



# Code generation and domain-specific modeling for user interfaces of embedded devices

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Code Generation 2010, Cambridge, UK  
B. Braun Medical Hungary Ltd., 2010-06-19, v2

**B | BRAUN**  
SHARING EXPERTISE

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## Company Information

**B.Braun:** family owned, Germany, Melsungen based, multinational company, 40K employees, 4B€ revenue

**B.Braun Avitum:** part (10%) of B.Braun, 0.4B€ revenue, app. 10% ww dialysis market-share

**B.Braun in Hungary:**

**B.Braun Medical Hungary Ltd.** / B.Braun Avitum Hungary: 1.4K employees

- Dialysis network, 18 dialysis stations, app. 30% Hungarian dialysis market-share
- Plastic disposable production
- Sales of all B.Braun products
- **Development Group, B.Braun Avitum R&D Machines Location Budapest**

**B.Braun in Hungary** has grown from a Hungarian private company, **Rolitron Ltd.** since 1991.

**B.Braun Melsungen AG** and **Rolitron Ltd.** used to be partners since early 1980s.

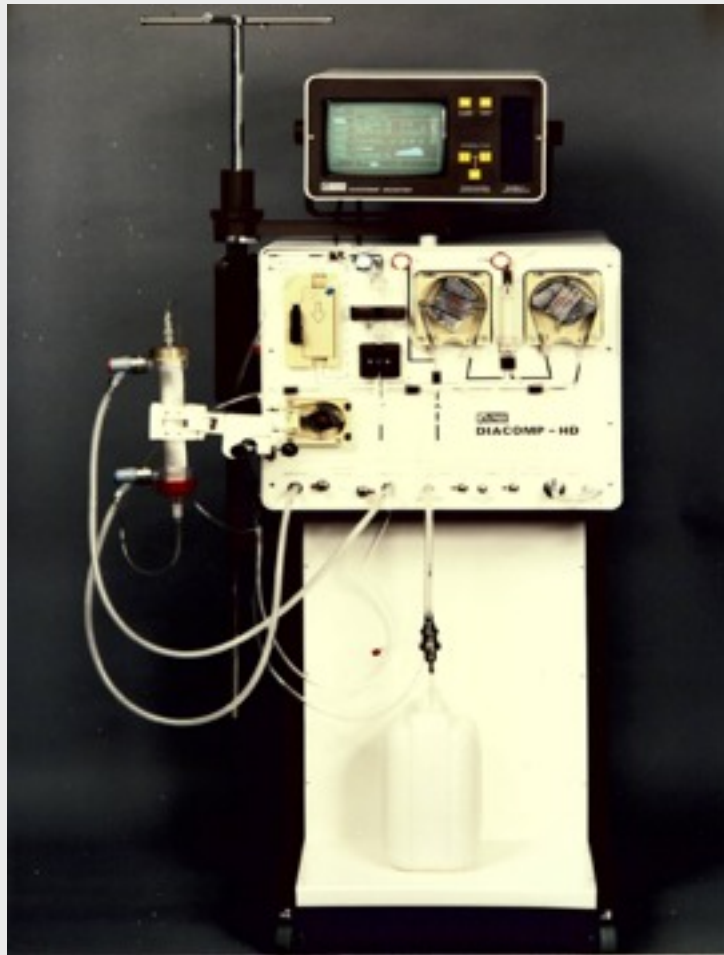
Early 1980s

B.Braun Avitum R&D Machines Location Budapest – Rolitron PD machine



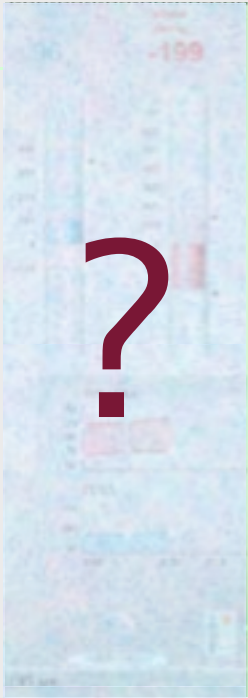
## Mid and Late 1980s

### B. Braun Avitum R&D Machines Location Budapest – Rolitron HD machine



1991-2010

## B.Braun Avitum R&D Machines Location Budapest – the actual Job



New UI prototype

Dialog, Dialog Advanced  
Dialog+, Dialog+ Evolution  
Chronic dialysis

Diapact

Acute dialysis

Plasmata Futura

Plasma therapy

**2009/2010**

## **B.Braun Avitum R&D Machines Location Budapest – the Team**



## Overview of the Project

**Domain:** ExtraCorporeal Blood (ECB) treatment equipment; dialysis and plasma therapy machines

**The motivation is: the world's best (usable) dialysis machine user interface!**

- systematic usability engineering (not part of this presentation)
- new domain specific software development technology with code-generation (tool-chain)
- new run-time user interface technology (re-engineering, legacy SW, "UI transplantation")
- new support tool technology (tools used by non-developers, too)
- new networking technology

**Development Process Innovation:** Domain Specific Modeling (DSM)

**Product Innovation:** Client (Browser) - Server Architecture for User Interface



## Development Process Innovation

Development Process Innovation: Domain Specific Modeling (DSM)

Targeted improvement:

- separation of development concerns
- less manpower for user interface maintenance
- faster time to market at new or modified application features
- better quality than current practices
- software product line approach
- automatic user interface related testing

Separation of development concerns:

- style guide / pattern library – incl. in the tool-chain and in the run-time system
- application user interface – defined and generated by the development tool-chain
- localization /labeling – defined by the support tools
- user interface run-time system
- application run-time system
- design control and regulatory documentation

## Product Innovation

Product Innovation: Client (Browser) – Server Architecture for User Interface

Primary improvement

- user interface of web technology
- support tools of web technology
- inherent networking capabilities

proprietary B.Braun architecture for ECB machines  
see next 2 slides

Additional improvement

- consistency of application user interface
- consistency of labeling and user interface
- refactoring of legacy software (non user interface software)
- up-to-date design control and regulatory documentation

## Product Innovation – Inherent Networking Capabilities

... “Via a web server and a browser, the ECB station communicates with a data net to which external browsers and external web servers are connected.”...

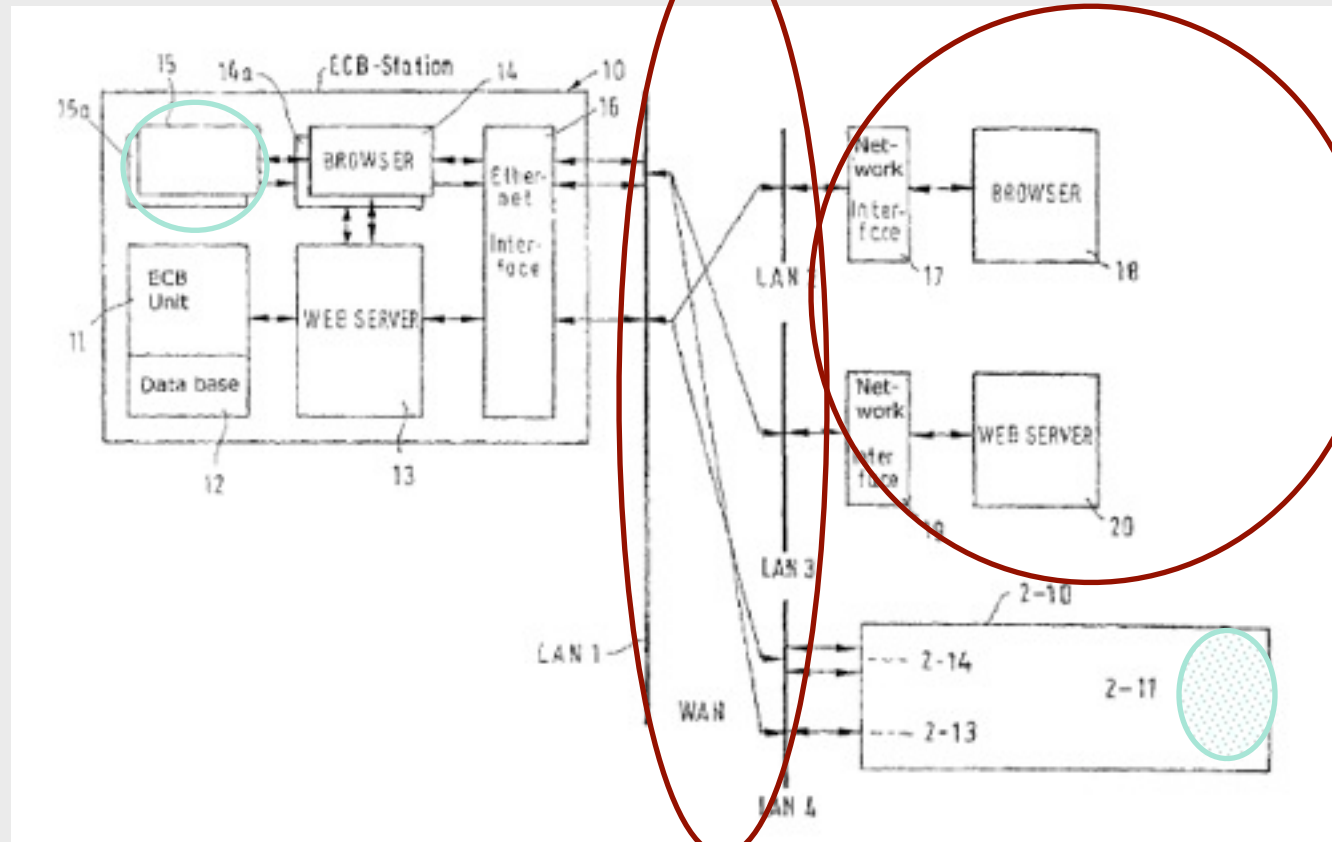
(12) <b>United States Patent</b> <b>Mueller et al.</b>	(10) <b>Patent No.:</b> <b>US 7,044,927 B2</b> (45) <b>Date of Patent:</b> <b>May 16, 2006</b>
(54) <b>EXTRACORPOREAL BLOOD TREATMENT SYSTEM</b>	(56) <b>References Cited</b>
(75) Inventors: <b>Friedrich Mueller</b> , Loehenberg (DE); <b>Sándor Dolgos</b> , Szentendre (HU); <b>Péter Szamkó</b> , Goed (HU)	U.S. PATENT DOCUMENTS
(73) Assignee: <b>B. Braun Medizintechnologie GmbH</b> , Melsungen (DE)	5,715,823 A 2/1998 Wood et al. 5,788,851 A 8/1998 Kenley et al. 5,891,035 A 4/1999 Wood et al. 6,551,266 B1 * 4/2003 Davis, Jr. .... 604/6.09 6,589,482 B1 * 7/2003 Burbank et al. .... 422/44 2003/0154108 A1* 8/2003 Fletcher-Haynes et al. .... 705/3
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 774 days.	* cited by examiner <i>Primary Examiner</i> —Patricia Bianco <i>Assistant Examiner</i> —Leslie R. Deak (74) <i>Attorney, Agent, or Firm</i> —Diller, Ramik & Wight
(21) Appl. No.: <b>09/971,031</b>	(57) <b>ABSTRACT</b>
(22) Filed: <b>Oct. 5, 2001</b>	An extracorporeal blood treatment system comprises an ECB station with an ECB unit, such as a dialysis machine. <u>Via a web server and a browser, the ECB station communicates with a data net to which external browsers and external web servers are connected. Thus, settings and maintenance operations may be performed on the ECB unit from a remote location. On the other hand, patient-related,</u>
(65) <b>Prior Publication Data</b> US 2002/0082728 A1 Jun. 27, 2002	
(30) <b>Foreign Application Priority Data</b> Oct. 5, 2000 (DE) ..... 100 49 393	

## Product Innovation – Inherent Networking Capabilities (cont.)

New User Interface

Data net

External Servers and Browsers



## Project Development Phase – Lessons Learnt

It's been and it still is a great challenge for us!

See also pitfalls in next slide!

1. use outsourcing for technology step
2. use outsourcing for manpower gap
3. develop a good baseline version / sprint 0
4. continue with agile prototyping
5. separate concerns, especially pattern library and even more the application user interface
6. define proper lifecycle activities for separate concerns
7. integrate development tool-chain into existing processes
8. develop iterative software revisions meanwhile keep improving development processes
9. use issue tracking system for both the development and problem resolution activities
10. keep extending and training internal manpower
11. change anything (software or process) and any time if reasonably necessary, don't mind the loss

## Pitfalls

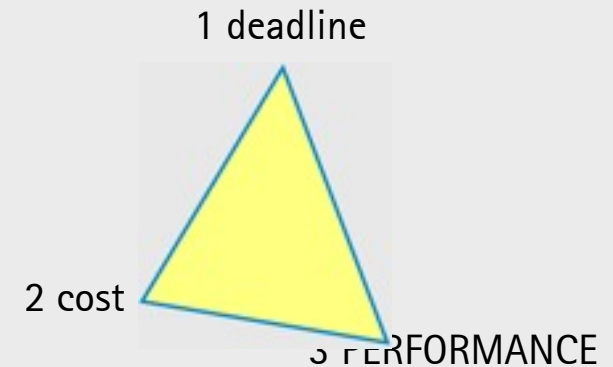
1. keep insisting on original project goals, especially separation of concerns, until reasonable
2. never do anything more than really necessary
3. in outsourcing: reconcile the 2 antagonistic world of industry practitioners and academic people
4. initially, before significant project efforts train both above groups for the other disciplines
5. in technology step beyond outsourcing involve internals not just occasionally train them
6. extend and train manpower by continuous mentoring not just occasionally train them
7. avoid deadlocks among team members – communicate hindrances at once!
8. avoid inefficient task allocation – is it the optimum distribution of activities here and now?
9. avoid pseudo activities – why do you think it is necessary?
10. avoid pseudo planning – why do you list your backlog for long ahead, do just one item instead?!
11. don't hesitate too long may be learning by doing and then changing is more efficient!

## Golden Triangles (as we see them)

### The top 3 Project KPIs:

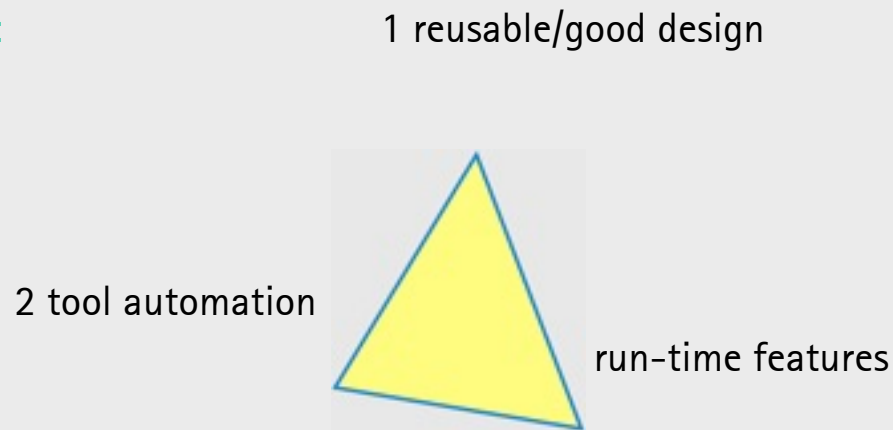
- deadline
- cost
- PERFORMANCE

Note: software component project in a machine project!



### The top 3 PERFORMANCE Qualities:

- reusable/good design
- tool automation
- run-time features



## Summary

User interface development and maintenance will be significantly changed

There are still risks considering deadline, cost, hardware capacity, software quality and regulatory

Pure ROI – cost of project vs. maintenance costs at this machine only – is guessed till 2014

Advantages that are not easy to calculate: up-to-date features, long term platform, user experience

Risk that are not easy to foresee: integrating the new processes into the full co. organization

Thank you for your attention!