Modeling Application Landscapes as Dynamic Systems

Master’s Thesis | SS2013

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1. Motivation: A system theoretic perspective

Increased competitive environment
- External sources for change: business, law, and technology evolution
- Constant change is needed to adapt to the complexity of the environment

Increased importance of IT and business IT alignment
- Internal sources for change: BPR, M&A, IT and company transformation
- Constant change is necessary to adapt to the needs of the business

Problem:
Uncertainty of change processes:
outcome often unexpected through omitting important influence factors like people and the behavioral aspect and a system’s dynamics.
2. Definitions

**Enterprise Architecture (EA)** is a coherent whole of principles, methods, and models that are used in the **design** and **realization** of an **enterprise’s organizational structure, business processes, information systems, and infrastructure**. (Lankhorst 2005)

**EA management (EAM)** is a continuous management function seeking to improve the alignment of business and IT and to guide the **managed evolution of an organization**. Based on a holistic perspective on the organization the EA management function is concerned with the management, i.e., the documentation, analysis, planning, and enactment, of the EA. (Buckl 2011)

A **system** consists of

- a **boundary** delineating the environment from the system parts,
- an **interface** defining the interaction and behavior of the system and
- an **inside setup** with the structure, states and state transitions. (Broy 2012)
### 3. Dynamics

<table>
<thead>
<tr>
<th>Mainland Australia</th>
<th>System</th>
<th>Application Landscape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor crop on sugar cane plantation</td>
<td>Problem</td>
<td>High functional redundancy</td>
</tr>
<tr>
<td>Distribution of bugs</td>
<td>Cause</td>
<td>Unmanaged application introductions</td>
</tr>
<tr>
<td>Introduction of cane toad to kill bugs</td>
<td>Measure</td>
<td>Standardization</td>
</tr>
</tbody>
</table>

#### Outcome 1
- Less bugs
- Less functional redundancy

#### Outcome 2
- Less business IT alignment?
- Shadow IT?
- Inconsistent business logic?
- Security issues?
- Inefficiencies?

#### Reason
- No consideration of behavioral aspects over time
4. Layers from EA Structure to IT Success

- **Structure**
  - Static AL Architecture
  - System Dynamics

- **Behavior**
  - Business Process Support
  - System Dynamics

- **Alignment**
  - Business Process Support
  - Goals

- **IT Success**
  - KPIs

- **as-is**
  - to-be

Indicates the flow from current state to desired state through various layers and dimensions.
## 5. Thesis

<table>
<thead>
<tr>
<th>Research Question:</th>
<th>How can application landscapes be modeled as dynamic systems in order to increase predictability of possible outcomes of structural change?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methodology:</td>
<td>Design Science</td>
</tr>
<tr>
<td>Evaluation:</td>
<td>Qualitative interviews</td>
</tr>
<tr>
<td>Outcomes:</td>
<td>Least complicated useful model; Examples of use; Providing a base and motivations for further research.</td>
</tr>
<tr>
<td>Scope:</td>
<td>Environmental change and software / EA evolution have an impact on behavior but are not meant by the term dynamics in this context. Dynamics and behavior can be found in the whole EA, but this thesis is about application landscapes only.</td>
</tr>
</tbody>
</table>
6. Possible Components of the Model

**Elements**

- Application
- Business Process
- Person
- Project
  - User
  - Owner
  - Developer
  - Other Stakeholder

**Links**

- supports
- is viable to
- develops
- waits for
- uses
- excludes
- authorizes
- communicate
- includes
- depends on
- needs coordination with .. about ..

**States**

- Application: running, maintenance, expiring, defect, deprecated
- Business Process: initiated, supported, deprecated
- Person: owning, developing, using, rejecting
- Project: initiated, started, declined, finished

**Functions**

- create (element)
- activate (element)
- passivate (element)
- delete (element)
- link (element1, element2, link)
- unlink (element1, element2, link)
- assign (element, state)
- assert (element, state)
- change (element, state)
7. References


1. Motivation
2. Scope and Definition
3. Dynamics
4. Structure to Success
5. Thesis overview
6. First modeling approach
7. References
### Classification of Systems

<table>
<thead>
<tr>
<th>Class</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Source</strong></td>
<td></td>
</tr>
<tr>
<td>natural</td>
<td>weather system, organic system</td>
</tr>
<tr>
<td>man-made</td>
<td>mechanical system, social system</td>
</tr>
<tr>
<td><strong>Behavior</strong></td>
<td></td>
</tr>
<tr>
<td>static</td>
<td>logical system, number system</td>
</tr>
<tr>
<td>dynamic</td>
<td>economic system, political system</td>
</tr>
<tr>
<td><strong>Entirety</strong></td>
<td></td>
</tr>
<tr>
<td>overall</td>
<td>atomic system, planetary system</td>
</tr>
<tr>
<td>partial</td>
<td>subsystem, system of systems</td>
</tr>
<tr>
<td><strong>Interaction</strong></td>
<td></td>
</tr>
<tr>
<td>open</td>
<td>human-machine system, economic system</td>
</tr>
<tr>
<td>closed</td>
<td>laboratory experiment, designed formal system</td>
</tr>
<tr>
<td>isolated</td>
<td>energetically closed physical system</td>
</tr>
<tr>
<td><strong>Stability</strong></td>
<td></td>
</tr>
<tr>
<td>(meta-) stable</td>
<td>cybernetic system, predator-prey system</td>
</tr>
<tr>
<td>unstable</td>
<td>chemical system, negative feedback system</td>
</tr>
<tr>
<td>indifferent</td>
<td>ecosystem, evolution system</td>
</tr>
</tbody>
</table>
Co-evolving System Path

Kandjani et al. (2013)
Complexity Surplus

Drivers

- Local Decision Making / Politics
- Development of Technology / IT Industry
- Mergers & Acquisitions
- Local Decision Making / Politics
- Business Model
- Regulation

see also [3]
Research Methodology

Environment (Application Domain)
- People
- Organizational Systems
- Technical Systems
- Problems & Opportunities

Design Science Research
- Relevance Cycle
  - Requirements
  - Field Testing
- Design Cycle
  - Build Design Artifacts & Processes
  - Grounding
  - Additions to KB
- Evaluate

Knowledge Base (Foundations)
- Scientific Theories & Methods
- Experience & Expertise
- Meta-Artifacts (Design Products & Design Processes)

Own illustration, based on Hevner (2007)
Research Schedule

Problem identification
- Problem
- Relevance
- Methodology
- Presentation

Solution design
- Grounding Th.
- Model design
- Model Applic.

Evaluation
- Rigor Cycle
- Evaluation

Thesis & Review
- Inaugural presentation
- Final presentation

Introduction
- Methodology
- Research Questions

Theory and Concepts
- Possible Models

Least c/u Model
- Results & Evaluation

Benefits & Limitations
- Use Cases

Conclusion

Own illustration, based on Offermann et al. (2009)
Backup References


