Abstract

Many products today are developed for highly dynamic markets while the products and functions get more and more integrated. The product and service realization is based on fast changing technologies that come together in complex value chains. The challenge for modern companies in innovative domains is to survive in this dynamic world.

In this paper we explore the contribution of architecting and standardization to the company success. We look at the why, when, who and how questions of standardization and at the role of architecting in the standardization process.
Problem Statement

How to survive in innovative domains?

- Fast moving market
- Complex value chains
- Fast moving technology
- Increased integration
That is easy...

How to survive in innovative domains?
fast moving market
fast moving technology
complex value chains
increased integration
By being the fittest in your ecological (economical) niche!

Architecting and Standardization
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September 9, 2018
ECMAproblemPun
1. employ skilled system architects
2. apply an agile system architecting process
3. determine the right subjects and moments for standardization
4. apply a sensible standardization process
How to survive in innovative domains?

standardization

what

why

how

when

who
How to survive in innovative domains?

standardization

what

why

how

when

who
Classification of Standardization Tactics

- system of systems
  - provides
  - system
    - interoperates with
    - component
      - uses
      - + focus on core value
      - + use of commodity components
      - + provide choice to customer
      - + compete on performance and functionality
      - + enlarge application potential
      - + customer value
    - complementing system
Focus on Core; not on Key or Base Technology?

- Core
- Key
- Base

Technology life cycle:
- Own value IP
- Critical for final performance
- Commodity

Actions:
- make
- outsource
- buy
- refer customer to 3rd party

Partnering
How to survive in innovative domains?

standardization

what

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When to Standardize

- too early
  - requirements unknown
  - technological compromises
  - loss of competitive edge
  - insufficient and uncertain facts
  - wrong expectations
  - intuition not calibrated

- right moment
  - problem is understood
  - domain structure is clear
  - broadening set of stakeholders
  - technology is ripe

- too late
  - caught in proprietary legacy
  - poor interoperability
  - customer demands standards
  - focus on key i.s.o. core
  - market does not take off
    (Metcalf's law)

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ECMAwhenToStandardize
Roadmapping as Tool

Customer objectives
Application
Conceptual
Realization
time, ca 5 years
drives, requires
supports, enables

Market
Products
Technology
People
Process

standardization concern
provides interoperability
provides interoperability use of standards

Customer needs
elements trends

Technology needs
opportunities

standardization process
tactics deployment

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ECMAroadmapping
Purchased SW Requires Embedding

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HMPAembedding
Embedding Costs of Purchased SW

- Installation
- Configuration
- Customization
- Start up, shutdown
- Specifications
- Interface to application SW
- Exception handling
- Resource allocation and monitoring provision
- Resource tuning, see above
- Safety design
- Security design

Functional system design
sw design

Add semantics level
use of appropriate low level mechanisms
match to high level mechanisms:
- notification, scheduling
- job requests, subscriptions

System monitor
Error propagation
Logging

CPU
Memory
Disk
Balance of Considerations and Trends

- innovation from outside
- focus on core technology
- initial cost reduction
- faster to market
- interoperability
- functional integration

- transition cost
- required know how
- release propagation
- integration effort
- embedding
- flexibility
- resource use
- performance
- license costs

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ECMAbalance
Example of Lifecycle Reference Model

- **information handling**: entirely distributed
  - wide variation due to "socio-geographics":
    - psycho-social,
    - political, cultural factors

- **imaging and treatment**: localised
  - patient focus
  - safety critical
  - limited variation due to "nature":
    - human anatomy
    - pathologies
    - imaging physics

- **image handling**: distributed
  - limited variation due to "nature":
    - human anatomy
    - pathologies
    - imaging physics

- **base technology**: not health care specific
  - short life-cycles
  - rapid innovation

- **archiving**: service business
  - not health care specific
  - extreme robust
  - fire, earthquake, flood proof
  - life time
  - 100 yrs (human life)
Evolution from Proprietary to Standard

- High innovation rate
- Global standardization takes more than 5 years
- High interoperability

Legend:
- Applications
- Product family
- Vendor
- World standard

Diagram:
- ACR/NEMA
- DICOM
- Philips
- GE
- Siemens
- CT
- MRI
- Cardio vascular
- URF
- Medical imaging
- Cardio analyse
- Bolus chase
- Vascular analyse
- RF
How to survive in innovative domains?

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Standards describe **what**

**black box** (interface) **level:**
- protocols
- functions
- parameters
- formats
  - behavior
  - characteristics

**white box** (implementation) **level:**
- protocols
- functions
- parameters
- formats
  - realizations
  - limitations
  - constraints
  - opportunities
  - behavior
  - characteristics
white box know how:

current and future realization:

- design choices
- technology capabilities
- domain concepts
- limitations
- constraints
- opportunities

what needs to be defined

- functions
- parameters
- formats
- protocols
- behavior
- characteristics

realism/acceptance level

- time
- effort
- cost
Towards a Standard

market
needs
expectations
concerns

black box level:
functions
parameters
formats
protocols
behavior
characteristics

white box know how:
current and future realization:
design choices
technology capabilities
domain concepts
limitations
constraints
opportunities

future proof; room for innovation
market enabler; room for added value
not locked into specific technology constraints
realistic and acceptable; time, cost, effort
What Should be in a Standard

**Standard: what**

requirements at conceptual level,

*no design or implementation*

as minimal as possible

the minimal set of (interface) requirements to:

1) ensure interoperability
2) foster innovation and
3) maximise the room for added value.
Embedding in a Reference Architecture

**reference architecture**

**context + system model:**
- function allocation
- composition guidance
- emerging characteristics
- processes

**is this a standard?**

**framework** for

**standards**

**conform to**

**implementations**
How to survive in innovative domains?

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Flow of Standardization

explore
market needs
stakeholders (competitors, suppliers, partners, customers, ...)
existing realizations
implementation issues

analyze
iterate
manage and facilitate
(heterogeneous stakeholders, create support and acceptance)
write and debate
(scoping, negotiation)
prototype and validate

standardize
decide
publish
provide reference implementation (optional)

deploy
push
manage compliance
evolve standard
Who Contributes and Participates?

How to survive in innovative domains?

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Simplified Process Decomposition

- Strategy
- Customer oriented (sales, service, production) process
- Product creation process
- People, process and technology management process

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Internal Standardization Process == Highly Strategic!

- **strategy process**
- **customer oriented** (sales, service, production) process
- **product creation** process
- **people, process and technology management process**

**Architecting and Standardization**

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ECMAd2018Simplified
Non technical aspects of standardization

- *legal, IP oriented*
  - licenses
  - patents
  - copyright

- *political*
  - decision power
  - who is in control?
  - (hidden) interests
  - coalitions
  - networks

- *business*
  - value chains
  - business models
  - market development

- *social*
  - privacy
  - social value

standardization
Architect and Standards: Love-Hate Relationship

love
- no worries: concerns are taken care of
- focus on core problems
- facilitates interoperability

hate
- limits innovation (harness)
- limits solution space
- simplistic management orders
Conclusions

How to survive in innovative domains?

3. determine the right subjects and moments for standardization
4. apply a sensible standardization process

**standardization**

**what**
- minimal, as little as possible requirements (not design or implementation)
- room for added value and innovation

**why**
- unlock market (e.g. interoperability)
- focus on core assets
- optimize supply chain

**how**
- fast iteration
- make rationale explicit
- roadmapping

**when**
- problem is understood
- domain structure is clear
- broadening set of stakeholders
- technology is ripe

**who**
- strategic insight
- technology know how
- market know how
- social and political insight
- ambitious but cautious