Der Erfolg hat viele Gesichter:
WIT-Dissertantinnen stellen sich vor

Sabine Graf, Birgit Korherr, Elke Michlmayr,
Marion Murzek, Andrea Schauerhuber,
Veronika Stefanov, Nevena Stolba und Martina Umlauft

Marion Murzek

- murzek@wit.tuwien.ac.at
- http://wit.tuwien.ac.at/people/murzek

ModelMorphing
ModelMorphing

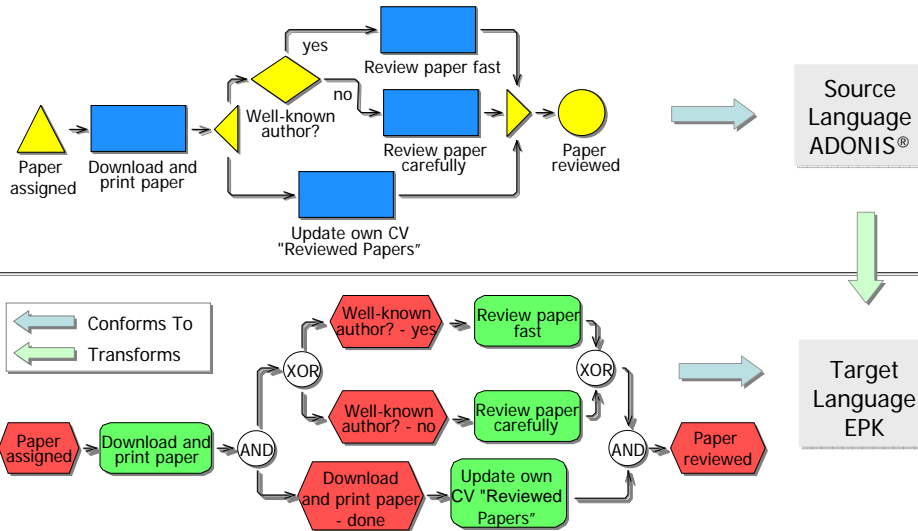# The Model Morphing Approach – Transforming Business Process Models

- Supervisors:
    - Prof. Gerti Kappel (Vienna University of Technology, Austria)
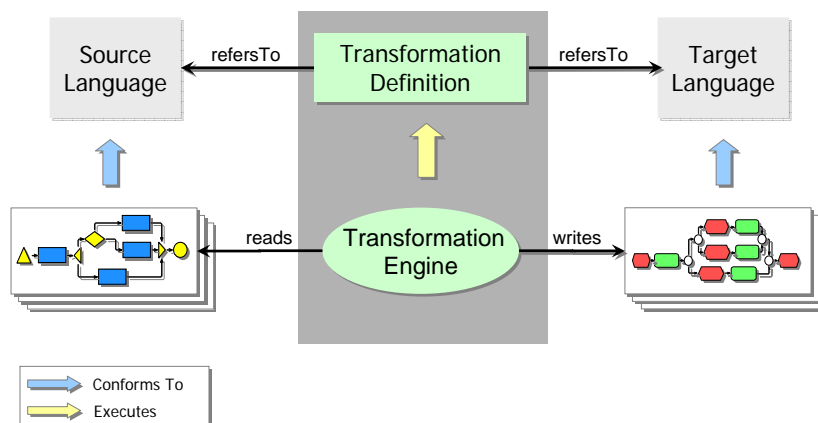   - Prof. Dimitris Karagiannis (University of Vienna, Austria)

Babel Fish – Language Translation

YAHOO! BABEL FISH
DEUTSCHLAND

Target Language

Source Language

Auf deutsch

Suchen Sie im Web nach diesem Text

Erneut übersetzen (Maximal 150 Wörter)

Englisch ins Deutsche | Übersetzen

Conforms To
Translate

Business Process Model Transformation

Source Language ADONIS®

Target Language EPK

Conforms To
Transforms

Paper assigned — Download and print paper — Well-known author? — yes — Review paper fast — no — Review paper carefully — Update own CV "Reviewed Papers" — Paper reviewed

Paper assigned — Download and print paper — AND — XOR — Well-known author? - yes — Review paper fast — Well-known author? - no — Review paper carefully — Download and print paper - done — Update own CV "Reviewed Papers" — XOR — AND — Paper reviewed

Traditional Model Transformation Approaches

Source Language — refersTo — Transformation Definition — refersTo — Target Language

reads — Transformation Engine — writes

Conforms To
Executes

K. Czarnecki, S. Helsen: "Feature-based survey of model transformation approaches."
IBM Systems Journal, pages 621–645, 2006

Problems at Hand

- *Generic Transformation Languages*
  - No focus on specific problems of a domain

- *Good solutions for trivial (1:1, 1:n, n:1) relationships*
  - No special support for non-trivial problems

- *Sophisticated solutions for non-trivial problems*
  - Excellent technical skills required

- *Low Reusability*
  - Copy – Paste

The Model Morphing Approach
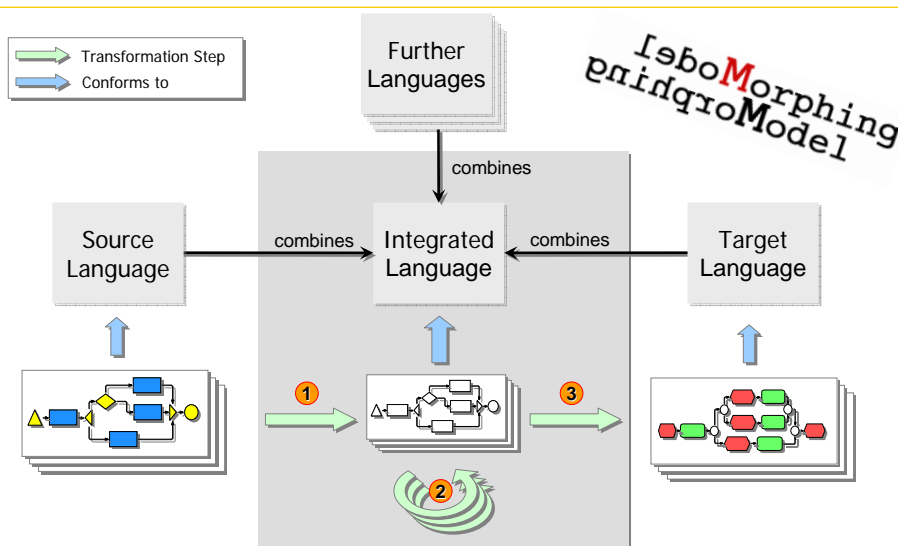
M. Murzek, G. Kramler: "The Model Morphing Approach - Horizontal Transformations between Business Process Models." Proceedings of BIR 2007, Tampere, Finnland S. 88 - 103.

Contribution

- ## A new model transformation approach using *existing model transformation technologies*

- ## Benefits:

  - *Black Box Approach – Encapsulation*
    - Each problem may be treated by its own
  - *Reusable*
    - Methods and Algorithms
  - *Easy to use*
    - Only low technical knowledge needed
  - *Domain-Specific*
    - Focus on the specific problems of a given area

M. Murzek, G. Kramler: "The Model Morphing Approach - Horizontal Transformations between Business Process Models." Proceedings of BIR 2007, Tampere, Finnland S. 88 - 103.

Selected Publications

M.Strommer, M.Murzek, M.Wimmer: **Applying Model Transformation By-Example on Business Process Modeling Languages** *Accepted at the 3rd International Workshop on Foundations and Practices of UML at the 26the International Conference on Conceptual Modelling, ER 2007, Auckland, New Zealand, November 2007 (PDF)* Oktober 2007

M. Murzek, G. Kramler: **The Model Morphing Approach - Horizontal Transformations between Business Process Models** *Proceedings of the 6th International Conference on Perspecitves in Business Information Research - BIR 2007 ", J. Nummenmaa, E. Söderström (Hrg.); Department of Computer Sciences, University of Tampere, Tampere, Finnland (2007), S. 88 - 103. (PDF)* Juni 2007

M.Murzek, G.Kramler: **BUSINESS PROCESS MODEL TRANSFORMATION ISSUES - The top 7 adversaries encountered at defining model transformations** *Conference Paper at the 9th International Conference on Enterprise Information Systems ICEIS 2007, Funchal, Madeira - Portugal, Juni 2007(PDF)* Oktober 2006

M.Murzek, G.Kramler, E.Michlmayr: **Structural Patterns for the Transformation of Business Process Models** *Accepted at the International Workshop on Models for Enterprise Computing (IWMEC 2006) at the 10th IEEE International EDOC Conference (EDOC 2006) "The Enterprise Computing Conference", Hong Kong, October 2006 (PDF)* Mai 2006

M.Murzek, G.Kappel, G.Kramler: **Model Transformations in Practice Using the BOC Model Transformer** *Paper for the Workshop "Model Transformation in Practice" at MoDELS 2005, Montego Bay, Jamaica, October 2005 (PDF)* Oktober 2005

H. Kühn, M. Murzek: **Modelling: From Craftsmanship to Automation.** *Accepted for publication at the 4th International Conference on Perspectives in Business Informatics Research BIR 2005, October 3-4, 2005, University of Skövde, Sweden (PDF)* Februar 2005

H.Kühn, M.Murzek: **Interoperability Issues in Metamodelling Platforms** *Conference Paper at the First International Conference on Interoperability of Enterprise Software and Applications INTEROP-ESA'05, Geneva, Switzerland, February 2005 (PDF)* Dezember 2004

H.Kühn, M.Murzek, F.Bayer: **Business Model Interoperability using Enterprise Model Integration**, *Position Paper for eChallenges2004, Vienna, October 2004 (PDF)* Juni 2004

H.Kühn, M.Murzek, F.Bayer: **Horizontal Business Process Model Interoperability Using Model Transformation**, *Position Paper for Workshop INTERREST 2004 at ECOOP 2004, Oslo, June 2004 (PDF)*

Birgit Korherr

- korherr@wit.tuwien.ac.at
- http://wit.tuwien.ac.at/people/korherr

Business Process Modelling – Languages, Goals and Variabilities

- Supervisors:
    Prof. Gerti Kappel (Vienna University of Technology, Austria)
    Ao. Prof. Christian Huemer (Vienna University of Technology, Austria)

Introduction

Languages　**Goals**　**Variabilities**

Research and industry have only marginally addressed the alignment of business processes and IT

THE GOAL: Extending existing BPMLs with missing concepts and notations

Goals of the Evaluation

Languages   Goals   Variabilities

1. Generic business process metamodel that captures a wide range of business process concepts

2. Evaluation of six well-established BPMLs according to the generic metamodel

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Goals and Performance Measures

Languages   **Goals**   Variabilities

Extending well-known BPMLs to make **goals** and **performance measures** conceptually visible
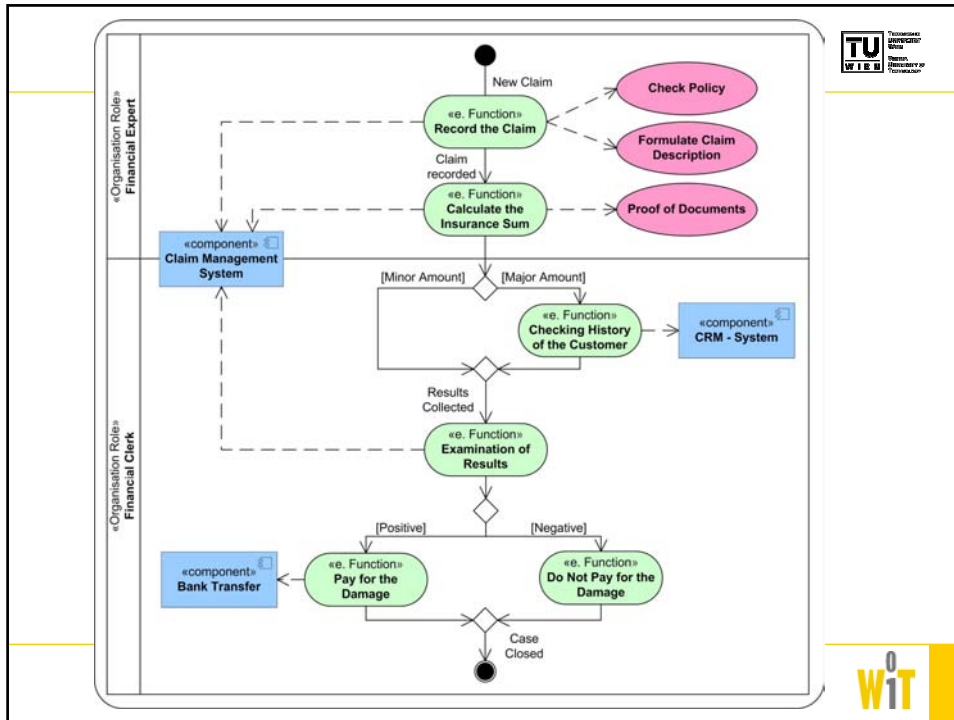
Time   Quality   Costs
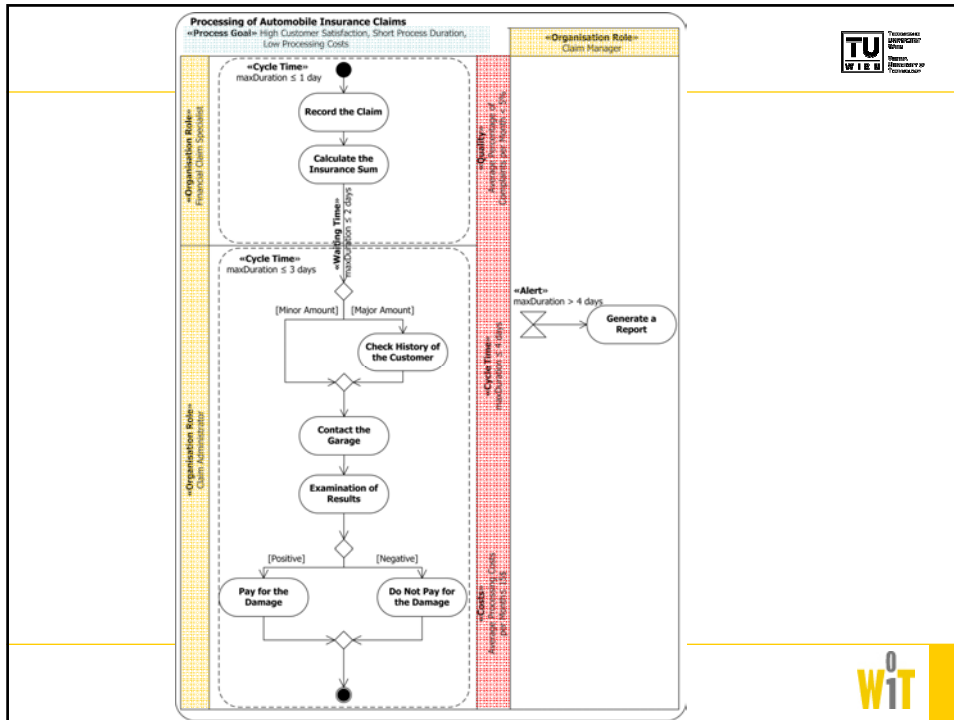
Linking BPs with Software

Languages   **Goals**   **Variabilities**

Extending a well-known BPML to make the **dependency** between **process flow** and **software systems** conceptually visible

Variabilities and Business Processes
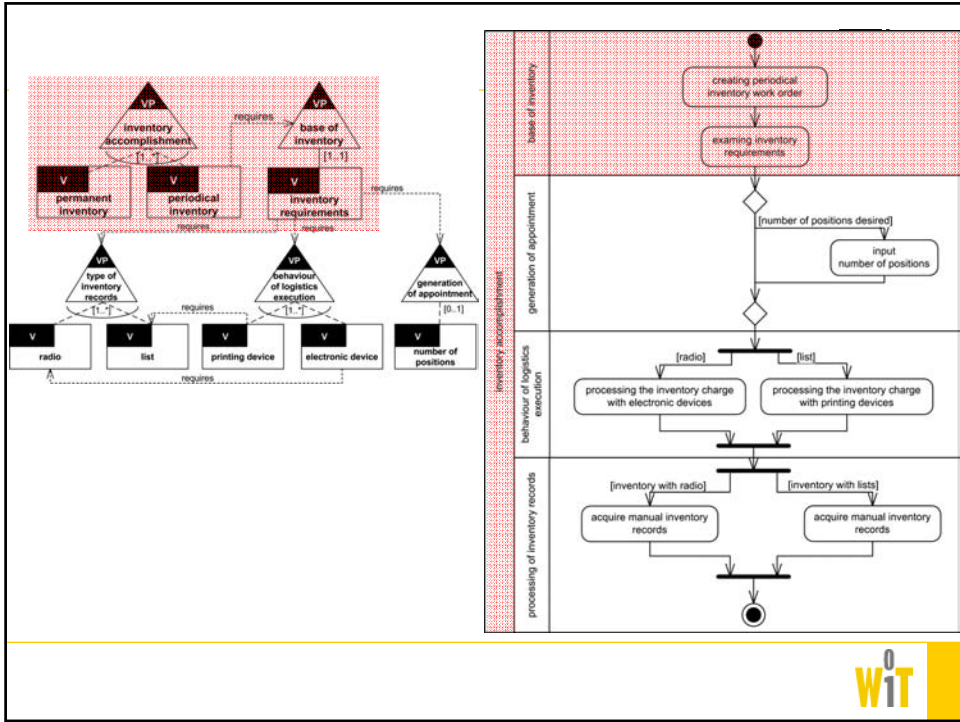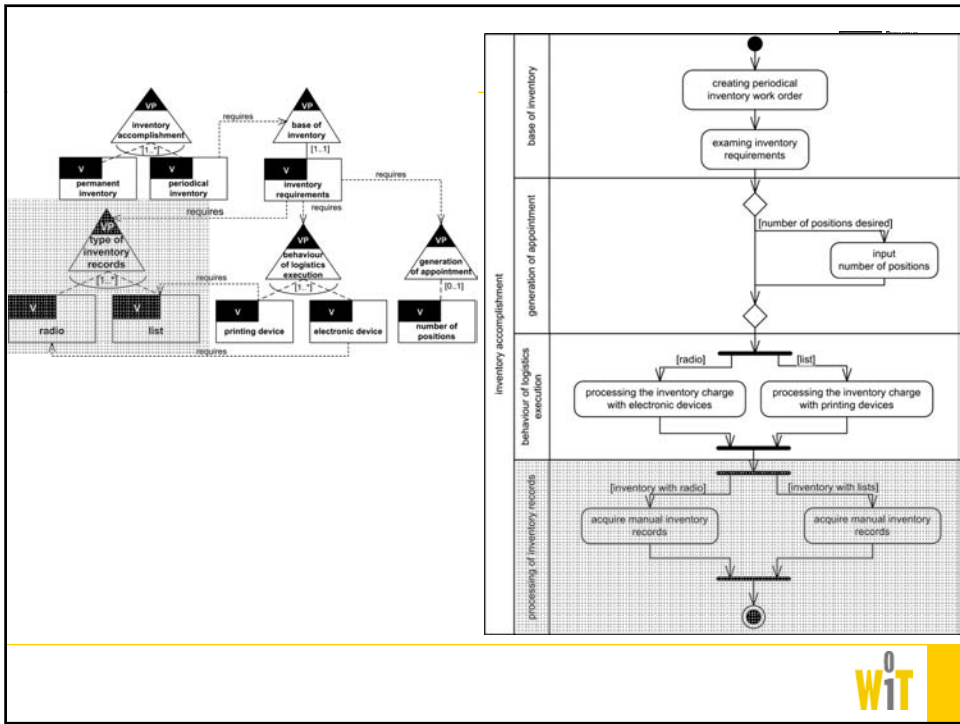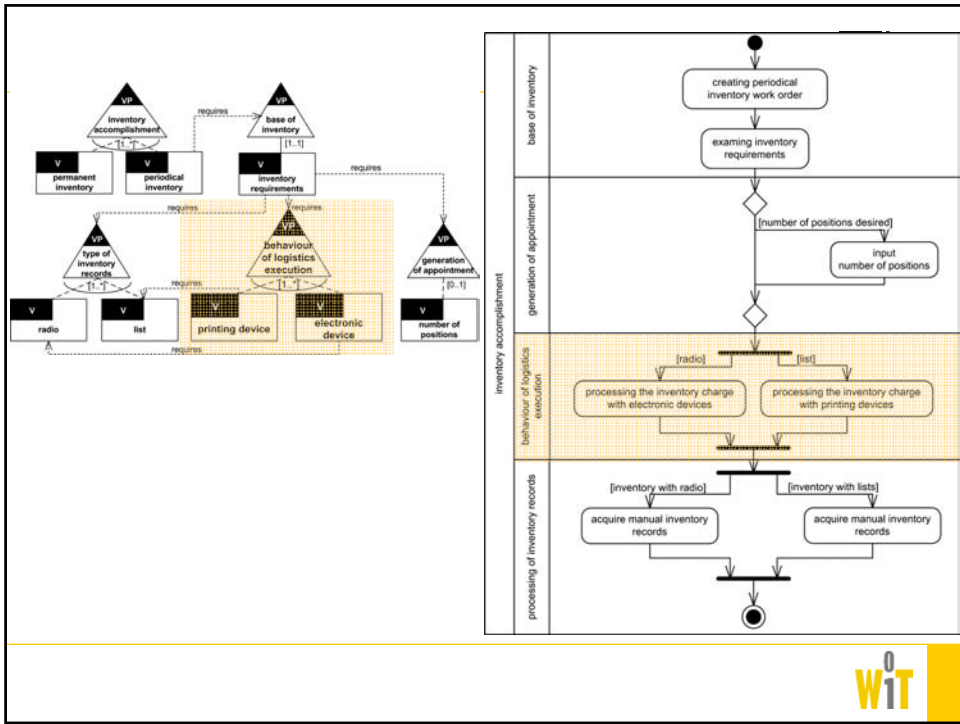
Languages   **Goals**   **Variabilities**

1. Provide variability models to software developers in a UML notation

2. Show the **dependency between variability models and business processes** to visualize the relationship between structural models and behavioural models
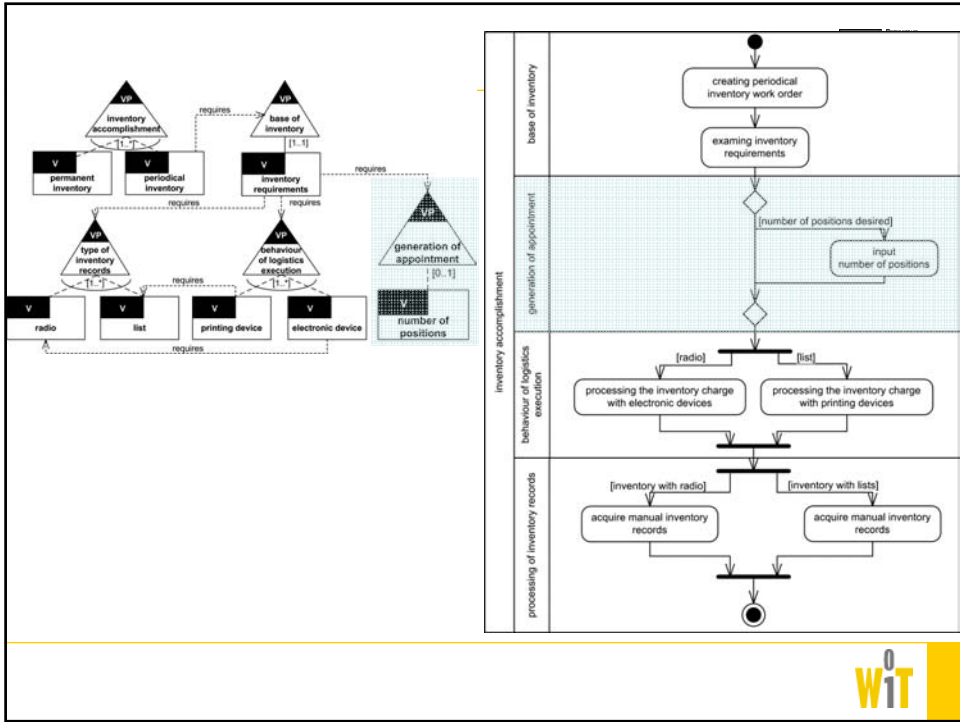
Publications

- Birgit Korherr and Beate List: **A UML 2 Profile for Variability Models and their Dependency to Business Processes.** 1st International Workshop on Enterprise Information Systems Engineering (WEISE 07), September 2007, Regensburg, Germany, IEEE Press, 2007.
- Birgit Korherr and Beate List: **Extending the EPC and the BPMN with Business Process Goals and Performance Measures.** 9th International Conference on Enterprise Information Systems (ICEIS 07), June 2007, Madeira, Portugal, ACM Press, 2007.
- Birgit Korherr and Beate List: **Extending the EPC with Performance Measures (short paper).** Proceedings of the 22nd ACM Symposium on Applied Computing (SAC'07), Seoul, Korea, March 11-15, ACM Press, 2007.
- Birgit Korherr and Beate List: **Extending the UML 2 Activity Diagram with Business Process Goals and Performance Measures and the Mapping to BPEL.** 2nd International Workshop on Best Practices of UML (BP-UML'06) at the 25th International Converence on Conceptual Modeling (ER'06), November 2006, Tucson, Arizona, USA, 2006, Spinger Verlag, Lecture Notes in Computer Science.
- Birgit Korherr and Beate List: **Aligning Business Processes and Software - Connecting the UML Profile for Event Driven Process Chains with Use Cases and Components.** CAiSE Forum Proceedings at the 18th Conference on Advanced Information System Engineering (CAiSE'06), June 2006, Luxembourg, 2006.
- Birgit Korherr and Beate List: **A UML 2 Profile for Event Driven Process Chains.** Proceedings of the 1st IFIP International Conference on Research and Practical Issues of Enterprise Information Systems (CONFENIS 2006), April 2006, Vienna, Austria, 2006, Springer Verlag, IFIP.
- Beate List and Birgit Korherr: **An Evaluation of Conceptual Business Process Modelling Languages.** Proceedings of the 21st ACM Symposium on Applied Computing (SAC'06), April 2006, Dijon, France, ACM Press, 2006.
- Beate List and Birgit Korherr: **A UML 2 Profile for Business Process Modelling.** Proceedings of the 1st International Workshop on Best Practices of UML (BP-UML 2005) at the 24th International Conference on Conceptual Modeling (ER 2005), Klagenfurt, Austria, 2005, Springer Verlag, Lecture Notes in Computer Science.
- Veronika Stefanov, Beate List and Birgit Korherr: **Extending UML 2 Activity Diagrams with Business Intelligence Objects.** Proceedings of the 7th International Conference on Data Warehousing and Knowledge Discovery (DaWaK 2005), August 2005, Copenhagen, Denmark, Springer Verlag, Lecture Notes in Computer Science.

Veronika Stefanov

- stefanov@wit.tuwien.ac.at
- http://wit.tuwien.ac.at/people/stefanov

Conceptual Models and Model-Based Business Metadata to Bridge the Gap between Data Warehouses and Organizations

- Supervisors:

  Prof. Gerti Kappel (Vienna University of Technology, Austria)

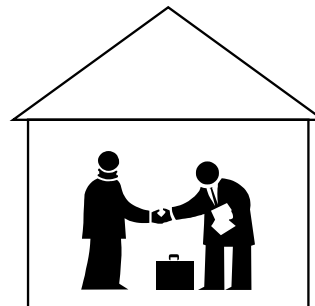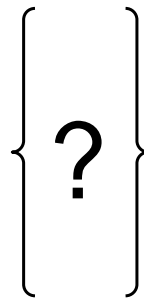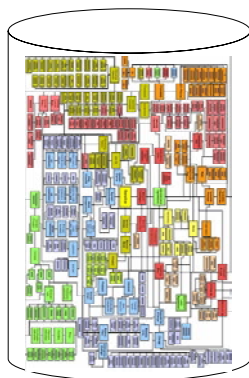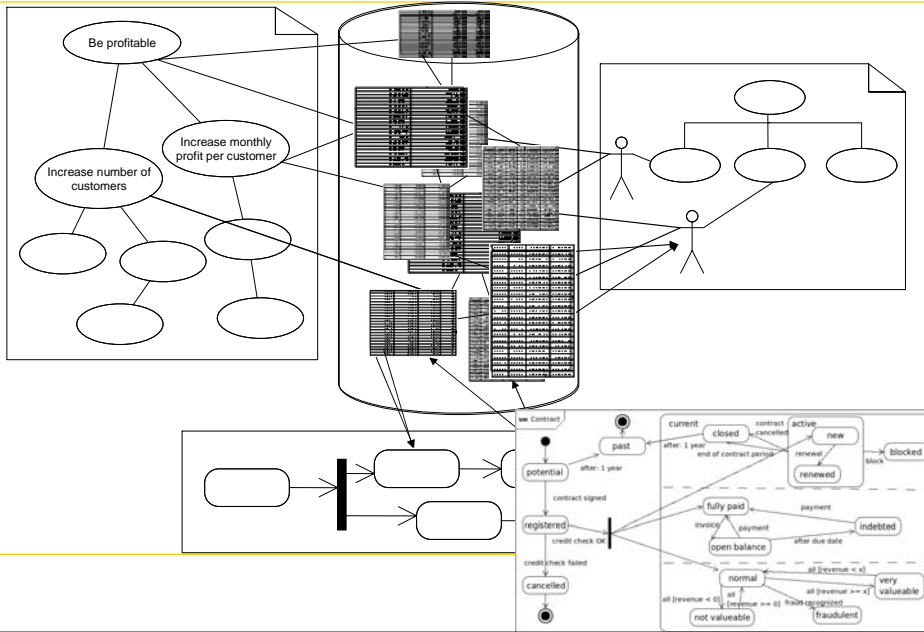 Prof. Juan-Carlos Trujillo (University of Alicante, Spain)

€ 96,99	3,85%	759,06	64	0,8703736	0,15045066
€ 92,26	78,72%	150,37	34	0,49072507	0,62221774
	1,18%	17,00	50	0,97769119	0,11646777
		146,02	40	0,49860329	0,99421023
		314,28	64	0,10312222	0,97463959
	14,67%	792,26	51	0,18697208	0,46412436
€ 97,75	37,66%	23,45	53	0,05320183	0,70652997
€ 38,82	4,22%	496,72	29	0,18732788	0,95846537
€ 48,32	29,97%				0,34329486
€ 83,41					0,59427304
€ 57,51					20395349
€ 11,29	2				0,34355596
€ 34,54	27,44%		0067		0,22184559
€ 57,12	95,69%	411,34	66	0,84746473	0,16245299
€ 11,85	66,21%	979,68	30	0,7707576	0,82169234
€ 39,58	5,18%	688,44	70	0,34195124	0,51447832
€ 47,37	90,29%	407,68	78	0,5685245	0,69041139
€ 65,01	74,16%	68,21	26	0,23515974	0,7150941
€ 63,71	15,05%	68,90	71	0,78455731	0,34868819
€ 35,67	67,80%	848,17	100	0,0216663	0,9960421
€ 26,10	34,08%	77,01	17	0,99662383	0,05398598
€ 40,29	40,76%	573,56	80	0,25593633	0,76199841

Be profitable

Increase number of customers

Increase monthly profit per customer

D
E
F

27%

{ ? }

Model the Relationships

Adding Context to the Data Warehouse

Selected Publications

- Veronika Stefanov, Beate List: **A UML Profile for Modeling Data Warehouse Usage**, Advances in Conceptual Modeling - Foundations and Applications ER 2007 Workshops, 3rd International Workshop on Foundations and Practices of UML (FP-UML 2007), in conjuntion with the 26th International Conference on Conceptual Modelling (ER 2007), November 5-9, 2007 Auckland, New Zealand, Springer Verlag, Lecture Notes in Computer Science 4802
- Veronika Stefanov and Beate List: **A UML Profile for Representing Business Object States in a Data Warehouse**, 9th International Conference on Data Warehousing and Knowledge Discovery (DaWaK 2007), September 2007, Regensburg, Germany, Springer Verlag, Lecture Notes in Computer Science 4654.
- Veronika Stefanov and Beate List: **Explaining Data Warehouse Data to Business Users - A Model-Based Approach to Business Metadata**, 15th European Conference on Information Systems (ECIS 2007), June 2007, 2062-2073, St. Gallen, Switzerland
- Veronika Stefanov and Beate List: **Business Metadata for the Data Warehouse - Weaving Enterprise Goals and Multidimensional Models**, International Workshop on Models for Enterprise Computing (IWMEC) at the 10th International Enterprise Distributed Object Computing Conference (EDOC 2006), October 2006, Hong Kong, China
- Veronika Stefanov: **Bridging the Gap between Data Warehouses and Organizations**, Proceedings of Workshops and Doctoral Consortium, 18th Conference on Advanced Information System Engineering (CAiSE'06), Namur University Press, June 2006, Luxembourg
- Veronika Stefanov, Beate List and Josef Schiefer: **Bridging the Gap between Data Warehouses and Business Processes - A Business Intelligence Perspective for Event-Driven Process Chains**, Proceedings of the 9th International Enterprise Distributed Object Computing Conference (EDOC 2005), September 2005, Enschede, The Netherlands, 2005, IEEE Press.
- Veronika Stefanov, Beate List and Birgit Korherr: **Extending UML 2 Activity Diagrams with Business Intelligence Objects**, Proceedings of the 7th International Conference on Data Warehousing and Knowledge Discovery (DaWaK 2005), August 2005, Copenhagen, Denmark, Springer Verlag, Lecture Notes in Computer Science 3589.
- Veronika Stefanov and Beate List: **A Performance Measurement Perspective for Event-Driven Process Chains**, Proceedings of the 16th International Workshop on Database and Expert Systems Applications (DEXA 2005), First International Workshop on Business Process Monitoring & Performance Management (BPMPM 2005), August 2005, Copenhagen, Denmark, IEEE Press.

Nevena Stolba

- stolba@wit.tuwien.ac.at
- http://www.wit.at/people/stolba/

Towards a Sustainable Data Warehouse Approach for Evidence-Based Healthcare

- Supervisors:
  Prof. A Min Tjoa (Vienna University of Technology, Austria)
  Prof. Thomas Mück (Vienna University of Technology, Austria)

Motivation for my Research Work

- Growing need for integrated healthcare (HC)

- Evidence-based medicine (EBM)

- Data warehousing technology can facilitate EBM through:
    - (1) supporting rule development process
    - (2) providing EBM-enriched knowledge base

- Decentralized data storage of sensitive patient data

- This Thesis provides the roadmap for achieving a sustainable HC decision support system

My Research Question

- How to provide interoperability among heterogeneous healthcare information systems?

- How to integrate evidence-based guidelines into clinical decision support systems?

- How to assure data privacy for sensitive patient data?

Federated DWH Approach for the Healthcare Environment

Healthcare benefits from:

- **SCALABILITY**
  - Easy addition of new components and users
- **INTEROPERABILITY**
  - Acquisition, transformation and load of heterogeneous medical data
  - Adoption of international standards
  - Building of a life-time EPR
- **QUALITY OF CARE**
  - Development of EBG
  - Integrating EBG into DSS
- **SECURITY**
  - Decentralized data storage
  - Depersonalization
  - Pseudonymization
  - Role-based access
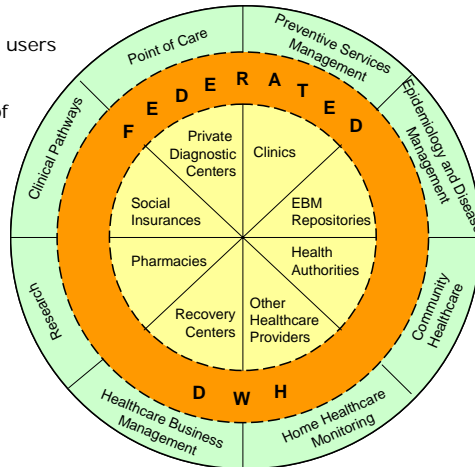
EBM = Evidence Based Medicine
DWH = Data Warehouse
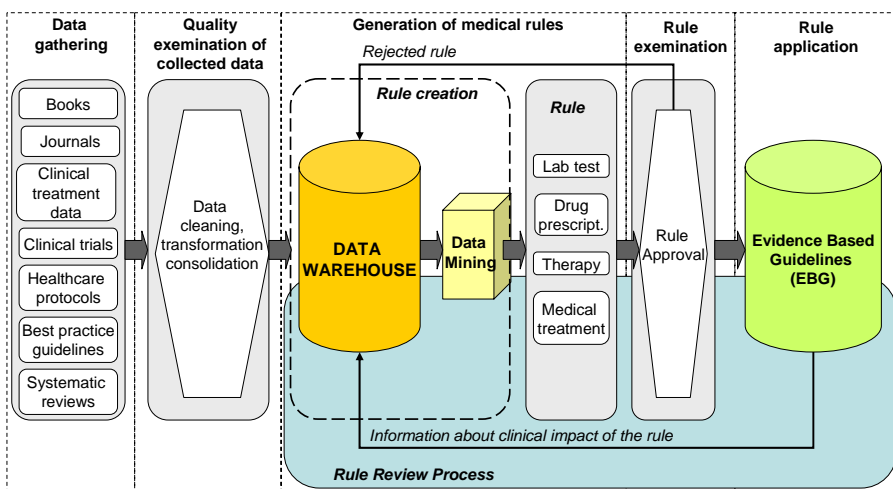EPR = Electronic Patient Record
DDS = Decision Support System
EBG = Evidence Based Guidelines

Application Fields for DWH-Supported EBM (1/2)

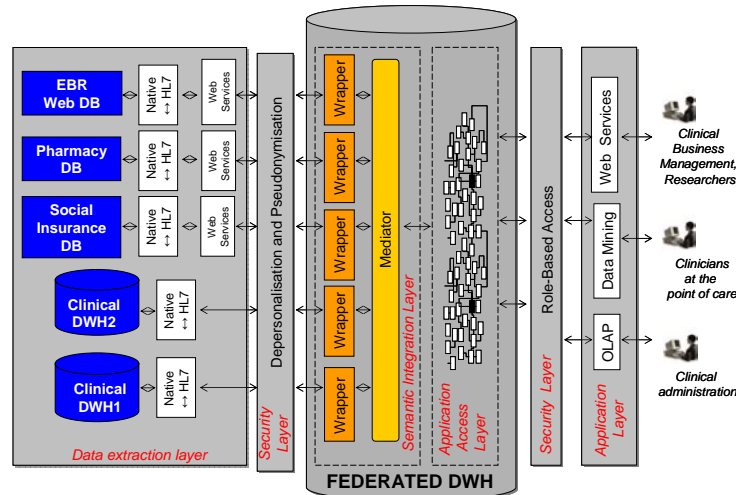Generation of evidence-based guidelines

EBM = Evidence Based Medicine   DWH = Data Warehouse

Application Fields for
DWH-Supported EBM (2/2)

Integration of EBM into clinical decision making process

EBM = Evidence Based Medicine   DWH = Data Warehouse

Contribution of this Thesis

- The concept of the federated DWH developed in this Thesis
  - can be deployed to enable efficient interoperability between heterogeneous medical information systems
  - is the ideal basis for integration of EBM into clinical decision support process.

- Federated DWH approach proposed by the Thesis guaranties the decentralization of security assurance.

- This concept enables strategic decision making for both clinical business management and for the care givers at the point of care.

DWH = Data Warehouse

My Publications

- Nevena Stolba, Tho Manh Nguyen, A Min Tjoa: **Towards sustainable decision-support system facilitating EBM**, 29th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC 2007), Lyon, France, August 2007.

- Nevena Stolba, Alexander Schanner: **eHealth Integrator - Clinical Data Integration in Lower Austria**, Third International Conference on Computational Intelligence in Medicine and Healthcare (CIMED 2007), Plymouth, England, July 2007.

- Nevena Stolba, A Min Tjoa, Thomas Mueck, Marko Banek: **Federated Data Warehouse Approach to Support the National and International Interoperability of Healthcare Information Systems**, 15th European Conference on Information Systems (ECIS 2007), St. Gallen, Switzerland, June 2007.

- Nevena Stolba, Tho Manh Nguyen, A Min Tjoa: **Towards a Data Warehouse Based Approach to Support Healthcare Knowledge Development and Sharing**, 2007 Information Resources Management Association (IRMA) International Conference, Vancouver, Canada, May 2007.*

- Marko Banek, A Min Tjoa, Nevena Stolba: **Integrating different grain levels in a medical data warehouse federation**, 8th International Conference on Data Warehousing and Knowledge Discovery (DaWaK 2006), Krakow, Poland, September 2006.

- Nevena Stolba, Marko Banek, A Min Tjoa: **The Security Issue of Federated Data Warehouses in the Area of Evidence-Based Medicine**, First International Conference on Availability, Reliability and Security (ARES 2006), Vienna, Austria, IEEE Computer Society Press, Apri 2006.

- Nevena Stolba, A Min Tjoa: **The Relevance of Data Warehousing and Data Mining in the Field of Evidence-Based Medicine to Support Healthcare Decision Making**, International Conference on Computer Science (ICCS 2006), Prague, Czech Republic, Enformatika: Volume 11, February 2006.

- Nevena Stolba, A Min Tjoa: **An Approach towards the Fulfilment of Security Requirements for Decision Support Systems in the Field of Evidence-Based Healthcare**, Knowledge Rights - Legal, Societal and Related Technological Aspects (KnowRight2006), Vienna, Austria, Austrian Computer Sociaty, pp. 51-59, February 2006.

* "Best Paper Award" winning paper

Elke Michlmayr

- michlmayr@wit.tuwien.ac.at
- http://wit.tuwien.ac.at/people/michlmayr

Ant Algorithms for Self-Organization in Social Networks

- Supervisors:
  - Prof. Gerti Kappel (Vienna University of Technology, Austria)
  - Prof. Wolfgang Nejdl (University of Hannover, Germany)

Background and Motivation
Self-Organization

- A dynamical and adaptive process where systems acquire and maintain structure
  - *without external control*
- Pattern at the macro-level dynamically emerges from
  - *interactions between the parts at the micro-level*

- *Fascinating! Can we apply this in computer science?*

Background and Motivation
## Ant Algorithms

- Yes we can.
  - *Ant algorithms are used for graph-based optimization problems*
- Positive feedback
  - *Ants prefer the trails that have been used by other ants*
- Negative feedback
  - *Pheromone trails evaporate over time*

- My thesis applies these basic principles to social networks
  - Peer-to-peer networks
  - Social bookmarking systems
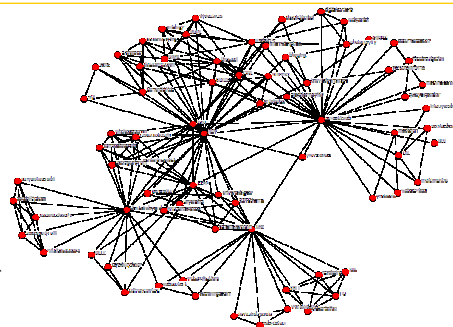
Thesis

Methodology

- Design of algorithm
  - Models user activity pattern
  - Reacts to changes in pattern over time

- Implementation of test framework
  - Metrics
  - Statistical evaluation

- Two case studies
  - Content-based search in peer-to-peer networks
  - Learning of user profiles from social bookmarking systems (internship at HP Labs Bristol)
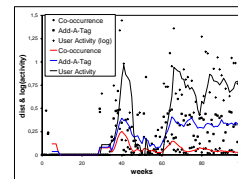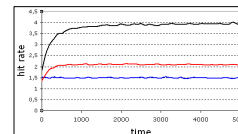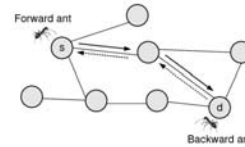
Thesis

Results and Contributions

- User profiles
  - Include both long-term and short-term interests at any given point in time
  - Show relationships between interests

- Visualization tool
  - Replays a user's personal interest history

- Improved user interface for personalized access to annotated data sources
  - Acts as a lens for browsing huge data collections

Selected Publications

E. Michlmayr: "**Self-Organization for Search in Peer-to-Peer Networks: The Exploitation-Exploration Dilemma**," International Conference on Bio inspired Models of Network, Information and Computing Systems (BIONETICS 2006), Cavalese, Italy, Dec 2006.
- Extended version published as Book chapter in "Advances in biologically inspired information systems: models, methods, and tools", Springer Studies in Computational Intelligence, 2007.

E. Michlmayr, A. Pany, S. Graf: "**Applying Ant-based Multi-Agent Systems to Query Routing in Distributed Environments**," 3rd IEEE Conference On Intelligent Systems (IEEE IS'06), London, UK, Sep 2006.

E. Michlmayr, A. Pany, G. Kappel: "**Using Taxonomies for Content-based Routing with Ants**," 2nd Workshop on Innovations in Web Infrastructure, WWW2006, Edinburgh, UK, May 2006.
- Extended version published in Journal of Computer Networks, 2007

E. Michlmayr, "**Ant Algorithms for Search in Unstructured Peer-to-Peer Networks**", Ph.D. Workshop, ICDE 2006, Atlanta, Georgia, USA, April 2006.

E. Michlmayr, S. Graf, W. Siberski, W. Nejdl, "**Query Routing with Ants**," Workshop on Ontologies in P2P Communities, ESWC2005, Heraklion, Crete, May 2005.

E. Michlmayr, S. Cayzer: "**Learning User Profiles from Tagging Data and Leveraging them for Personal(ized) Information Access**", Workshop on Tagging and Metadata for Social Information Organization, WWW2007, Banff, Alberta, Canada, May 2007.
- Also published as HP Technical Report.

E. Michlmayr, S. Cayzer, P. Shabajee: "**Add-A-Tag: Learning Adaptive User Profiles from Bookmark Collections**", Poster paper, International Conference on Weblogs and Social Media (ICWSM'06), Boulder, Colorado, USA, March 2007.

E. Michlmayr, "**A Case Study on Emergent Semantics in Communities**," Workshop on Semantic Network Analysis, ISWC2005, Galway, Ireland, November 2005.

Martina Umlauft

- umlauft@wit.tuwien.ac.at
- http://wit.tuwien.ac.at/people/umlauft
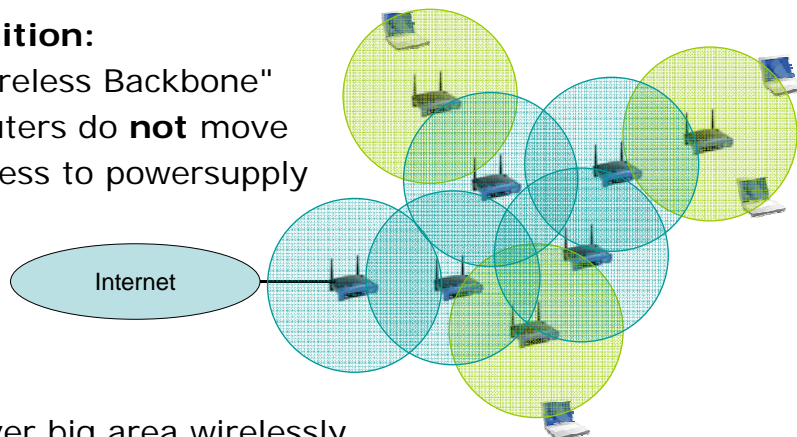
Routing in Wireless Mesh Networks

- Supervisors:
  Prof. Dietmar Dietrich (Vienna University of Technology)
  Ao.Prof. Wolfgang Kastner (Vienna University of Technology)

Wireless Mesh Networks

Definition:
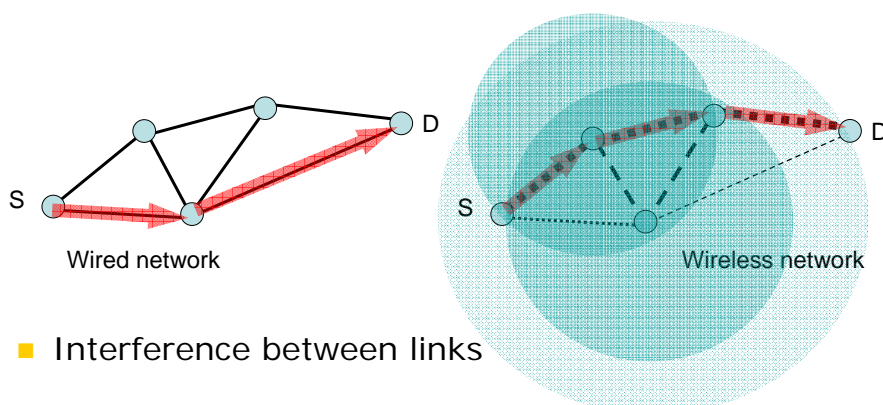- "Wireless Backbone"
- Routers do **not** move
- Access to powersupply

Internet

Use:
- Cover big area wirelessly
- Fast & easy deployment

Wireless Station

WLAN Router/AP

The Problem

- Hop-count is a bad routing metric:
  - Far links are usually worse than short links
  - Links vary over time

S

D

Wired network

S

D

Wireless network

- Interference between links

Research Question

- Wireless aware routing
- Influence on Internet protocols & applications?

➜ QoS aware routing in wireless multi-hop

Approach:
- Ant-based Routing Algorithm /w QoS support

Method:
- Simulation /w ns-2 Network Simulator

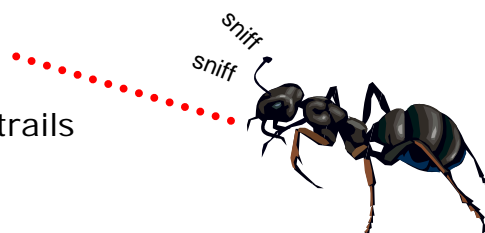## Ant-based Algorithms

- Inspired by nature: behavior of ants
- *Single ants are stupid, but the whole system exhibits "intelligent" behavior*

sniff
sniff

Algorithm:
1. Ants lay pheromone trails
2. Finding the way:
   - Trail: x% follow
     (100-x)% walk randomly
   - No trail: walk randomly.
3. Pheromones evaporate over time -> unused trails vanish.

Contribution of the Thesis

- Currently no support for different QoS classes of traffic
- Highly interactive vs. background traffic
- Delay / Jitter / Bandwidth
- Eg. video conference vs. Web surfing

Contribution:

- Different types of ants responsible for different types of traffic
- -> "colored pheromones":
  Colors correspond to traffic QoS classes

Publications & Awards

- **Google Europe Anita Borg Memorial Scholarship 2007**

- Martina Umlauft, Peter Reichl: **Getting Network Simulation Basics Right – A Note on Seed Setting Effects for the ns-2 Random Number Generator.** In Steve Powell et al (Eds.), Wireless Technology: Applications, Management, and Security, Springer, to appear.

- Martina Umlauft: **Some Thoughts on Wireless Network Modelling.** Student Poster Session, 5th IEEE International Conference on Industrial Informatics (INDIN 2007), July 23-27, 2007, Vienna, Austria.

- Martina Umlauft, Peter Reichl: **Experiences with the ns-2 Network Simulator - Explicitly Setting Seeds Considered Harmful.** Proceedings of the 6th Wireless Telecommunications Symposium (WTS 2007), April 26-28, 2007, Pomona, CA, USA.

- Martina Umlauft: **_Web Performance in a Hybrid Ad hoc Network based on UMTS_** (short paper). Proc. 14th International Conference on Telecommunication Systems - Modeling and Analysis (ICTSM 2006), October 2006, Reading, PA, USA.

- Martina Umlauft: **_Relay Devices in UMTS Networks - Effects on Application Performance_** (Poster). Proceedings of the IFIP Fifth Annual Mediterranean Ad Hoc Networking Workshop (Med-Hoc-Net 2006), June 2006, Lipari, Italy.

Andrea Schauerhuber

- schauerhuber@wit.tuwien.ac.at
- http://wit.tuwien.ac.at/people/schauerhuber

aspect**UWA**

Applying **Aspect**-Orientation to the Model-Driven Development of **U**biquitous **W**eb **A**pplications

- Supervisors:
  Prof. Gerti Kappel (Vienna University of Technology)
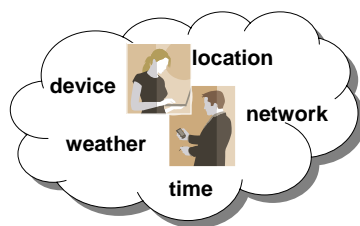 Prof. Werner Retschitzegger (Johannes Kepler University Linz)

Motivation

Ubiquitous Web Applications

- React to **the context of use**
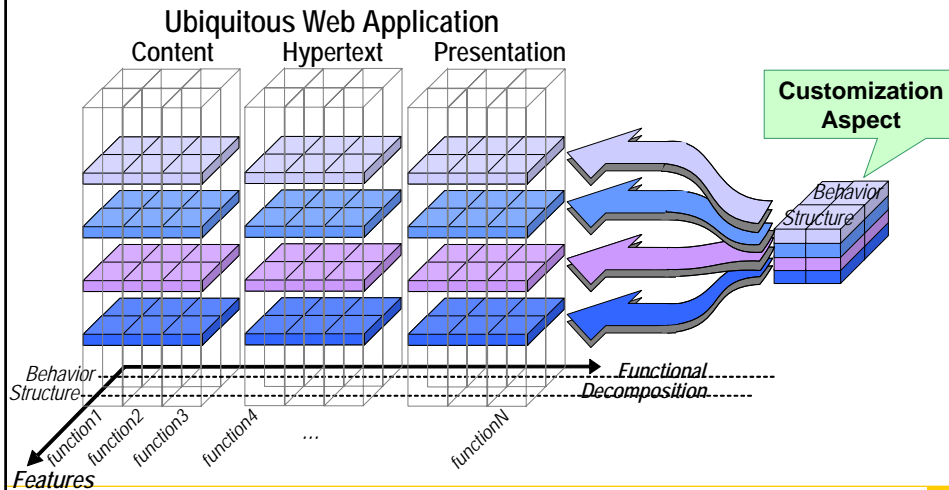
location
device
network
weather
time

- **Customization** functionality maps **context** to necessary **adaptations**

- **Problem during design:**
  - **Customization** functionality is **intermingled** with core functionality
  - **Negative effect** on: Understandability, Reusability, Maintenance

The aspectUWA Solution
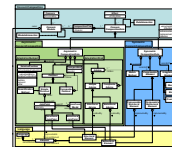*Aspect-Orientation for Modeling Customization*

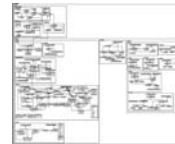---

Methodology of this Thesis

1. **Conceptual reference model** for aspect-oriented modeling
   - Framework for extending any web modeling language

2. Selection of a **web modeling language**
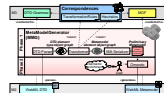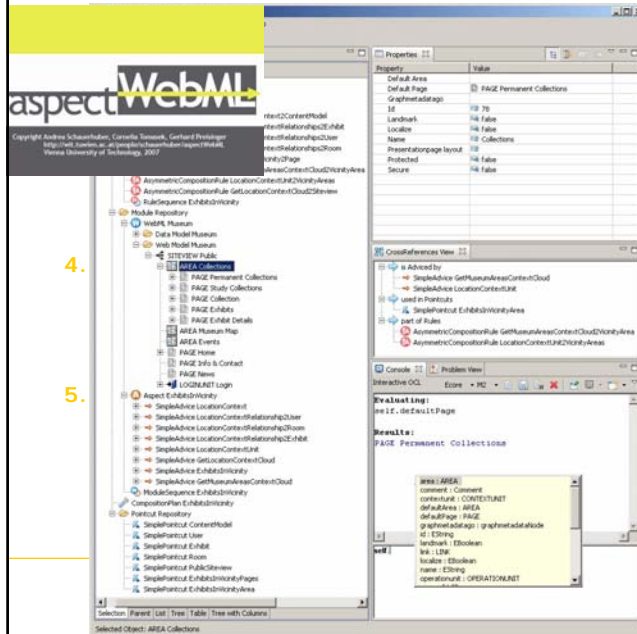   - Design of a metamodel

Contributions

Conceptual Reference Model
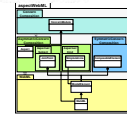
WebML Metamodel

DTD2MOF Framework

Methodology of this Thesis

Contributions

Language

aspectWebML Modeling Environment

Context-Aware Museum Case Study

Publications

Journals

1. A. Schauerhuber, M. Wimmer, E. Kapsammer, W. Schwinger, W. Retschitzegger. *Bridging WebML to Model-Driven Engineering: From DTDs to MOF.* **IET Software Journal, Vol. 1, No. 3, Institution of Engineering and Technology, June 2007.**

Workshops

2. M. Wimmer, A. Schauerhuber, M. Strommer, W. Schwinger, G. Kappel. *A Semi-automatic Approach for bridging DSLs with UML.* **7th OOPSLA Workshop on Domain-Specific Modeling, in conjunction with OOPSLA'07**, Montréal, Canada, October 2007.

3. M. Wimmer, A. Schauerhuber, W. Schwinger, and H. Kargl. *On the Integration of Web Modeling Languages: Preliminary Results and Future Challenges.* **3rd Workshop on Model-Driven Web Engineering (MDWE 2007), in conjunction with ICWE'07**, Como, Italy, July 2007.

4. A. Vallecillo, N. Koch, C. Cachero, S. Comai, P. Fraternali, I. Garrigós, J. Gómez, G. Kappel, A. Knapp, M. Matera, S. Meliá, N. Moreno, B. Pröll, T. Reiter, W. Retschitzegger, J. E. Rivera, A. Schauerhuber, W. Schwinger, M. Wimmer, G.Zhang. *MDWEnet: A Practical Approach to Achieving Interoperability of Model-Driven Web Engineering Methods.* **3rd Workshop on Model-Driven Web Engineering (MDWE 2007), in conjunction with ICWE'07**, Como, Italy, July 2007.

5. A. Schauerhuber, M. Wimmer, W. Schwinger, E. Kapsammer, W. Retschitzegger. *Aspect-Oriented Modeling of Ubiquitous Web Applications: The aspectWebML Approach.* **5th Workshop on Model-Based Development for Computer-Based Systems: Domain-Specific Approaches to Model-Based Development, in conjunction with ECBS'07**, Tucson, AZ, USA, March 2007.

6. G. Kappel, H. Kargl, G. Kramler, A. Schauerhuber, M. Seidl, M. Strommer, M. Wimmer. *Matching Metamodels with Semantic Systems - An Experience Report.* **BTW 2007 Workshop Model Management und Metadaten-Verwaltung**, Aachen, 05.03.2007 - 09.03.2007, 2007.

7. A. Schauerhuber, M. Wimmer, E. Kapsammer. *Bridging existing Web Modeling Languages to Model-Driven Engineering: A Metamodel for WebML.* **2nd Workshop on Model-Driven Web Engineering (MDWE 2006), in conjunction with ICWE'06**, Stanford Linear Accelerator Center, Palo Alto, California, July 2006.

8. T. Reiter, W. Retschitzegger, A. Schauerhuber, W. Schwinger, E. Kapsammer. *Enabling API-based Tool Integration through Aspect-Orientation.* **2nd Workshop on Models and Aspects, in conjunction with ECOOP'06**, Nantes, France, July 2006.

9. A. Schauerhuber, W. Schwinger, E. Kapsammer, W. Retschitzegger, M. Wimmer. *Towards a Common Reference Architecture for Aspect-Oriented Modeling.* **8th International Workshop on Aspect-Oriented Modeling, in conjunction with AOSD'06**, Bonn, Germany, March, 2006.

Posters & PhD Proposals

10. A. Schauerhuber. *aspectUWA: Applying Aspect-Orientation to the Model-Driven Development of Ubiquitous Web Applications.* **Student Extravaganza, AOSD'06**, Bonn, Germany, March, 2006. (PhD Proposal)

11. A. Schauerhuber. *aspectUWA: Applying Aspect-Orientation to the Model-Driven Development of Ubiquitous Web Applications.* **Student Extravaganza: Poster Event, AOSD'06**, Bonn, Germany, March, 2006.

Technical Reports

12. A. Schauerhuber, W. Schwinger, E. Kapsammer, W. Retschitzegger, M. Wimmer, G. Kappel. *A Survey on Aspect-Oriented Modeling Approaches.* Technical Report, Vienna University of Technology, October 2007

13. A. Schauerhuber, W. Schwinger, W. Retschitzegger, M. Wimmer, G. Kappel. *A Survey on Web Modeling Approaches for Ubiquitous Web Applications.* Technical Report, Vienna University of Technology, October 2007.

14. M. Wimmer, A Schauerhuber, M. Strommer, J. Flandorfer, W. Schwinger, G. Kappel. *How Web 2.0 can leverage Model Engineering in Practice.* Technical Report, Vienna University of Technology, 2007.

15. M. Wimmer, A. Schauerhuber, E. Kapsammer, G. Kramler. *From Document Type Definitions to Metamodels: The WebML Case Study.* Technical Report, Vienna University of Technology, March 2006.

16. W. Schwinger, Ch. Grün, B. Pröll, W. Retschitzegger, A. Schauerhuber. *Context-awareness in Mobile Tourism Guides - A Comprehensive Survey*, Technical Report, Vienna University of Technology, July 2005.

Sabine Graf

- graf@wit.tuwien.ac.at
- http://wit.tuwien.ac.at/people/graf

Adaptivity in Learning Management Systems focussing on Learning Styles

- Supervisors:
    Prof. Kinshuk (Athabasca University, Canada)
    Prof. Gerti Kappel (Vienna University of Technology, Austria)

Why shall we provide adaptivity in technology enhanced learning?

- Learners have different needs and characteristics

- Adaptivity increases the learning progress, leads to better performance, and makes learning easier

- Learning Styles (Felder-Silverman)
  - Active/Reflective
  - Sensing/Intuitive
  - Visual/Verbal
  - Sequential/Global

Comparison of Adaptive Systems and Learning Management Systems

Adaptive Systems

+ provide adaptivity
- lack in supporting teachers needs
- not so commonly used

Learning Management Systems

+ are commonly and successfully used
+ support teachers in creating and managing online courses
- Provide only little or, in most cases, no adaptivity

Research Issues

■ How to incorporate learning styles in LMS?

- How to identify learning styles?
- How to improve the detection process of learning styles by the use of additional sources?
- How to provide adaptivity based on learning styles in LMS?
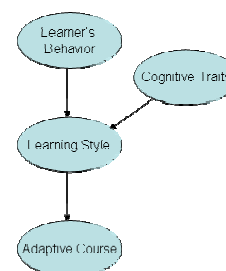
■ General aims
- Developing a concept for LMS in general
- Implementing and evaluating the concept by the use of a prototype (Moodle)
- Teachers should have as little as possible additional effort

LMS = Learning Management System

How to identify learning styles?

- **By questionnaires**
  - Motivate students to fill it out
  - Non-intentional influences
  - Can be done only once
- **By looking at the students behaviour and actions**
  - Advantages
    - Can be done automatically → no additional effort for students
    - Can be updated frequently → higher fault-tolerance
  - Problem/Challenge:
    - Get enough reliable information to build a robust student model

How to identify learning styles based on the behaviour of learners?

- **Preceding study**
  Do students with different learning styles really behave differently in LMS?
- **Main Study**
  - Determining relevant patterns of behaviour
  - Building a model for inferring learning styles from the behaviour
    - Data-driven approach
    - Literature-based approach
  - Evaluation
    - 75 participants
    - Compared the difference between results from the questionnaire, the data-driven approach, and the literature-based approach

Results

- Correctly detected learning styles:

	act/ref	sen/int	vis/ver	seq/glo
data-driven	62.50%	65.00%	68.75%	66.25%
literature-based	**79.33%**	**77.33%**	**76.67%**	**73.33%**

- Literature-based approach → suitable instrument for identifying learning styles

- Developed a stand-alone tool for identifying learning styles in LMS applying on the literature-based approach

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Improving the detection of learning styles by using information from cognitive traits

- Investigated the relationship between learning styles and cognitive traits (working memory capacity) in order to get more information
- Comprehensive literature review
  → Indirect relationships between learning styles and WMC
- Exploratory Study with 39 students
  → Promising results (correlations were found)
- Main Study with 225 students
  → Relationship were discovered between WMC and active/reflective, sensing/intuitive and visual/verbal dimension

WMC = Working Memory Capacity

How to provide adaptive courses in LMS?

- Aimed at developing a concept which enables LMS to automatically generate adaptive courses
- Incorporates only common types of learning objects
  - Content
  - Outlines
  - Conclusions
  - Examples
  - Self-assessment tests
  - Exercises
- Adaptation Features
  - Number and position of types of learning objects

Evaluation of the Concept

- 437 participants
- Randomly assigned to 3 groups:
  - Courses that fit to the students' learning styles (matched group)
  - Courses that do not fit to the students' learning styles (mismatched group)
  - Standard course which includes all learning objects (standard group)
- Procedure
  - Students filled out a learning style questionnaire
  - Adaptive course is automatically generated and presented
  - Students were nevertheless able to access all learning objects and take a different learning path

Results

- Matched Group:

    less time (32%) and equal grades

- Mismatched Group:

    ask more often for additional

    learning objects

→ Demonstrates positive effect of adaptivity

Conclusions

- Adaptivity is an important issue for supporting learners

- Extending LMS by combining the advantages of LMS and adaptive systems leads to a more supportive learning environment for learners

Selected Publications

Refereed Journal Publications
- Sabine Graf, Taiyu Lin, and Kinshuk (accepted). **The relationship between learning styles and cognitive traits - Getting addtional information for improving student modelling**. International Journal on Computers in Human Behavior.
- Sabine Graf, Silvia R. Viola, Kinshuk, and Tommaso Leo (2007). **In-depth Analysis of the Felder-Silverman Learning Style Dimensions**. Journal of Research on Technology in Education, Vol. 40, No. 1, pp. 79-93.
- Dunwei Wen, Sabine Graf, Chung Hsien Lan, Terry Anderson, Kinshuk, Ken Dickson (2007). **Supporting Web-based Learning through Adaptive Assessment**. FormaMente Journal, Vol. 2, No. 1-2, pp. 45-79.
- Silvia R. Viola, Sabine Graf, Kinshuk, and Tommaso Leo (2007). **Investigating Relationships within the Index of Learning Styles: A Data-Driven Approach**. International Journal of Interactive Technology and Smart Education, Vol. 4, No. 1, pp. 7-18.

Book Chapters
- Sabine Graf and Kinshuk (accepted). **Learner Modelling Through Analyzing Cognitive Skills and Learning Styles**. In H. H. Adelsberger, Kinshuk, J. M. Pawlowski, D. Sampson, International Handbook on Information Technologies for Learning, Education and Training (2nd edition), Springer.
- Sabine Graf and Kinshuk (accepted). **Analysing the Behaviour of Students in Learning Management Systems with respect to Learning Styles**. In M. Wallace, M. Angelides, P. Mylonas, Springer Series on Studies in Computational Intelligence.
- Sabine Graf and Kinshuk (accepted). **Technologies linking learning, cognition and instruction**. In J. M. Spector, M. D. Merrill, J. J. G. van Merrienboer, & M. P. Driscoll, Handbook of Research on Educational Communications and Technology (3rd edition).

Refereed Conference Publications
- Sabine Graf, Taiyu Lin, and Kinshuk (2007). **Analysing the Relationship between Learning Styles and Cognitive Traits**, Proceedings of the IEEE International Conference on Advanced Learning Technologies (ICALT 2007), Niigata, Japan, July 2007, pp. 235-239. *
- Sabine Graf and Kinshuk (2007). **Providing Adaptive Courses in Learning Management Systems with Respect to Learning Styles**, *Proceedings of the World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education (eLearn 2007)*, Quebec City, Canada, October 2007.
- Sabine Graf, Silvia Rita Viola, Kinshuk (2007). **Automatic Student Modelling for Detecting Learning Style Preferences in Learning Management Systems**. Proceedings of the IADIS International Conference on Cognition and Exploratory Learning in Digital Age (CELDA 2007), Algarve, Portugal, December 2007.
- Sabine Graf and Kinshuk (2006). **An Approach for Detecting Learning Styles in Learning Management Systems**. Proceedings of the IEEE International Conference on Advances Learning Technologies (ICALT 06), Kerkrade, Netherlands, July 2006, pp. 161-163

* "Best Paper Award" winning paper