XML-BASED IMPACT ANALYSIS USING CHANGE-DETECTION APPROACH FOR SYSTEM INTERFACE CONTROL

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Abstract: In this paper, an XML-based approach is presented for the impact analysis of interface control in sustained systems. Once a system is completed developed, it goes into a sustained phase supported by many interfaces. As new technologies develop, updating and maintaining such systems require non-trivial efforts. A clear pre-requisite before the deployment of a new system is to clarify the influence of changes on other systems connected through interfaces. However, as each sustained system manages its own information separately, integrating relevant information among the interfaced systems is a major hurdle. In our approach, the XML technology is applied to support impact analysis for interface control architecture using change-detection approach for the reference. In particular, I focus on messaging interface issues in Health Level Seven typically used in medical information system and propose a scheme to represent message information that can be used for the decision support of interface impact between sustained systems.

1 INTRODUCTION

System engineering efforts are vital to make decisions before making system changes associated with new requirements. In large-scale system, many supporting engineers would be involved in the engineering process through the technical committee. As system environments change rapidly and engineering change efforts for impact analysis increase significantly, many documentation is considered to carefully examine in terms of non-functional view as well as functional perspective. *Engineering Change Proposal (ECP)*, which is one of the key documentation for configuration management, contains the description about change requests/requirements and how they should be reviewed and implemented(Arnold, 1993). The proposed approach, therefore, is the extended framework with impact analysis for interface control using change-detection approach with XML like Figure 1.

This paper suggests an effective process and method to consider interface control requirement during the impact analysis. For dealing with the interface control, change detection approach (CDA) for impact analysis is discussed as a lightweight tool. In order to handle, interface control requirement, engineering change proposal (ECP) for impact analysis are covered.(Yoo, 2004)

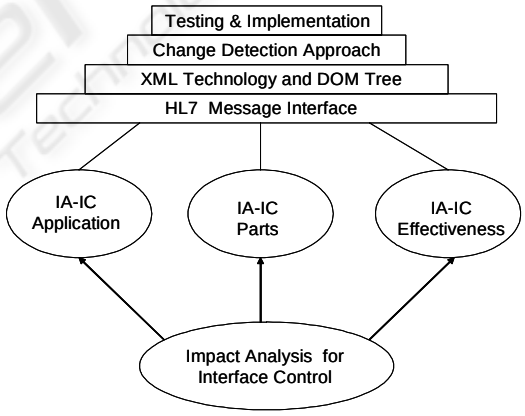

Figure 1: Extended Impact Analysis for Interface Control (IA-IC) Framework

Also, since there is system resource information without specification, common vehicle to exchange information effectively is required. In this paper, *Extensible Markup Language (XML)* technology is used for supporting engineering change efforts for impact analysis. An XML is widely used as a standard for information exchange on the World Wide Web.(W3C, 2000)

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2 BACKGROUND AND PROBLEM STATEMENTS

Under considering an world-wide deployed US health system involving 8 sub-systems A through H with more than 50 to 200 sites, a impact analysis for interface control is essential for decision-making.

Consider the interface between systems A and B. The *Health Level Seven* (HL7) protocol messaging supported by the interface engine between A and B is given in Figure 2 as an example from.

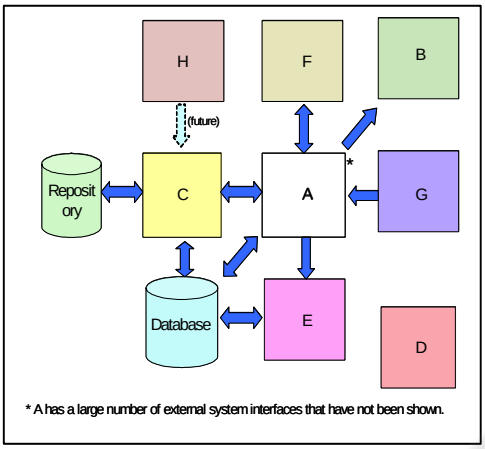


Figure 2: Sustained System Interface Architecture

In table I, the several cases for change are presented. In change cases (1-3), even though it may takes for a while to find out the result whether or not to analyze the impact, system engineer can say Yes or No. But the analysis result is dependent to their knowledge and experience. And there are many cases existed not for sure.

Table I: Change Case Table for the system

Change Case	System A	System B
1	Insert	Yes/No
2	Delete	Yes/No
3	Update	Yes/No
4	Volume	N/A
5	Environment	N/A
6	Combined	N/A

If change cases (4-6) are considered, the situation for system impact analysis for interface control is getting harder than previous case. For example, if the messaging volume of the system A is 25% increasing, how much of system B is affected by this change in terms of performance. What about the system interface impact when the system A change the security policy and install the new security patch at the same environment? Is this change providing impact for the system B? In order to solve the problem caused by change, the system testers need to be involved more system and sustained system project schedule is delayed accordingly. Creating ECP for Configuration Management (CM) should be required.

3 XML-BASED IMPACT ANALAYSIS FOR INTERFACE CONTROL

In this paper, the way to do system impact analysis is discussed for system engineer more effectively and accurately in time manner. The situation of change request based on health system using HL7 protocol is considered. And the effective representation is addressed using XML.

```
<?xml version="1.0" encoding="EUC-KR"?>
<HL7import>
  <Segment1>MSH
    <Element1>
        <Field1>^</Field1>
        <Field2>~</Field2>
        <Field3>\</Field3>
        <Field4>amp</Field4>
    </Element1>
    <Element2>ADT1</Element2>
    <Element3>MCM</Element3>
    <Element4>LABADT</Element4>
    <Element5>198808181126</Element5>
    <Element6>Security</Element6>
    <Element7>
        <Field1>ADT</Field1>
        <Field2/>
        <Field3>A01</Field3>
    </Element7>
    <Element8>MSG00001</Element8>
    <Element9>P</Element9>
    <Element10>2.3.1</Element10>
  </Segment1>
  <Segment2>EVN
    <Element1>A01</Element1>
    <Element2>198808181123</Element2>
  </Segment2>
<Segment3>PID
    <Element1>1</Element1>
    <Element2>
        <Field1>PATID12345</Field1>
        <Field2>M11</Field2>
        <Field3>ADT</Field3>
    </Element2>
    <Element3>MR</Element3>
<Element4>
        <Field1>MCM</Field1>
        <Field2/>
        <Field3>123456789</Field3>
        <Field4/>
        <Field5/>
        <Field6>USSSA</Field6>
        <Field7>SS</Field7>
    </Element4>
    <Element5>
        <Field1>JOHNES</Field1>
        <Field2>WILLIAM</Field2>
        <Field3>A</Field3>
        <Field4>III</Field4>
    </Element5>
    <Element6>M-</Element6>
    <Element7>C</Element7>
    <Element8>
        <Field1>1200</Field1>
        <Field2>N</Field2>
        <Field3>ELM</Field3>
        <Field4>STREET</Field4>
        <Field5/>
        <Field6>GREENSBORO</Field6>
        <Field7>NC</Field7>
        <Field8>27401-1020</Field8>
</Element8>
    <Element9>GL</Element9>
    <Element10>(919)379-1212</Element10>
    <Element11>(919)271-3434</Element11>
    <Element12>S</Element12>
    <Element13/>
        <Field1>PATID12345001</Field1>
        <Field2>2</Field2>
        <Field3>M10</Field3>
        <Field4>ADT1</Field4>
        <Field5>AN</Field5>
        <Field6>A</Field6>
<Element14>123456789</Element14>
    <Element15/>
        <Field1>987654</Field1>
        <Field2>NC</Field2>
  </Segment3>
  <Segment4>NK1
    <Element1>1</Element1>
    <Element2>
        <Field1>JOHNES</Field1>
        <Field2>BARBARA</Field2>
        <Field3>K</Field3>
    </Element2>
    <Element3>
        <Field1>WI</Field1>
        <Field2>WIFE</Field2>
    </Element3>
    <Element4>
        <Field1>NK</Field1>
        <Field2>NEXT OF KIN</Field2>
    </Element4>
  </Segment4>
  <Segment5>PV1
    <Element1>1</Element1>
    <Element2>I</Element2>
    <Element3>
        <Field1>2000</Field1>
        <Field2>2012</Field2>
        <Field3>01</Field3>
    </Element3>
    <Element4>
        <Field1>004777</Field1>
        <Field2>LEBAUER</Field2>
        <Field3>SIDNEY</Field3>
        <Field4>J.</Field4>
    </Element4>
    <Element5>SUR</Element5>
  </Segment5>
</HL7import>
```

Figure 3: Converted XML from HL7 Sample Message

Figure 3 is the corresponding representation of HL7 example. XML representation is more understandable for system engineer and scalable to different format for future needs. Whenever

appropriate, it can be possibly triggered and converted by the development.

Figure 4(upper part) depicts the ideal data flow among the different modules in this interface. The HL7 message received by the communication modules from the external system goes to the HL7 engine module. After the HL7 engine module edits the HL7 message, it passes the decoded data to the queue and the encoded acknowledgement back to the communication module. The communication module then sends back the acknowledgement to the external system. The parsed data stored in the queue will then be mapped and sent to the receiving system/HL7 internal file. Likewise, if the edit is not successful, no data will be sent to the parsed/destination file.

Figure 4 (lower part) shows the XML based information architecture mapping to each offline or online assets. Our focus is regarding offline assets such as documents and data dictionary. Using these artifacts, the DTD and Document XML are generated. However as there exist some inconsistency or some gaps between the document and real system, it is also required to verify the information using online log file and parsed data.

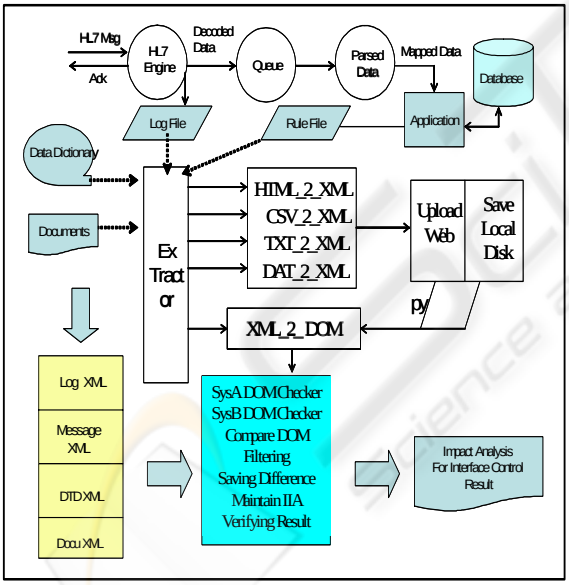


Figure 4: Proposed XML based IA-IC Architecture

As defined by HL7 standard, each message is composed of logical groupings of data entities, named message, segment, and elements. Some segments may be optional or repeatable in a message. Figure 5 depicts the logical structure of the entities and some examples.

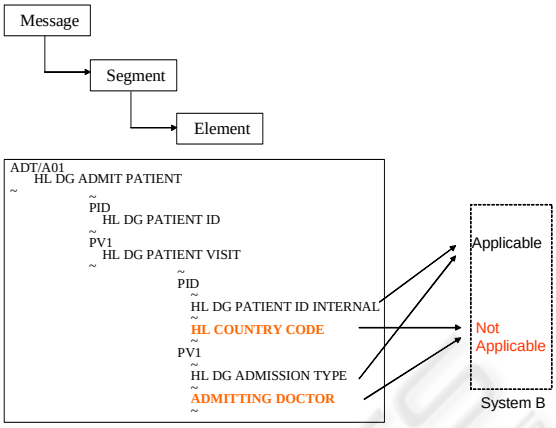


Figure 5: HL7 Example for IA-IC

Based on the testing for the research with XML-based representation, an HL7 message transferred from system A to system B used is found only about 30% of the time in terms of message-level and only 50% of the messages are being used if I consider element-level. In other words, by using XML-based message modeling the meaningful portion of messages is identified for decision-making and is managed the part required to enhance interface impact analysis as well as updating impact analysis for each system.

4 CHANGE-DETECTION APPROACH

The time for efforts and potential error is mitigated.

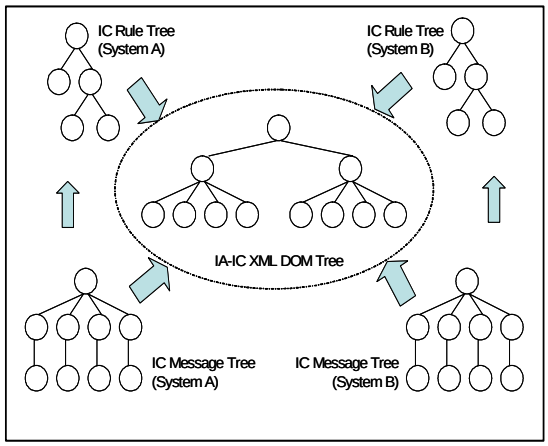


Figure 6: IA-IC XML DOM Tree

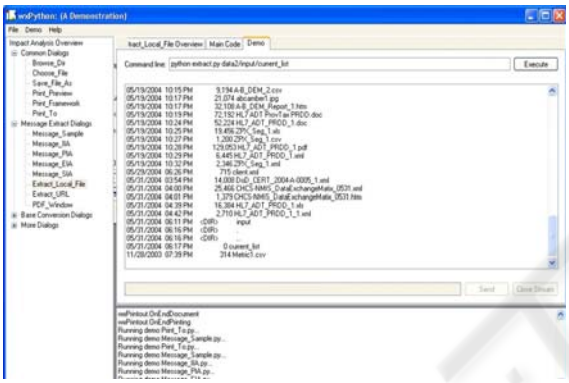
This paper suggests extended IA-IC tree by considering combined scheme with HL7 testing and change detection approach by XML technology.

Figure 6 is an example of DOM integration with message trees and rule trees.

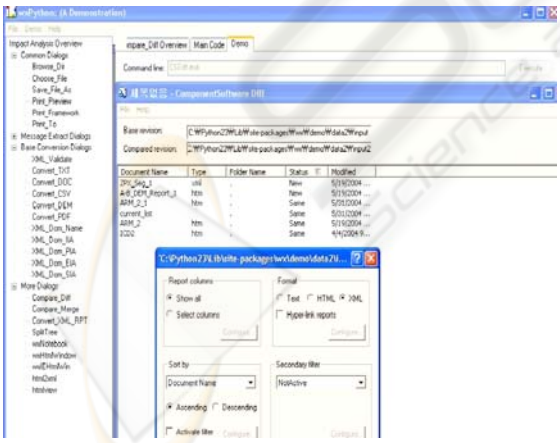
For traversing the information under the XML DOM tree structure, given algorithm using XPath and XSLT is used. XPath takes a navigational approach for specifying the nodes to be selected, hence a large number of navigational axes have been defined in XPath.

5 IMPLEMENTING XML-BASED IA-IC

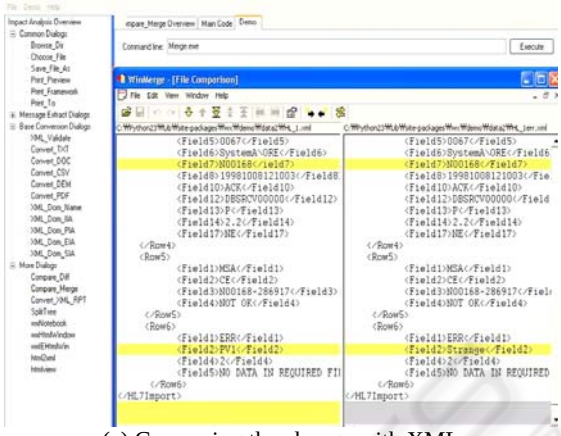
A common environment as shown(Figure 7) can be built for the simulation of the performance requirement and the impact analysis on the interface.



(a) Extracting the change of artifacts



(b) Comparing the difference of control documents



(c) Comparing the change with XML

Figure 7: Executable IA-IC Architecture Implementation

6 CONCLUSIONS AND FUTURE WORK

The engineering issues are discussed to meet changing functional requirement in systems maintenance phase. In particular, the impact analysis for interface control is focused on in the presence of interface requirement and performance requirement in large scaled sustained system. A baseline using XML-based representation to handle changing functional requirements is considered with the process for impact analysis. The XML-based change-detection approach enables supporting engineers' collaboration effectively to meet the limited time requirement. Through a health system example, engineering steps are addressed for integrating information and sharing analysis result during ECP process.

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