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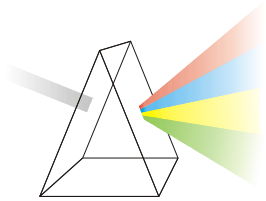
Summer School in Trento



Trento, June 19-30 2006

# Overview on Engineering Issues in Ubiquitous Web Applications

## CUSTOMIZATION



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Department of Telecooperation

## Outline of the Module 2/1

### Modeling of Ubiquitous Web applications

- Motivation
- Customization
- Excuse: Supporting person with disabilities
- Excuse: Linzer Mobile Guide
- Design space of Customization

### The UWA Approach to Customization

- Customization Architecture
- Context Models
- Customization Rules
- Customization Example
- Tool Support

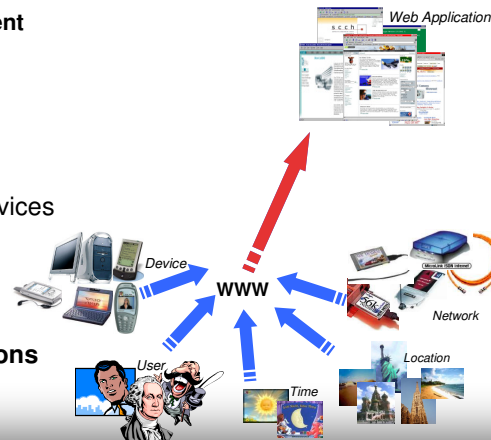
## Motivation

### Demand for Ubiquitous Web Applications

- executed in a **web-based environment**
- complex** systems
- characterized by **hypermedia & traditional application logic**
- interactive transactional systems**
- allow for ubiquitous access to services  
**anytime / anywhere / anymedia**

### Pivotal

- accessibility **despite of restrictions**
- best quality** of service



## Motivation

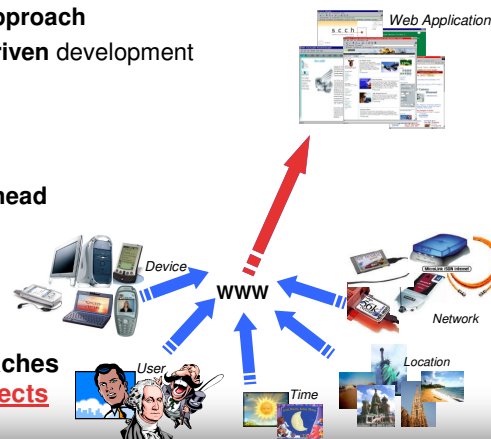
### Current development of Ubiquitous Web Applications:

- ad-hoc implementation**
- non systematic disciplined approach**
- tool-driven and technology-driven development**

### Consequently:

- high costs**
- unsatisfied requirements**
- increased maintenance overhead**
- disregarding full potential of ubiquity**

**Modelling is important**  
**but existing modelling approaches**  
**fall short in considering all aspects**  
**of UWAs**

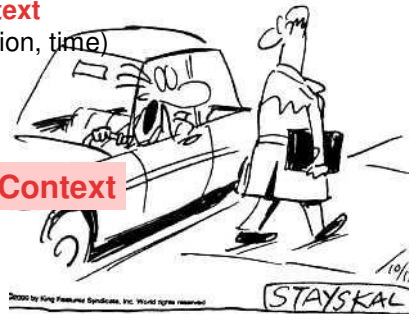


## Motivation

- ❑ Ubiquitous Web Applications:
  - have to be **"aware"** of their **context** (e.g.: device, network, user, location, time)
  - have to **adapt** accordingly

**Customisation = Adaptation to Context**

- ❑ Enables to **exploit the possibilities of ubiquity**:
  - **personalised services**
  - **location-based services**
  - **device-optimised service**



"Excuse me ... could you tell my car's navigational system how to get to Bucknell and Smith Road?"

## Goals of Customization

- ❑ **Goals of Customization**:
  - **increasing the user value** of the applications
    - each particular user is provided with a **specific added value**
    - e.g. **personalization**: give me just the information I am interested in
  - ➔ **"semantic enhancement"**
  - **keeping the user value equivalent across despite restrictions of the context of usage**
    - the user's value is **maintained despite constraints** in the environment
    - e.g. **multi-delivery**: give me the news information regardless whether I use my PC or a smart phone
  - ➔ **"semantic equivalence"**

## Outline of the Module 2/1

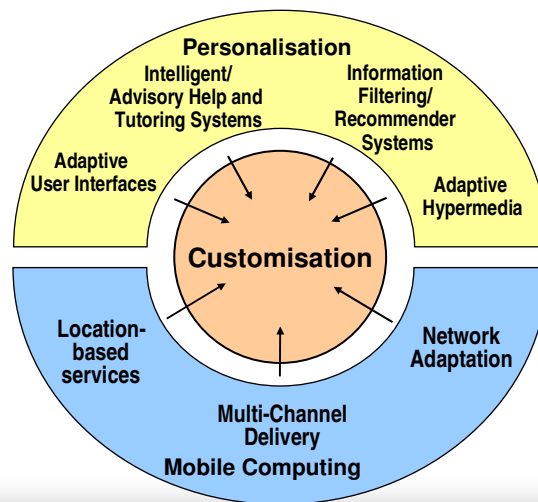
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## Customization: Where does it come from?





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### Adaptive user interfaces

cf., e.g., . D. Good, J. A. Whiteside, D. R. Wixon, S. J. Jones, "Building a User-Derived Interface", *Communications of the ACM (CACM)*, Vol. 27, No. 10, October 1984.

### Intelligent or advisory user interfaces

cf., e.g., J. M. Carroll, and A. P. Aaronson, "Learning by Doing With Simulated Intelligent Help", *Communications of the ACM (CACM)*, Vol. 31, No. 9, September 1988.

### Information filtering and recommender systems

cf., e.g., M. Loeb, D. Terry, "Information Filtering", *Communications of the ACM (CACM)*, Vol. 35, No. 12, Dec. 1992 and C. Avery, and R. Zeckhauser, "Recommender Systems for Evaluating Computer Messages", *Communications of the ACM (CACM)*, Vol. 40, No. 3, March 1997.

### Adaptive hypertext and hypermedia

cf., e.g., P. Brusilovsky, "Adaptive Hypermedia: An Attempt to Analyse and Generalize", *Multimedia, Hypermedia, and Virtual Reality: Models, Systems, and Applications*, P. Brusilovsky, P. Kommers, and N. Streitz (eds.), Springer. Berlin, 1996.



## Customization: Where does it come from?

### Location-based Services

cf., e.g., R. Oppermann, and M. Specht, "A Nomadic Information System for Adaptive Exhibition Guidance", *Proc. of the International Conference on Hypermedia and Interactivity in Museums (ICHIM)*, D. Bearman and J. Trant (eds.), Washington, September 1999

### Multi-channel Delivery

cf., e.g., J. Eisenstein, J. Vanderdonckt, A. Puerta: "Applying Model-Based Techniques to the Development of UIs for Mobile Computers", Fifth International Conference on Intelligent User Interfaces (IUI), ACM Press, pp. 69-76., 2001.

cf., e.g., R. Mohan, J. R. Smith, C-S. Li: "Adapting Multimedia Internet Content for Universal Access", *IEEE Trans. on Multimedia*, Vol. 1, No. 1, March 1999, pp. 104-114.

### Network Adaptation

cf., e.g., B. Badrinath, A. Fox, L. Kleinrock, G. Popek, P. Reiher, M. Satyanarayanan, "A conceptual framework for network and client adaptation", *IEEE Mobile Networks and Applications (MONET)*, Vol. 5 No. 4, pp 221-231, 2000.



## Context

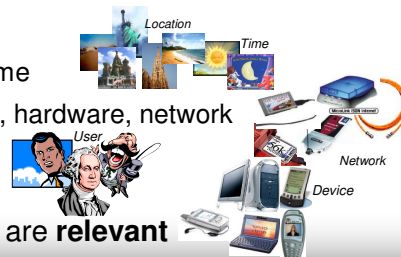
### What is Context?

#### □ "Situation of Use"

- **Sensed** from the environment:  
e.g.: temperature, pressure, GPS-position
- Explicitly given information in terms of "**profiles**":  
e.g.: user profile, device profile, network profile

#### □ Relevant Information:

- **Natural context:** e.g.: location, time
- **Technical context:** e.g.: browser, hardware, network application
- **Social context:** e.g.: user



#### □ Certain situations in the context are **relevant**



## Adaptation

### What is Adaptation?

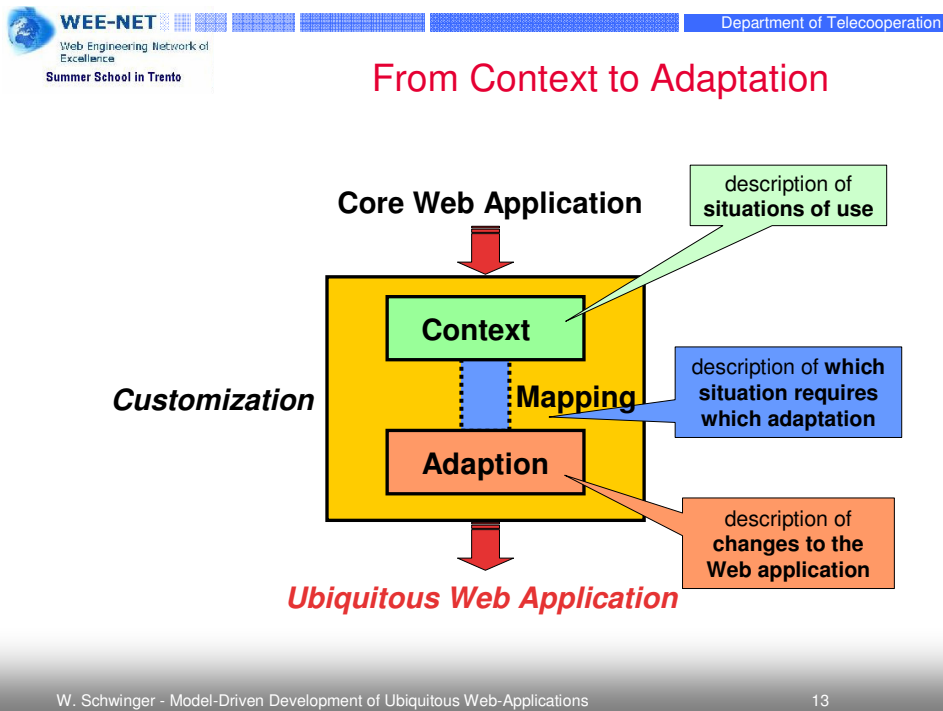
#### □ Responsible for appropriate "**changes**" of the Web application to reflect the context

#### □ Examples:

- **Consider current location** in a car navigation system when directing a driver
- **Personalize the explanations in an eLearning application** to reflect the pre-knowledge of a student
- **Delete pictures** from a web page **when displayed on a mobile phone**

or even:

- **Design** a on-site **personalized** guided tour for tourist using **various devices** (combining a series of different adaptations)



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- ## Goals of Customization
- ❑ **Applications of Customization**
    - **Adaptive personalization:**
      - user preferences captured in form of profiles along with dynamic observation of the user to tailor the Web application towards the needs of the user.
    - **Functional needs:**
      - applications may depend on the context data, like of example location aware city maps
    - **Exception handling:**
      - critical events may require proper reaction being performed.
    - **Interaction-enabling functionalities:**
      - context could consider handicaps or physical disabilities of user to enable these users to properly interact.
    - **Enhanced effectiveness:**
      - the overall effectiveness can be significantly enhanced by means of context-aware extensions.
- W. Schwinger - Model-Driven Development of Ubiquitous Web-Applications 14

## Goals of Customization

### □ Types of Context-ness

- **Context-aware:**
  - the Web application's **functional value is increased** by context information but also the Web applications also functions reasonably without additional context information (e.g. sorting of list of restaurants with respect to user preferences)
- **Context-dependent:**
  - the Web application **can only function** when a certain context is available (e.g. location aware city guide)
- **Context-bound:**
  - the Web application's functionality **is only available** in a certain context either due to physical restrictions (e.g. access point available) or logical restrictions (e.g. certain access rights)
- **Context-enabled:**
  - the Web application **only makes sense** if context information is available (e.g. navigation system)

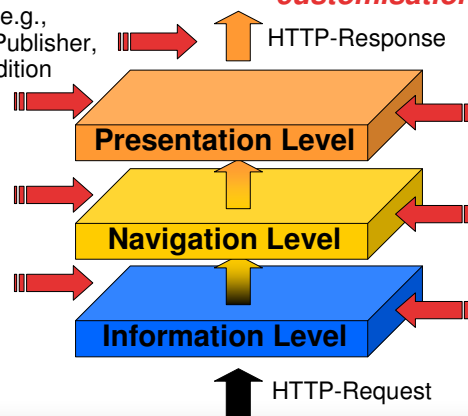
## Where does Customisation take place?

### External (proxy-based) Customisation

most approaches, e.g.,  
IBM Transcoding Publisher,  
Oracle Wireless Edition

➤ *Is the application customisation-aware or not?*

Inter-Level Customisation  
▪ e.g., WebML



Intra-Level Customisation  
▪ e.g., OOHDM,  
WUML



## The Problem

### Users with Special Needs

#### Impairments

- Visual → Disorders in the functions of the eye ranging from reduced capability of sight, color-blindness to total disability to see (e.g., cataracts or retinal detachment)
- Physical → Disorders in the musculoskeletal condition having impact on the coordination of movement, movement accuracy, grip power, etc. up to the state of not being able to use hands or feet at all willingly (e.g., cerebral palsy or rheumatism)
- Hearing → Disorders in perceiving audio, ranging from problems in understanding normal conversations to complete deafness (e.g., high or low tone hearing loss).
- Speech → Disorders manifested by significant difficulties in the acquisition and use of listening, speaking, writing, reading, reasoning, or mathematical abilities.
- Learning → Disorders of language, articulation, fluency, or voice which interfere with communication.



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## The Problem

### Home Environment



### Various equipment:

- > lights
- > telephone
- > TV-sets
- > VCRs
- > Motor-driven bed
- > Shades

### Various functions:

- > on/off
- > play, pause, stop
- > forward/backward
- > up/down
- > programming VCR
- > use TV text service

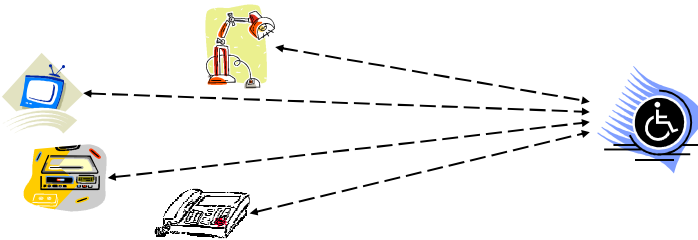
### Various interaction styles:

- > buttons
- > knob
- > wheel
- > displays

## The Problem

### Home Environment

### Users with Special Needs



Disabled persons need to interact with their home environment

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## The Problem

Home Environment      Users with Special Needs

mismatch between:

equipment's capabilities      abilities of persons (motion, recognition, and perception)

**!** currently, human need to adapt to the machine

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## The Problem

**but, the machine should adapt to the human!**

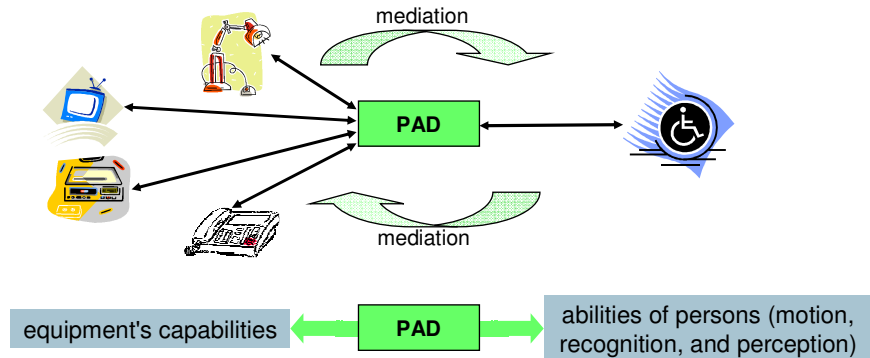
- **Personal Assisting Device (PAD)**
  - can be used to interface with the home environment
  - takes into account the users capabilities
  - may help to overcome impairments:
    - **visual:** zoom utility, text readers, Braille output
    - **physical:** controlling motor devices
    - **hearing:** audio-2-text converters, visual indicators
    - **learning:** simplified interfaces
    - **speech:** text-2-speech output

PAD

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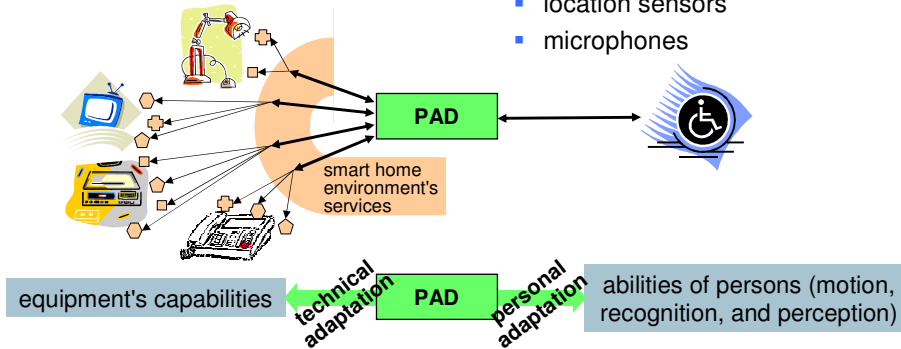
## The Problem

- **Personal Assisting Device (PAD) mediates between the user and the home environment**



## The Problem

- **Prerequisite:**
  - technical interoperability of the home equipment with the PAD
  - considering users capabilities
- Pervasive computing paves the way for **smart home environments:**
  - networked sensors and actuators
  - location sensors
  - microphones



Prerequisite for intelligent **adaptation**, in terms of **customization**, is **contextual information**



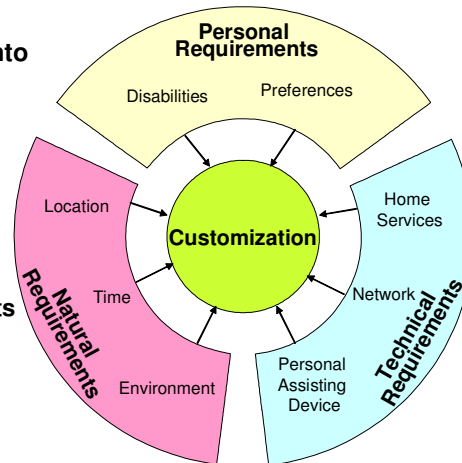
## Requirements for Assisting Persons with Special Needs

### Customization has to taken into account:

- personal requirements
- technical requirements
- natural requirements

### Smart home environment's services shall:

- **adapt to these requirements**
- **adapt more or less automatically**



## Requirements for Assisting Persons with Special Needs

### Personal Requirements

- person's disabilities
  - visual
  - physical
  - hearing
  - learning
  - speech
- person's individual preferences, e.g.
  - the preferred TV channels available via a quick list
  - the crispness of the toast produced by the toaster
  - the setting of the heating / cooling system
- explicit preferences vs. learned preferences, e.g.:
  - getting the morning news before having day's first coffee
  - having the shades pulled down and the light dimmed before starting a night TV session
- convenience vs. vital importance
  - e.g. an emergency number which can be easily accessed
- stable vs. change frequently / evolve constantly over time

➔ degree depends on individual



➔ important to **keep the user in control!**



## Requirements for Assisting Persons with Special Needs

### Technical Requirements

- Personal Assisting Device
  - specialized towards the person's disabilities:
  - certain abilities: various I/O-modes (e.g., visual, audio, Braille output)
  - certain restrictions: battery power, memory, CPU speed, etc.
- home services
  - different functionality
  - different content, presentation and handling options
  - fundamentally different functionalities (microwave oven vs. motor-adjustable bed)
  - comparable functionalities (like play, pause and skip) - may be treated as a group of services
- network
  - various networking technology means employed
  - some home equipment may require **broadband** WLAN connection, for, e.g., streaming multimedia to the PAD
  - others, like sensors, may encounter a less **small bandwidth and inaccuracy of transmission**



## Requirements for Assisting Persons with Special Needs

### Natural Requirements

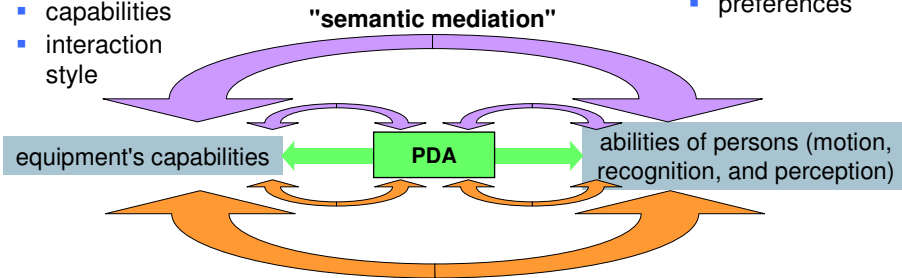
- location
  - mobility of the user
  - location-aware services
  - various location tracking technologies exist:
    - physical contact
    - RFID chips
    - Signal triangulation
- time
  - services scheduled automatically
- environment
  - room temperature for the heating/cooling system
  - sunlight for setting the brightness of a display
  - background noise for adjusting the volume of the home entertainment system
  - etc.





## Bridging by Customization

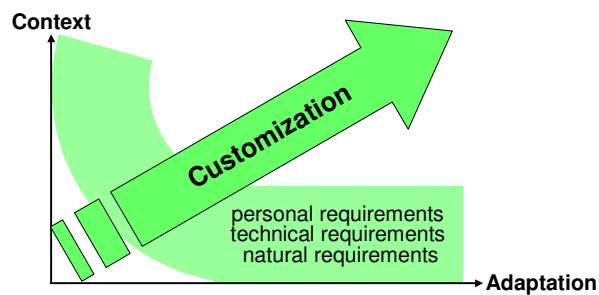
- processes
- intentions
- services
- functional dependencies
- goals
- capabilities
- limitations
- preferences
- interaction style



- "operational mediation" by customization**
- sensors
  - actuators
  - physical spaces
  - profile information
  - reduction effects
  - transcoding effects
  - enhancement effects
  - I/O devices
  - presentation modes
  - PDA capabilities



## Customization Issues



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#### Excuse: Linzer Mobile Guide

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## LiMoG

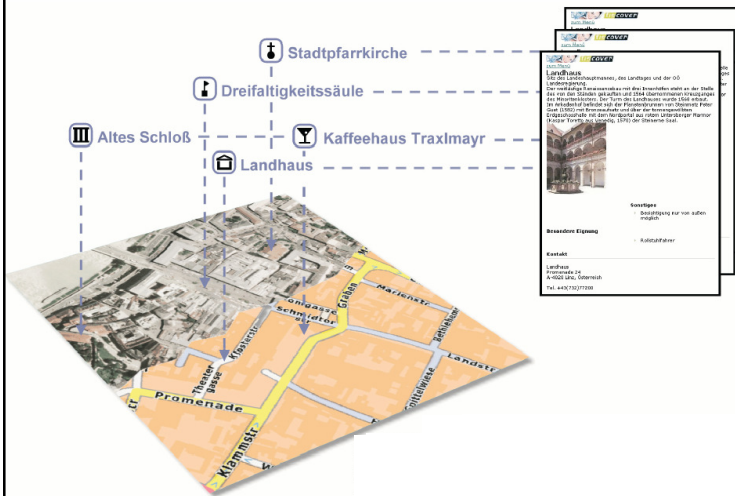
### LiMoG - Linzer Mobile Guide

- Based on web-browser
- GPS-sensor for location information
- Map from OÖ map service (cf. [www.doris.ooe.gv.at](http://www.doris.ooe.gv.at))
- Point of interest information for Tiscover ([www.tiscover.at](http://www.tiscover.at)) system
- **Functions:**
  - display different categories of points of interest
  - get detailed information
  - zooming, panning
  - find buddy
  - guestbook

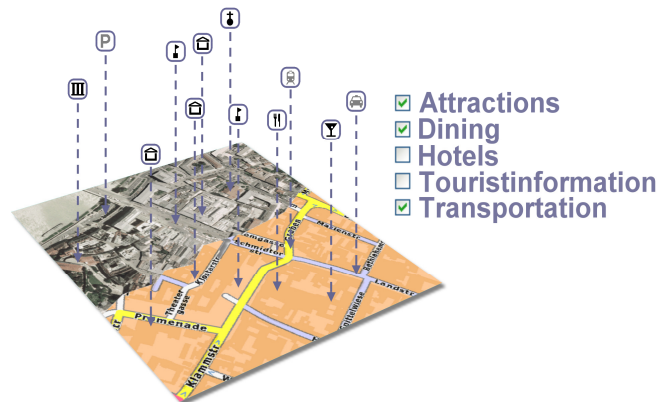




## LIMOG - TIScover Connection



## Thematic Overlays



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## Proximity Search

The diagram illustrates a proximity search mechanism. On the left, a 3D map shows a city street grid with several yellow circular search radiuses centered on specific points. Dashed lines connect these points to a search interface on the right. The interface features a magnifying glass icon with a question mark inside, and three concentric circles representing search radii of 50 m, 100 m, and 200 m.

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## Location - Content - GuestBook

The diagram shows the integration of location, content, and a guestbook. On the left is a map screen showing a street view with labels like 'Rathausgasse' and 'Pfarrgasse'. In the center is an information screen titled 'Dreifaltigkeitssäule' with text describing the monument and a small image. On the right is a guestbook screen titled 'Dreifaltigkeitssäule:' with a date 'FREITAG 22 JULY 2005' and two entries: 'Nice City' and 'Visit to Linz'. Yellow arrows indicate the flow of information from the map to the information screen, and from the information screen to the guestbook screen. Below the screens are three colored arrows pointing right, labeled 'Map Screen', 'Information Screen', and 'Guestbook Screen'.

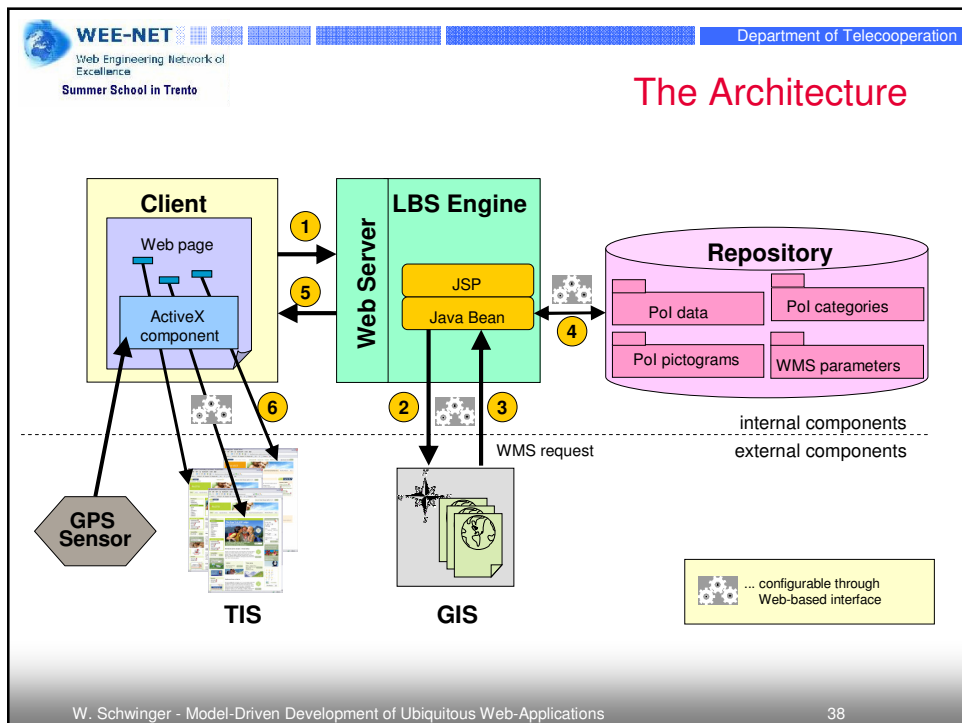
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## Mapping Location Information to Content

- 1: Choose POI Category
- 2: Set Location of POI
- 3: Enter POI specific data
- 4: Browse to TIS Web Page
- 5: Link TIS to GIS
- 6: Submit POI

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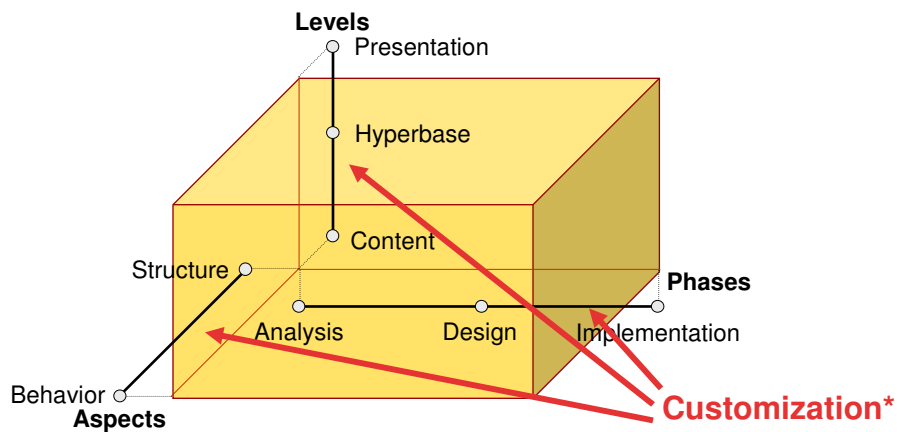
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## Customization as New Modeling Dimension



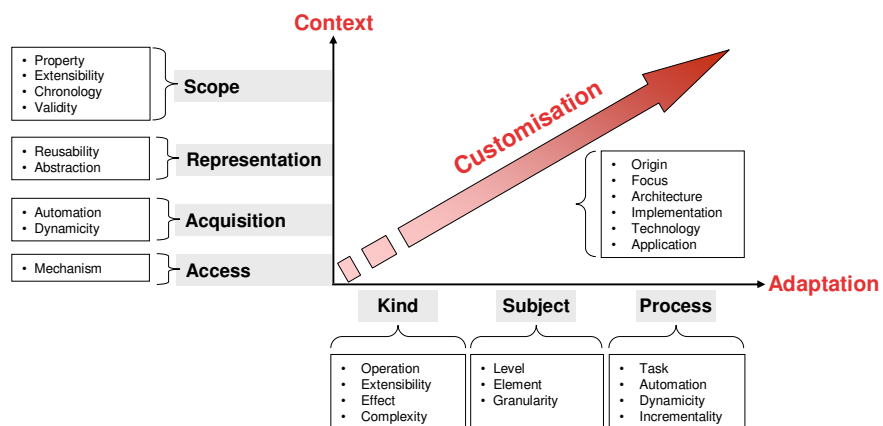
\* Kappel Gerti, Pröll Birgit, Retschitzegger Werner, Schwinger Wieland: "Customisation for Ubiquitous Web Applications - A Comparison of Approaches", International Journal of Web Engineering and Technology (IJWET), Inderscience Publishers, viewg, January 2003.

## Customization in all its Dimensions

### □ Customization needs to be considered in all its dimensions:

- Dynamically **personalization** along with **mobile computing** context
- **Extensibility** to introduce new context information (open for new context like temperature, battery level etc.)
- Combination of **context situations**
- **Separation** between current context and profile information required
- Necessity to enable **customization at all three levels**
- Integration of **micro and macro adaptation** seamlessly
- Demand for **dynamic customization** additionally to static customization

## Design Space of Customisation





## Context

### Kind of Context

- ❑ **Property:** aspects of the context which are relevant
  - **Natural context:** location time
  - **Technical context:** device, browser, network bandwidth, application itself
  - **Social context:** user, user groups
  
- ❑ **Genericity:** how generic certain context information is
  - **Application specific:** only needed for a particular web application only
  - **Application independent / generic:** applies for a series of applications
    - **External source / third party provider:** information is available outside the application



## Context

### Subject of Context

- ❑ **Time Span:** for which time span the context is considered
  - **Current context:** context at the time of the request, e.g.: current user
  - **Historical context:** previous context, e.g.: previously visited locations
  - **Future context:** prediction of future context, e.g.: prediction of throughput
  
- ❑ **Abstraction:** at which level the context information is considered
  - **Physical context:** can be directly sensed for the environment, e.g.: cellID
  - **Logical context:** additional explicit information, e.g.: street name



## Context Quality of Context

- ❑ **Automation:** how automatic the context information is considered
  - **Automatic:** context information is collected automatically, e.g.: usage analysis
  - **Manual:** explicitly given information, e.g.: user specifies his/her preferences
  - **Semi-automatic:** combination of automatic and manual
- ❑ **Availability:** how unavailability of context information is treated
  - **Default context:** a default is assumed, e.g.: user's ID is not available assume default user
  - **Provide context manually:** query for the context, e.g.: if the current location is not available, prompt the user
  - **Denial of the service:** service won't work without the context, e.g.: "service only available for registered users"



## Context Quality of Context

- ❑ **Dynamicity:** how frequently the context is considered
  - **Static:** determined once at application start up, e.g.: the device used to select the appropriate interaction style
  - **Dynamic:** determined during runtime, e.g.: the bandwidth to adapt the resolution accordingly
- ❑ **Validity:** how valid the context information is
  - Context properties may not be valid during the complete period until they are sensed again, e.g.: if the location information doesn't change within a certain period, the device might not be online any longer, thus the location information might no longer be valid



## Adaptation Kind of Adaptation

- ❑ **Effect:** what is the effect of the adaptation
  - **Enhance:** adding to the service, e.g.: displaying personalised ads
  - **Reduce:** removing certain parts of the service, e.g.: disabling video sequences
  - **Transform:** combination of enhancement and reduction, e.g.: showing a textual description instead of a road map
- ❑ **Complexity:** atomicity of the adaptation
  - **Atomic:** is performed as a whole, e.g.: disabling a picture
  - **Composed:** combination of a series of adaptations, e.g.: showing a textual description instead of a road map is composed of the removal of the road map and the presentation of the textual description
- ❑ **Genericity:** reusability of adaptation
  - **Application specific:** just meaningful for a certain web application
  - **Generic:** independent of the actual web application



## Adaptation Subject of Adaptation

- ❑ **Application level:** which levels are adapted
  - **Content level:** domain dependent data, e.g.: discount calculation
  - **Hyperbase level:** logical composition of the hypertext and access structures, e.g.: guided tour navigation rather than free navigation
  - **Presentation level:** layout to each page, e.g.: use adequate grey scale representation for colour blind
- ❑ **Application element:** which elements are adapted
  - **Elements of content, hyperbase, and presentation level:** e.g.: like pages, links, access structures, input fields, lists
- ❑ **Granularity:** which level of detail the adaptation is applied
  - **Micro adaptation:** fine-grained adaptation effecting a single element, e.g.: disable a single link
  - **Macro adaptation:** large parts are adapted effecting multiple application elements, e.g.: change from a screen oriented presentation to a print oriented presentation
- ❑ **Abstraction:** which level of abstraction the adaptation addresses
  - **Type level:** adaptation through schema evolution, e.g.: removing attributes
  - **Instance level:** certain instances are adapted, e.g.: filtering certain restaurants complying with the user's price category





## Adaptation Subject of Adaptation

- ❑ **Dynamicity:** how frequently the context is considered
  - **Static:** results of adaptation are already defined at design time, e.g.: two predefined version of an image with high and low resolution intended for a desktop computer and a handheld, respectively
  - **Dynamic:** results of adaptation are generated during runtime, e.g.: adapting an image according to bandwidth during runtime
  
- ❑ **Automation:** how automatic the adaptation is
  - **Automatic:** the user cannot take influence on the adaptation
  - **Manual:** the user decides which adaptation to apply
  - **Semi-automatic:** combination of automatic and manual



## Adaptation Quality of Adaptation

- ❑ **Visibility:** to whom the adaptation is visible
  - **Globally:** all users within the same session perceive the adaptation
  - **Group of users:** a certain group of users perceive the adaptation, e.g.: authorized users
  - **Individual users:** adaptation is perceivable only for an individual user, e.g.: regarding personal preferences
  
- ❑ **Reusability:** how the adaptation can be reused
  - **From scratch:** adaptation is done on bases of the original (non-adapted) version, e.g.: transforming a video to a series of picture scenes needs to be conducted from the original video
  - **Incrementally:** subsequent adaptations are conducted on bases of the previously adapted version, e.g.: continuously adaptation towards the user's usage habits

## Customisation

- Semantic value:** in which way the semantics are effected
  - **Enhance:** customisation realises a better service, e.g.: location-awareness and personalisation
  - **Reduce:** customisation produces a reduced service, e.g.: restriction for non-authorized user
  - **Preserve:** maintain the service, e.g.: throughout the restricted capabilities of devices
- Initiation:** which point in time the customisation is initiated
  - **Immediate:** initiated each time a change in the context is detected independently of any user's request , e.g.: pre-generation
  - **Deferred:** not before a user request for a certain page, e.g. on demand
  - **Periodic:** customisation is triggered periodically

## Adaptation Operations Classification Criteria

- Kind of Adaptation**
  - **Effect:** enhancement, reduction, increase
  - **Complexity:** atomic, composed
  - **Genericity:** generic, application-specific

		Adaptation Operation		
		<code>enableEntity ()</code>	<code>removeLink ()</code>	<code>setCollectionFilter ()</code>
Kind of Adaptation	Effect	enhancement	reduction	reduction
	Complexity	atomic	atomic	atomic
	Genericity	generic	generic	generic

## Adaptation Operations Classification Criteria

### □ Subject of Adaptation

- **Design Level:** Information Design, Navigation Design, Presentation Design, Operation Design
- **Model Element:** Entity, Link, Collection, Semantic Association, ...
- **Granularity:** micro adaptation, macro adaptation
- **Abstraction:** type level, instance level

		Adaptation Operation		
		<code>enableEntity ()</code>	<code>removeLink ()</code>	<code>setCollectionFilter ()</code>
Subject of Adaptation	Design Level	Information Design	Navigation Design	Navigation Design
	Model Element	Entity	Link	Collection
	Granularity	micro adaptation	micro adaptation	micro adaptation
	Abstraction	type level	type level	instance level

## Adaptation Operations Classification Criteria

### □ Quality of Adaptation

- **Dynamicity:** static, dynamic
- **Automation:** automatic, semi-automatic, manual
- **Visibility:** global, user, user group, session
- **Reusability:** incremental, from scratch

		Adaptation Operation		
		<code>enableEntity ()</code>	<code>removeLink ()</code>	<code>setCollectionFilter ()</code>
Quality of Adaptation	Dynamicity	static	static	dynamic
	Automation	automatic	automatic	automatic
	Visibility	global to session	global to session	global to session
	Reusability	incremental	incremental	from scratch

## Adaptation Operations Taxonomy (Still Unordered)

### Adaptation operations found in existing approaches:

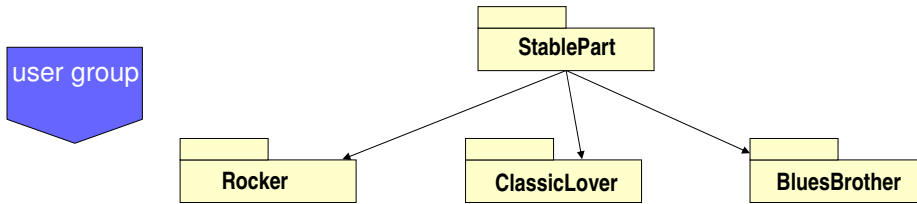
- chgPresentationMarkupLanguage (HTML, WML, XHTML, etc.)
- chg(Within)MediaType (Text, Image, Audio, Video)
- chgSize (image), chgResolution (image)
- chgLanguage (English, German, Italian, etc.)
- chgCurrency (ATS, ITL, EUR, etc.)
- chgDiscount (numericValue)
- chgNavigation, chgTable2BulletList, chgImage2Link
- compress, summariseText, preFetchData, execute
- recommend, compose, filter, sort, reduce, split, replace
- enable/show/add vs.disable/hide/remove (link, page, image, etc.)

## Customization Requirements Customizability

<b>Context</b>	<b>static</b>	<i>Definition</i>	The context situations in which the Web application is used is known at design time. The applications are designed to function as seperated applications.
		<i>Example</i>	The context of a tourist information system is either Web or WAP. Either the Web Application is used in the Web-context or it is used in the Wap-context. (context: non-changing)
	<b>dynamic</b>	<i>Definition</i>	The context situation evolves during run-time.
		<i>Example</i>	The history of previous visited pages is evolving during run-times. (context: changing)
<b>Adaptation</b>	<b>static</b>	<i>Definition</i>	The adaption is avaiable at definition time.
		<i>Example</i>	The adapted versions – a color version and a b/w version of a picture is avaiable at definition time. (adaptation: choose)
	<b>dynamic</b>	<i>Definition</i>	The adaption is computed during run-time
		<i>Example</i>	The compression of a picture is computed during run-time by taking into account the current bandwidth available (adaptation: compute)

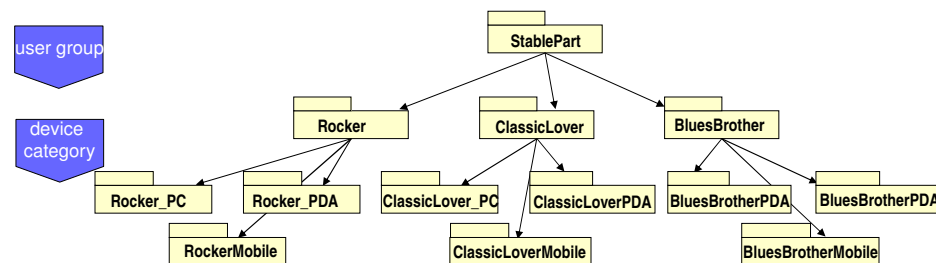
## Customisation by Static Adaptation

□ along: **user group**



## Customisation by Static Adaptation

□ along: **user group & device category**

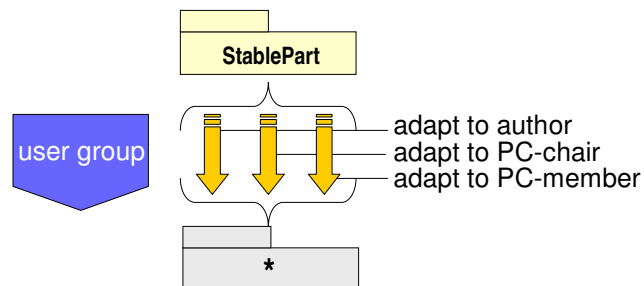


## Customisation by Static Adaptation

- Customisation by means of static adaptation
  - The designer can produce a series of statically adapted design versions with respect to a (distinguishing) context property, i. e., explicitly defining the **results of customisation**
    - e.g., making different designs for "PC\_Chair" and "Author", both encountering a very distinct application (i. e.: different information, different navigation, and different presentation)
  - Suffers from the "combinatoric explosion" problem
    - ⇒  **$n^m$  different design versions**
      - n** ... number of distinct context property values
      - m** ... number of considered context properties
- **Advantage:**
  - outcome of customisation is seen at design time
- **Disadvantage:**
  - limited number of statically adapted version

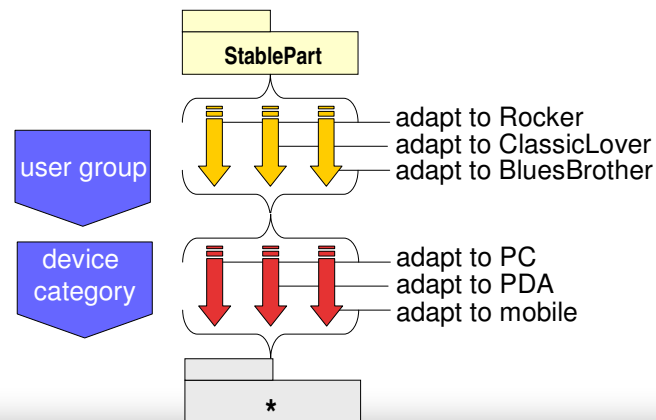
## Customisation by Dynamic Adaptation

- customisation along: **user group**



## Customisation by Dynamic Adaptation

- customisation along: **user group** & **device category**

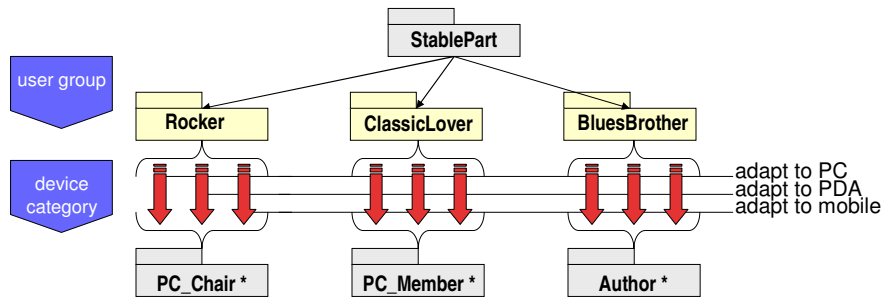


## Customisation by Dynamic Adaptation

- Customisation by means of dynamic adaptation
  - The designer specifies customisation rules which dynamically apply adaptation operations to potentially statically adapted design versions, i. e., defining **transformation process of customisation**
    - e.g. modelling a general model and just specifying the variations according to the dynamically found type of user.
  - linear growth instead of combinatory explosion  
 $\Rightarrow n * m$  **different customisation rules**
    - $n$  .... number of distinct context property values
    - $m$  ... number of considered context properties
- **Advantage**
  - required for customisation towards context properties encountering a virtually unlimited number of context property values
- **Disadvantage:**
  - outcome of customisation is not seen at design time
  - difficult to detect conflicting adaptations

## Customisation by Static and Dynamic Adaptation

- customisation along: **user group** & **device category**

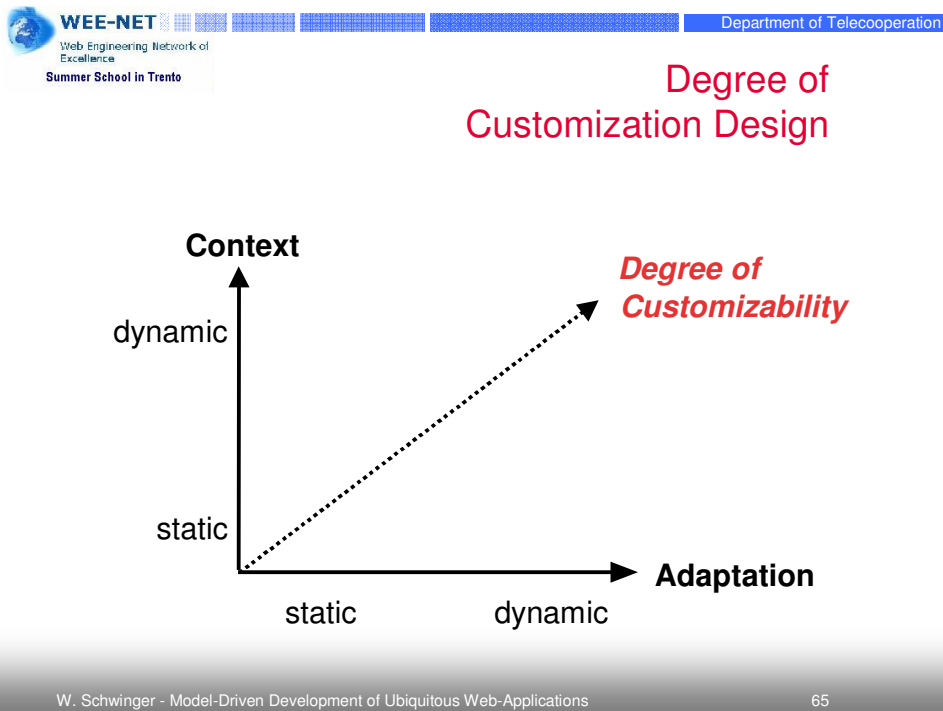


- Static and dynamic adaptation can be used **complementary**
- Statically adapted** designs should only be used for context properties requiring **"fundamentally" different designs**
- Dynamic adaptation** necessary for an **unlimited number of variations**

## Customization Requirements Customizability Examples

<b>dynamic context</b>	Present to new customers different contract condition information than to regular customer. The two <b>presented versions are static</b> whereas the decision when a customer gets into the category regular customer is of <b>dynamic context computed on bases of previous visits</b>	Compress the presented pictures on bases of a changing bandwidth rate. The <b>current bandwidth</b> is taken for to <b>compute</b> the compressed picture <b>adequately</b> .
<b>static context</b>	Model two different WebSites Presentations: one for the Web and one for the Web by actually defining the <b>two different versions at definition time</b> .	Present only those films released for children for the childrens web site. The sites are <b>seperated thus giving static context</b> . The page with the <b>list of films is computed</b> during run-time <b>by checking for</b> each film whether it is released for under-eighteen.
	<b>static adaptation</b>	<b>dynamic adaptation</b>





- WEE-NET Web Engineering Network of Excellence Summer School in Trento Department of Telecooperation
- ## Take Home Message
- 1** Exploiting the full potential of Ubiquitous Web applications requires proper modelling!
  - 2** Development of Ubiquitous Web applications is more than a simple if-clause!
  - 3** Customization is a mechanism to realise Ubiquitous Web applications
  - 4** Customization = adaptation to context
- W. Schwinger - Model-Driven Development of Ubiquitous Web-Applications 66



# Thank you for your attention!



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