

Mapping Data Flow Models to the Palladio Component Model

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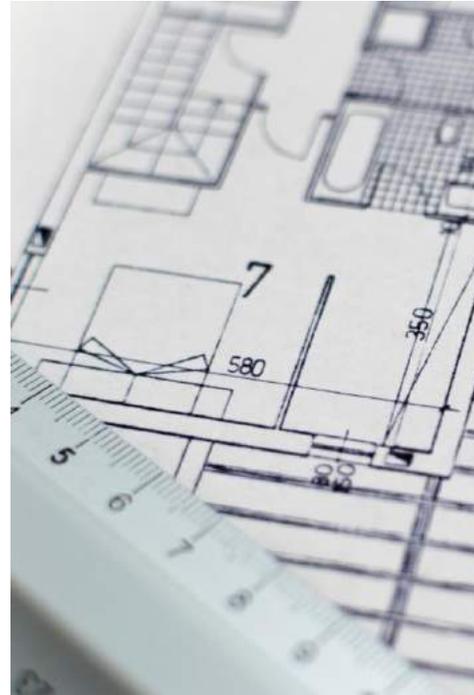
SOFTWARE DESIGN AND QUALITY GROUP,
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Motivation

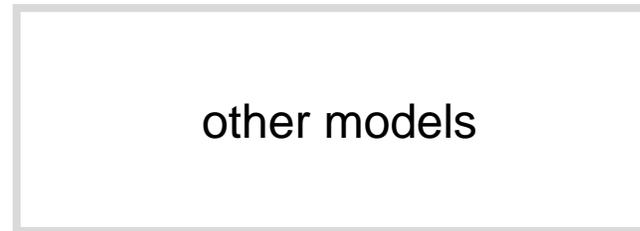
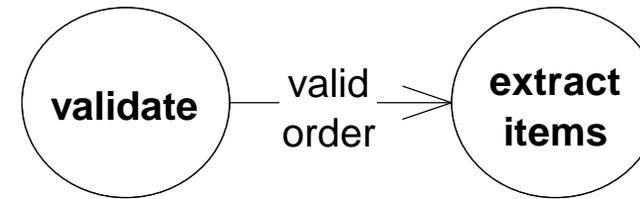
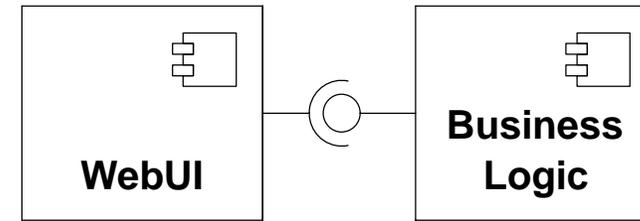


Software Architects



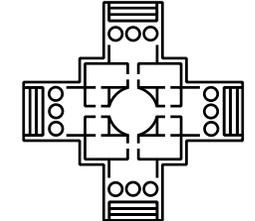
Sketched Architecture

Will quality goals be achieved?



Architecture Models

Are all models consistent?



Analyses

Are results compatible?

High Level Challenges and Goals



Challenges of multiple models and analyses

- Consistency between separated models not trivial
- Additional maintenance effort for multiple models
- Analysis results have to be about same version



Benefit of using dedicated models and analyses

- Modeling approach tailored to quality analysis
- Established analyses provide good predictions

Motivation ➤ State of the Art ➤ Foundations ➤ Running Example ➤ Mappings ➤ Process ➤ Summary

Topics in this Talk



Covered Models

- Data Flow Diagrams (DFDs)
[DeMarco79]
- Palladio Component Model (PCM)
[Reussner16]



Covered Challenges

- Consistency:
Mapping rules between DFDs and PCM
- Maintenance Effort:
Idea for automated PCM stub generation

Motivation ➤ State of the Art ➤ Foundations ➤ Running Example ➤ Mappings ➤ Process ➤ Summary

State of the Art

Relation Data Flow and Control Flow Diagrams

- Mapping DFD to object-oriented design [Alabiso88]

handling of ambiguities and design space not clear

- Mapping DFD to fine-grained behavior [LarsenPlatToetenel94]

no realistic DFDs (1:1 mapping of inputs to outputs)

Resolving ambiguities

- Control flow nodes in DFDs [WardMellor86]

breaks separation between requirements and design

- Relation inputs and outputs [TsePong89][BrunzaWeide93]

Does not match required level of abstraction

Foundations

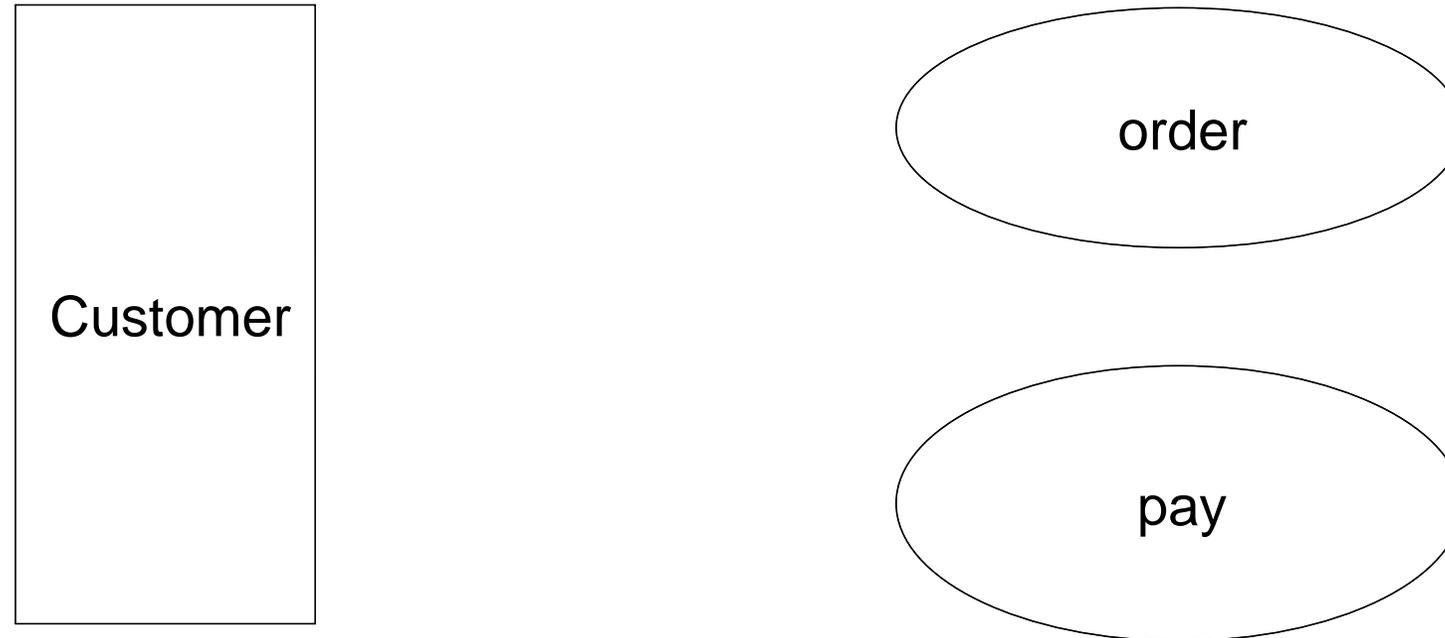
Data Flow Diagrams

- Defined by DeMarco
- Sources, sinks, processors, files, data flows

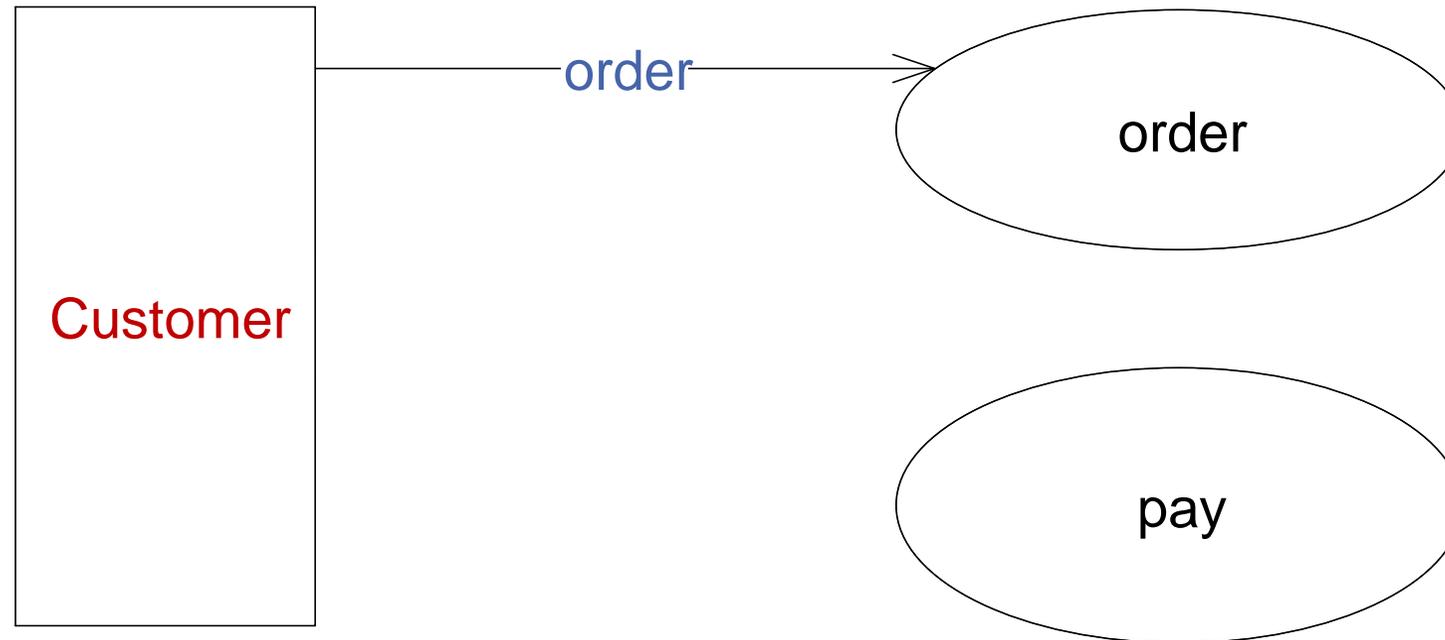
Data Mapping Extension

- Mapping of input data to output data [BrunzaWeide93]
- E : Set of all entities
- D : Set of all data
- (e, D_{in}, D_{out}) : Mapping with $e \in E \wedge D_{in}, D_{out} \in D$

Running Example

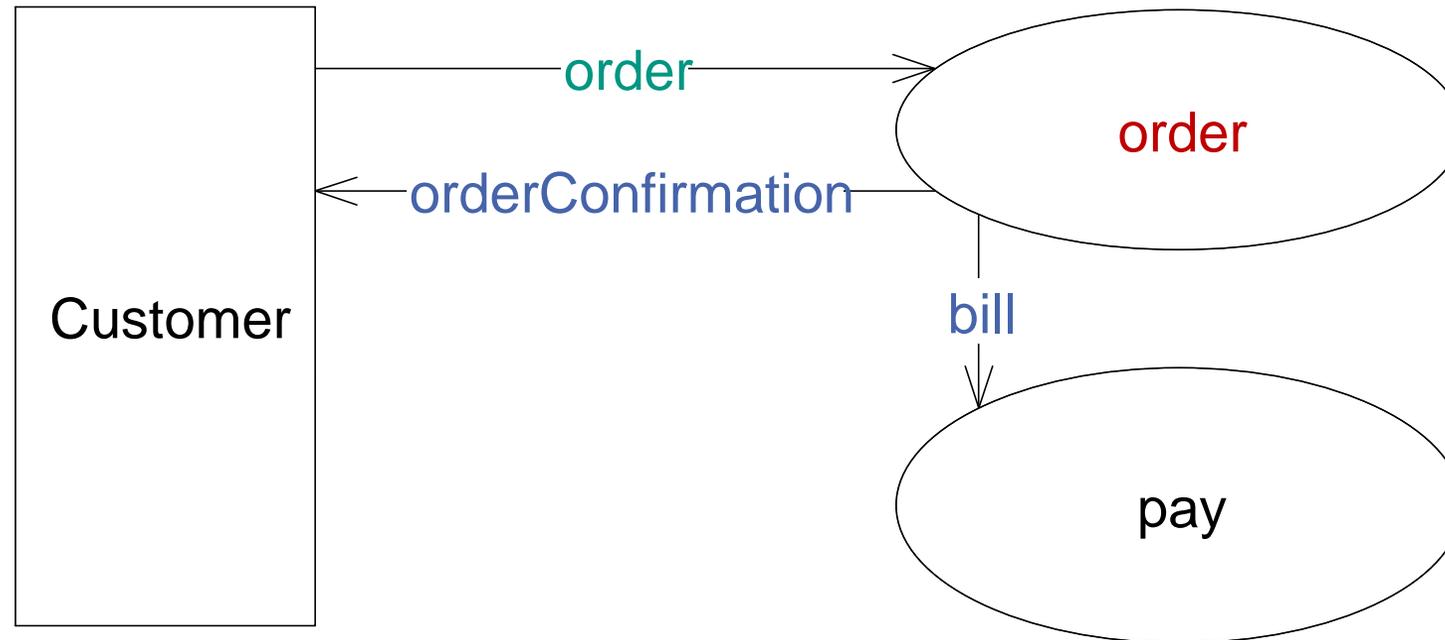


Running Example



(Customer, \emptyset , {order})

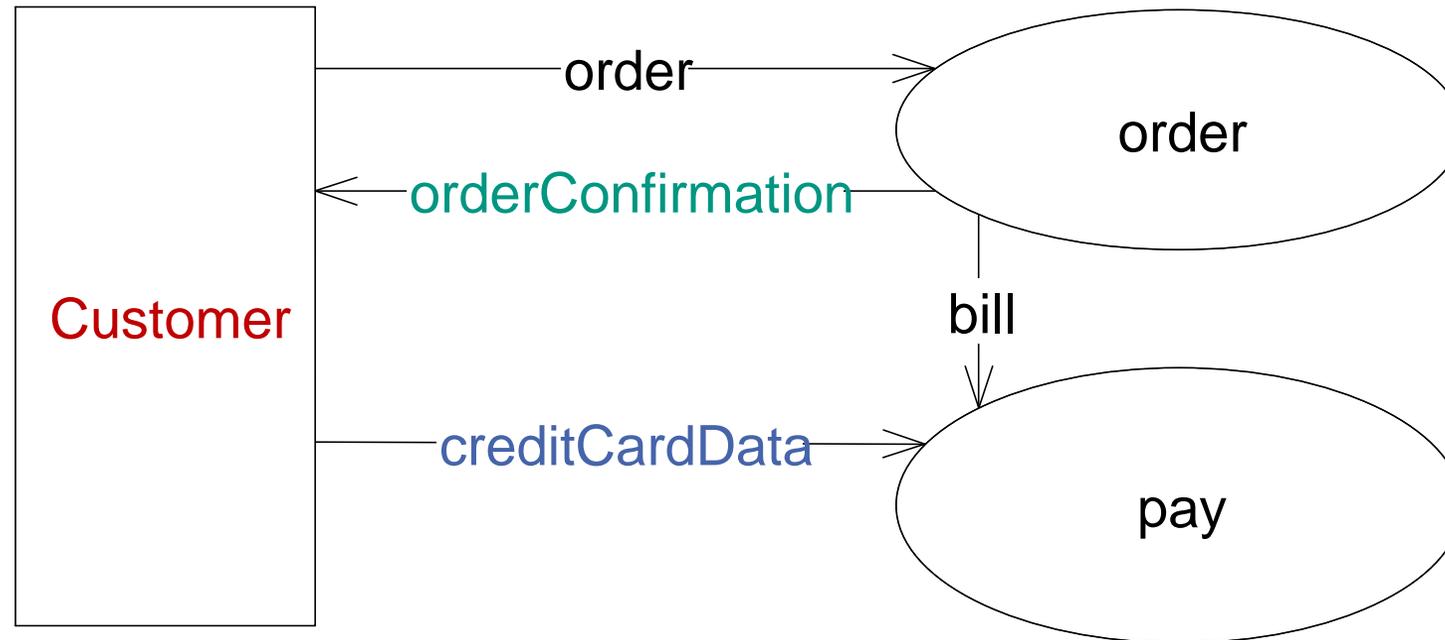
Running Example



(Customer, \emptyset , {order})

(**order**, {order}, {orderConfirmation, bill})

Running Example

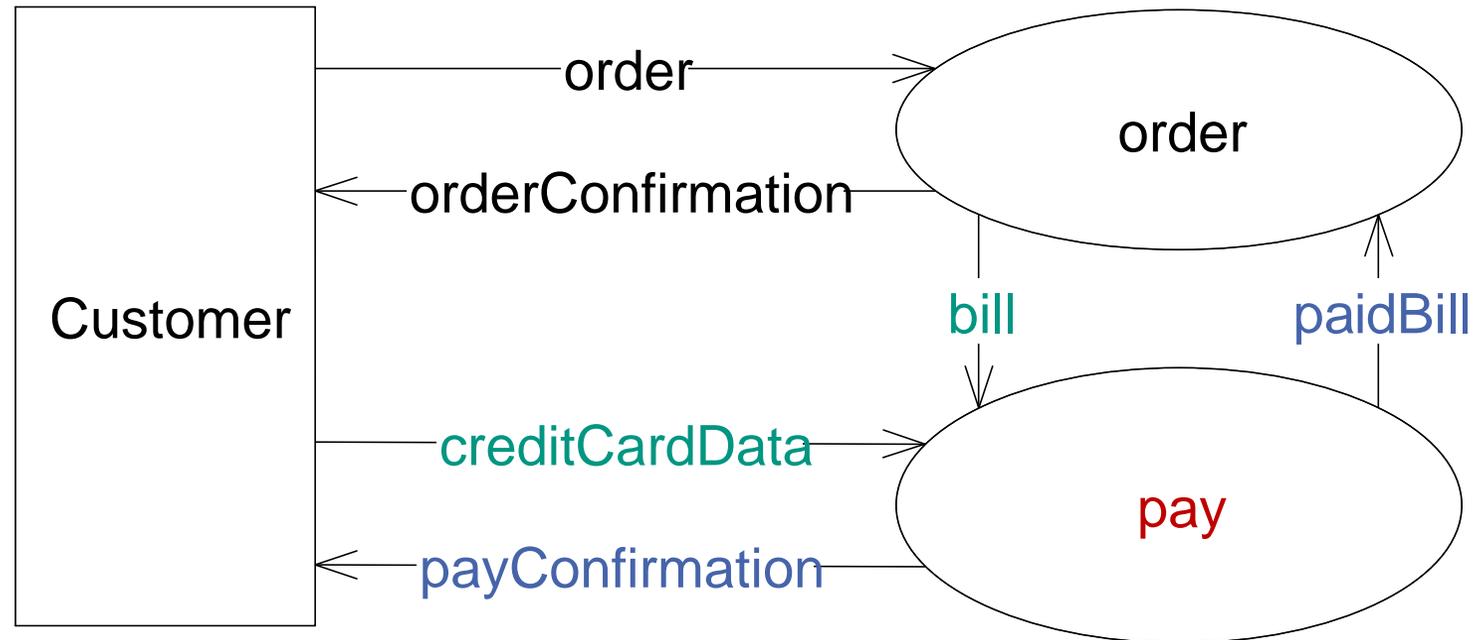


(Customer, \emptyset , {order})

(order, {order}, {orderConfirmation, bill})

(Customer, {orderConfirmation}, {creditCardData})

Running Example



(Customer, \emptyset , {order})

(order, {order}, {orderConfirmation, bill})

(Customer, {orderConfirmation}, {creditCardData})

(pay, {creditCardData, bill}, {paidBill, payConfirmation})

Coverage of Views by Mapping Rules



Structural View

- Components
- System

covered



Behavioral View

- Usage
- Component Behavior

covered



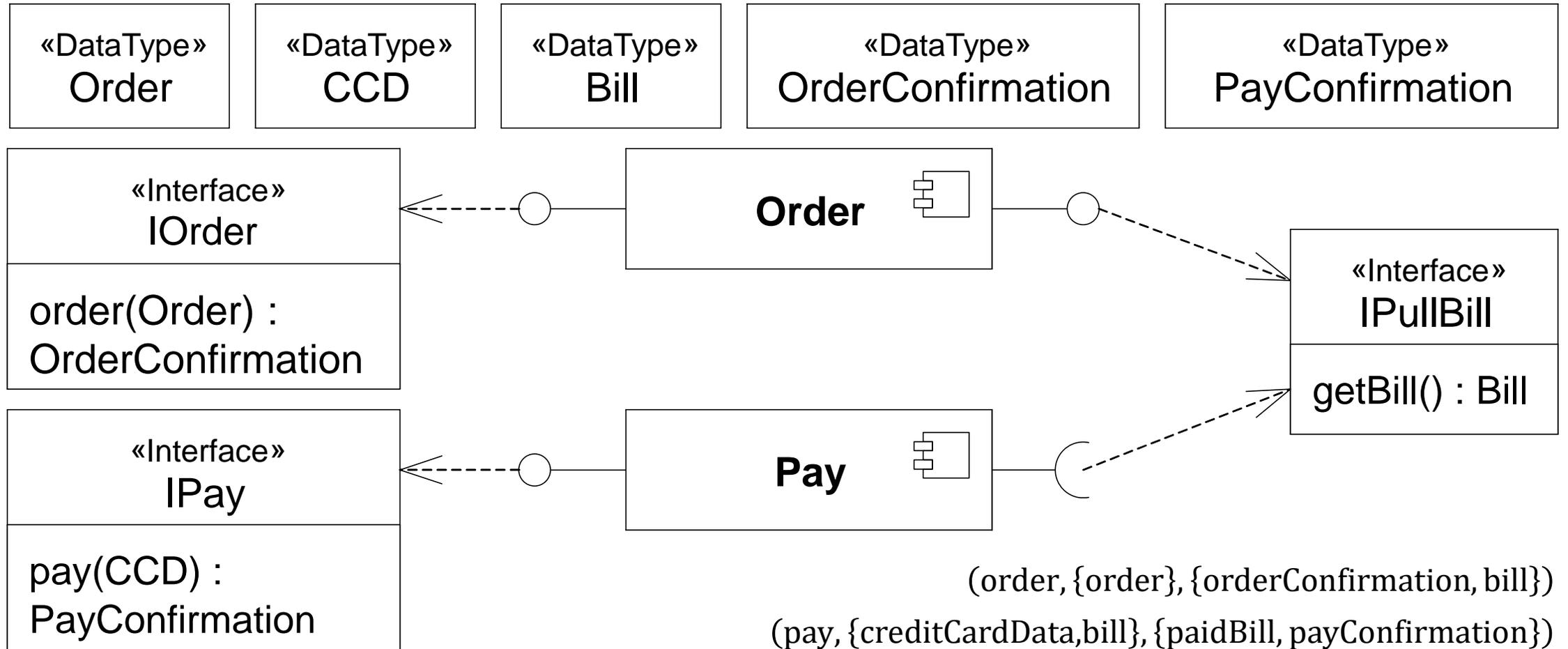
Deployment

- Resources
- Allocation

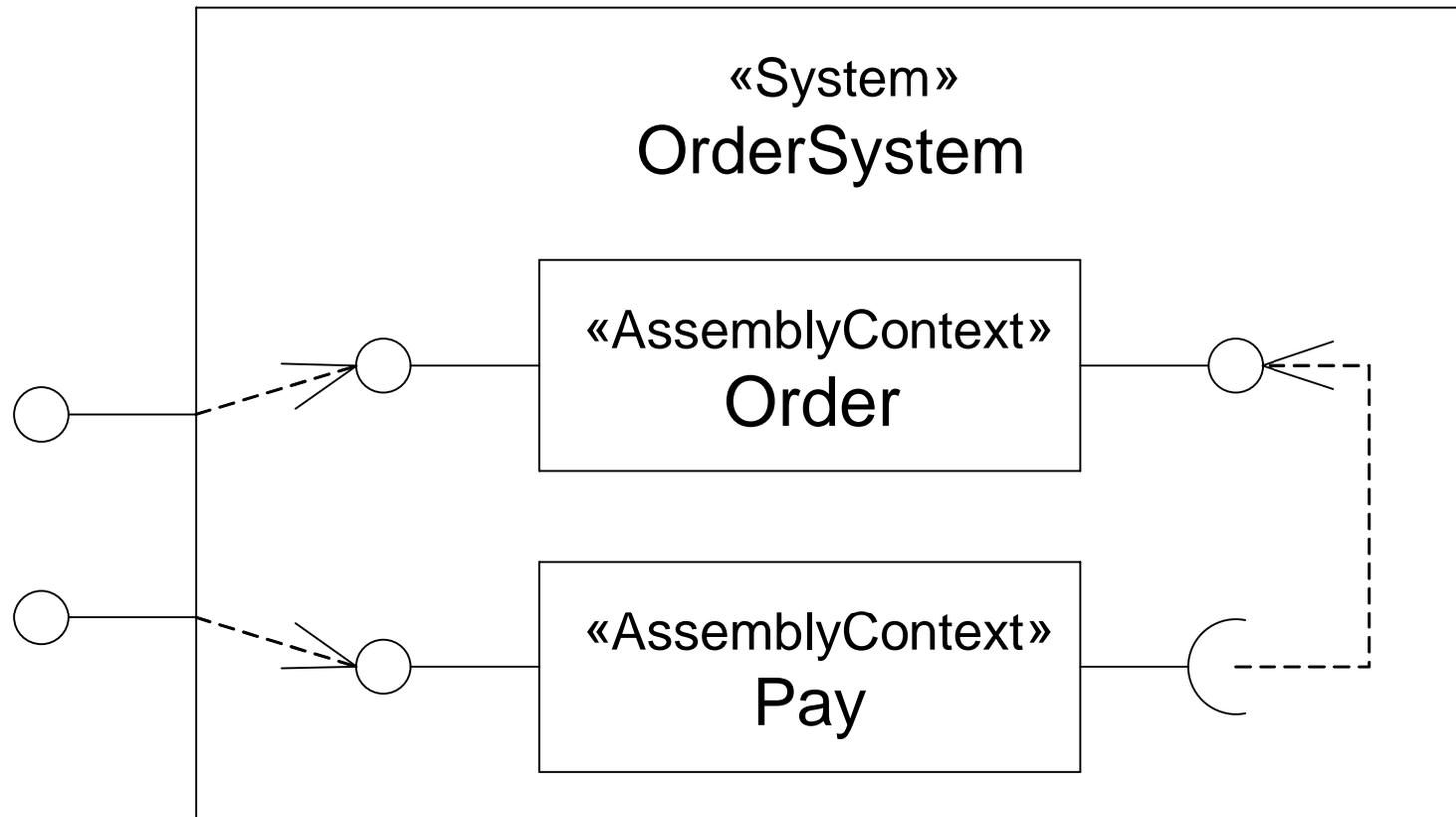
not covered

Motivation ➤ State of the Art ➤ Foundations ➤ Running Example ➤ **Mappings** ➤ Process ➤ Summary

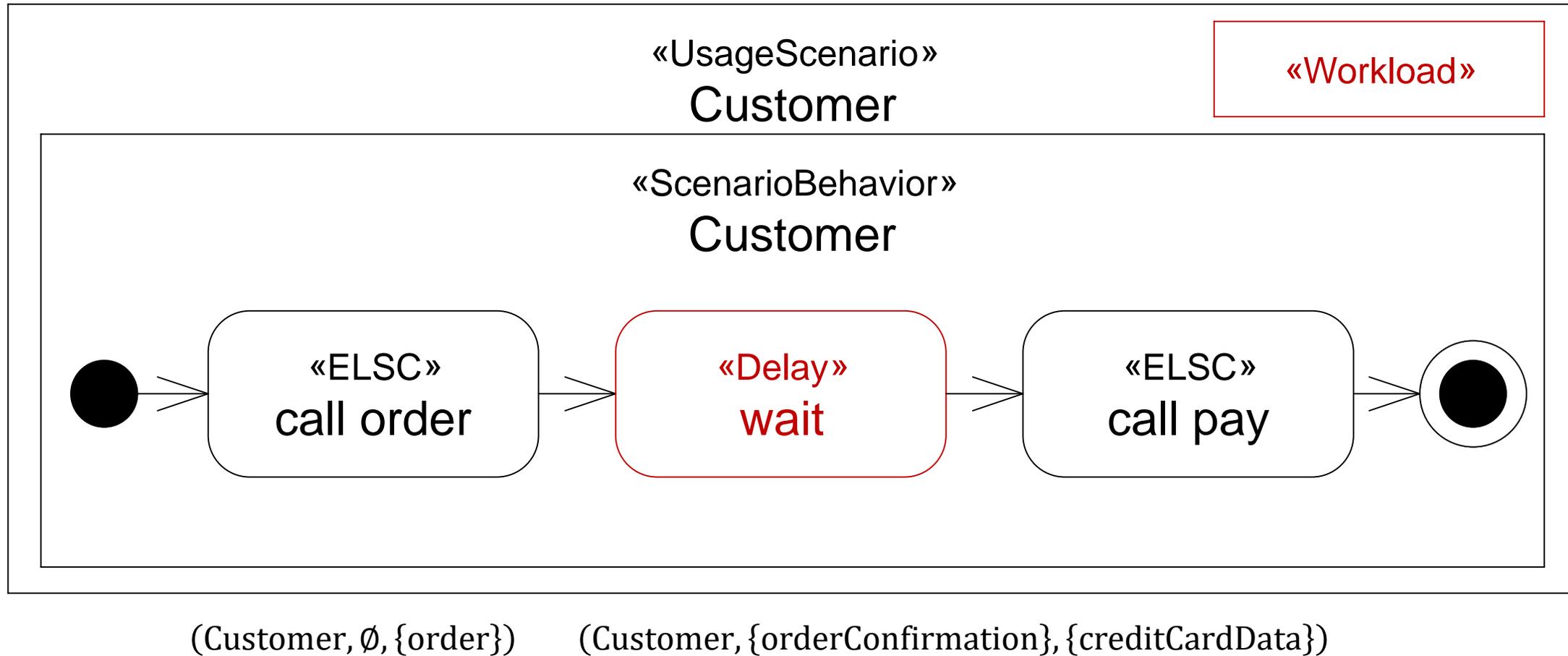
Structural View – Components



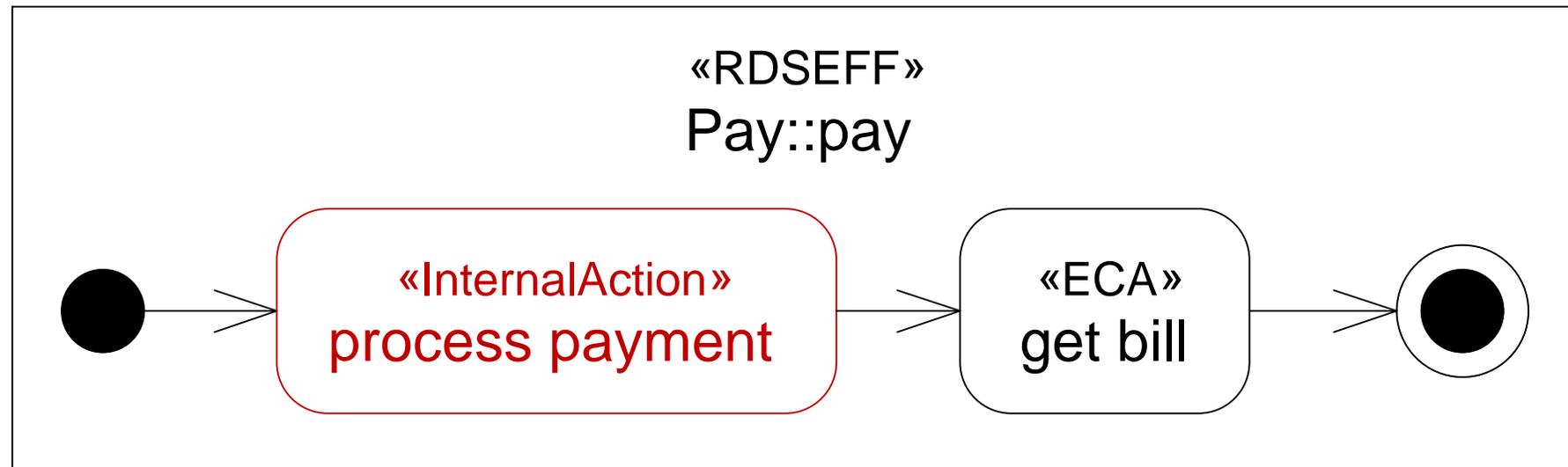
Structural View – System



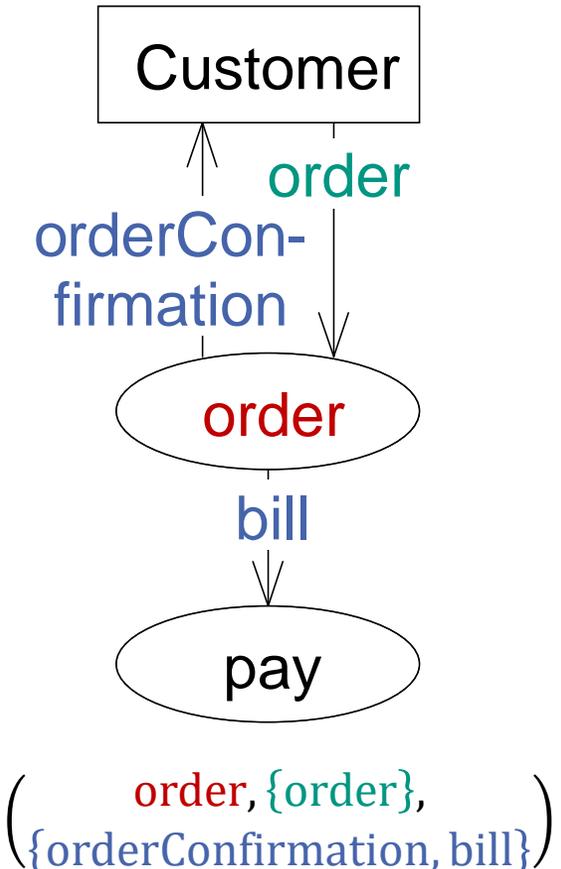
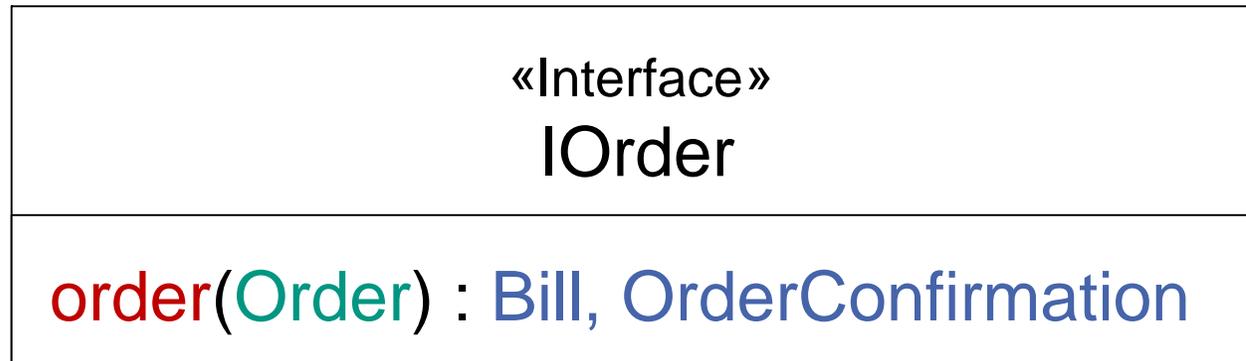
Behavioral View – Usage



Behavioral View – Component Behavior



Mapping Data Dependencies to Signatures

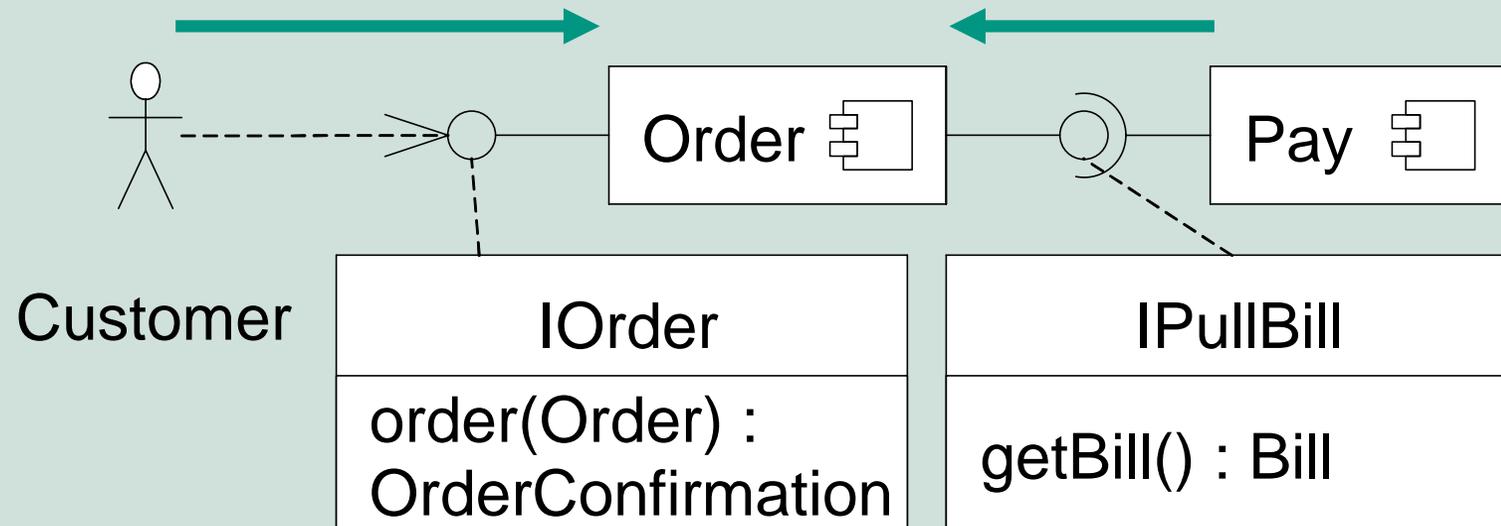


Assumptions

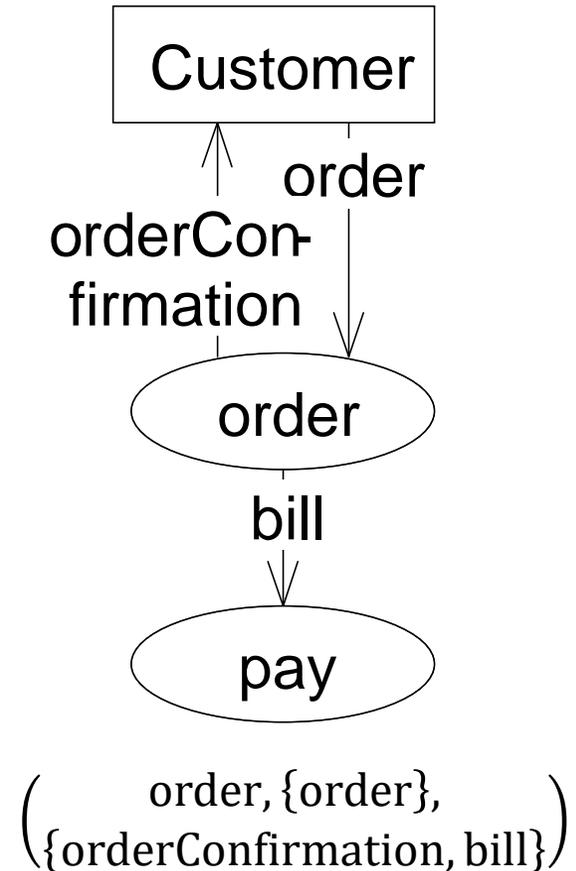
- Identification of caller
- All data has to originate from and go to caller

Handling Different Data Sources and Targets

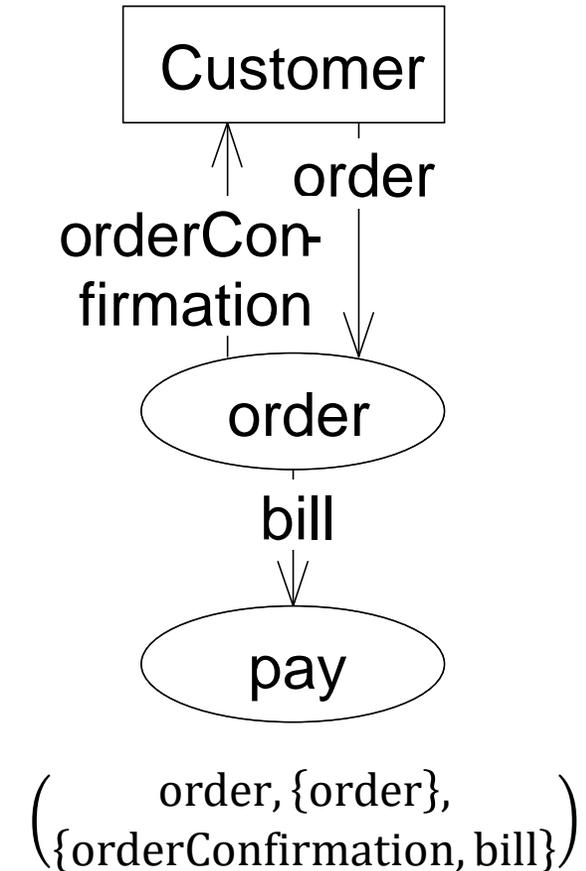
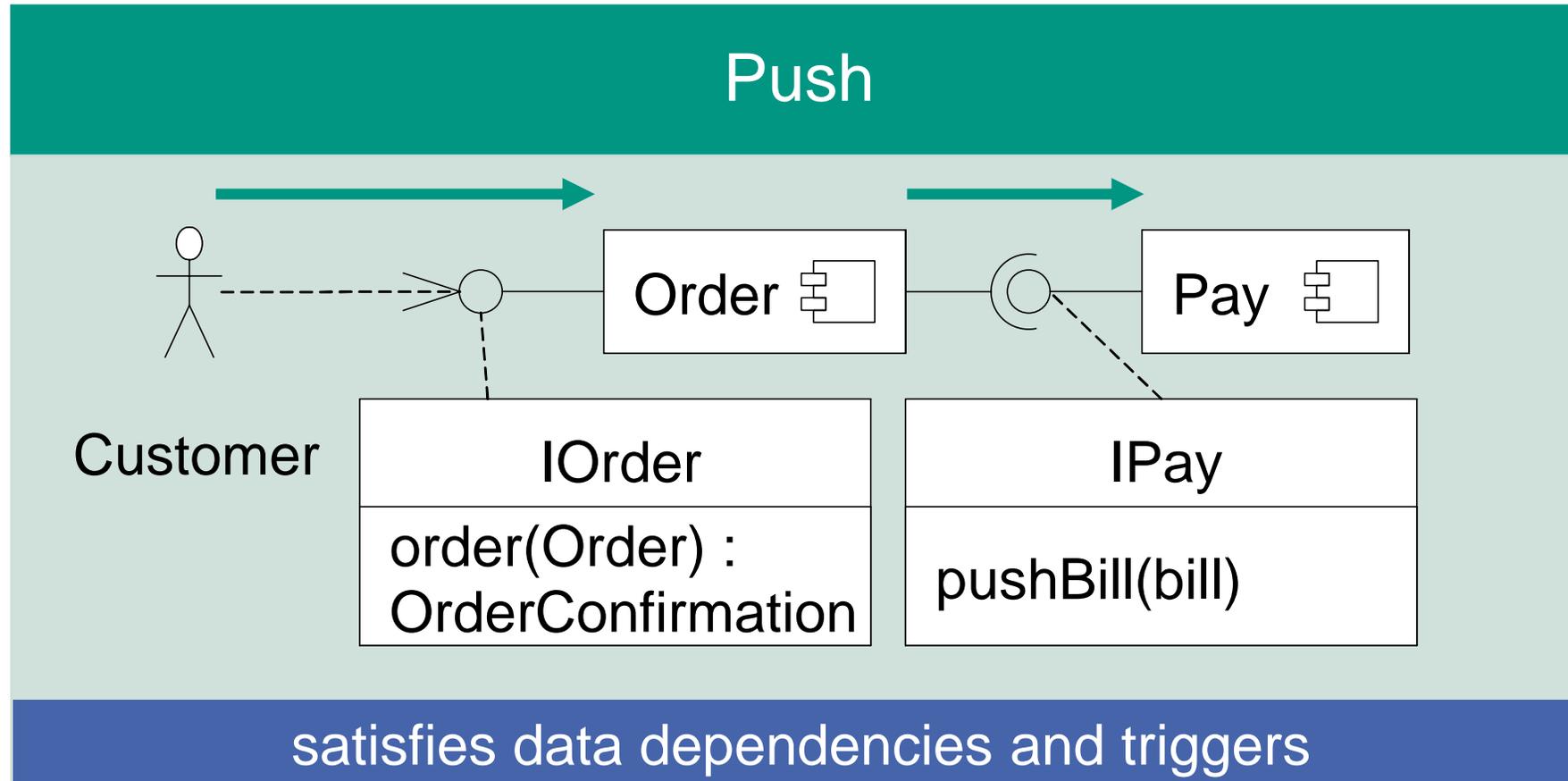
Pull



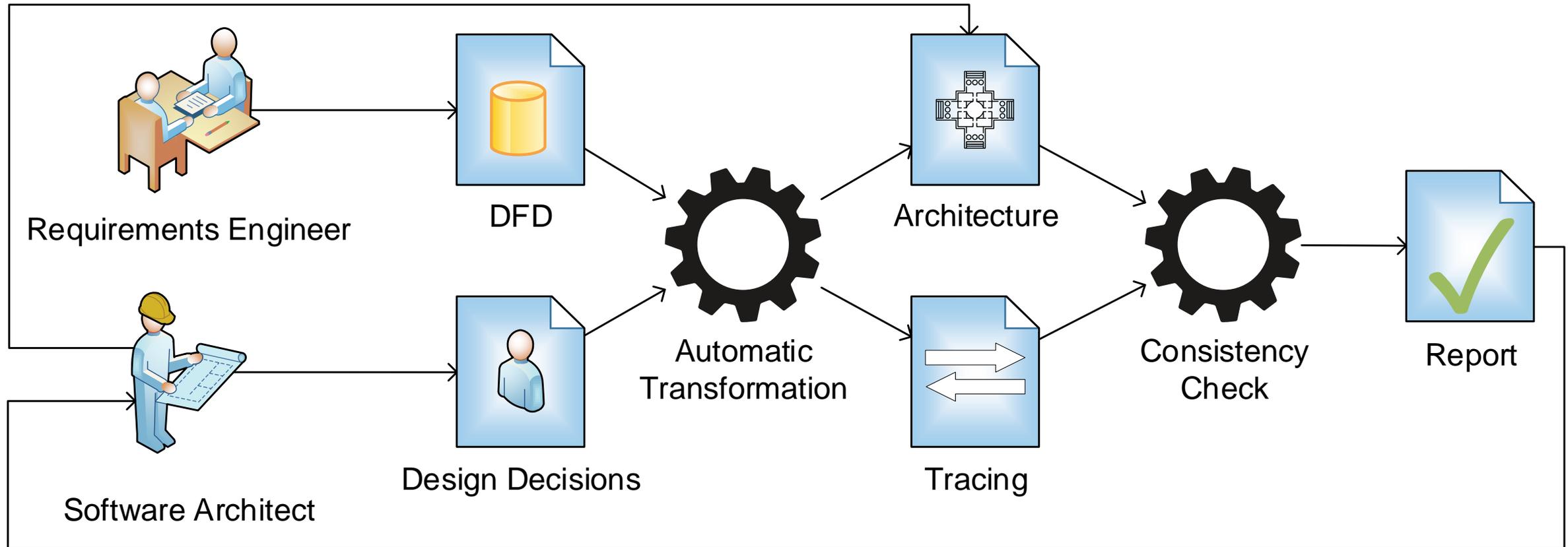
requirement: data must not be trigger for process



Handling Different Data Sources and Targets



Envisioned Development Process



Conclusion

Summary

- Motivation: DFDs and PCM instances tailored for different quality analyses
- Approach: Mappings from DFDs to PCM are possible but not trivial
- Customization: Considering design decisions necessary for realistic architectures

Envisioned Benefit

- Use best fitting models and analyses for quality prediction
- Lower effort for using both models together

Future Work

- Identify further call patterns and complete mappings
- Define set of selectable design decisions
- Realize automated transformation to apply mappings

Literature References

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P. T. Ward and S. J. Mellor. Structured development for real-time systems. Vol. 3: Implementation modeling techniques. Yourdon Press, 1986.
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B. Alabiso. “Transformation of Data Flow Analysis Models to Object Oriented Design”. In: OOPSLA'88. ACM, 1988, pp. 335-354.
- **[TsePong89]**
T. H. Tse and L. Pong. “Towards a Formal Foundation for DeMarco Data Flow Diagrams”. In: The Computer Journal 32.1 (1989), pp. 1-12.

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P. Brunza and T. van der Weide. The Semantics of Data Flow Diagrams. Technical Report TR 89-16. Dept. of Information Systems, University of Nijmegen, 1993.

- **[LarsenPlatToetenel94]**

P. G. Larsen, N. Plat, and H. Toetenel. „A Formal Semantics of Data Flow Diagrams”. In: FAOC 6.6 (1994), pp. 586-606.

- **[Reussner16]**

R. H. Reussner et al. Modeling and Simulating Software Architectures - The Palladio Approach. MIT Press, 2016.

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