Health care world >> PMS catalogue

- Application models
- protocols
- services
- data dictionaries
- network infrastructure
- interface adapters

MR GE  CT GE  Xray vasc  RAD dig.  US dig.
MR Siemens  MR Philips  CT Philips  Xray R/F  US video
MR cardio
US cardio
Xray cardio
monitor cardio
CIS
CCW view
Care Vue
cine view
cardio analysis
endosc. video
MR/CT enhance
Xray enhance
Xray surgery
Surgery Guide
statistic analysis
spread sheet
DTP
speech recog
Sh. term storage  Archive  Lab IS  Report  demo
image man.  HIS  teach  tele view
EasyVision family of products

Examination rooms

R/F

Vascular

print

store

phase 1: 1992

Examination rooms

MR

CT

MPR

MPR

print

store

phase 2: 1994

phase 3: 1996

print

view

clinical focus

research

archive
Product types:

- Modality productivity enhancers:
  - Easyvision R/F
  - Easyvision RAD
  - Easyvision CT/MR
  street price ca 50 k$, high added clinical value; sales directly related to modality sales

- Clinical Focus:
  - Neurovision
  - Image Guided Surgery
  street price ca 100 k$, very high added clinical value; sales limited to specialist areas

- “PACS” workstations
  - Teleradiology Workstation
  - Critical Care Workstation
  - Multi modality review station
  street price ca 25 k$, low added value, low margin; sales potentially very high
Simplified layers

- applications
- services and common appl
- toolboxes
- CDSpack
- HW + OS
september 1991

View, test vehicle only

image gfx UI DB

SunOS, SunView

Standard Sun workstation
september 1992

```
R/F application

<table>
<thead>
<tr>
<th>Print</th>
<th>Store</th>
<th>View</th>
<th>Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td>spool</td>
<td>HCU</td>
<td>store</td>
<td>image</td>
</tr>
<tr>
<td>gfx</td>
<td>UI</td>
<td>DB</td>
<td>PMS net in</td>
</tr>
<tr>
<td>NIX</td>
<td></td>
<td></td>
<td>PMS net out</td>
</tr>
</tbody>
</table>

SunOS

Standard IPX workstation

Desk, cabinet, cables, etc.

RC driver

3M

DSI
```
## june 1994

<table>
<thead>
<tr>
<th>EasyVision CT/MR</th>
<th>EasyVision R/F</th>
<th>EV RAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>specializedappl. (dental, etc.)</td>
<td>specialized appl.</td>
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<table>
<thead>
<tr>
<th>MR</th>
<th>CT</th>
<th>RF</th>
<th>Vascular</th>
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<th>PCR</th>
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<table>
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<tr>
<th>Compose</th>
<th>Print</th>
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<th>MPR</th>
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<th>Export</th>
<th>Cluster</th>
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</table>

**CDSpack**

<table>
<thead>
<tr>
<th>RC dials driver</th>
<th>HC driver</th>
<th>DOR driver</th>
<th>NIX</th>
<th>Solaris</th>
</tr>
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<tbody>
<tr>
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**service mode**

<table>
<thead>
<tr>
<th>SW keys</th>
<th>config</th>
<th>install</th>
<th>Start up</th>
</tr>
</thead>
<tbody>
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**remote access customization**

<table>
<thead>
<tr>
<th>dev. tools</th>
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<tbody>
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</tbody>
</table>

**customization**

<table>
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<th>SW keys</th>
<th>config</th>
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**new HCU**

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<tbody>
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</table>

**remote access**

<table>
<thead>
<tr>
<th>RC inter</th>
<th>HC inter</th>
<th>DOR</th>
<th>Standard IPX or SS5 workstation</th>
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<tbody>
<tr>
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</tbody>
</table>

**Desk, cabinet, cables, etc.**

<table>
<thead>
<tr>
<th>MR</th>
<th>CT</th>
<th>DSI</th>
<th>DCAS</th>
<th>PCR</th>
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**specialized appl. (dental, etc.)**

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**CDSpack**

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**remote access**

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**new HCU**

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</tr>
</tbody>
</table>
june 1994

EasyVision

specialized appl. (dental.)

specialized appl.

MR  CT  RF  Vascular  Cardio  PCR

Compose  Print  Store  MPR  View  Export  Cluster

spool  HCU  store  image  gfx  UI  DB  PMS net in  PMS net out

CDSpack

Solaris

RC  HC DOR

driver  driver  driver

remote access

customization

service

tools

Sw keys

config

install

Start up

Desk, cabinet, cables

MR  CT  DSI  DCAS  PCR

new HCU

remote access

customization

service

tools
1996

Back-ends | EGN | ER | RAD | EV ct/ | EV R/F
----------|-----|----|-----|-------|-------

| specialized appl. (dental, bolus chase, cardio analysis, etc) |
| MR | CT | RF | Vascular | Cardio | PCR |

| interfacing RIS, etc. |
| Compose | Print | Store | MPR | View | Export | Cluster |

| spool | HCU | store | image | gfx | UI | DB | PMS net in | PMS net out |

| CDSpack |
| RC driver | HC driver | DOR driver | NIX |

Solaris

| install |
| RC dials interf | HC interf | DOR | Standard SS5 or Ultra workstation |

| Desk, cabinet, cables, etc. |

| Start up |
| RC dials |

| new HCU |

MR | CT | DSI | DCAS | PCR |
A look into the future

From box to function:

- customer wants any function on any location/time, not limited by “random” product or box boundaries

In parallel with:

- large number of clinical applications
- integration of health care function
- break down in manageable projects / teams,
lifecycle independency
- finite number of skilled development personnel
(R)evolution in 25 years

Table 1:

<table>
<thead>
<tr>
<th></th>
<th>1980</th>
<th>1995</th>
<th>2005</th>
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<tbody>
<tr>
<td>integration level</td>
<td>generator</td>
<td>department</td>
<td>health</td>
</tr>
<tr>
<td></td>
<td>stand</td>
<td></td>
<td>care</td>
</tr>
<tr>
<td>time to market</td>
<td>2-5 year</td>
<td>1-2 year</td>
<td>0.5 year</td>
</tr>
<tr>
<td>code size complete</td>
<td>$10^4$-$10^5$</td>
<td>$10^6$</td>
<td>$10^7$-$10^8$</td>
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<tr>
<td>product</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>memory size</td>
<td>96 kB</td>
<td>96 MB</td>
<td>? GB</td>
</tr>
<tr>
<td>CPU power</td>
<td>0.1 MIPS</td>
<td>100 MIPS</td>
<td>? GIPS</td>
</tr>
<tr>
<td>dev group size</td>
<td>10-50</td>
<td>50-200</td>
<td>?</td>
</tr>
<tr>
<td>of which ASW</td>
<td>2-10</td>
<td>20-60</td>
<td>?</td>
</tr>
</tbody>
</table>
Information model

- Applications
  - DICOM
    - PMG
    - ARC
    - ACR/NEMA
  - ICS/WS
    - PMS
    - ARC

**High innovation rate**

**Total transition takes more than 5 years**

**High interoperability**

- stimulate
- promote
EasyVision in 2000

- More than 100 independent applications
- Interoperating fluently with other EV applications
- Interoperating fluently with other vendors
- Interoperating fluently with other healthcare applications (information systems, etc.)
- SW only
- Running on at least UNIX and NT platforms
- Distributed development process
- Consolidation and cross fertilization process
- Platform for innovative applications in image handling, analysis, clinical focus.
# Extrapolation CDS SW.

<table>
<thead>
<tr>
<th>Year</th>
<th># appl</th>
<th>Mega lines</th>
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<tbody>
<tr>
<td>1991</td>
<td>0</td>
<td>0.1</td>
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<td>1992</td>
<td>2</td>
<td>0.35</td>
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<tr>
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<td>8</td>
<td>0.6</td>
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<tr>
<td>1996</td>
<td>32</td>
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<tr>
<td>1999</td>
<td>100</td>
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</table>
Adding an application

applications

services and common appl

toolboxes

CDSpack

HW + OS

new

modified

extended
# Table 2: Efficiency through re-use

<table>
<thead>
<tr>
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<tr>
<td>applications</td>
<td>1</td>
<td>4</td>
<td>8</td>
<td>16</td>
<td>32</td>
</tr>
<tr>
<td>inputs, a.o. modalities</td>
<td>1</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td></td>
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<tr>
<td><strong>people</strong></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>infrastructure</td>
<td></td>
<td>20+15</td>
<td>21+16</td>
<td>22+16</td>
<td></td>
</tr>
<tr>
<td>application</td>
<td></td>
<td>27</td>
<td>35</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>52</td>
<td>62</td>
<td>72</td>
<td>79</td>
<td></td>
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<tr>
<td><strong>efficiency</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>people per application</td>
<td>13</td>
<td>8</td>
<td>5</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
EasyVision technology:

- Standard (Sun) workstation
- Unix (Solaris 2.x)
- Off the shelf hardware peripherals
  only exception: Hardcopy Interface board
- Home made:
  + data base engine
  + higher level communication protocols
  + windowing environment
  + GUI
  + graphics
  + Image processing library
  + notification, call back scheduling
- Entirely OO based:
  + Objective-C
  + 1000 classes
innovation from outside

concentration on key technology

initial cost reduction

low level interoperability

cohabitation

transition cost

know how required

release propagation

integration effort

embedding

flexibility

resource use

performance

license costs

BUY

MAKE

trend
Buy, potential components:

- Operating system
- Communication
- Data base engine
- User interface and related utilities
- Graphics and related utilities
- Image processing
- 3D rendering
- Foundation classes
- Installation
- Licensing, SW keys
- Security, a.o. encryption
- Multi media, virtual reality peripheral support
- etc.
Easyvision development method:

- prototype
  - clinical feedback
  - technological feasibility

- evaluate
  - well defined specification
  - outline design

- engineering
  - coding, testing
  - alpha, beta test
# The platform as deliverable

## Development process

- **Source Software**
  - shared and product generation
  - recipes
  - documentation
  - review metrics
  - admin highlights

- **target OS, other purchased items**
  - test images
  - clinical images
  - documentation tools

- **compile, link etc tools**

- **cluster OS**

- **customization, support and control of dev. process**

- **configuration management (code, PR’s, documentation)**

- **infrastructure conditions, HW+OS**

## Actual infrastructure and resources

## Mapping on infrastructure and resources

- **test programs**
  - test definition
  - (in, out, criterium)

- **specifications**

- **test images**

- **clinical images**

- **documentation tools**
Technological changes, opportunities

• Corba, SOM, OLE, ...
• Java, ...
• Windows NT, Windows 95, OS 2
• Taligent, Spring, ...
• SW only products
• Multi media (HW+SW)
Re-use levels

• Concepts
• Development Process
• Interoperability architecture
• Functional specifications
• User interface
• Algorithms
• Design
• Verification (test suite, spec)
• Skills
• Copy implementation, code
• Implementation, code
• Application modules