Industrial Experience: *building* *a Web Portal Product Line* *using* *a Lightweight, Reactive Approach*

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Overview

- **Introduction**
  - Challenges & Opportunities of Web Engineering
  - Product Lines
- **Web Portal Product Journey**
  - Conventional Starting Point - Portal Overview
  - Conventional Starting Point - Design
  - Reuse Goals and Benefits
- **The XVCL Approach**
  - Introduction to XVCL & Design of Web Portal Architecture
- **Results and Experiences**
- **Conclusions**

Challenges of Web Engineering

Web Applications play increasingly important role in businesses:

- Fuzzy, often changing requirements
- Tight development and maintenance schedules
- Growing complexity of Web Applications:
  - Web Sites ➔ Web Portals ➔ full-blown Business Enterprise Applications
- Web technologies change and multiply fast:
  - Constant evolution of web technologies (J2EE, .NET, etc)
  - Conventional methods and processes must be adjusted to meet the realities of the Web engineering

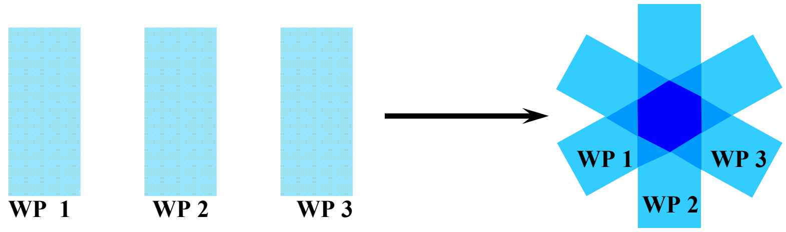
Where are the opportunities?

- **Much Similarities across Web Applications**
- **Capturing and benefiting on similarities**

- **Web technologies supporting the above:**
  - ASP, JSP, PHP
  - J2EE, .NET
  - Design patterns
  - General OO and component concepts
  - …
  - XVCL

A Web Portal Product Line

A WP Product Line is a family of similar WPs



- Understand what’s similar and what’s different among WPs
- Manage WPs from a common base of reusable code
  (called a product line architecture)

Objectives of the PL approach

Apply reuse techniques in order to:

- Reduce the system development cost
- Reduce time to the market
- Simplify maintenance
- Expand range of products and address new market segments

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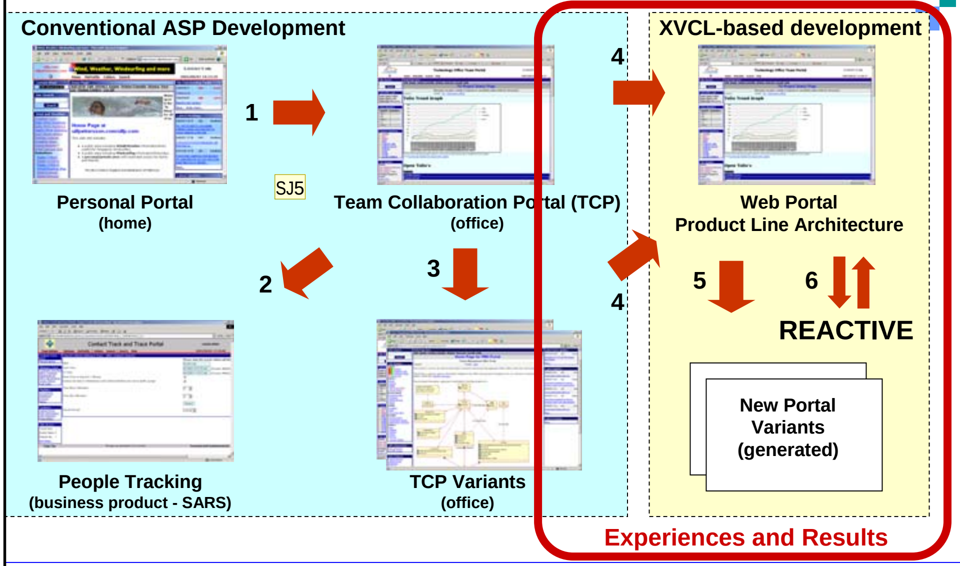
Conventional Starting Point



Conventional ASP Development

XVCL-based development

1

SJ5

2

3

4

4

5

6

Personal Portal
(home)

Team Collaboration Portal (TCP)
(office)

People Tracking
(business product - SARS)

TCP Variants
(office)

Web Portal
Product Line Architecture

REACTIVE

New Portal
Variants
(generated)

Experiences and Results

Slide 8

SJ5 indicate WPs

- used internaly at ST Electronics
- business products (SARS)

Stan Jarzabek, 8/8/2005

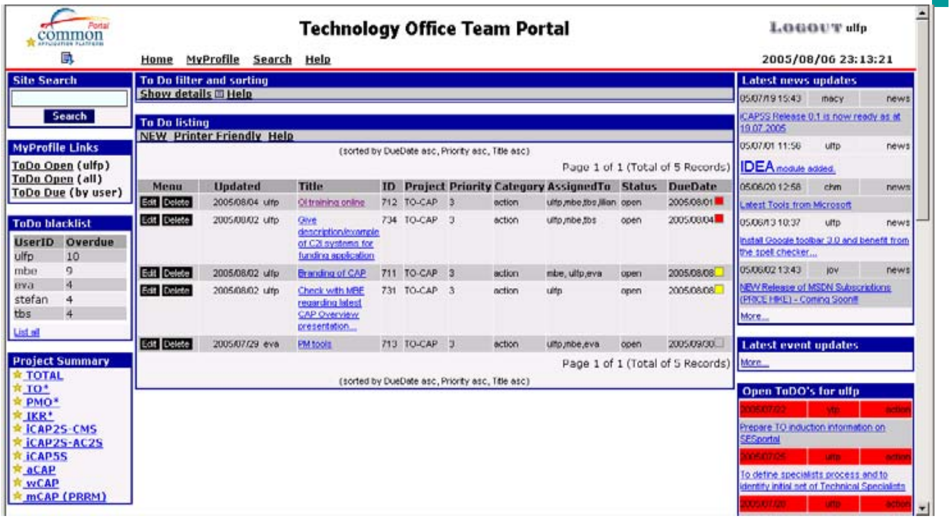
Team Collaboration Portal - Overview

A Web Portal for supporting a Team&Project-based work environment.

Has elements of:

- Web portal
- Simple content management
- Simple workflow support
- Collaboration environment

Team Collaboration Portal – GUI



Technology Office Team Portal

LOGOUT ulfp

Home MyProfile Search Help

2005/08/06 23:13:21

Site Search

Search

MyProfile Links

ToDo Open (ulfp)
ToDo Open (all)
ToDo Due (by user)

ToDo blacklist

UserID	Overdue
ulfp	10
mbe	9
eva	4
stefan	4
tbs	4

List all

Project Summary

- TOTAL
- TO*
- PMO*
- IKR*
- iCAP2S-CMS
- iCAP2S-AC2S
- iCAP5S
- aCAP
- wCAP
- mCAP (PRRM)

To Do filter and sorting

Show details ▣ Help

To Do listing

NEW Printer Friendly Help

(sorted by DueDate asc, Priority asc, Title asc)

Page 1 of 1 (Total of 5 Records)

Menu	Updated	Title	ID	Project	Priority	Category	AssignedTo	Status	DueDate
Edit Delete	2005/08/04 ulfp	OI training online	712	TO-CAP	3	action	ulfp,mbe,tbs,lilian	open	2005/08/01 🟥
Edit Delete	2005/08/02 ulfp	Give description/example of C2I systems for funding application	734	TO-CAP	3	action	ulfp,mbe,tbs	open	2005/08/04 🟥
Edit Delete	2005/08/02 ulfp	Branding of CAP	711	TO-CAP	3	action	mbe, ulfp,eva	open	2005/08/08 🟨
Edit Delete	2005/08/02 ulfp	Check with MBE regarding latest CAP Overview presentation...	731	TO-CAP	3	action	ulfp	open	2005/08/08 🟨
Edit Delete	2005/07/29 eva	PM tools	713	TO-CAP	3	action	ulfp,mbe,eva	open	2005/09/30 □

Page 1 of 1 (Total of 5 Records)

(sorted by DueDate asc, Priority asc, Title asc)

Latest news updates

05/07/19 15:43 macy news
iCAPSS Release 0.1 is now ready as at 19.07.2005

05/07/01 11:56 ulfp news
IDEA module added.

05/06/20 12:58 chm news
Latest Tools from Microsoft

05/06/13 10:37 ulfp news
Install Google toolbar 3.0 and benefit from the spell checker...

05/06/02 13:43 jov news
NEW Release of MSDN Subscriptions (PRICE HIKE) - Coming Soon!!

More...

Latest event updates

More...

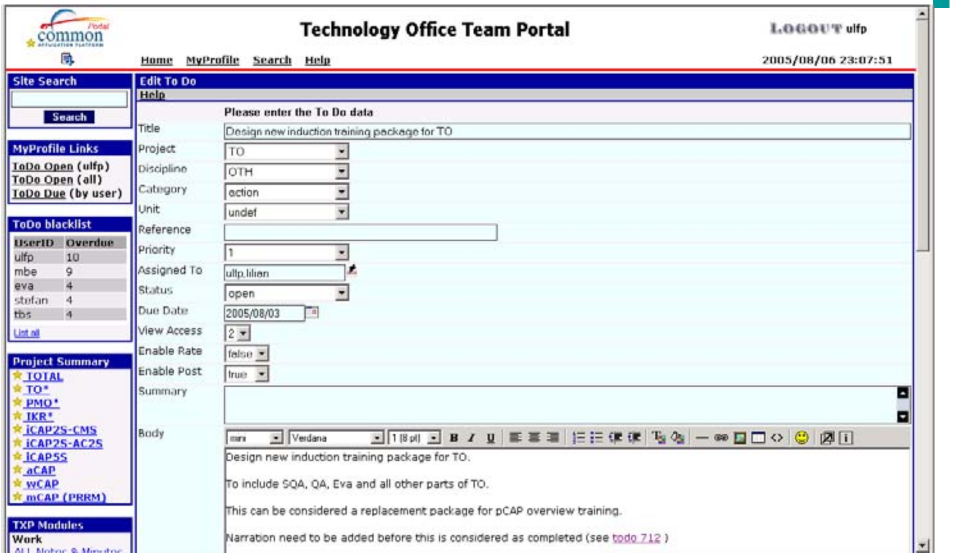
Open ToDO's for ulfp

2005/07/22 ylp action
Prepare TO induction information on SESportal

2005/07/05 ulfp action
To define specialists process and to identify initial set of Technical Specialists

2005/07/20 ulfp action

Team Collaboration Portal – GUI



Technology Office Team Portal

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- aCAP
- wCAP
- mCAP (PRRM)

TXP Modules

Work

ALL Notes & Minutes

Edit To Do

Help

Please enter the To Do data

Title	Design new induction training package for TO
Project	TO
Discipline	OTH
Category	action
Unit	undef
Reference	
Priority	1
Assigned To	ulfp,lilian
Status	open
Due Date	2005/08/03
View Access	2
Enable Rate	false
Enable Post	true
Summary	
Body	mini · Verdana · 1 (8 pt)

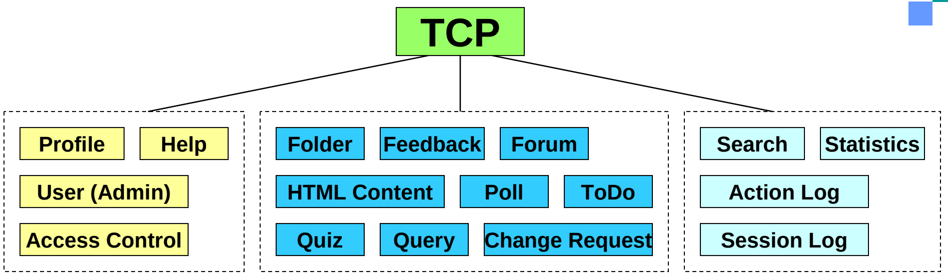
Design new induction training package for TO.

To include SQA, QA, Eva and all other parts of TO.

This can be considered a replacement package for pCAP overview training.

Narration need to be added before this is considered as completed (see todo 712)

Team Collaboration Portal – Modules



"Standard Entities"
Managed by Admin

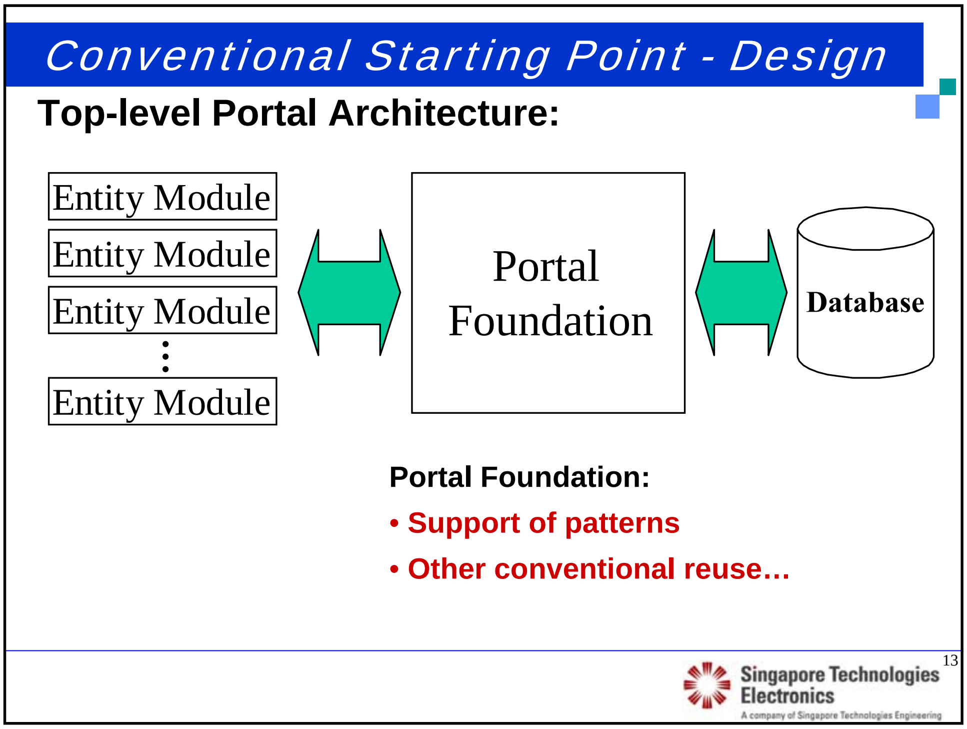
-Insert
-Update/Edit
-Delete
-Query/List/Sort
-View

"TCP Entities"
Managed by Portal Users

-Insert
-Update/Edit
-Delete
-Associate/Composite
-Query/List/Sort
-View
-Printer Friendly
-History/Versioning

"Standard Features"

-Query/List/Sort
-View



Conventional Starting Point - Design

Top-level Portal Architecture:

Entity Module

Entity Module

Entity Module

⋮

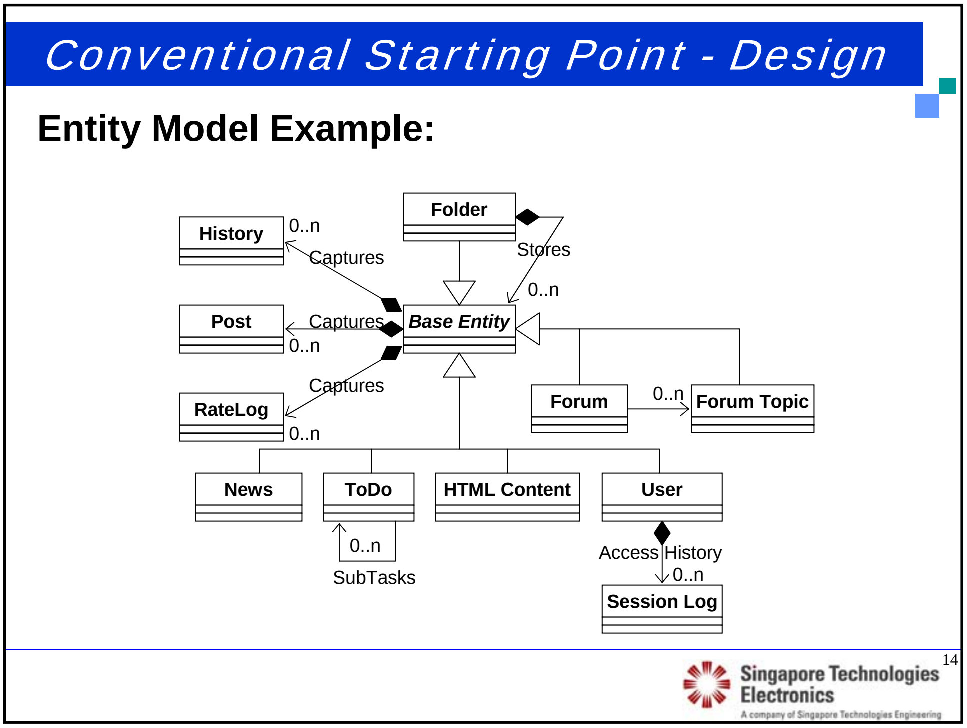
Entity Module

Portal Foundation

Database

Portal Foundation:

- **Support of patterns**
- **Other conventional reuse…**

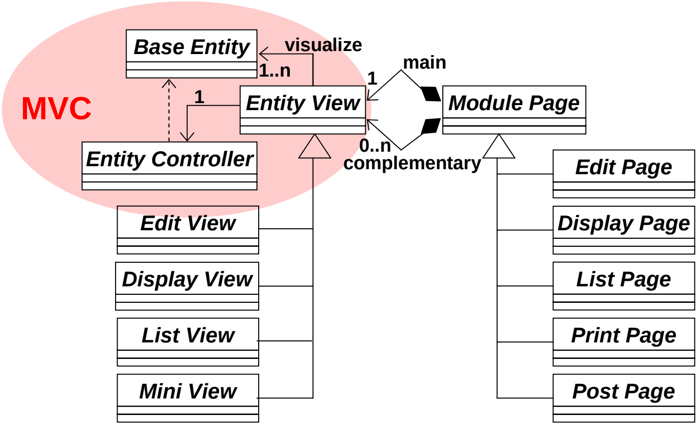


Conventional Starting Point - Design

Entity Model Example:

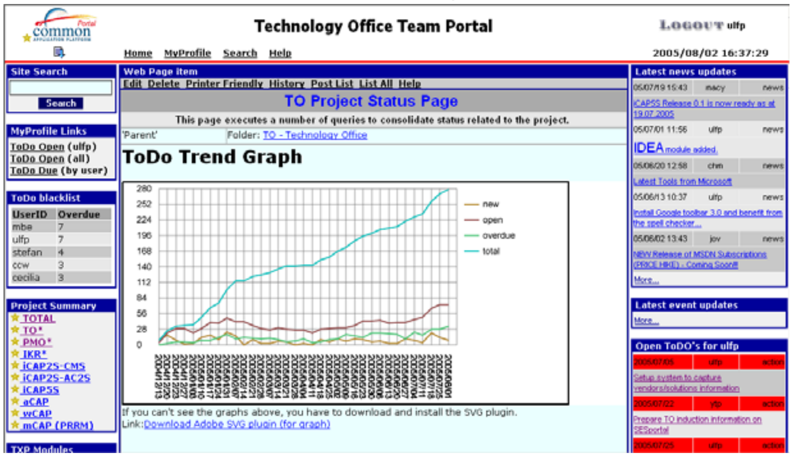
Conventional Starting Point - Design

Meta-model related to Base Entity:



Conventional Starting Point - Design

Composition of views on a page:



Technology Office Team Portal

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2005/08/02 16:37:29

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- ☆ mCAP (PRRM)

TXP Modules

Web Page item

Edit Delete Printer Friendly History Post List List All Help

TO Project Status Page

This page executes a number of queries to consolidate status related to the project.

'Parent'	Folder: TO - Technology Office

ToDo Trend Graph

If you can't see the graphs above, you have to download and install the SVG plugin.
Link:Download Adobe SVG plugin (for graph)

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More...

Latest event updates

More...

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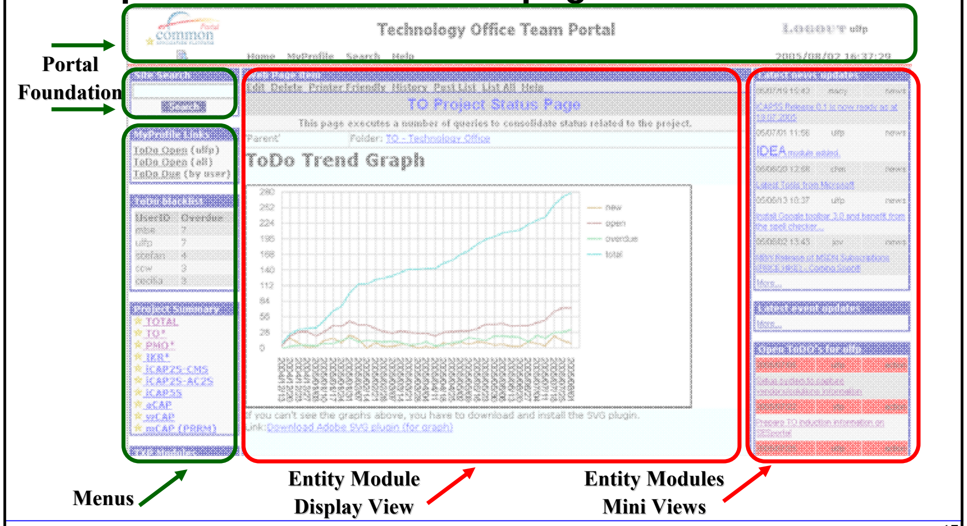
2005/07/05	ulfp	action
Setup system to capture vendors/solutions information		
2005/07/22	ytp	action
Prepare TO induction information on SESportal		
2005/07/25	ulfp	action

Conventional Starting Point - Design

Composition of views on a page:



common Portal

Technology Office Team Portal

LOGOUT ulfp

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2005/08/02 16:37:29

Site Search

MyProfile Links

ToDo Open (ulfp)
ToDo Open (all)
ToDo Due (by user)

ToDo Slackers

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cow	3
cecilia	3

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Latest news updates

IDEA module edited.

More...

Latest event updates

More...

Open ToDO's for ulfp

Portal Foundation

Menus

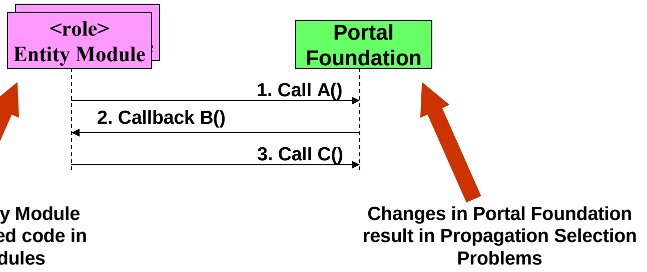
Entity Module Display View

Entity Modules Mini Views

Problems with conventional approach

Pattern-rich approach

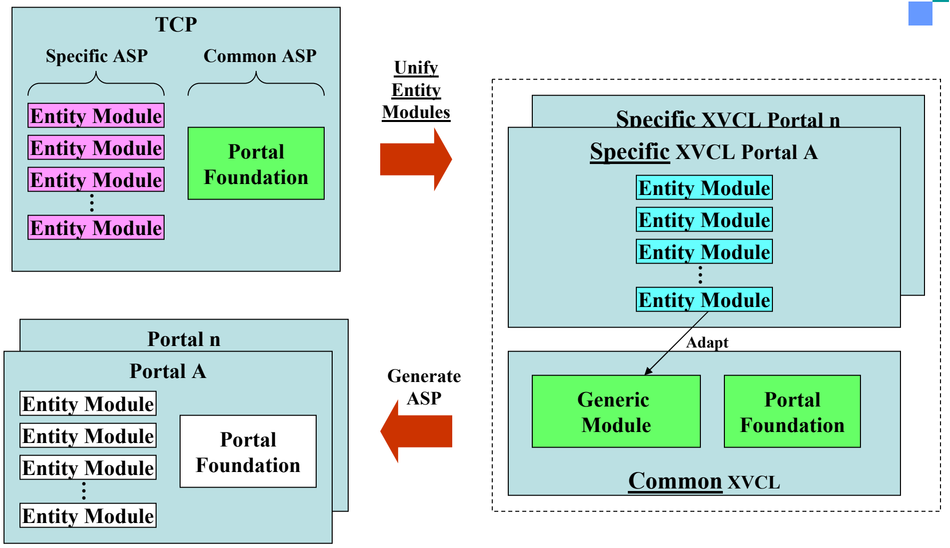
- **Reuse of Entity Modules across portals**
  - Difficult to manage selective changes and unify enhancements
    - Changes needed for a specific module but not for other modules
    - Same changes needed, but at different time
- **Enhancement to patterns**



Changes in Entity Module result in duplicated code in all Entity Modules

Changes in Portal Foundation result in Propagation Selection Problems

What we want to achieve



TCP

Specific ASP

Common ASP

Entity Module
Entity Module
Entity Module
⋮
Entity Module

Portal Foundation

Unify Entity Modules

Specific XVCL Portal n

Specific XVCL Portal A

Entity Module
Entity Module
Entity Module
⋮
Entity Module

Adapt

Generic Module

Portal Foundation

Common XVCL

Generate ASP

Portal n

Portal A

Entity Module
Entity Module
Entity Module
⋮
Entity Module

Portal Foundation

Reuse Goals

Some goals of pragmatic reuse:

- Unify similarity patterns with generic structures at all levels:
  - Unify similar portal modules with “generic module”
  - Unify other meta-model design elements:
    - Entity, Controller, Views, Pages, etc.
- Provide a mechanism to derive concrete instances from generic ones.
- Establish understanding of what is generic and what is specific.

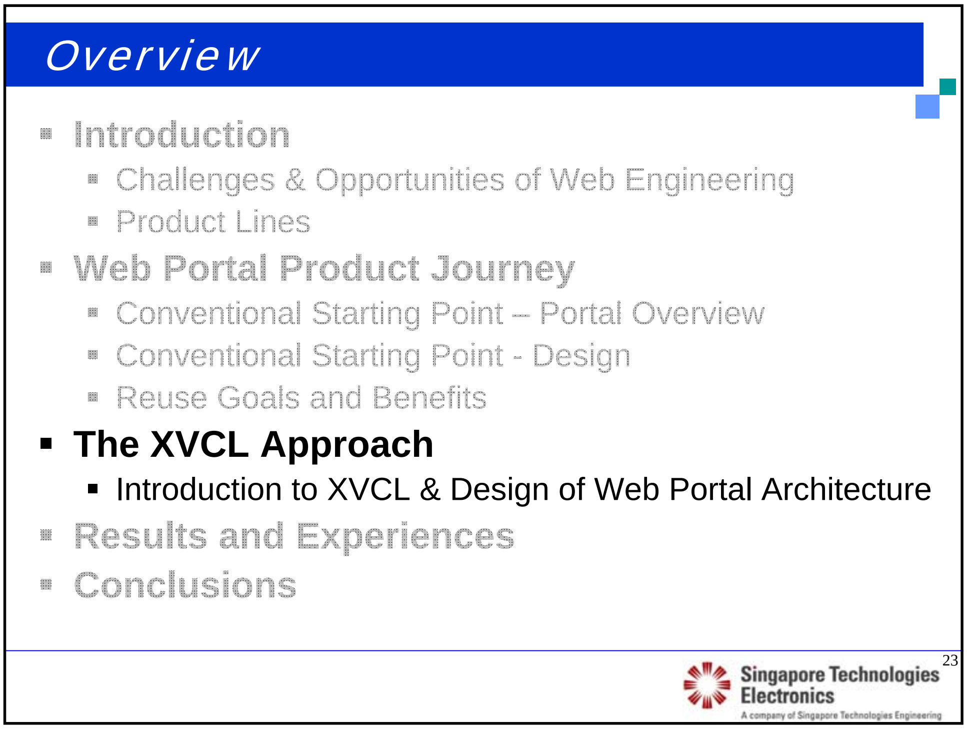
Reuse Goals

Some goals of pragmatic reuse:

- Unify similarity patterns with generic structures at all levels:
  - unify similar portal modules with “generic module”
- Unify similar views across modules with “generic views”:
  - Edit View [M], List View [M], …
  - Also applicable to Entity, Controller, Pages, etc.
- Provide a mechanism to derive concrete instances from generic ones:
  - Edit View [M] -> Edit View [User], Edit View [ToDo], ..
- Design a “generic TCP”
- Simplification and engineering benefit of unification

Expected benefits of a “generic TCP”

- **Conceptually simpler, smaller size**
- **Easier to trace the impact of changes**
  - better traceability
  - less number of modifications to implement an enhancement
  - controlled change propagation from generic to concrete instances
  - reduced risk of update anomalies
- **Uniformity of design within TCP**
- **Reuse of generic solutions**
  - within TCP
  - across portal family
- **Improved maintainability**
  - unique variations should not pollute generic code
  - clear separation of differences from similarities
  - avoiding explosion of similar components and files



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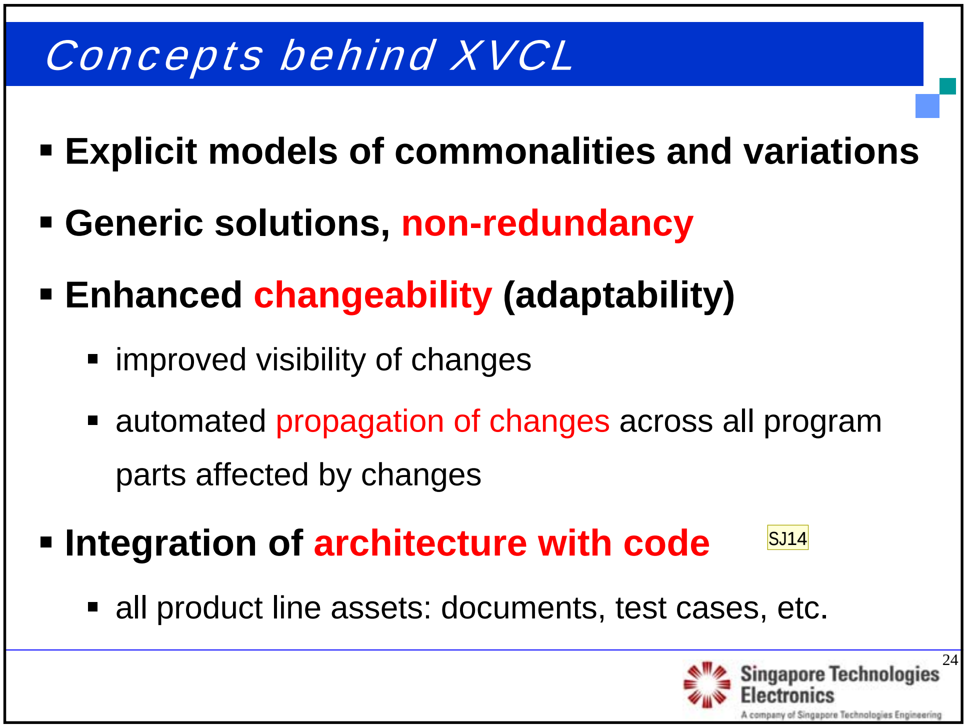


Concepts behind XVCL

- **Explicit models of commonalities and variations**
- **Generic solutions, non-redundancy**
- **Enhanced changeability (adaptability)**
  - improved visibility of changes
  - automated propagation of changes across all program parts affected by changes
- **Integration of architecture with code** SJ14
  - all product line assets: documents, test cases, etc.

Slide 24

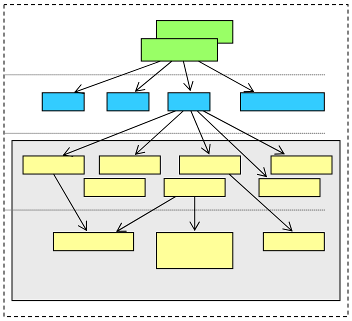
SJ14 delete?

Stan Jarzabek, 8/8/2005

XVCL concepts

an x-frame: a generic adaptable meta-component

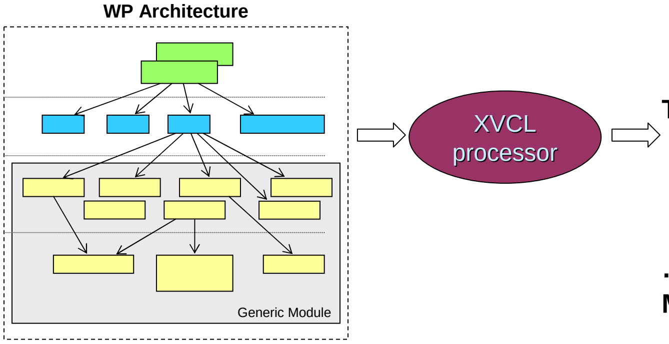
x-framework: a library of x-frames



- a product line architecture

Generation of WPs

from the WP Architecture, we generate many different WPs:



TCP:

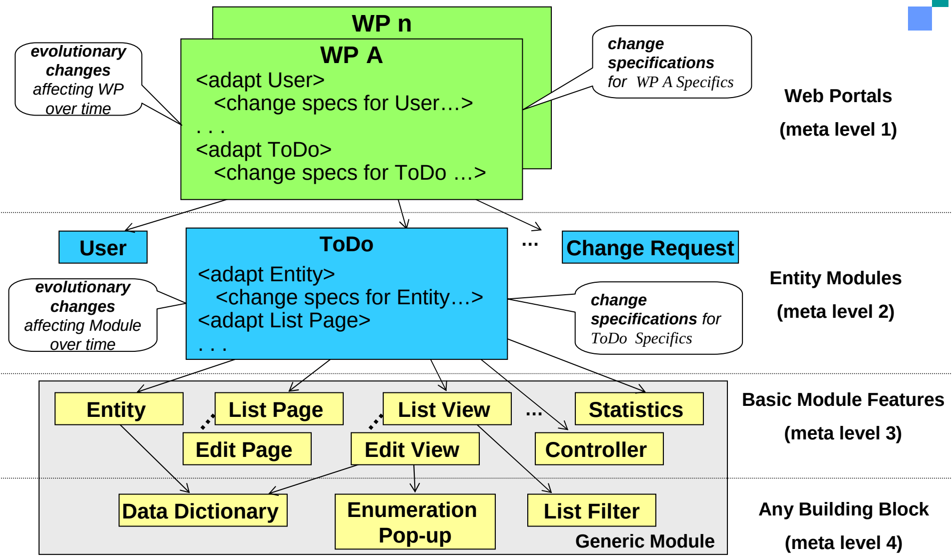
User Module
- View [User] page
- Edit [User] page
  - Edit [User] View
- …

ToDo Module
- View [ToDo] page
- Edit [ToDo] page
  - Edit [ToDo] View
- …

…

Module n

an x-framework: WP Architecture



WP n

WP A
<adapt User>
<change specs for User…>
. . .
<adapt ToDo>
<change specs for ToDo …>

evolutionary changes affecting WP over time

change specifications for WP A Specifics

Web Portals
(meta level 1)

User

ToDo
<adapt Entity>
<change specs for Entity…>
<adapt List Page>
. . .

…

Change Request

evolutionary changes affecting Module over time

change specifications for ToDo Specifics

Entity Modules
(meta level 2)

Entity

List Page

Edit Page

List View

Edit View

…

Statistics

Controller

Basic Module Features
(meta level 3)

Data Dictionary

Enumeration Pop-up

List Filter

Generic Module

Any Building Block
(meta level 4)

An x-frame in XVCL

A kind of a template

A generic building block for programs

- class, architectural element, interface def, ...

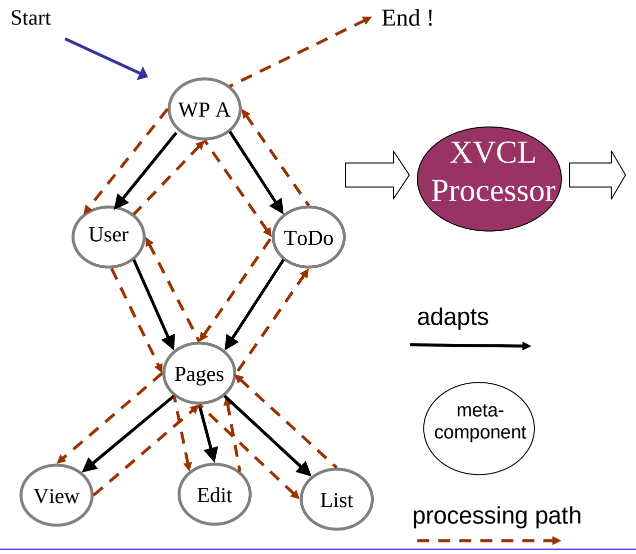
Contains parameter slots:

- values, expressions, selection, iteration, …
- other meta-components

Program generation:

- “composition with adaptation” of meta-components

Generating TCP the WP Architecture



User module

- View [User] page
- Edit [User] page
- List [User] page

ToDo module

- View [ToDo] page
- Edit [ToDo] page
- List [ToDo] page

generated classes

XVCL adaptation mechanisms

- Adaptation of x-frames at the composition point
- Generic names: variables and expressions
- Selection among many given options
- Insertions at break points
- Iteration (code generation)

ToDo

```
<adapt Entity>
    <set Name="ToDo">
    <set InheritBase = "True">
    <insert "BrkName">
      'inserted code'
```

Entity

```
Class ?@Name?
<select InheritBase>
   <case "true"> 'code for inheritance"
<break "BrkName">
  'default code
</break>
```

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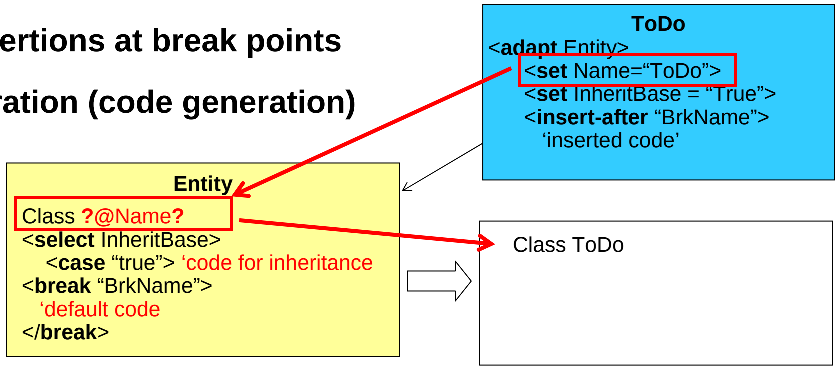

ToDo

```
<adapt Entity>
   <set Name=“ToDo”>
   <set InheritBase = “True”>
   <insert-after “BrkName”>
      ‘inserted code’
```

Entity

```
Class ?@Name?
<select InheritBase>
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```

```
Class ToDo
```

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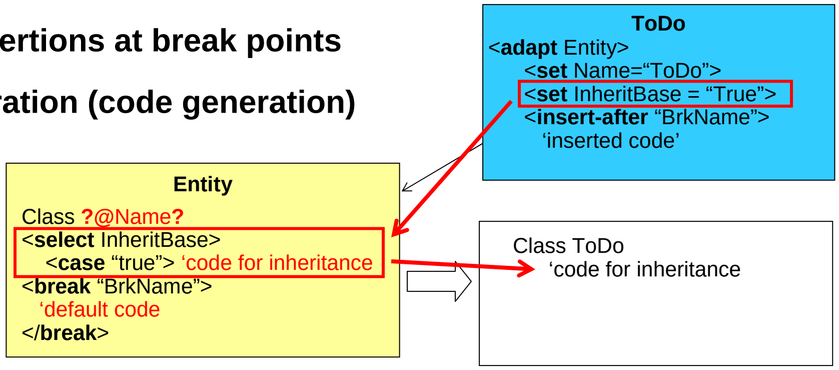

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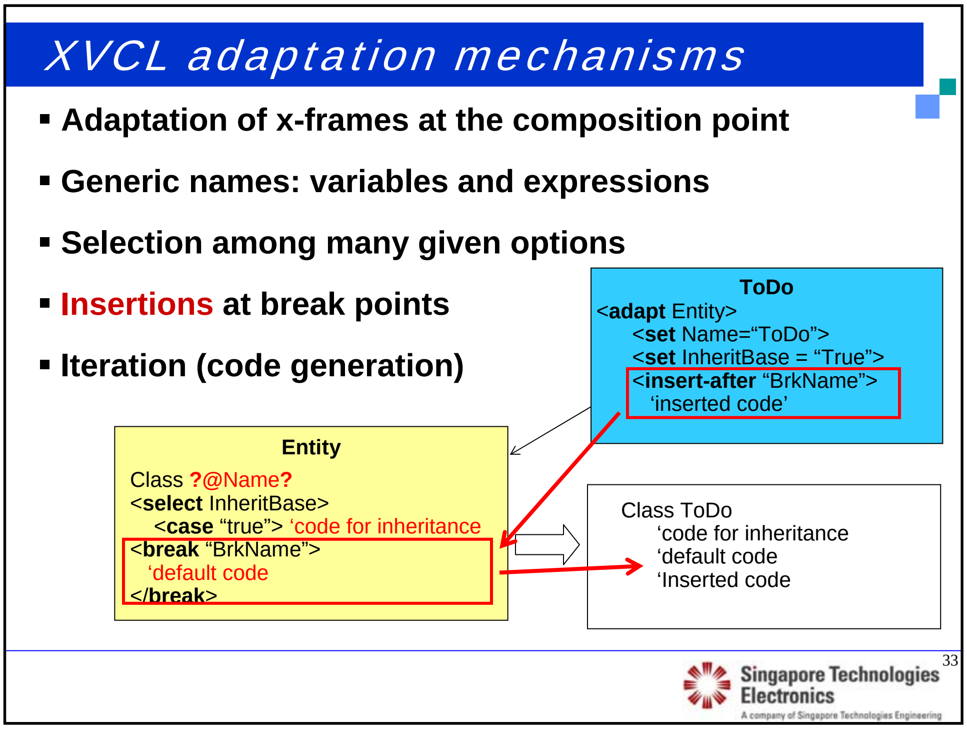

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      'default code
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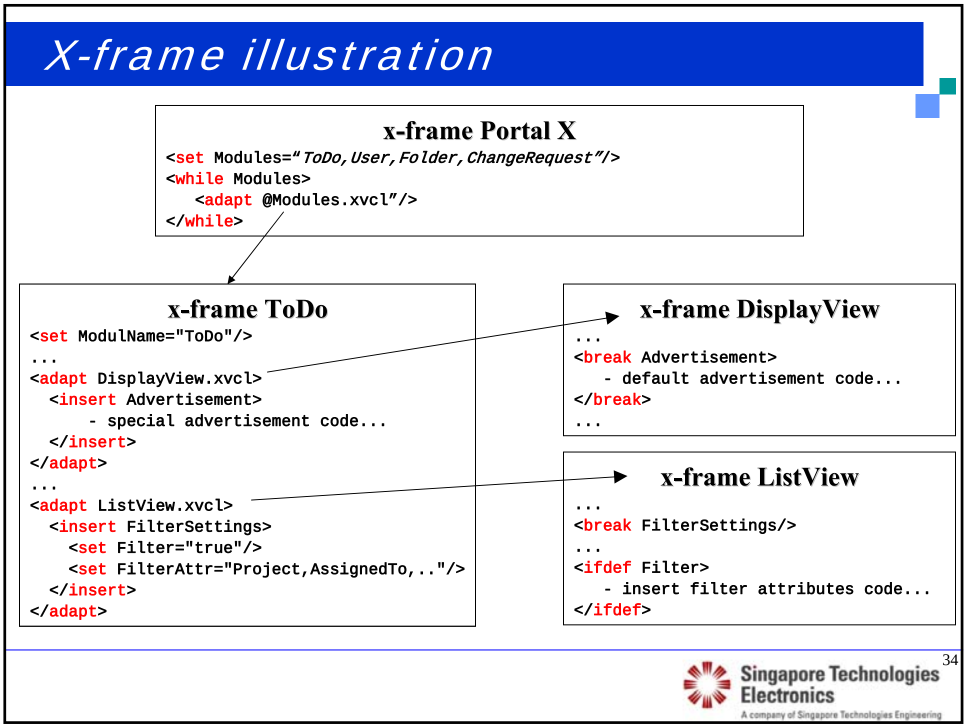


X-frame illustration

x-frame Portal X

```
<set Modules="ToDo,User,Folder,ChangeRequest"/>
<while Modules>
   <adapt @Modules.xvcl"/>
</while>
```

x-frame ToDo

```
<set ModulName="ToDo"/>
...
<adapt DisplayView.xvcl>
  <insert Advertisement>
      - special advertisement code...
  </insert>
</adapt>
...
<adapt ListView.xvcl>
  <insert FilterSettings>
    <set Filter="true"/>
    <set FilterAttr="Project,AssignedTo,.."/>
  </insert>
</adapt>
```

x-frame DisplayView

```
...
<break Advertisement>
   - default advertisement code...
</break>
...
```

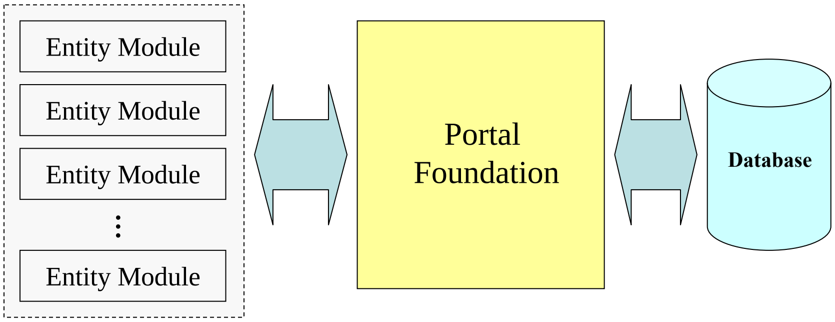
x-frame ListView

```
...
<break FilterSettings/>
...
<ifdef Filter>
   - insert filter attributes code...
</ifdef>
```

Our Focus Area

Focus Area:

- Unify Patterns of similar design across Entity Modules



Entity Module

Entity Module

Entity Module

⋮

Entity Module

Portal Foundation

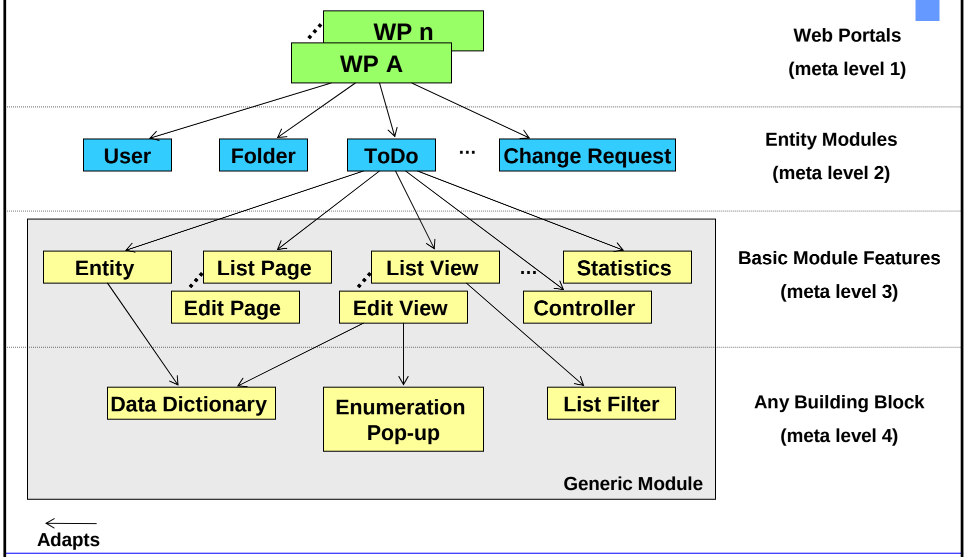
Database

Unify Similarities Across Entity Modules

Examples of Entity Module Differences:

- Entity class properties and types
  - Different properties & property types
  - Data dictionary based properties
  - Inheritance through include (no inheritance in ASP)
- Associations
  - Same entity has different association relationships in different portals
- Business logic
  - Change Request workflow (different logic in different projects)
- User Interface characteristics
  - Display characteristics (coloring based on property values, etc)
  - Input type (text, dropdown, list popup, date calendar, etc)
  - Input validation

Structure of WP Architecture



WP n

WP A

Web Portals

(meta level 1)

User

Folder

ToDo

…

Change Request

Entity Modules

(meta level 2)

Entity

List Page

Edit Page

List View

Edit View

…

Statistics

Controller

Basic Module Features

(meta level 3)

Data Dictionary

Enumeration Pop-up

List Filter

Any Building Block

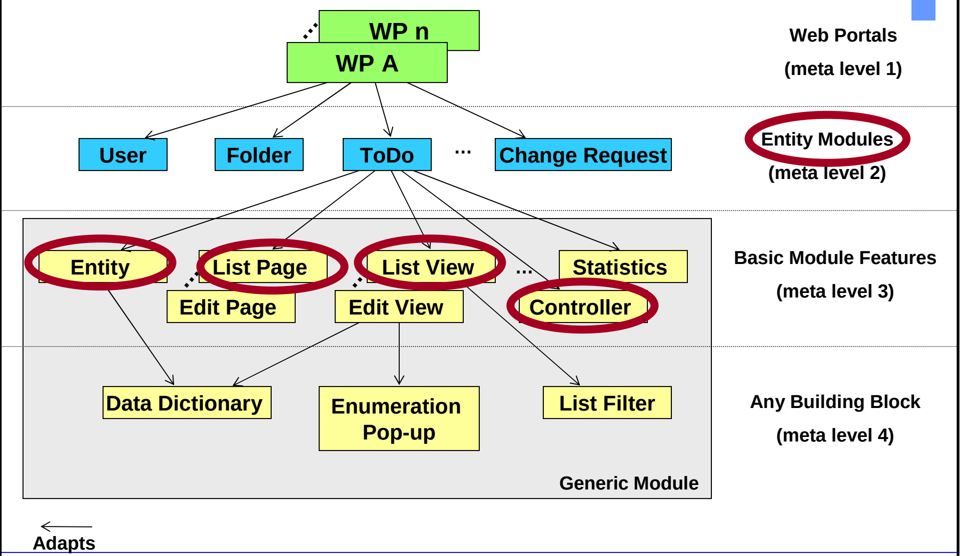
(meta level 4)

Generic Module

←

Adapts

Elements of conventional design in WP Architecture



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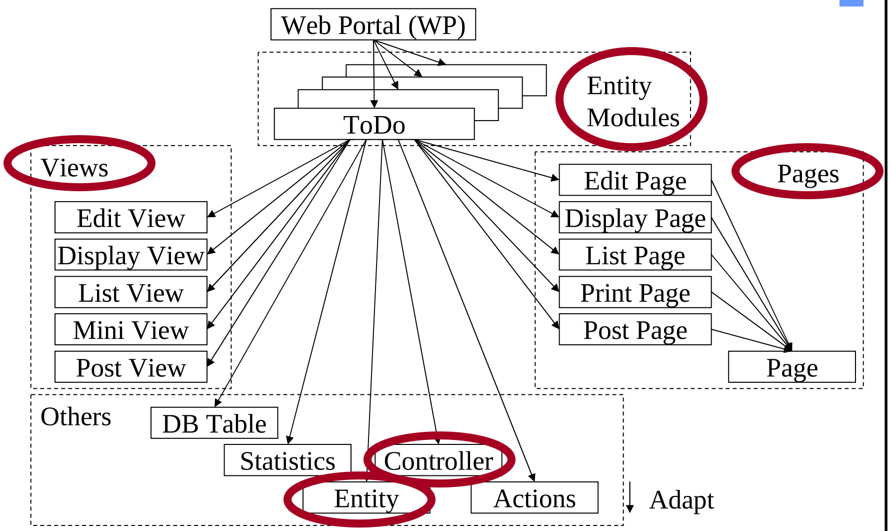
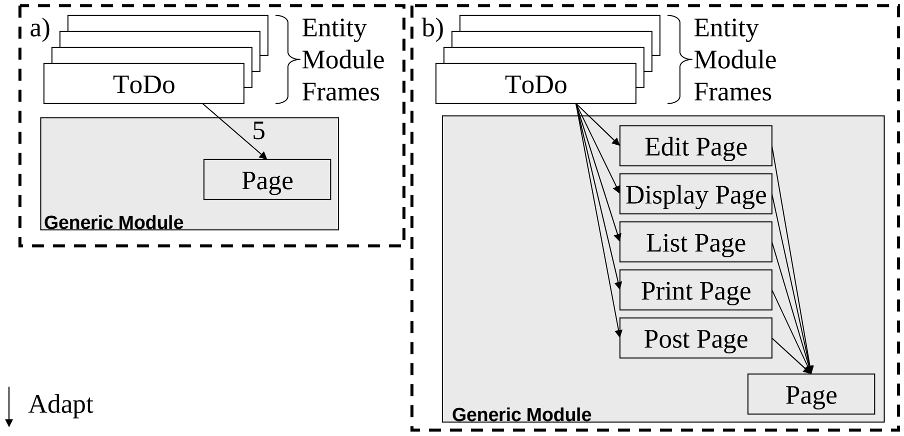


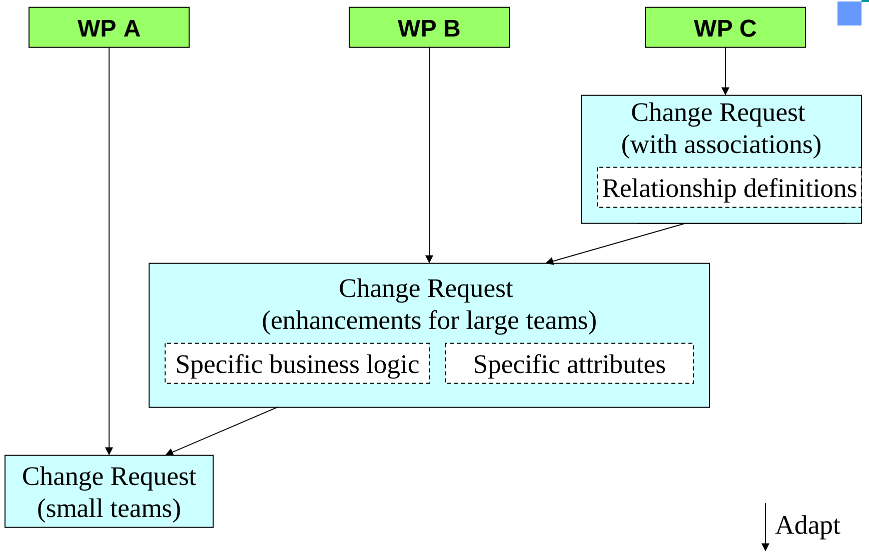
Conventional refinement of WP Architecture

Specialization of pages duplicated in all entity modules

Specialization of pages duplicated once in the generic module



Special refinement of WP Architecture



WP A

WP B

WP C

Change Request
(with associations)

Relationship definitions

Change Request
(enhancements for large teams)

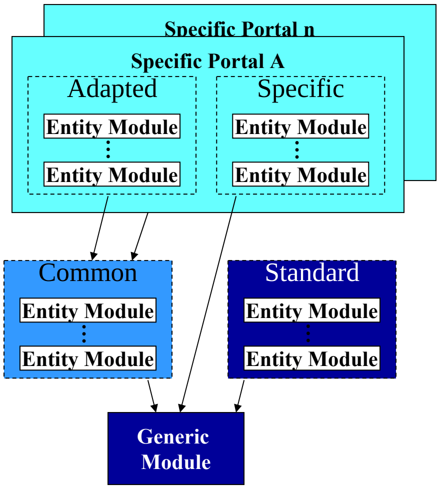
Specific business logic

Specific attributes

Change Request
(small teams)

Adapt

Entity Module Organization



Specific Portal n

Specific Portal A

Adapted

Entity Module
⋮
Entity Module

Specific

Entity Module
⋮
Entity Module

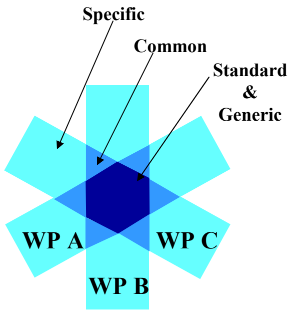
Common

Entity Module
⋮
Entity Module

Standard

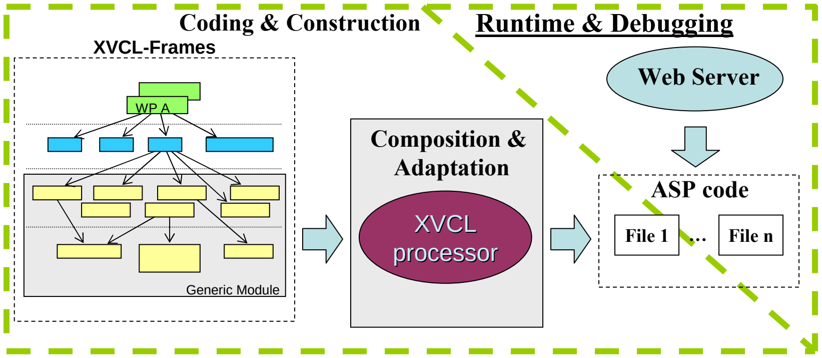
Entity Module
⋮
Entity Module

Generic Module



Runtime Perspective

Portal Construction from WP Architecture

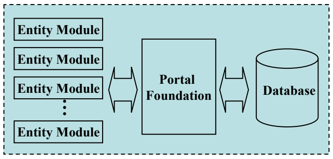


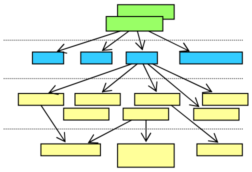
Overview

- Introduction
  - Challenges & Opportunities of Web Engineering
  - Product Lines
- Web Portal Product Journey
  - Conventional Starting Point – Portal Overview
  - Conventional Starting Point - Design
  - Reuse Goals and Benefits
- The XVCL Approach
  - Introduction to XVCL & Design of Web Portal Architecture
- **Results and Experiences**
- Conclusions

Results and Experiences *(1)*

Code Lines before and after application of XVCL





	Original TCP (ASP)	WP Architecture (XVCL)	Generated TCP (ASP)
Portal Foundation	15180	14021	16401
Specific Entity Modules	16322	1577	30474
Generic Entity Module	N/A	4119	N/A
Σ	31502	19717	46875

-37%

Table 1

Results and Experiences *(2)*

Code Lines before and after application of XVCL:

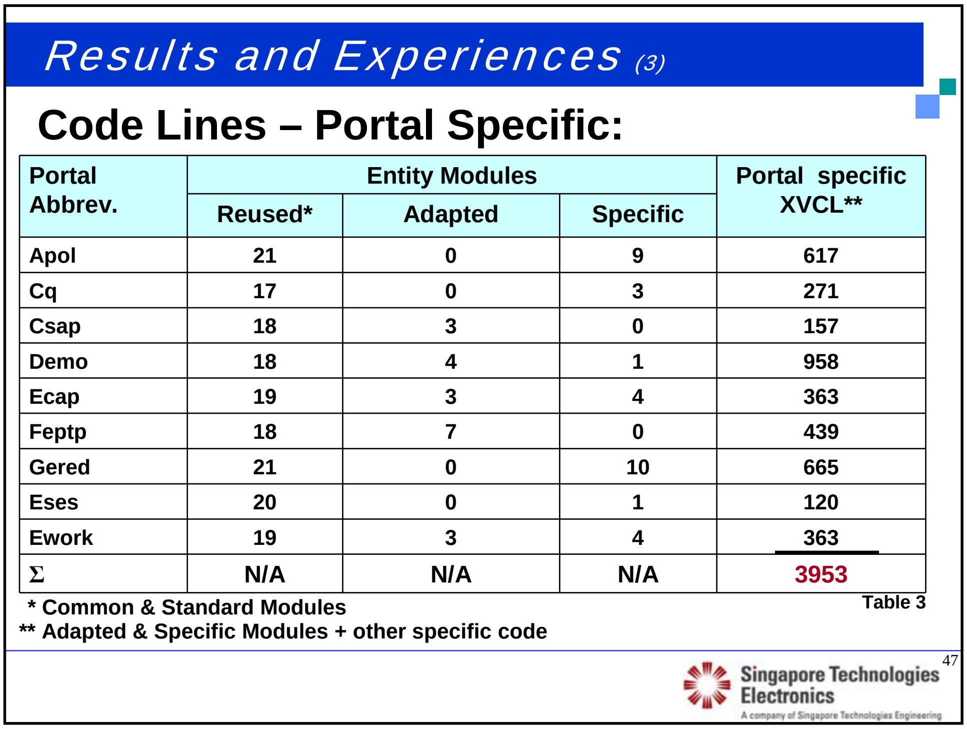
- Entity Modules – Our focus area for unification of similarities

Entity Module	Original TCP (ASP)	WP Architecture (XVCL)	Generated TCP (ASP)
Help*	722	133	1490
Web Page	514	50	1428
User	755	54	1717
. . .	. . .	. . .	. . .
ToDo (Task)	1295	147	2429
Σ	16322	1577	30474
Generic Entity Module	NA	4119	NA
Σ	16322	5696	30474

-90%

-65%

Table 2



Results and Experiences (3)

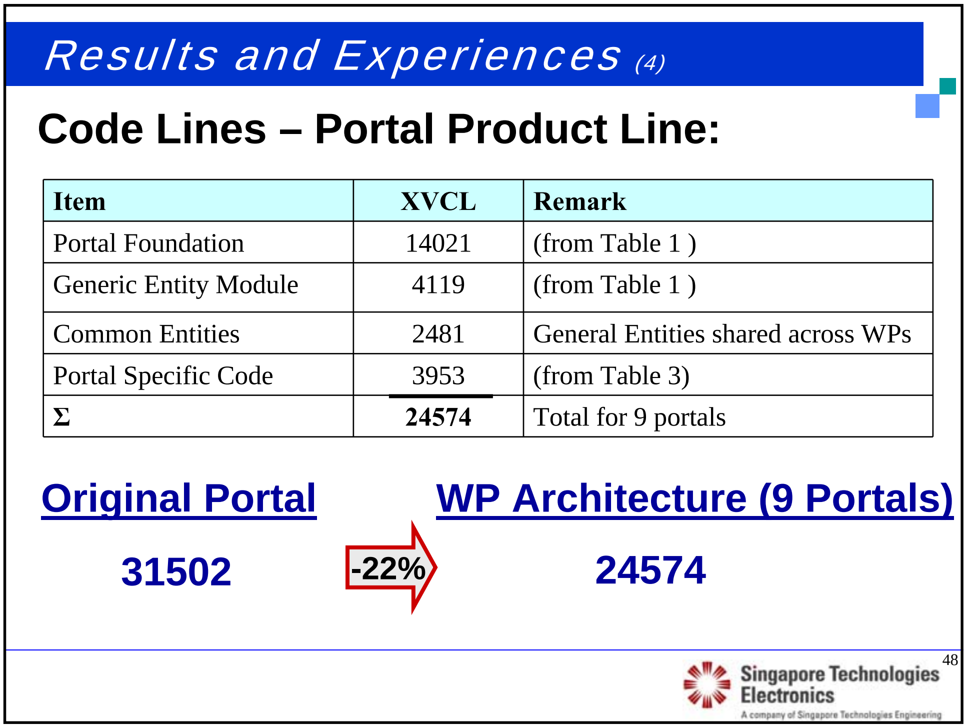
Code Lines – Portal Specific:

Portal Abbrev.	Entity Modules			Portal specific XVCL**
	Reused*	Adapted	Specific	
Apol	21	0	9	617
Cq	17	0	3	271
Csap	18	3	0	157
Demo	18	4	1	958
Ecap	19	3	4	363
Feptp	18	7	0	439
Gered	21	0	10	665
Eses	20	0	1	120
Ework	19	3	4	363
Σ	N/A	N/A	N/A	3953

Table 3

* Common & Standard Modules

** Adapted & Specific Modules + other specific code



Results and Experiences (4)

Code Lines – Portal Product Line:

Item	XVCL	Remark
Portal Foundation	14021	(from Table 1)
Generic Entity Module	4119	(from Table 1)
Common Entities	2481	General Entities shared across WPs
Portal Specific Code	3953	(from Table 3)
Σ	24574	Total for 9 portals

Original Portal 31502 -22% → **WP Architecture (9 Portals)** 24574

Results and Experiences *(5)*

Improvement areas:

- XVCL vs Integrated Development Environment (IDE)
  - No use of WYSIWYG generators
  - Developers first perception is primitive “feel”
- XVCL and debugging
  - Debugging of XVCL not possible (NUS working on tools)
  - Debugging of generated code is troublesome
- XVCL (XML) code mixed with native code
  - IDE setup can improve readability (keyword coloring, etc)
- No standards on how to approach XVCL development
  - Design and coding guidelines would be useful
  - Project Team organization and roles

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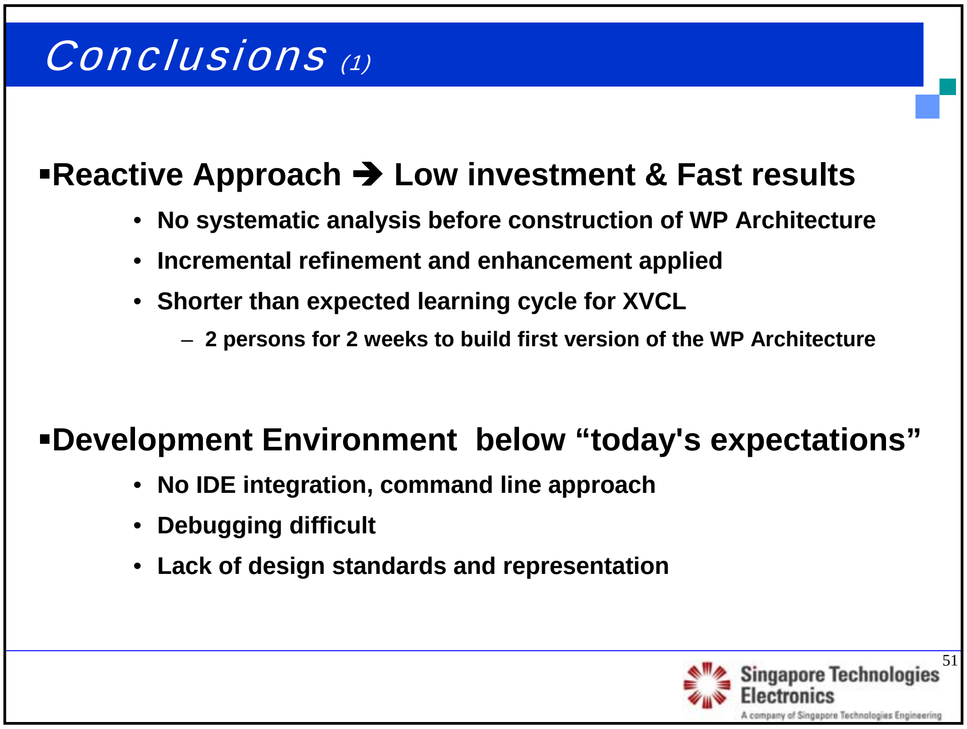
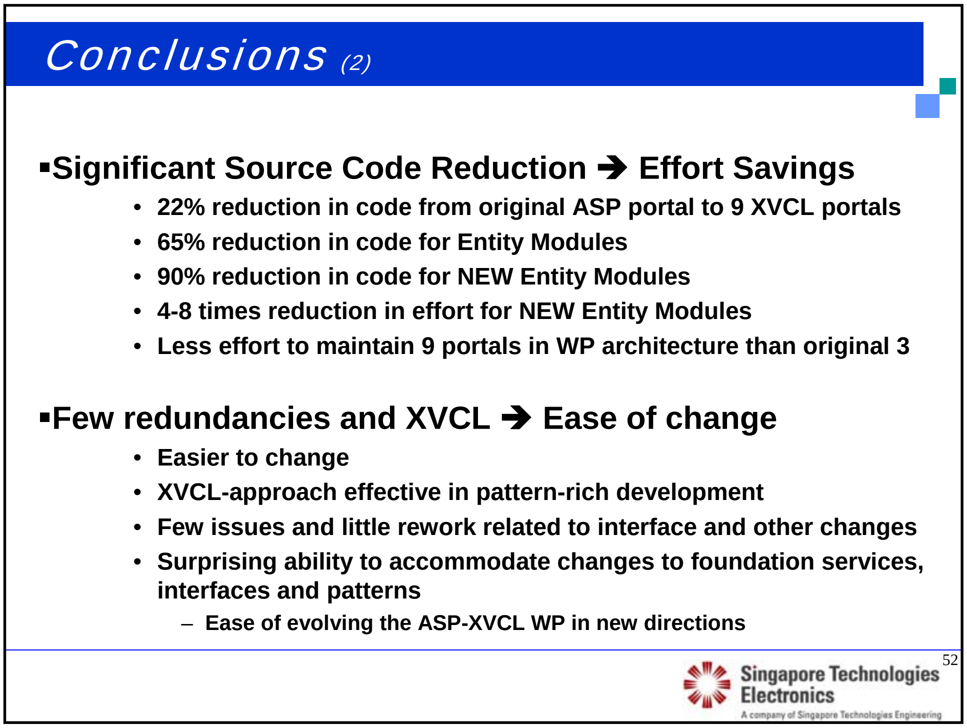


Conclusions *(1)*

- **Reactive Approach ➔ Low investment & Fast results**
    - **No systematic analysis before construction of WP Architecture**
    - **Incremental refinement and enhancement applied**
    - **Shorter than expected learning cycle for XVCL**
        - **2 persons for 2 weeks to build first version of the WP Architecture**

- **Development Environment below "today's expectations"**
    - **No IDE integration, command line approach**
    - **Debugging difficult**
    - **Lack of design standards and representation**



Conclusions *(2)*

- **Significant Source Code Reduction ➔ Effort Savings**
    - **22% reduction in code from original ASP portal to 9 XVCL portals**
    - **65% reduction in code for Entity Modules**
    - **90% reduction in code for NEW Entity Modules**
    - **4-8 times reduction in effort for NEW Entity Modules**
    - **Less effort to maintain 9 portals in WP architecture than original 3**

- **Few redundancies and XVCL ➔ Ease of change**
    - **Easier to change**
    - **XVCL-approach effective in pattern-rich development**
    - **Few issues and little rework related to interface and other changes**
    - **Surprising ability to accommodate changes to foundation services, interfaces and patterns**
        - **Ease of evolving the ASP-XVCL WP in new directions**