Component-based Development
Process and Component Lifecycle

Crnkovic, S. Larsson, Michel R. V. Chaudron, 2005

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What is this paper about?

- This paper describes principle differences of component-based and non component-based development processes.
- Overview of a case study from a company that applies component-based approach.
Component-based Development Process and Component Lifecycle

- A CBSE approach requires certain changes in development and life cycle processes.

- Very few CBSE works, either research and practical, have addressed these topics.
Component-based Development Process and Component Lifecycle

• Component-based approach has in last years shown considerable successes in many application domains like:
  ▪ Distributed and web-based systems.
  ▪ Desktop and graphical applications.
Component-based Development Process and Component Lifecycle

**Lifecycle processes:**
All activities of a product or a system during its entire life, from the business idea for its development, through its usage and its completion of use.

**Main groups of models:**
Sequential and evolutionary models

- These models can be applied in a component-based development, but require adoption to the principles of component-based approach.
Component-based Development Process and Component Lifecycle

Basic activities present in any lifecycle process model:

1. Requirements analysis and specification.
2. System design.
3. Implementation and unit testing.
4. System Integration.
5. System verification and validation.
6. Operation support and maintenance.
Component-based Development Process and Component Lifecycle

• The main idea of the component-based approach is building systems from pre-existing components.

• CBSE addresses challenges similar to those encountered elsewhere in software engineering.
Component-based Development Process and Component Lifecycle

Difference between component development and system development with components:

- System development the emphasis will be on finding the proper components and verifying them.
- Component development, design for reuse will be the main concern.

• These activities can be performed independently of each other.
  • Many components are developed by third parties, and some developed internally in the organization.

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Component-based Development Process and Component Lifecycle

Component-based Development Process

Non component Development Process

Component-based Development Process

Component Development

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Draw back from previous figure:

- It shows a simplified and process.
- Its assumption is that the components selected are close to the units identified in the design process.
- It does not consider what happens in the maintenance process.
A Detailed development process for CBD
Component-based Development Process and Component Lifecycle

Development process for CBD:

1. Requirements analysis and specification.
   - It is necessary to analyze whether these requirements can be fulfilled by available components.
   - Negotiate the requirements and modify them to be able to use the existing components.
Component-based Development Process and Component Lifecycle

Development process for CBD:

2. System design:

- It is also related to the availability of the components.

- Particular component model requires a particular architectural framework, and the application is supposed to use this framework. This directly has impact on architectural decisions.
  - component model requires a client-server architecture style, it is obvious that the application will use that style and not another.
Component-based Development Process and Component Lifecycle

Development process for CBD:

3. Implementation and unit testing:

1. select components.
2. adapt components (connect components).
3. test components.

4. System Integration:

Integration of standard infrastructure components that build a component framework and the application components.
Component-based Development Process and Component Lifecycle

Development process for CBD:

5. System verification and validation:

The specific problem for component-based approach is location of error, especially when components are “black box” type and delivered from different vendors.
Development process for CBD:

6. Operation support and maintenance:

• Similar to the implementation process.
• An existing component will be modified or a new version will be integrated into the system.
• Incompatibility between components, or by broken dependencies may occur, so the system must be tested.
Component-based Development Process and Component Lifecycle

Difference between Component-based Development and non Component-based Development:

In a component-based development process there are:

- **Less** efforts in programming.
- **More** efforts on dealing with components; locating, selecting.
- **More** efforts on verification and testing require.

The verification activity repeats in several phases, with different goals:

- In an isolation.
- In an assembly.
- When a component has been deployed into the system.

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Building reusable components:

- The process of building components can follow any development process model.
- Reusability, generality, flexibility, and portability are main concerns.
- The component development will require more efforts in testing and documentation to increasing understanding of the component.
Industrial Case of component-based process model

- A large international company in consumer electronics.

- The development divisions of the company are placed in four different countries and they produce numerous products with different variants and models.
Industrial Case of component-based process model

- The company has adopted component-based development.

- The component is internally developed and most of the tools are also internally developed.
Industrial Case of component-based process model

Product Software Architecture

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Industrial Case of component-based process model

Overall development process

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Industrial Case of component-based process model

• This process deliver new products every 6 months, while the development of subsystem components takes between 12 and 18 months.

• The overall development and production is successful, but the processes have several problems:
  1. Late discovery of errors, due to interface or architectural mismatches
  2. Insufficient specifications of semantics of the components due to inappropriate interfaces.
  3. Encapsulation of a service in components often occur.
Industrial Case of component-based process model

All these problems point out that it is difficult to perform the processes independently; negotiation between different subsystems and agreements in many technical details.
Industrial Case of component-based process model

- We can observe that project teams have many “non-productive” stakeholders.

- Because of component-based approach – more efforts must be put on overall architecture and test, and less on the implementation itself.

Project organization structure

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Conclusion

- A component-based approach cannot be fully utilized if the development organizations are not adopted the basic principles of CBSE.

- This approach aims for increased reusability of existing components, less implementations, and more verification.
Conclusion

• By an industrial case study we have pointed out:
  – The difficulties to achieve a complete separation of the development processes of systems.
  – Need for a project organization which puts a more important role on the **architectural** issues, and system and components **verification**.