A conceptual framework to apply Sakai with contract and its practical implementation

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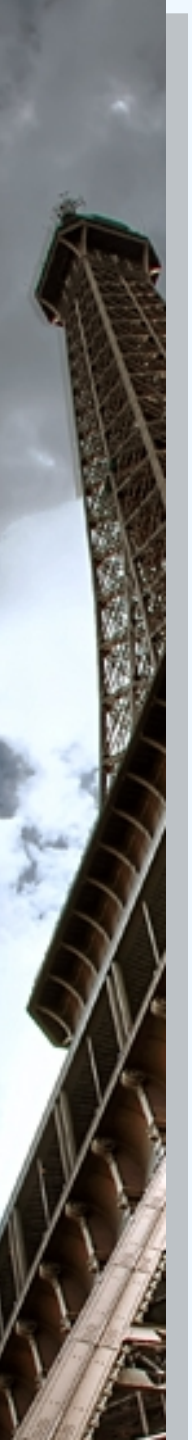


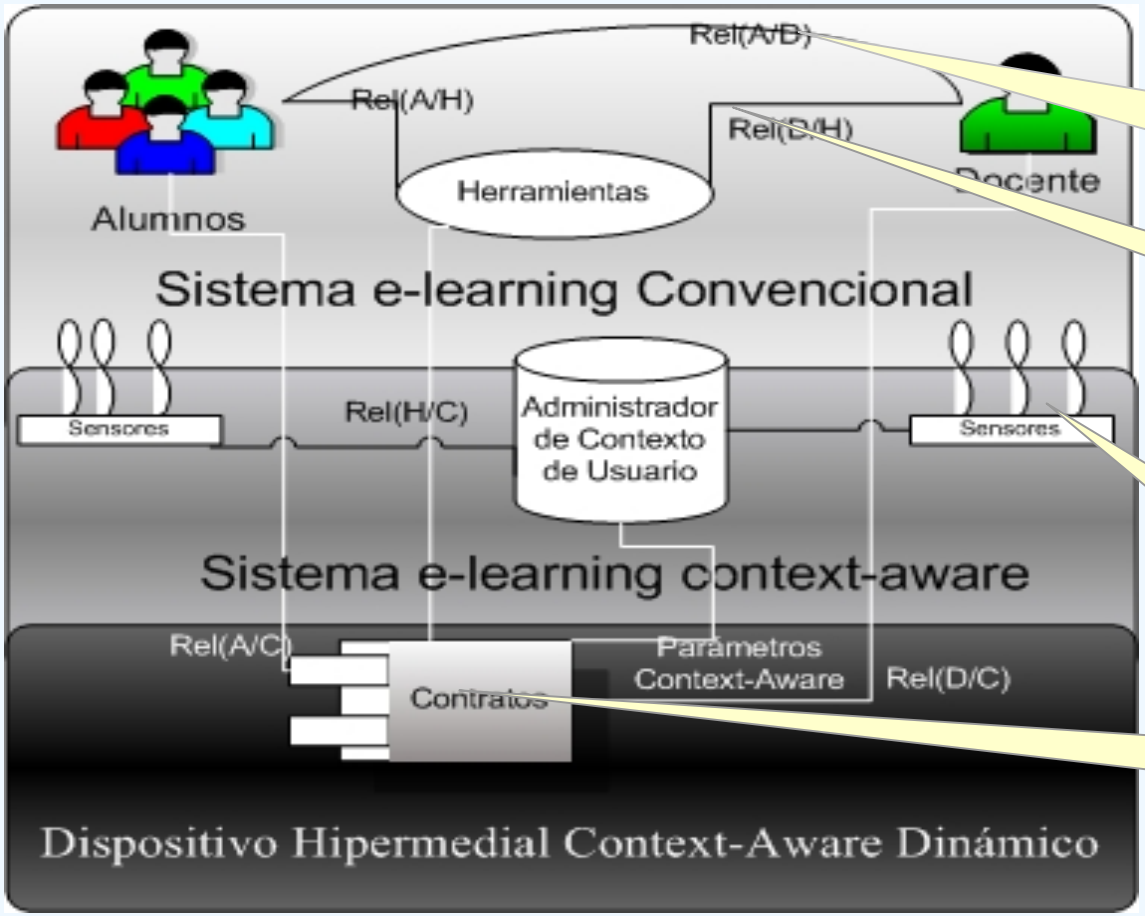
Overview

Topics

- How to assist a new kind of requirement of e-learning under the perspective of Dynamic Hypermedia Device (DHD).
- Technological aspect about the evolution of Sakai towards Sakai with Contract.
- Our proposal of implementation of contracts to Sakai.

Technological aspect about the evolution of Sakai towards Sakai with Contract

Levels of evolution



Components to study (*Theory*)

- Complex relationship *(Complex System)*
- Common relationships *(e-learning)*
- Sensors *(Application context-aware)*
- Piece of Software *(DHD)*

DHD's requirement

Requirement definitions

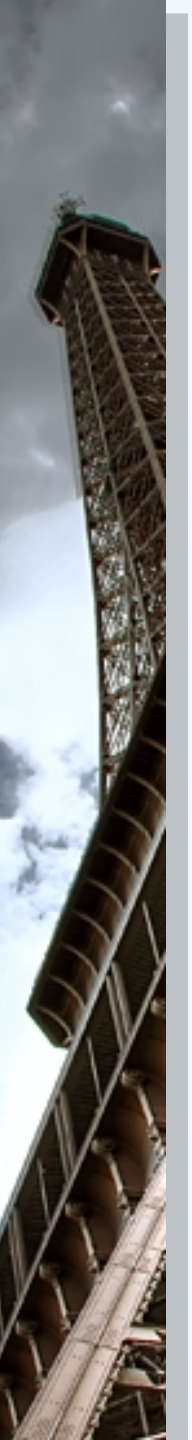
- Reflect in the system's architecture the differents level of changes (in run time) which are produced on the relationship under DH domain.
- Support evolution through the dynamic reconfiguration, without the services interruptions and minimizing Its impact in the global system.
- Obtain Hypermedial / Relation adaptation with context-aware aspects.

DHD's requirement

Requirement definitions

- Superposition captured through morphisms and universal constructions (colimits).

- Separation between computation and coordination captured through functors that map systems to coordination interfaces

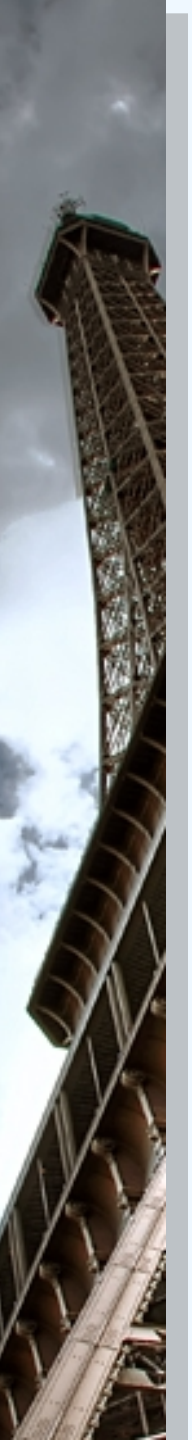


Contract to Sakai

Our interpretation of contract:

Contract is an abstraction for the modelling of interconnections. Whereas design-by-contract (B. Meyer) allows compile-time object-oriented interactions, we propose a notion of "composition contract" which allows run-time integration of services.

In general terms, a coordination contract is a connection that is established between a group of objects (i.e. participants). Through the contract, rules and constraints are superposed on the behavior of the participants, which determines a specific form of interaction. From a static point of view, a contract defines what in UML is known as an *association class*.



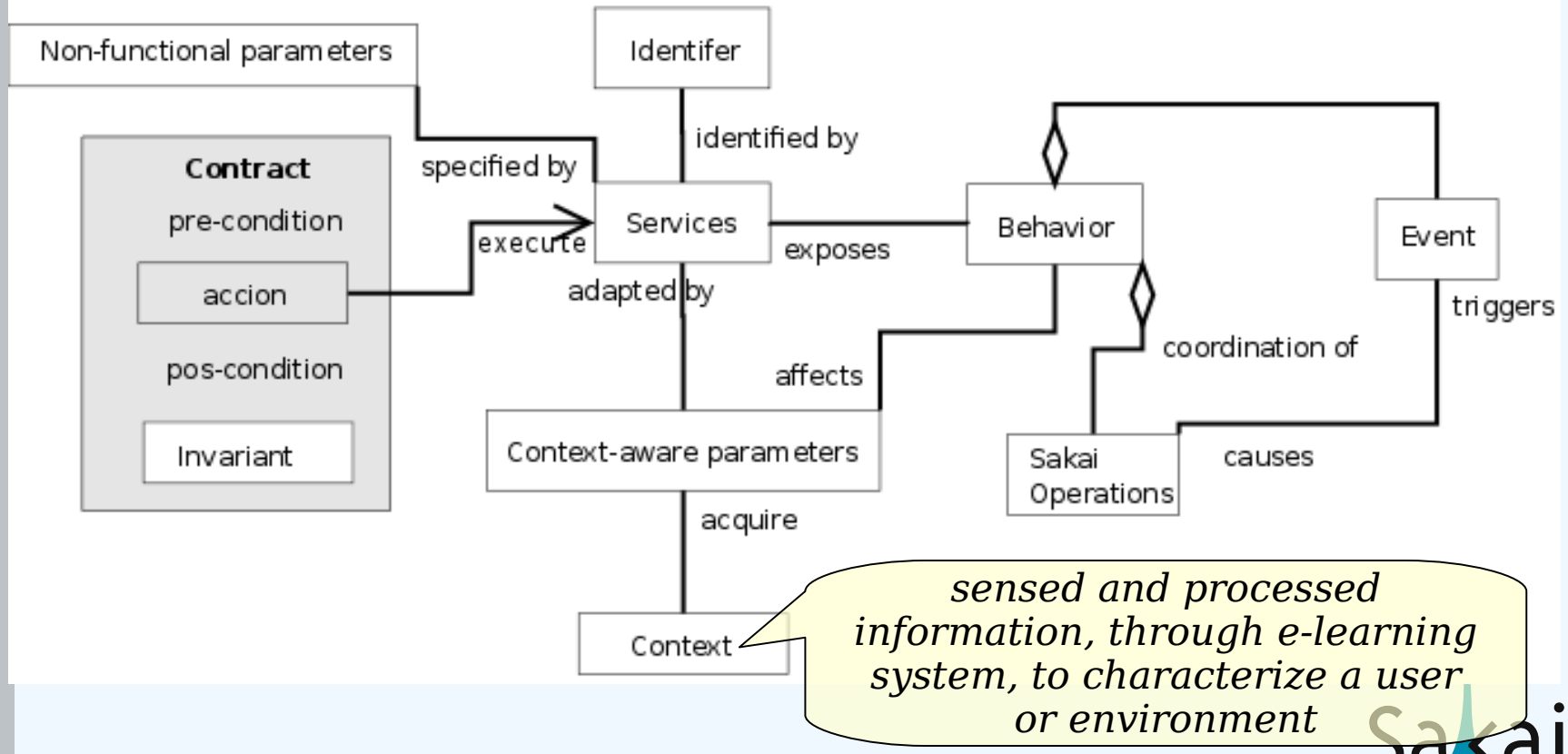
Our interpretation of contract to Sakai

The characteristics of contracts:

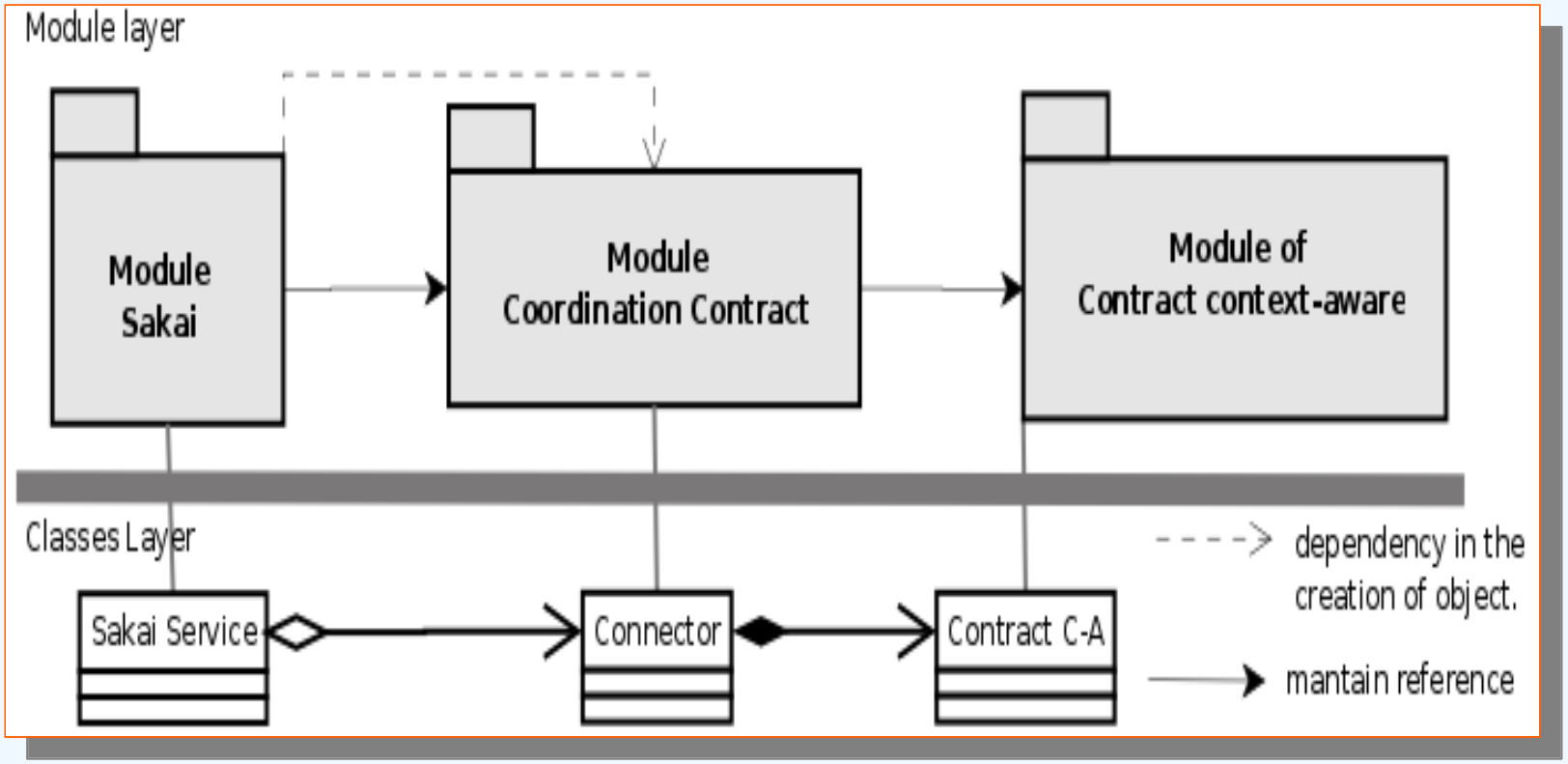
- A contract is a connection among objects (participants).
- A contract possesses rules and constraints on the behaviour of the participants.
- It is similar to association class in UML.
- A contract is a black-box.
- It is not accessible from other objects.
- It may be dynamically changed.
- It has been implemented with Java

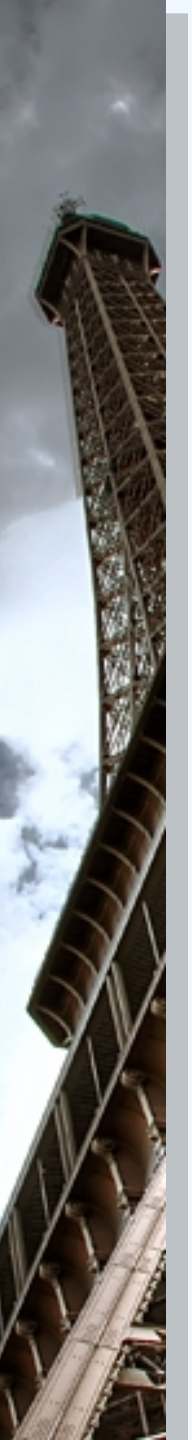
Contract with context-aware behaviour

Conceptual model of contract with context-aware behaviour proposed in the book *"Towards a Dynamic Hypermedial Device: Education and Research for the interactive audiovisual field" - Physical - Virtual Book (http://www.mesadearena.edu.ar)*. San Martín 2008



Integration Model of Sakai with Contract





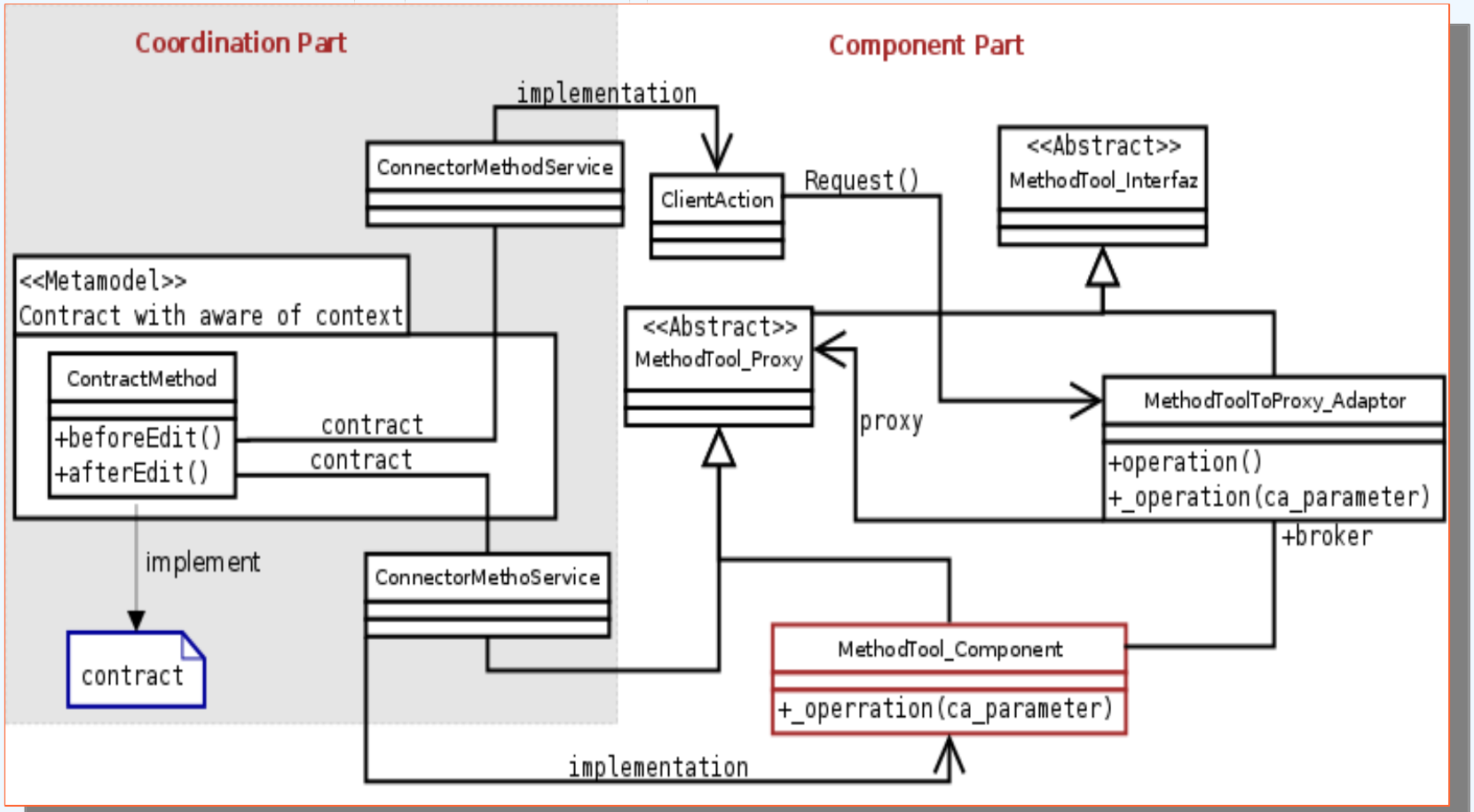
Using pattern to implement a coordination contract in Sakai (I)

The main requirements of the pattern can be divided into two categories:

1. General architecture requirements
    1.1 the ability to coordinate the behaviour of software components.
    1.2 minimising the number of required changes to the original components
    1.3 add and delete contracts in a “plug and play” mode.

2. “low-level” design requirements.
    2.1 Satisfy the semantics of contracts
    2.2 Optimise performance

Using pattern to implement a coordination contract in Sakai (II)



Use case to implement contract in Sakai (I)

Original Sakai Code

Step 1:
Take a original Sakai code file #0

```
import org.sakaiproject.discussion.api.DiscussionMessage;
import org.sakaiproject.discussion.api.DiscussionService;
public class DiscussionService extends BaseDiscussionService{
public MessageEdit editMessage(MessageChannel channel, String id){
return (MessageEdit) super.editResource(channel, id);
}
```

Step 2:
generation a file #1

Step 3:
generation a file #2

Use case to implement contract in Sakai (II)

1. Coordination contract and context-aware frameworks is imported

Step 4: generation a file #1

```
package org.sakaiproject.discussion.impl;
  import java.util.*;
  import cde.runtime.*;
  import obab.ca.*; // Framework context-aware

public abstract class DiscussionService extends

BaseMessageService implements

DiscussionService, ContextObserver,EntityTransferrer,
  ForoInterfac
```

Use case to implement contract in Sakai (III)

2. Added method by the Tool SwC (Sakai with Contract) to the indentification of classes which will be intercepted through the contract.

Step 5: generation a file #1

```
public long _getNumber() {
new ComponentOperationEvent(this, "getNumber").fireEvent();
return number; }
public messageEdit editMessage(MessageChannel channel, String
  id){
new ComponentOperationEvent(this , "Edit").fireEvent();
return (MessageEdit) super.editResource(channel, id);
}
```

Use case to implement contract in Sakai (IV)

3. Method which implement the caller of client object to Proxy.

Step 6: generation a file #1

```
protected CrdIProxy _proxy;
private static Class _classId= Sakai.Discussion.class;
public static Class GetClassId() {return _classId;}
public CrdIProxy GetProxy() { return _proxy; }
public void SetProxy( Object p ) {
if ( p instanceof CrdIProxy && p instanceof
DiscussionInterface) _proxy = (CrdIProxy)p; }
public void SetProxy(CrdIProxy p) { _proxy = p; }
AccountInterface GetProxy_Account() {
  if ( _proxy == null ) return null;
return (DiscussionInterface) _proxy.GetProxy(_classId);}
```

Use case to implement contract in Sakai (V)

*1. Portion of code where is imported the components of the different framework, the abstract classes are inherited from the connectors and proxys. The class of real object "MethodServiceComponent" is represented through the **subject** attribute.*

Step 7: generation a file #2

```
package org.sakaiproject; import java.util.*;
  import cde.runtime.*;
  import obab.ca.*;

public abstract class IDiscussionPartner extends

CrdContractPartner implements CrdIProxy, DiscussiontInterface {

protected Discussion subject;
```

Use case to implement contract in Sakai (VI)

2. Definition of the abstract method for the connection of the contract (implemented as "connectorMethodService" in the above pattern) with the services.

Step 8: generation a file #2

```
public void SetProxy(Object p) {subject.SetProxy(p);}
protected Object GetSubject_Object() { return subject; }
public void ResetProxy() { subject.SetProxy(null); }
```

Use case to implement contract in Sakai (VII)

3. Method which permit the access to the methods that defines the services (e.i. methods belonging to MethodServicesComponent class)

Step 9: generation a file #2

```
protected Discussion GetSubjectDiscussion()
  {return (Discussion) subject;}

protected IDiscussionPartner GetNextPartner_Discussion(){

return
  (IDiscussionPartner)GetNextPartner(Discussion.GetClassId());}
```

Use case to implement contract in Sakai (VIII)

*4. Implementation for defect of methods defined in the interfaces of the services. Through the method "**GetSubjectDiscussion()**" which was detailed above, can be reached the methods which was made by de SwC tools belonging the first files.*

Step 10: generation a file #2

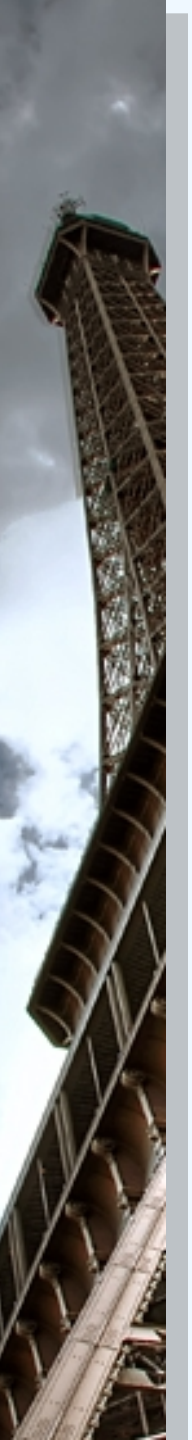
```
public void messageEdit (double amount,Customer c)throws
  DiscussionException {
IDiscussionPartner next = GetNextPartner_Discussion()
if (next != null) next.editMessage(amount,c);
else GetSubjectDiscussion()._editMessage(amount,c);
}
```

Use case to implement contract in Sakai (VIII)

5. Implementation of the conditionals of the contracts rules which are saved a XML files.

Step 11: generation a file #2

```
public CrdPartnerRules messageEdit_rules(string
  text,Student c) throws
DiscussionException, CrdExFailure {
 return new CrdPartnerRules (this);
}
```



Conclusion

The possibility of use coordination theory of contract as a way to implement some types of DHD's requirement used in:

- Design.
- Representation of DHD's relationship.

We invited you to see our next exposition called:

Towards a Dynamic Hypermedial Device (DHD)

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Argentina