Medical Imaging Workstation: CAF Views

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Abstract

The Customer objectives, Application and Functional views are described. The radiology department and the radiologist are the main customer. The clinical and the financial context of the radiology department is shown. The medical imaging workstation is positioned in the field of IT products and in the clinical workflow. The market segmentation is shown. The typical URF examination is explained. Key drivers are linked to application drivers and to product requirements. The functionality development over time is shown and the role of the information model for interoperability is discussed.
The clinical context of the radiology department

- family doctor
- referring physician
- radiologist
- nurse, operator
- patient
- request
- report
- findings
- interaction
- film
- image
- legend
  - paper or el. form
  - electronic
  - human interaction
    - intense
    - weak

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MICAFRequestFlow
The financial context of the radiology department

- Insurance
- Government
- Patient
- Radiology
- Equipment and service providers
- Facilities
- Schedules
- Equipment and services
- Payment
- Budget
- Regulations
- Bill
Application layering of IT systems

- Modalities from other vendors
  - HIS
  - Philips modalities
  - PACS
  - RIS
  - IT infrastructure
  - CIS
  - LIS

Medical imaging workstation

- Archive
- Report
- Review
- Tele
- Print

PACS

IT infrastructure

- Administrative mainframes

Legend

- Modality systems
- Modality enhancement
- Image workflow
- Clinical specific info
- Generic

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MICAfSystemLayers

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Reference model for healthcare automation

information handling
entirely distributed
\textit{wide} variation due to "socio-geographics":
- psycho-social,
- political, cultural factors

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

image handling
distributed
\textit{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)

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MICAFReferenceModel
Clinical information flow

- Acquire images
- Prepare diagnosis
- Diagnosis
- Report
- Authorise
- Archive

- Richness
- Clinical value
- Time

- Clinical review
- Education
- Research
- Treatment planning
- Demonstration
URF market segmentation

Cardiovascular
"high end"
high performance
extensive functionality

Radiography
"low end"
patient throughput
simple functionality

URF
universality
"workhorse"

high end URF
+vascular functionality

mid end URF

low end URF
price fighter

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MICAFmarketSegmentation
Typical case URF examination

3 examination rooms connected to 1 medical imaging workstation + printer

examination room: average 4 interleaved examinations / hour

image production: 20 \(1024^2\) 8 bit images per examination

film production: 3 films of 4k*5k pixels each

high quality output (bi-cubic interpolation)
Timing of typical URF examination rooms

9:00 9:30 10:00

- Exam room 1
- Patient 1: 9:00 - 9:30
- Patient 2: 9:30 - 10:00
- Patient 3: 9:30 - 10:00
- Patient 4: 9:30 - 10:00

1 hour

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MICAfTypicalTiming
### Key drivers, application drivers and requirements

<table>
<thead>
<tr>
<th>Customer key drivers</th>
<th>derived Application drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>report quality</td>
<td>selection of relevant material use of standards</td>
</tr>
<tr>
<td>diagnostic quality</td>
<td>acquisition and viewing settings contrast, brightness and resolution of light-box</td>
</tr>
<tr>
<td>safety and liability</td>
<td>clear patient identification left right indicators follow procedures freeze diagnostic information</td>
</tr>
<tr>
<td>cost per diagnose</td>
<td>interoperability over systems and vendors multiple images per film minimise operator handling multiple applications per system</td>
</tr>
<tr>
<td>time per diagnose</td>
<td>diagnose at light-box with films all preparation in exam room</td>
</tr>
</tbody>
</table>

#### Requirements

- import
- auto-print parameterized layout spooling
- storage navigation / selection auto-delete
- viewing contrast / brightness zoom annotate export
- system response system throughput image quality annotation material cost operational cost
- shared information model viewing settings patient, exam info
- functionality qualities interfaces

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MICAFkeydrivers
Retrospective functionality roadmap

1992
- RF 1.1
  - URF basis
  - View, Print
  - Store, Communicate

1993
- RF 1.2
  - vascular import

1994
- RF 2.1
  - cardio bolus chase

1995
- RF 2.2
  - Dicom

1996
- X 3.1
  - spine

CT/MR 1.1
- stack
- MPR
- dental

CT/MR 1.2
- MR
- import

CT/MR 2.1
- volume
- angio

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MICAFfunctionalityInTime
Information model, standardization for interoperability

- high innovation rate
- global standardization takes more than 5 years
- high interoperability

Legend:
- applications
- product family
- vendor
- world standard

DICOM
ACR
NEMA
Philips
GE
Siemens
MRI
CT
cardio
bolus chase
vascular analyse
RF
medical imaging
Siemens
GE
Philips
ACR/NEMA
DICOM

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MICAFinformationLayers
Coverage of submethods of the CAF views

Customer objectives
- key drivers
- value chain
- business models
- suppliers

Application
- context diagram
- stakeholders and concerns
- entity relationship models
- dynamic models

Functional
- case descriptions
- commercial decomposition
- service decomposition
- goods flow decomposition
- function and feature specifications
- performance
- external interfaces
- standards

Legend:
- explicitly addressed
- addressed only implicitly
- not addressed

Coverage based on documentation status of first product release