architectural milestones* performed prior to reaching the target architecture
- Decisions about how to shift from the baseline architecture to the target architecture
  - Selecting among roadmap alternatives
  - Decisions about architectural milestones
- Architectural milestones may not be actively or officially set in practice on a detailed level
  - Setting and following the optimal path toward the target architecture (i.e. optimal transitions) requires considerable resources
  - Milestones are set according to current needs (e.g. when technologies need to be replaced) considering architectural principles and/or the desired target architecture

Source: Shah & Mohamed, 2007 (adapted).

Architecture Transition Decisions

- Transition plan
  - Documents the activities undertaken during the shift from the baseline to the target architecture
  - Specifications of the baseline (as-is) and target (to-be) architecture views in terms of managing the architectural transition's feasibility
  - May include risk assessment, gap analysis, and transition's supporting resources
  - Individual transitions may develop only one or a few architectural domains
- Decisions about the activities to be undertaken during the shift from the baseline to the target architecture
- Architecture transitions plans typically involve short-term decisions
  - Always making transitions in the direction of the target state (i.e. optimal transitions) requires considerable resources
  - Transitions are made when required or feasible (e.g. when technologies need to be replaced) considering architectural principles and/or the desired target architecture
  - Sometimes the transition towards the target architecture has to be postponed by implementing short-term solutions due to financial reasons
  - Short transitions are less risky
- Architecture transition plans may not be officially approved
  - They may be working papers used by the stakeholders carrying out the transition and may or may not be officially approved
  - Usually officially approved in the case of technology decommission (project plan)

Source: Shah & Mohamed, 2007 (adapted); Focus Group Interview.

Architecture
Principle and Guideline Decisions

- Architecture principles and guidelines
  - Contain goals, constraints, and guidelines for any IT use or deployment in the organization
  - Represent a shared understanding on what needs to be done to reach the target architecture
- Decisions about
  - goals for IT development or use (e.g. reusing existing components),
  - architectural constraints for IT development or use (e.g. standardized interfaces, allowed and non-allowed technologies)
  - guidelines for IT development or use (e.g. organization-specific best practices)

Source: Lindström, 2006 (adapted); Focus Group Interview.

Architecture Vision, Objective, and Expected Benefit Decisions

- Architecture vision
  - A high-level ideal image or desired target state of architecture
- Architecture objectives and expected benefits
  - What benefits the organization wants or expects to achieve by enterprise architecture (e.g. flexibility or management of complexity)
  - May be expressed on different levels of abstraction
- Decisions about
  - The selection of structures and components that exist in the ideal or the desired state of the oranization
  - The selection of objectives and expected benefits

Source: Armour et al. 1999.

Information System / Software Architecture Decisions

- Architectural decisions are those that must be made from an overall system perspective and define
  - system's key structural elements,
  - the externally visible properties of these elements and their relationships
  - how to achieve the architecturally significant requirements
- Information system or software architecture decisions are made in
  - Design of architecture (which design decisions to make)
  - Systems / software development (which and why certain design decisions have been made)
  - Architecture evolution (adding or removing design decisions while sustaining consistency)
  - Reuse of software architecture (use of earlier tried and tested combinations of design decisions)
  - Integration of systems (unification of design decisions)

Sources: Jansen & Bosch, 2005; Bass et al., 1998.

Example: Architecture Design Decisions

- Architecture design decisions describe
  - Architectural additions, subtractions and modifications
  - Rationale (The reasons behind the decision)
  - Design rules (mandatory prescriptions for further design decisions)
  - Design constraints (what is not allowed in the future of the design)
  - Additional requirements (what additional requirements does the decision add to the architecture)

Source: Jansen & Bosch, 2005.

Architecture Decision Makers

- Architect
  - Enterprise architect
  - System / software architect
- IT developers (design-level decisions)
- Project decision makers
  - Project manager
  - Steering group
  - Customer
- Strategic planning decision makers
- Portfolio management decision makers
- Business decision makers

Source: Focus Group Interview.

Decision Making Process of an Architect

1) Identifying problem and needs
2) Developing a set of alternatives
3) Assessing their viability
4) Review the decisions with the stakeholders
5) Once the architect obtains buy-in on the choices, further defining the architecture
6) Communicating architecture, decisions and rationales

Source: Tyree & Akerman, 2005.

Enterprise Architecture Decision Principles

- *Make only those decisions that have to be made on the enterprise level to achieve the business strategy and meet the architecture objectives and vision*
- *Provide decision makers on lower levels with the information required for their decision making*
- *Only make decisions that are enforceable and will be enforced*
- *There must be a traceable connection from business strategy to each decision*
- *Prepare for future changes when making a decision; architecture should be agile, adaptable and aligned*
- *It is better to make a decision than tumble into one*
- *Communicate decisions with their rationale*

Sources: Malan & Bredemeyer, 2002; 2004; Focus Group Interview.

Rational Architecture Decision Making

- A knowledge of alternatives: Decision makers have a set of alternatives for action
  - Different architecture alternatives
- A knowledge of consequences: Decision makers know the consequences of alternative actions
  - Consequences of architecture choices can be and are described at least on some level
- A consistent preference ordering: Decision makers have consistent values
  - Defined and accepted goals for architectures
- A decision rule: Decision makers have rules by which they select a single alternative of action on the basis of its consequences for the preferences
  - A defined way how it is proceed in the decision making

Sources: Cook et al., 2007 (adapted); Gigerenzer & Selten 2002 (adapted); Shapira, 1997 (adapted).

Co-Operation in Decision Making (1/2)

- EA decision making is dependent on the organization in question
  - Some organizations avoid establishing additional points or groups for EA decision making
  - EA decision making may be incorporated in various existing decision making points
  - Organizational maturity, business environment and governance model have an effect on how EA decisions are made
  - EA decisions are also made in cooperation with partners
- EA decisions are typically reactive
  - They are made according to the needs of the business
  - Costs and effects are important decision making criteria
  - Different areas of business in an organization may make EA decisions without considering the big picture, which may incur indirect effects (e.g. expenses) in other part of the organization, especially in the long-term

Sources: Focus Group Interview.

Co-Operation in Decision Making (2/2)

- A standardization process
  - that is approached centrally and
  - that is inclusive of the staff expected to adhere to the decisions made in the process

  is more likely to produce practical results and will be in a much better position to achieve adherence
- For enterprise-wide standards, central architects *and* technical staff within business units should get their say before a consensus-based decision is reached
- A standardization process could be especially feasible for architecture decisions with extensive effects in the organization
- In some organizations all architecture decisions are addressed in IT management/business units before implementation

Sources: Leganza, 2001; Focus Group Interview.

Enterprise Architecture Decision Making Levels

- EA vs. Strategic Management
  - EA may be a subordinate of all organizational strategies (i.e. business and IT)
  - EA is only one way of implementing organizational strategies
  - EA has an effect on strategy implementation through process definition and design which in turn affects lower architectural levels
- EA vs. IT Portfolio Management
  - EA may have a ”power of veto” on decisions on how IT implementations are done
  - However, EA does not necessarily define what is implemented (stated on organizational strategy)
- EA vs. IT Project Management
  - EA provides the overall picture to projects through guidance
  - Projects provide feedback on EA’s feasibility

Sources: Focus Group Interview.

4) Management of Architecture Decisions

Management of Knowledge on Architecture Decisions

- Management of knowledge
  - Identifying, eliciting and storing knowledge and information in repositories
  - Interaction among knowledge workers for explicating and sharing knowledge
- **Decisions** and **their rationale** are important architectural knowledge to share
  - Enables follow-up evaluation and decreases the willingness to question decisions
  - Not sharing decision and rationale information may endorse decision making in silos
  - Even if the decisions made sense when they were made (e.g. under resource constraints), afterwards no context exists around decisions without rationale information
- Architecting environment determines what architectural knowledge is shared and how
  - E.g. decision's characteristics, level of detail, repository, and means of communication
  - Dependent on e.g. governance model, level of decision making, decision making point, organizational structure, business environment
  - EA decisions are typically documented at least on the project level
- Tailoring architectural knowledge sharing
  - Take the architecting environment into account
  - Stimulate stakeholders to share 'their' decisions
  - Consider the effects of the decision: which stakeholders should know about it?
  - Let architecture descriptions address the knowledge need of stakeholders that use them
  - Do not document overly detailed information on the enterprise architecture level
  - Involve all stakeholders who are active in the architecting process

Sources: Farenorst, 2006; Tyree & Akerman, 2005; Focus Group Interview.

Architecture Decision Documentation

Decision characteristics to document

- Issue (the issue addressed by the decision)
- Decision (the selected option)
- Status (decision's status, e.g. pending, decided, or approved)
- Decision maker
- Assumptions (environmental factors affecting the decision)
- Constraints (additional constraints to the environment)
- Options and alternatives
- Argument (why a certain option was selected)
- Implications (e.g. need to make other decisions, new or changed requirements, new constraints, need for resources)
- Related decisions
- Related requirements (mapping of decisions to objectives or requirements)
- Related artifacts (related architecture, design, or scope documents that the decision impacts)
- Related principles (related architectural principles and the decision's compliance with them)
- Other notes

Source: Tyree & Akerman, 2005 (adapted).

Summary and Conclusions (1/3)

- EA decisions are high level decisions that can involve
  - Selection of architecture plans (target, transition, vision)
  - Selection of architecture standards, principles and guidelines
  - Decisions about the objectives of architecture work in the organization
- EA decisions are not necessarily official or actively made
  - Baseline architecture is constantly monitored and improvements planned but the big picture is not necessarily taken into account
  - Target architecture state should be officially approved
  - Architecture transition plans can be working papers and the transitions are not necessarily systematic because of short-term business needs and resource restrictions
- Decisions on lower architectural levels (e.g. SA) are typically related to a specific architectural design level and involve
  - Definition of key structural elements,
  - Definition of externally visible properties of these elements and their relationships
  - Decision about how to achieve the architecturally significant requirements

Summary and Conclusions (2/3)

- Rational architecture decision making features
  - Identification of alternatives
  - Identification of consequences of the alternatives
  - Knowledge on preferences and their order (e.g. business and architectural goals)
  - Usage of defined, communicated decision rule to select a single alternative considering its consequences and the preferences
- Architectural decisions should also
  - Be made only if absolutely necessary to achieve business strategy and meet architectural objectives
  - Be traceable to business objectives
  - Not be overly detailed on the enterprise level
  - Take possible future change needs into account (architectural agility, adaptability and alignment)
  - Be enforceable and enforced
  - Be communicated with their rationale

Summary and Conclusions (3/3)

- Architectural decision making is dependent on the organization in question
  - Decision makers involve various roles including architects, project roles and business management roles
  - Decision making may be fragmented to various decision making points in the organizations and decisions are also made in cooperation with partners
  - EA team may have power over some decisions in the organization (e.g. IT portfolio and project planning) but may need approval for their own decisions from various points (e.g. business or IT management)
- Architectural decision making may be reactive and driven by the business
  - Architecture is only one way of enforcing organizational strategies
  - Architecture decisions are made according to the needs of the business
  - Business may make architecture decisions without considering the big picture
  - Business may have knowledge that is not disclosed to architecture decision makers
- Architectural decision making does not typically differ from other decision making in organizations
- There should be a distinct rationale if it is to be separated from other decision making

Implications for Practitioners

- Plan architecture decision making and management:
  - should architectural decision making be separate from other decision making
  - what decisions are necessary to enforce organizational strategies
  - what kind of decision criteria should be used
  - how detailed should decisions be
  - how to build in agility, adaptability and alignment into decisions
  - what kind of decisions should be officially approved
  - where the decisions should be made and by whom
  - who should gather the information required for decisions
  - how are the decisions documented and communicated
  - who enforces the decisions
- Cooperate with stakeholders in decision making; architecture may not have very established, official or influential position on its own
- Communicate architecture decisions with their rationale to relevant stakeholders; merely storing decision documentation in a repository is not sufficient

Further Research

- Should archtitectural decision making be separate from other kinds of decision making and why?
- What kind of standardized process could be used for architectural decision making?
- What kind of reference models could be used to document different types of architecture decisions?
- What feasible generic criteria could be used for different types of architecture decisions?
- What kind of architecture decisions should generically be consciously made and officially approved?
- What would be the best levels or points of decision making for different types of architecture decisions?
- What is the best way share architecture decision knowledge?
- How organizational or architectural maturity or business environment affects architectural decision making and management?

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