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
- Fast moving technology
- Complex value chains
- 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!
Postulated Solution

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**
- **When**
- **How**
- **Who**
How to survive in innovative domains?

standardization

what

why

how

when

who
System of systems provides system, which interoperates with complementing system. This approach focuses on core value, competes on performance and functionality, enlarges application potential, and creates customer value.

- Provide choice to customer
- Compete on performance and functionality
- Enlarge application potential
- Customer value
- Focus on core value
- Use of commodity components
Focus on Core; not on Key or Base Technology?

- Core
- Key
- Base

Technology life cycle

- Own value IP
- Critical for final performance
- Commodity

Partnering

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

Total Product

Architecting and Standardization

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June 21, 2020
SSScoreKeyBase
How to survive in innovative domains?

standardization

what

why

how

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who
## When to Standardize

<table>
<thead>
<tr>
<th>too early</th>
<th>right moment</th>
<th>too late</th>
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- **problem is understood**
- **domain structure is clear**
- **broadening set of stakeholders**
- **technology is ripe**

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

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

- **Customer objectives**: customer needs, supports, enables market.
- **Application**: expectations, trends.
- **Conceptual**: technology needs, opportunities.
- **Realization**: standardization process tactics, deployment.
- **Process**: standardization concern.

- Provides interoperability.
- Provides interoperability use of standards.
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

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Balance of Considerations and Trends

- Innovation from outside
- Focus on core technology
- Initial cost reduction
- Faster to market
- Interoperability
- Functional integration
- License costs
- Performance
- Resource use
- Flexibility
- Embedding
- Integration effort
- Required know-how
- Release propagation
- Transition cost

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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

**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

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

**standardization**

**what**

**why**

**when**

**how**

**who**
Standards describe **what**
Input from implementation know how

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

ambitious but cautious

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

framework for

standards

is this a standard?

conform to

implementations

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ECMAnReferenceArchitecture
How to survive in innovative domains?

why
how
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who
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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

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RSPprocessDecomposition
Internal Standardization Process == Highly Strategic!

- Strategy
- Process
- Customer
- Supplying Business
- Value
- Product Creation
- Customer Oriented (sales, service, production)
- Technology
- Management Process

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ECMAprocessSimplified
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 (harnass)
- limits solution space
- simplistic management orders
3. determine the right subjects and moments for **standardization**

4. apply a sensible **standardization** process

**standardization**

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

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

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

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

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