

Managing Customizable User Interface for Web Application Product Lines using Delta Modeling

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FAKULTAS
ILMU
KOMPUTER

JYU LINZ INSTITUTE
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Christian Doppler Lab VaSiCS

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Outline

Introduction

- Background
- Motivation

Managing User Interface Variants

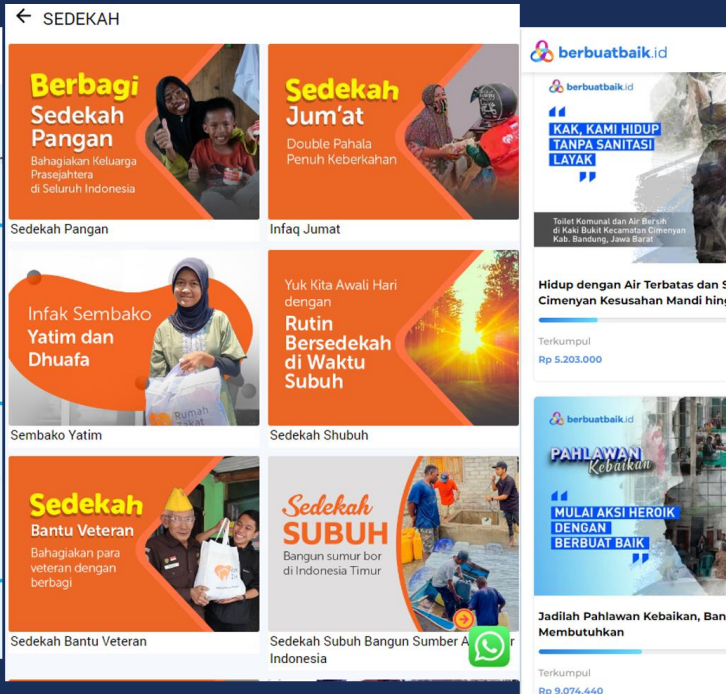
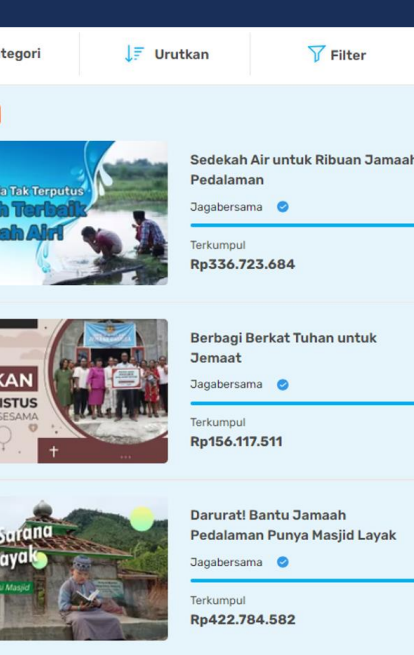
- Modeling with IFML Delta Extension
- Engineering Activities

Evaluation

- Feasibility of our approach
- Lesson Learned

Closing

- Concluding Remarks
- Future Work

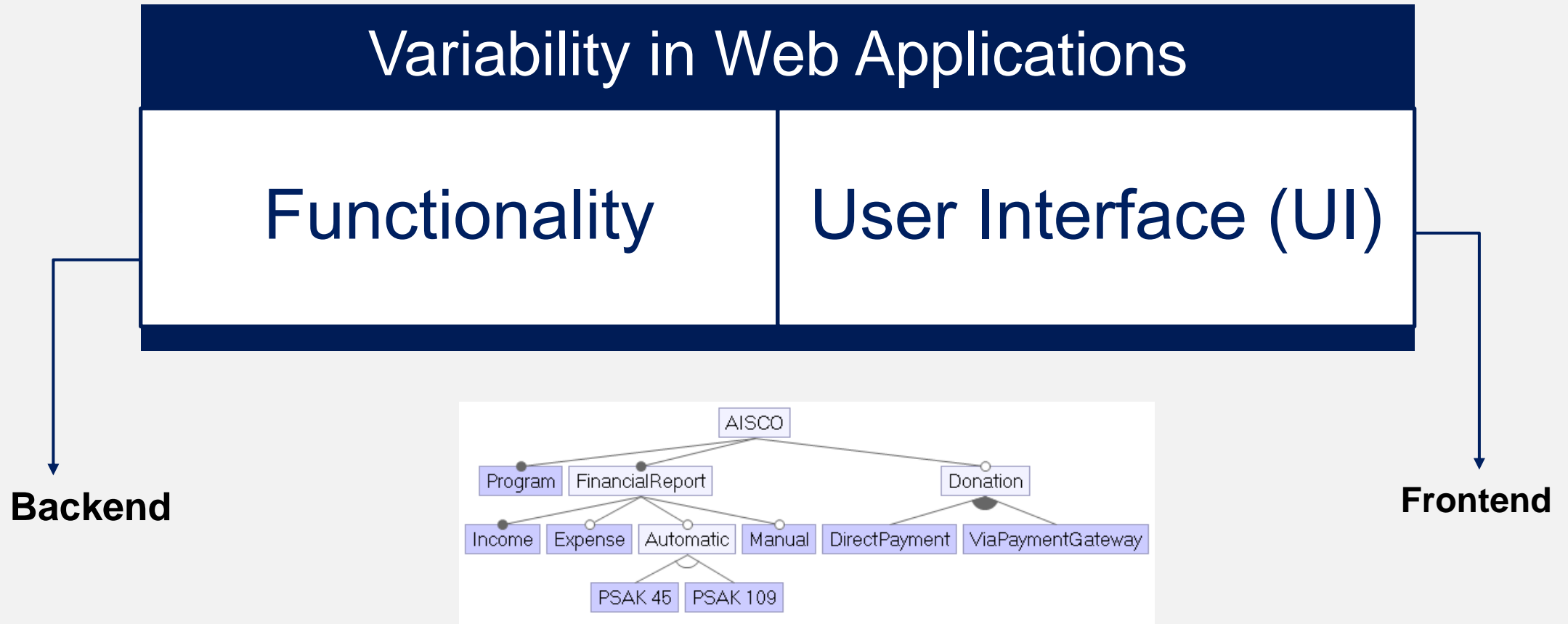


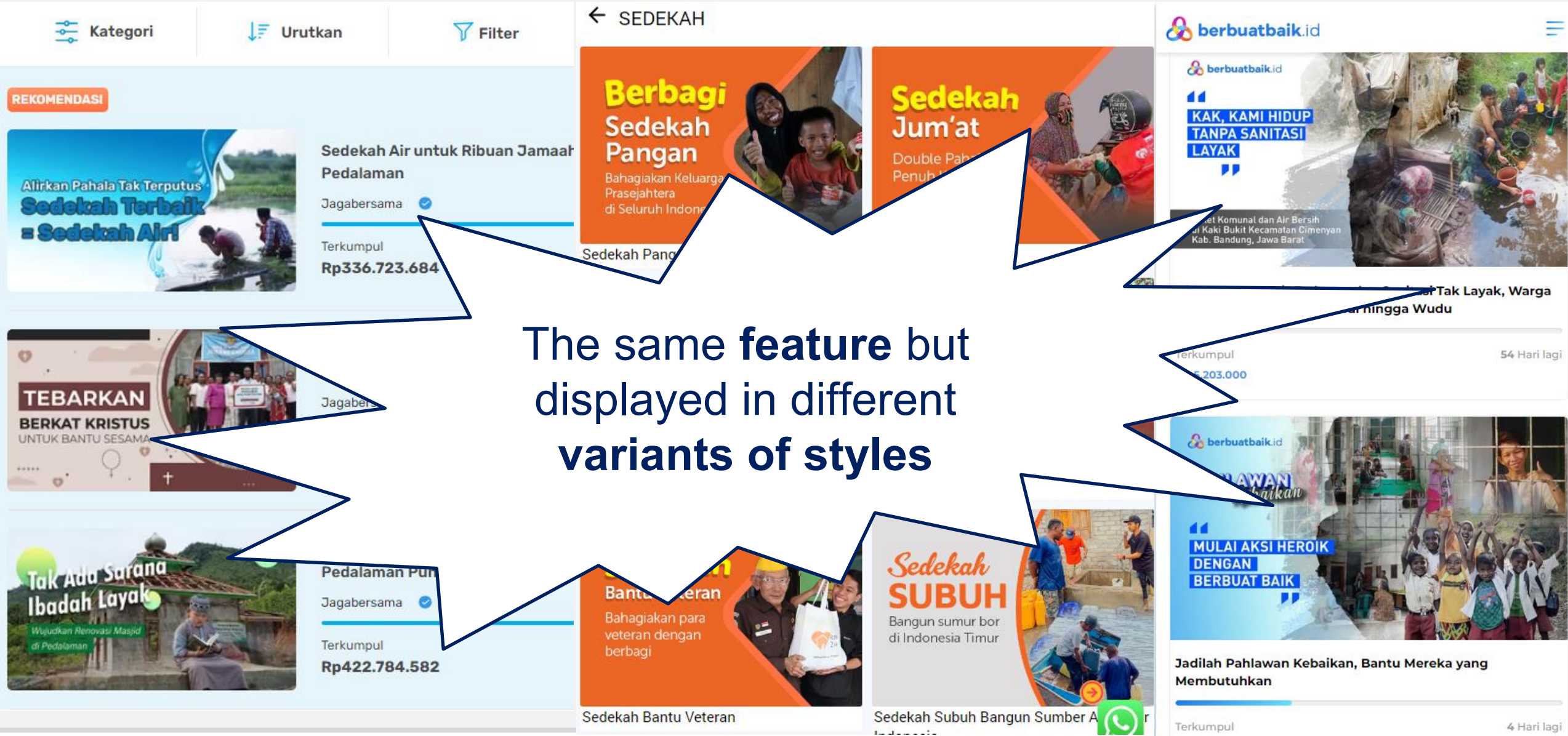
Introduction

Background and Current State-of-the-Practice



Background





The same feature but displayed in different variants of styles

Kategori

Urutkan

Filter

← SEDEKAH

berbuatbaik.id

REKOMENDASI

Alirkan Pahala Tak Terputus
Sedekah Terbaik = Sedekah Air

Sedekah Air untuk Ribuan Jamaah Pedalaman

Jagabersama

Terkumpul
Rp336.723.684

Berbagi Sedekah Pangan

Bahagiakan Keluarga Prasejahtera di Seluruh Indonesia

Sedekah Jum'at

Double Pahala Penuh

KAK, KAMI HIDUP TANPA SANITASI LAYAK

Desa Komunal dan Air Bersih di Kaki Bukit Kecamatan Cimenyang Kab. Bandung, Jawa Barat

TEBARKAN BERKAT KRISTUS UNTUK BANTU SESAMA

Jagabersama

Tak Ada Sarana Ibadah Layak

Wujudkan Renovasi Masjid di Pedalaman

Pedalaman Pun

Jagabersama

Terkumpul
Rp422.784.582

Bantu Veteran

Bahagiakan para veteran dengan berbagi

Sedekah SUBUH

Bangun sumur bor di Indonesia Timur

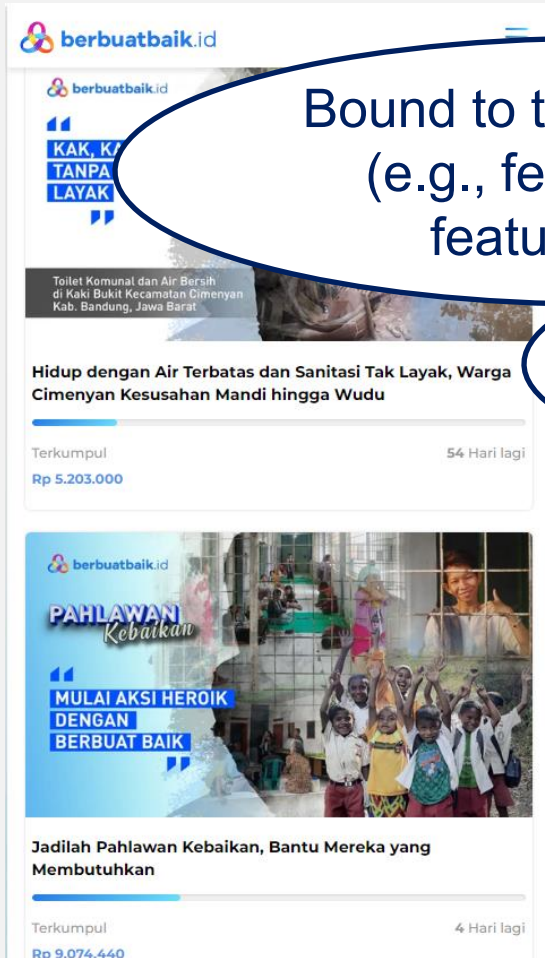
MULAI AKSI HEROIK DENGAN BERBUAT BAIK

Jadilah Pahlawan Kebaikan, Bantu Mereka yang Membutuhkan

Terkumpul
Rp 9.074.440

4 Hari lagi

UI Variations in SPLE



Bound to the functionality
(e.g., features in the
feature model)

A combination of **model
representation** and
customization is needed

Possible UI Variations

Layout

UI Widget

Coloring Scheme

How to model various UI of web applications in SPLE?

Abstract UI



The goal of generating UI in product line: automation + usability

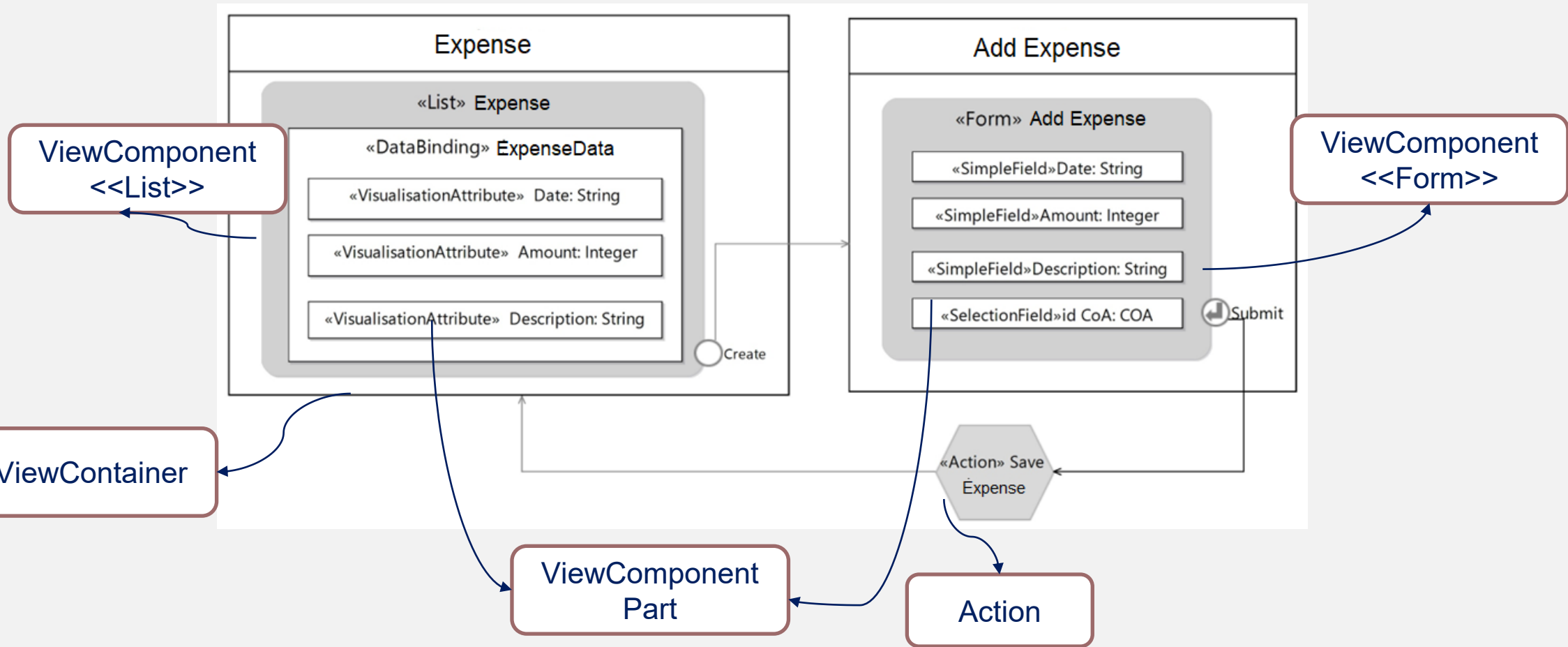


The abstract UI model can express different UI without considering any platform, technological, and/or implementation details.



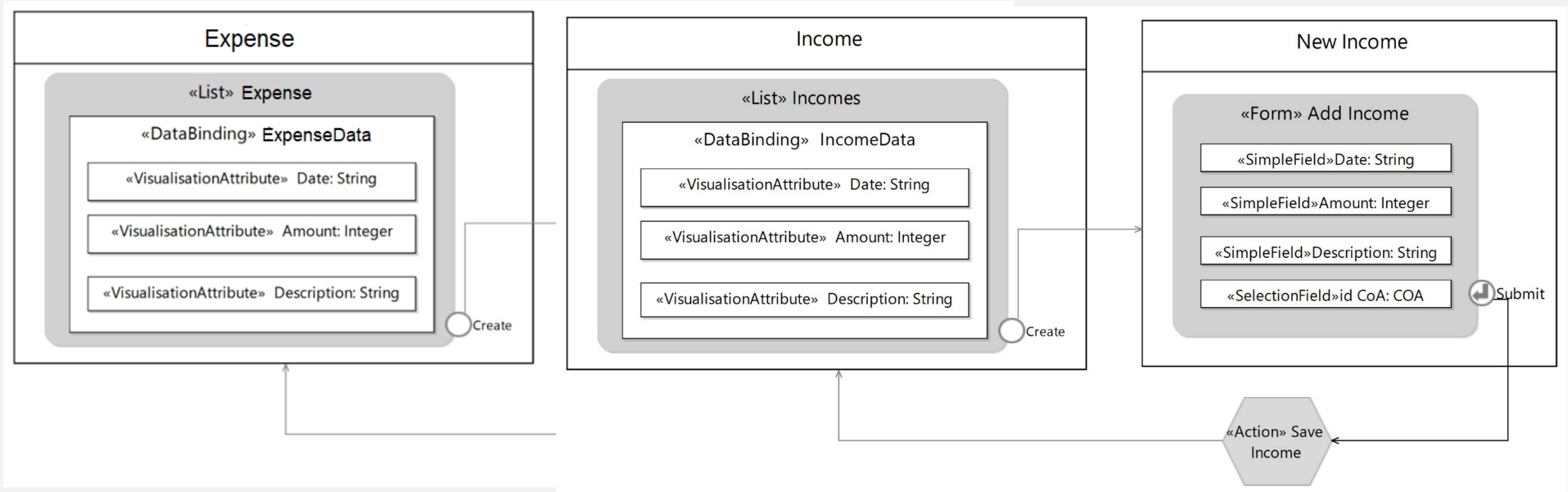
Interaction Flow Modeling Language (IFML) is IFML is an abstract UI model adopted by Object Management Group (OMG) as a standard for modeling the graphical UI of an interactive system.

IFML Example



Problem Statement

IFML is not designed to model variations, duplication is required to model similar elements



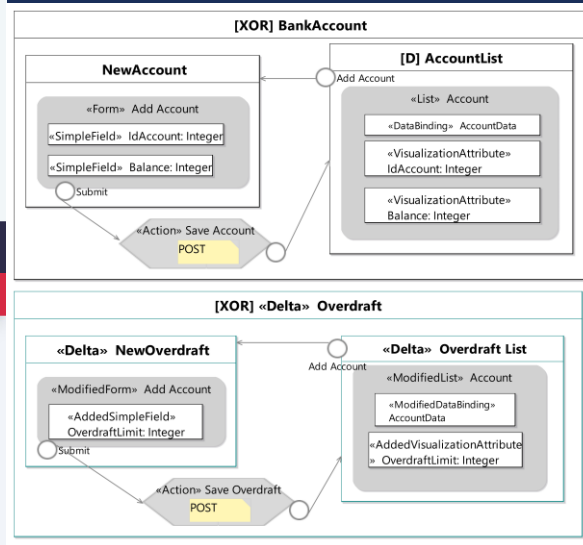
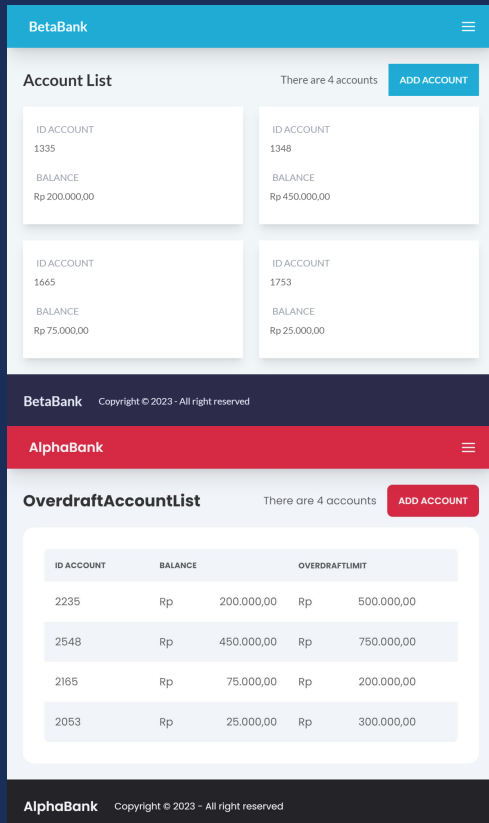
IFML Extension

- IFML has an extension mechanism to model specific domains.

Examples:

1. Extending the Interaction Flow Modeling Language (IFML) for Model Driven Development of **Mobile Applications Front End** (Brambilla et. al, 2014)
2. Extending Graphical Part of the Interaction Flow Modeling Language to Generate Rich **Internet Graphical User Interfaces** (Roubi et. al, 2016)
3. Extension of Interaction Flow Modeling Language for **Geographical Information Systems** (Hayat et.al, 2021)
4. Extending Interaction Flow Modeling Language as a Profile for **Form-making Systems** (Ghazaleh, 2021)

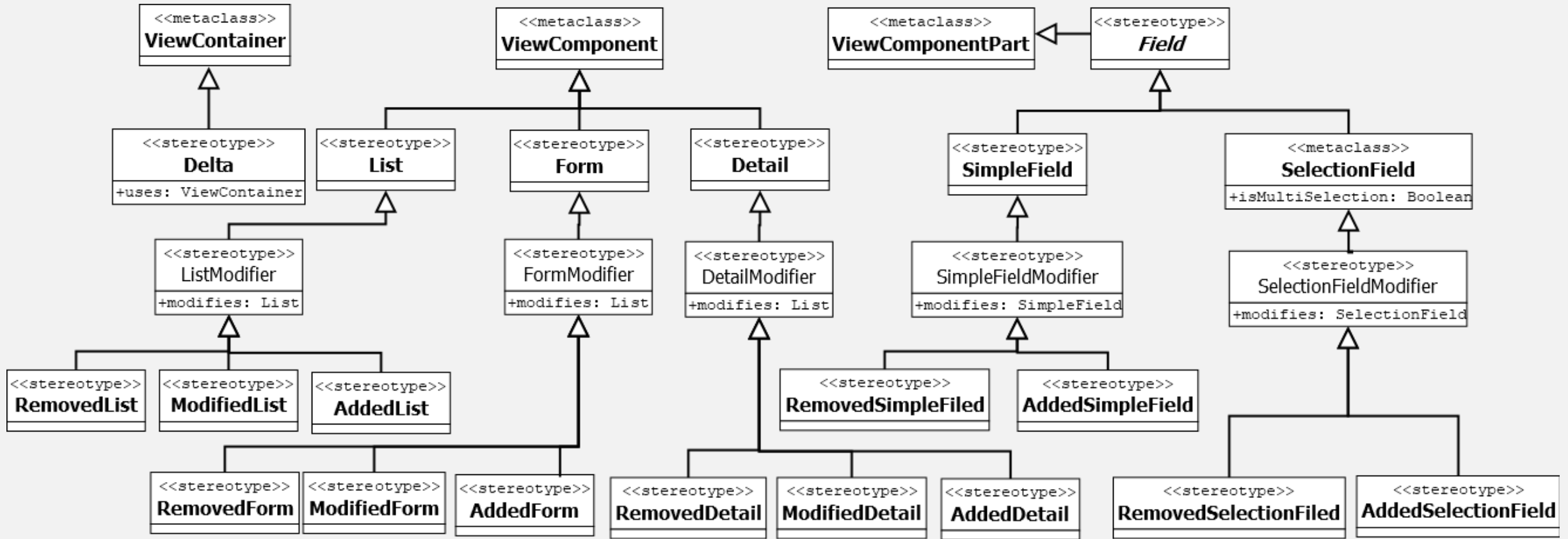
**Design a delta modeling for IFML diagram:
IFML-DOP extension**



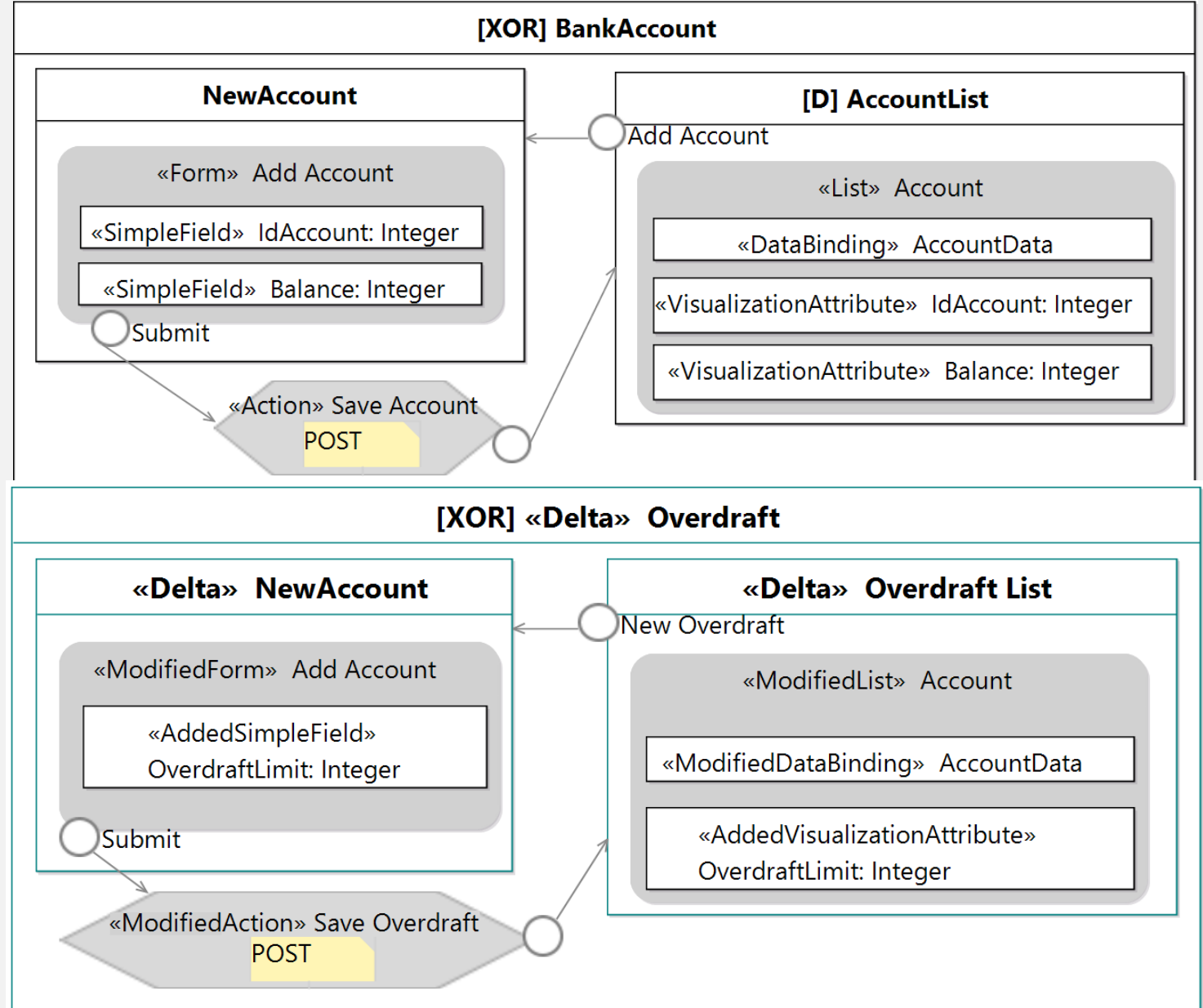
Designing User Interface Variants with IFML and Delta

Combination of abstract user interface model and variability mechanism

IFML Delta Extension



Example



Account List

There are 4 accounts

ADD ACCOUNT

ID ACCOUNT

1335

BALANCE

Rp 200.000,00

ID ACCOUNT

1348

BALANCE

Rp 450.000,00

ID ACCOUNT

1665

BALANCE

Rp 75.000,00

ID ACCOUNT

1753

BALANCE

Rp 25.000,00

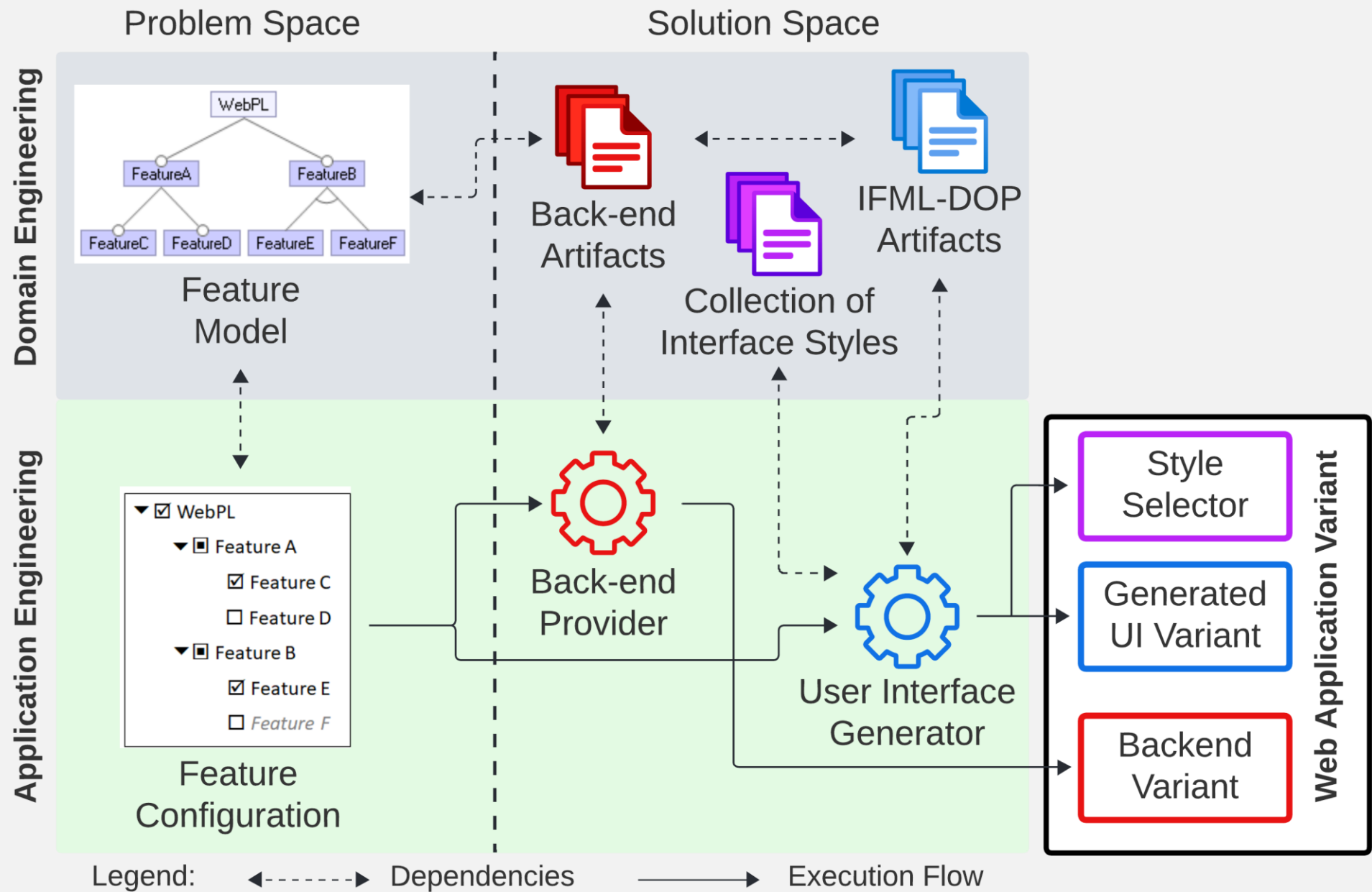
OverdraftAccountList

There are 4 accounts

ADD ACCOUNT

ID ACCOUNT	BALANCE	OVERDRAFTLIMIT
2235	Rp 200.000,00	Rp 500.000,00
2548	Rp 450.000,00	Rp 750.000,00
2165	Rp 75.000,00	Rp 200.000,00
2053	Rp 25.000,00	Rp 300.000,00

Engineering Activities



Selamat Datang

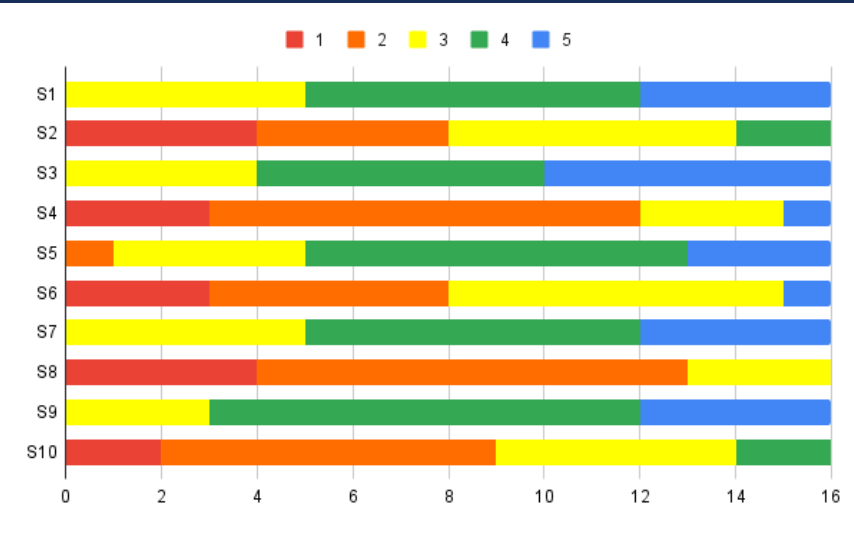
Yuk cari tahu lebih lanjut mengenai kami!

TENTANG KAMI



Evaluation

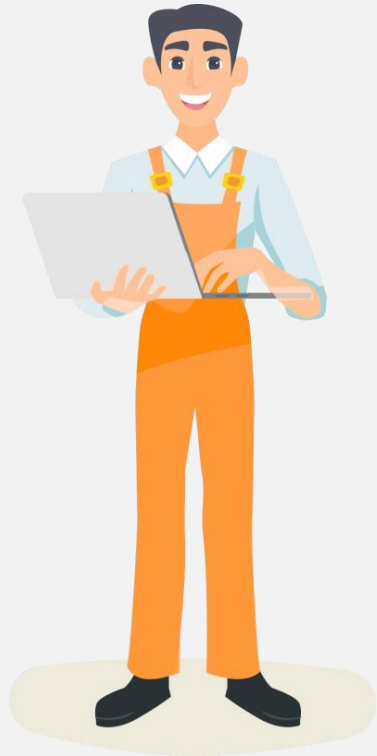
Case Study	Feature Models		Delta Modeling			
	Features	Variants	Delta Models	Min Op	Max Op	Avg Op
Bank Account	7	48	18	2	5	3
Payment Gateway	8	9	6	1	5	3
Charity Organization	21	1232*	26	2	5	3



The feasibility of managing user interface variants with IFML and Delta

Evaluation Strategy

Goal: Evaluate the **feasibility of managing UI variant**



RQ1: Can the customizable UI variants be successfully managed using IFML and its delta modeling extension?



Same with Configuration?



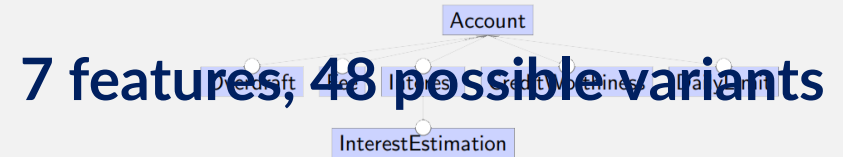
Without Error?

RQ2: What is the usability of the UI variants generated using our approach?

Case Studies



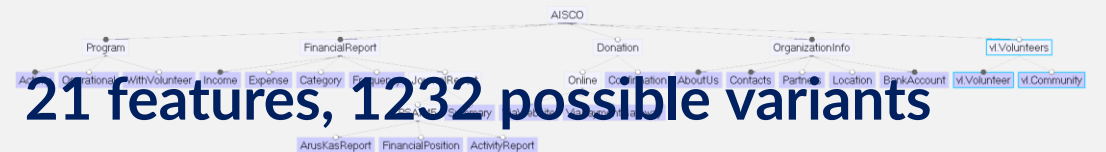
Bank Account



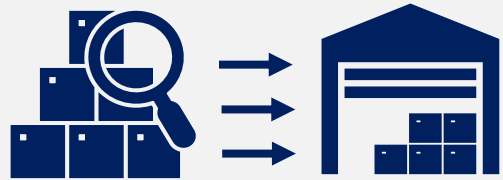
Payment Gateway



Charity Organization



Evaluation Setups



Applying Our Approach
to the Case Studies

Design IFML diagram with DOP

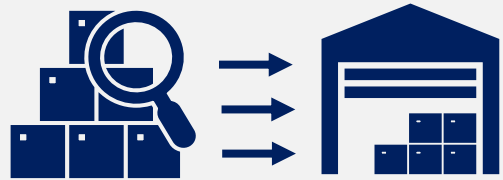
- Core Model: All concrete mandatory features from the feature model
- Delta Model: All concrete non-mandatory features
- Generate the UI based on feature selection



Questionnaire

- Evaluating the generated system, focused on Charity Organization case study
- 12 charity organization owners + 4 general users (e.g., charity donors or activists)
- *Online interview* using Zoom
- Filling out Systems Usability Scale (SUS) questionnaire + open-ended interview questions

Evaluation Results



Applying Our Approach to the Case Studies



Questionnaire

Case Study	Feature Models		Delta Modeling			
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Bank Account	7	48	18	2	5	3
Payment Gateway	8	9	6	1	5	3
Charity Organization	21	1232	26	2	5	3



Interested to use the website



Well-integrated website



Requires guidance to fully understand the website

Lessons Learned



What we achieve now



Feasible to generate UI variants



Customize UI elements of the generated website



Current approach can help engineers to generate UI variants with good usability



Things to Improve



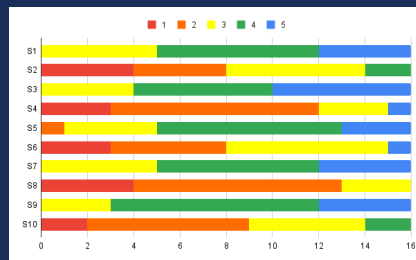
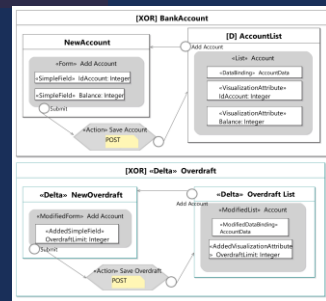
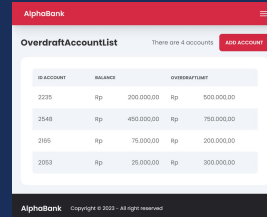
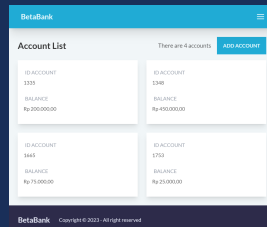
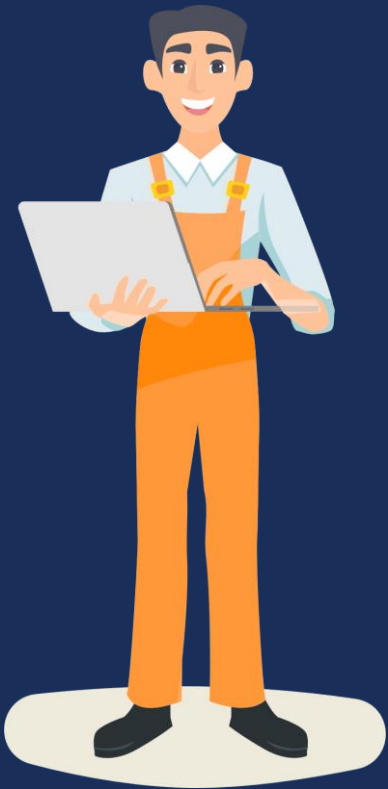
Need more sophisticated UI elements (e.g., file upload, modal)



Some UI customization is still limited (e.g., positioning)



Improving reusability of delta models through application conditions



S	Structure Models		Delta Modeling		
	Vars	Variants	Delta Models	Min Op	Max Op
S1	48	18	2	5	3
S2	9	6	1	5	3
S3	1232*	26	2	5	3

Closing

Concluding remarks and our outlook for future research

Concluding Remarks



IFML-Delta Extension

Integrating delta modeling concepts into IFML to model variability



Manage Customizable UI

Customizable UI variants are automatically generated from IFML



Feasibility

The feasibility of our approach is evaluated using case studies

Future Work

Concrete UI Employ concrete UI to improve the capabilities

Configuration Knowledge Mapping between Features and in Feature Model and ViewContainer in IFML

Evaluation Usability testing for our approach from the software engineers

Thank you | Dankeschön | Terima Kasih

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Demo & Tutorial <https://amanah.cs.ui.ac.id/research/ifml-regen>