

A Practical Perspective on the Design and Implementation of Enterprise Integration Solution to improve QoS using SAP NetWeaver Platform

K.KRISHNA MOHAN, A.K.VERMA, A.SRIVIDYA
Reliability Engineering Group, Department of Electrical Engineering,
Indian Institute of Technology Bombay, Mumbai – 400076, INDIA

and

Ravi Kumar GEDELA
Centre of Excellence- SAP, Satyam Computer Services Limited, India

Abstract

Most of the enterprise operations require information from several systems within and outside the enterprise(s). The past few years have seen explosive growth in direct program to program interaction for application integration, removing manual steps yielding tremendous improvements in reliability and efficiency.

This paper addresses the practical approach for the design and implementation of Enterprise Application integration in a heterogeneous environment with SAP NetWeaver Platform (i.e. Exchange Infrastructure (XI)/Process Integration (PI)) using a Customizable Tool named TEmplate based Functional Requirements for Integration Design (TEFRID) developed by the author(s) to improve the Quality of Service (QoS) and reduce the development time and cost with the end-to-end scenario development.

Key Words- Enterprise Application Integration (EAI), Adapters, Automation, Implementation, SAP NetWeaver Platform

1. INTRODUCTION

Providing integration solution between both SAP [1] and non-SAP systems with heterogeneity in the landscape is a big challenge to an organization. Different challenges to overcome; such as maintaining interfaces, reusability, productivity, quality of service, scalability and throughput have to be met. Towards this end, usage of SAP XI as a middleware is proposed. When the operating model of an organization has several departments/systems such as sales, purchase, orders etc., some of these systems together can be converted to a single SAP system. Suppose there are 200 systems in an organization on the whole and the organization wants to integrate their systems. Then, the 'to-be' landscape will Obviously have less number of systems than the 'as-is'

landscape (reduces to around 75 systems).

2. Related Work

There are several technologies that are used for both Internal and external integration. Hub-and-spoke architecture [2], often referred to as message broker or message-oriented middleware (MOM), provides a more elegant approach to enterprise application integration than a point to point integration model. Hub-and-spoke architectures consist of a centralized hub, which accepts requests from multiple applications that are connected to the centralized hub as spokes. Artix [3, 4], developed by IONA Technologies, enables designers to develop web services adapters for legacy systems and integrate them using a hub-and-spoke [5] approach. It claims to provide flexible and incremental integration approaches (which may be considered an integration strategy) but does not provide support to develop conversation policies.

3. SAP NetWeaver Exchange Infrastructure (XI) / Process Integration (PI)

AP NetWeaver offers Exchange Infrastructure (XI) for integration. XI as shown in Fig. 1 has the collection of components to implement the seamless integration between A2A, B2B, SAP and Non-SAP applications, etc. The components include *System Landscape Directory* – a central repository of information about Software and systems, *Integration Builder* – containing *Integration Repository* (IR) and *Integration Directory* (ID). IR is used for the design and development of the interfaces and ID is used for the configuration based on the customer landscape. The other components are the *Integration Server* – the central processing engine, *Adapter Engine* – JCA compliant engine to connect to backend systems, *Central Monitoring Engine* – to have a concrete understanding of the runtime behavior of the processes.

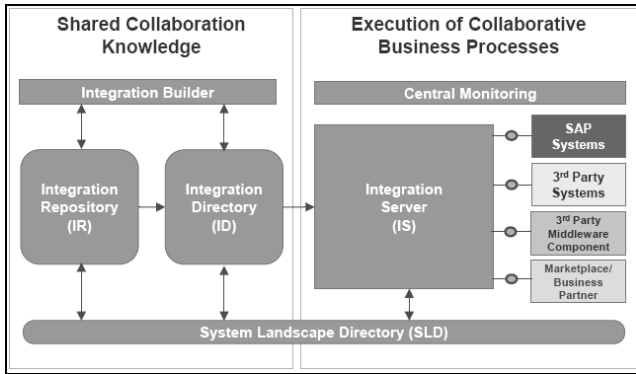


Fig. 1 SAP Net Weaver Exchange Infrastructure (XI) / Process Integration (PI) (Source: SAP AG 2004)

4. TEFRID Tool

All the steps involved in the traditional design uses SAP XI's Integration Directory (ID) and Integration Repository (IR) are being repeated for all the scenarios depicted in the paper.

By using the TEFRID Tool, we can generate Mapping guide (extra sheet will be added to the FS spread sheet after running the tool) which is very useful in developing mapping logic between sender and receiver, and XML Schema Definition (XSD) and content conversion (cc) parameters shown in Fig 2. We just need to import them into our integration builder (IB).

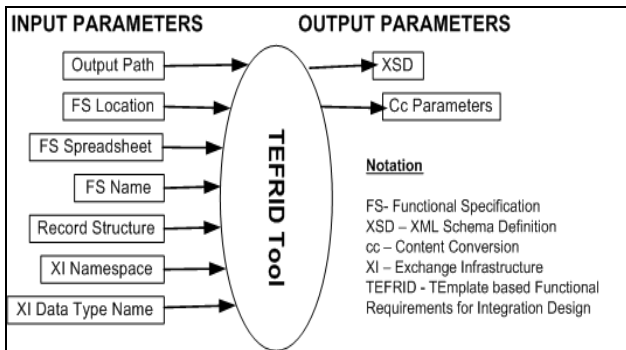


Fig. 2 Tool with input – output parameters

This TEFRID tool reduces time for creating these XSD and CC parameters shown in Fig 4. For example, in general it takes around 10 minutes to create a Data Type, using this tool we can create it within 3 minutes. This not only reduces the creation time, but also the manual intervention so that we can produce seamless results.

We directly import XSD into IR and use it as Data type for the interface. This is more useful when we are supposed to create a data type with more number of fields. Since the values are taken from the FS spreadsheet shown in Fig.3 there is no possibility of error from developer's perspective.

Category	Input Variables	Input Values	Description
File Info	OutProcessFileDir	C:\Documents and Settings\kiran\43183\Desktop\kiran	Design Document Folder
	DataProcessFileName	H:\K8-128182071\Output\Data-Process-Specification-13242014	Design Document Data Process File name
	OutputSDFFileDir	C:\Documents and Settings\kiran\43183\Desktop\kiran	Output Folder
	OutputSDFFileDir	C:\Documents and Settings\kiran\43183\Desktop\kiran	
	OutputSDFFileName	DTI_IRI_Tedatmi	Not need to specify
	OutputSDFFileDir	DTI_IRI_Tedatmi	Not need to specify
	OutputSDFFileDir	DTI_IRI_Tedatmi	Not need to specify
	OutputSDFFileDir	DTI_IRI_Tedatmi	Not need to specify
Record Info	RecordStructure	Record Data Type	Select logical Record Structure for this IF
	NameSpace	http://sap.com/namespaces/PI/PI/PI/PI	NameSpace of XI
	DataTypeName	DTI_IRI_Tedatmi	XI DataType Name
ABAP	DataTypeName1	DTI_IRI_Tedatmi	ABAP DataType Name
	OutputSDFFileDir	C:\Documents and Settings\kiran\43183\Desktop\kiran	

Fig. 3 Functional Specification (FS) template

The mapping guide that was generated from this tool is the most useful one when we do a complex mapping. There is every chance for errors in recognizing the mapping logic out of the FS since there are number of other columns in between. This mapping guide contains Field Number, Field Length, Field Format, SAP Field Number, SAP Field Length, Mapping Logic and Padding Description (i.e., padding required or not).

These scenarios are developed /implemented based on the functional specification document and the excel sheet should be macros enabled (MS Office 2007).

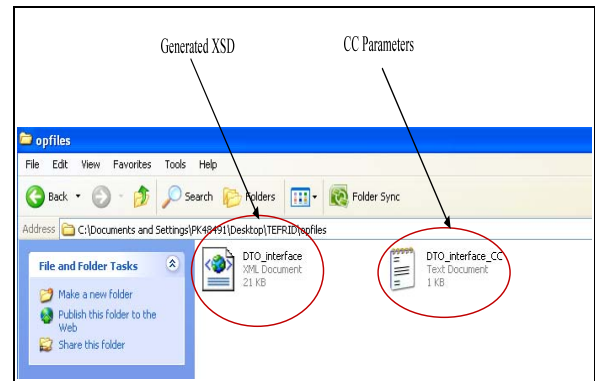


Fig. 4 Template creating XSD and CC parameters

5. Case Study

5.1. Problem Statement

Based on previous consulting engagements with fortune 500 customers, the authors have decided to present one of the case studies, which is a sample representation of problems faced during enterprise integration. One of the largest Asia pacific manufacturing companies has a vast heterogeneous landscape in its operating model. Providing optimal interoperability between these heterogeneous systems is a big challenge for such a company. For such problems the author(s) chose SAP NetWeaver as its landscape and SAP XI as an integration tool to provide an optimal solution.

Design and Implementation

The following table gives environment details of experimental setup.

Software Configuration	Java Web Start, SAP GUI, Microsoft Excel 2007.
Tools used	<ul style="list-style-type: none"> • SAP Exchange Infrastructure (Integration Repository, Integration Design, Integration Server), • TEFRID tool.
Technologies	<ul style="list-style-type: none"> • Java (for writing User Defined Functions), • UNIX shell scripts (to run OS commands in file adapter), • Microsoft Excel (for TEFRID tool)

Table 1 Environment details

5.2.1 Design Procedure

Integration Repository objects: The following snapshot shown in fig. 5 is the depiction of various steps involved in the creation of each design objects in IR

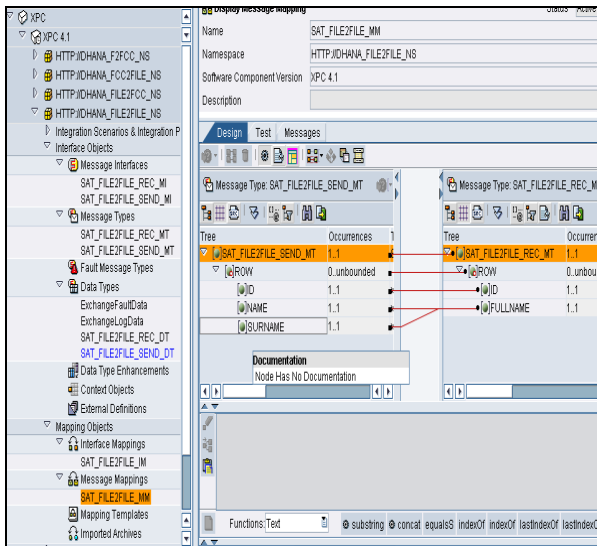


Fig. 5 Integration Repository snapshot

Integration Directory objects: The following snapshot shown in fig. 6 is the depiction of various steps involved in the creation of each configuration objects in ID.

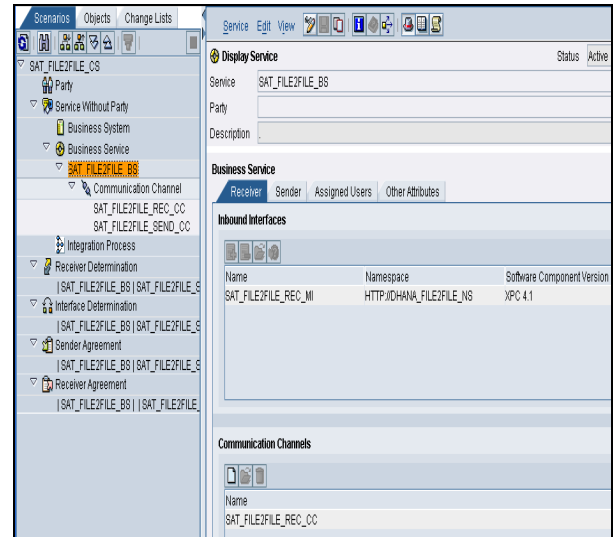


Fig. 6 Integration Directory snapshot

5.3 Using TEFRID Tool:

Before proceeding to the IR part, use TEFRID tool which generates XSD and CC parameters.

Get the functional specification from client and enter all details in TEFRID tool as mentioned in section 4. Subsequently it generates XSD at the output path specified as shown below in the following in XML schema.

```
<?xml version="1.0" encoding="UTF-8" ?>
- <xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns="http://namespace" targetNamespace="http://namespace">
- <xsd:complexType name="DTO_interface">
- <xsd:sequence>
- <xsd:element name="RS">
- <xsd:complexType>
- <xsd:sequence>
- <xsd:element name="HEADER">
- <xsd:complexType>
- <xsd:sequence>
- <xsd:element name="Field1">
- <xsd:annotation>
  <xsd:documentation
    xml:lang="EN">Information type
    code</xsd:documentation>
</xsd:annotation>
- <xsd:simpleType>
- <xsd:restriction base="xsd:string">
  <xsd:maxLength value="4" />
</xsd:restriction>
</xsd:simpleType>
</xsd:element>
```

Tool generated XML schema output

This XSD needs to be imported into Integration Repository.

Steps to be followed to import XSD:

1. Create Namespace and Data type (DT) which have the same format as that of generated XSD to avoid naming conflicts while importing.
2. Import the generated XSD into DT as follows:

Open Tools menu and select Import XSD as shown in Fig. 7.

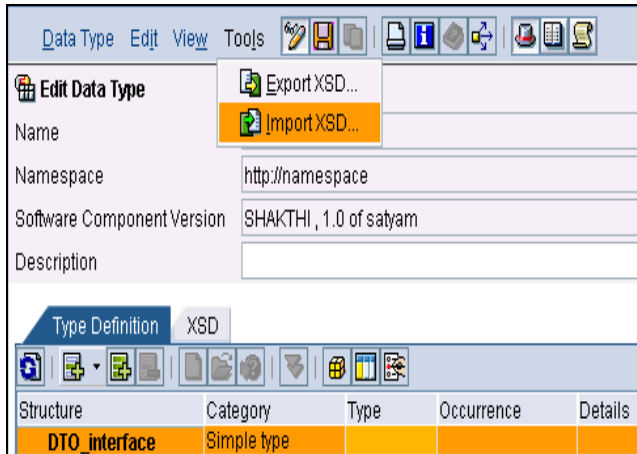


Fig. 7 Open tool menu of export and import XSD

Then the complete DT will appear same as the one we create manually as shown below in Fig. 8.

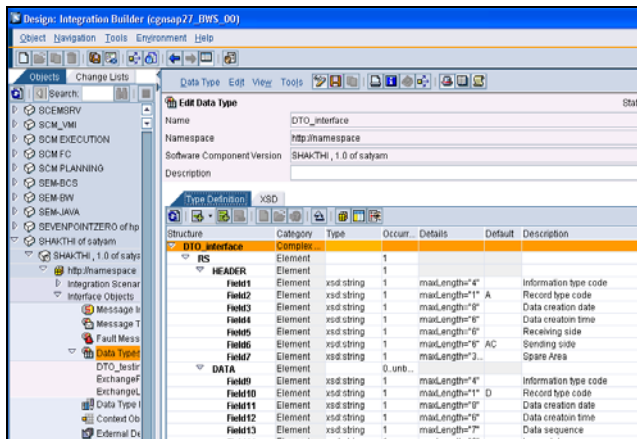


Fig. 8 XSD input for design

When DT has huge number of fields, there is an every chance for errors with manual creation. If we use this tool, errors can be reduced extensively and time for creation will also be reduced.

Mapping Guide generated: This mapping logic is generated for an outbound scenario (i.e., legacy system to SAP system scenario) as shown in Fig. 9.

Field Number	Field Len	Field Format	SAP Field Number	SAP Field Len	Mapping Logic	Padding Description
Field1	4	N/A	SAP-0028	10	SET MID(BH-TOU0-C,1,4)	Not Required
Field2	1	N/A			SET "A"	Not Required
Field3	8	YYYYWDD			SET System Date	Not Required
Field4	8	HHMMSS			SET System Time	Not Required
Field5	6	N/A			SET CONCATENATE(Field1,"0")	Not Required
Field6	6	N/A			SET "IM0AC"	Padding with trailing
Field7	369	N/A			SET "	Padding with trailing
Field8	-					Not Required
Field9	4	N/A	SAP-0028	10	SET MID(BH-TOU0-C,1,4)	Not Required
Field10	1	N/A			SET "D"	Not Required
Field11	8	YYYYWDD			SET Field3	Not Required
Field12	8	HHMMSS			SET Field4	Not Required
Field13	7	N/A			Field13 = Field13 + 1	Not Required
Field14	8	YYYYWDD	SAP-0010	8	SET OEI-0001	Not Required
Field15	8	YYYYWDD	SAP-0001	8	SET GI1-0002	Not Required
Field16	2	N/A	SAP-0015	4	SET OEI-0025	Not Required
Field17	4	N/A	SAP-0016	4	SET BH-EIGY-C	Padding with trailing
Field18	4	N/A			SET "000"	Padding with trailing
Field19	4	N/A			SET Field1	Not Required

Fig. 9 Mapping logic of legacy system to SAP system

Implementation Procedure

After completing the above design procedure steps, we get the file from sender legacy system and copy the same into the source path that is mentioned in the sender communication channel. Then, SAP XI generates the receiver file(s) depending upon the configuration chosen.

6. Results and Realized Benefits

The measure of benefits has different factors depending on the type of scenario we chose. In our case study (file to file scenario), the performance of the scenario depends upon the input file size, load on server and number of scenarios running at that particular time on server. The following Table 2 and Fig. 9 shows the performance (increasing file size / processing time) of file to file scenario.

Size of the input File	Process start time	Process end time	Process Time	Success / failure
1 KB	07:16:49	07:16:50	1 sec	success
14 KB	10:58:54	10:58:55	1 sec	Success
1684 KB	11:00:14	11:00:15	1 sec	Success
5050 KB	11:05:04	11:05:19	15 sec	Success
6705 KB	11:10:30	11:11:11	41 sec	Success
7956 KB	07:24:26	07:30:26	6 min	Success
13030 KB	07:57:52	07:59:46	~2 min	Success
15555 KB	09:03:49	09:06:23	1min 34 sec	success
16280 KB	11:37:35	11:39:46	2min 11 sec	Success
20138 KB				Failed
24470 KB				Failed
16855 KB				Failed
17244 KB				Failed

Table 2 Performance scenarios of file transfer

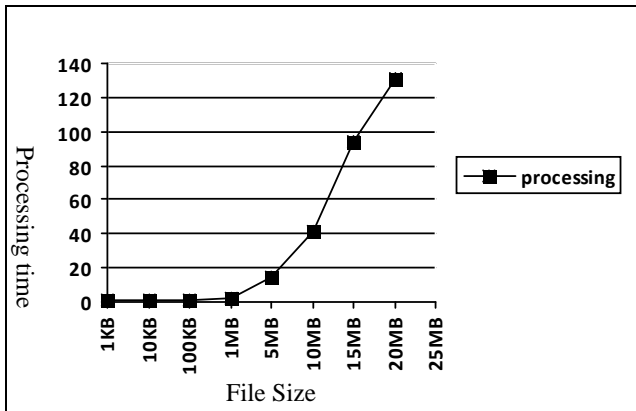


Fig 10 Graphical representation Performance scenarios of file transfer

The following screen shots from fig. 11 to 13 give the success/ failure monitoring output as the file size is increased.

SXMB_MONI output:

Status	Ack	Status	Executed From	Start Time	Executed Until	End Time	Send	Sender Schema	Sender Agent	Sender Service	Sender Namespace
Success			19.02.2008	13:56:18	19.02.2008	13:56:19				SAT_FILE2FILE_BS HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M	
Success			20.02.2008	07:03:18	20.02.2008	07:03:19				SAT_FILE2FILE_BS HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M	
Success			07.14.18	20.02.2008	07.14.21					SAT_FILE2FILE_BS HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M	
Success			07.16.49	20.02.2008	07.16.50					SAT_FILE2FILE_BS HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M	
Success			08.05.37	20.02.2008	08.05.46					SAT_FILE2FILE_BS HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M	
Success			10.08.09	20.02.2008	10.08.10					SAT_FILE2FILE_BS HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M	
Success			10.17.41	20.02.2008	10.17.43					SAT_FILE2FILE_BS HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M	
Success			10.30.11	20.02.2008	10.30.14					SAT_FILE2FILE_BS HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M	
Success			10.32.12	20.02.2008	10.32.12					SAT_FILE2FILE_BS HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M	
Success			10.57.54	20.02.2008	10.57.54					SAT_FILE2FILE_BS HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M	
Success			10.58.54	20.02.2008	10.58.55					SAT_FILE2FILE_BS HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M	
Success			11.00.14	20.02.2008	11.00.15					SAT_FILE2FILE_BS HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M	
Success			14.06.04	20.02.2008	14.06.13					SAT_FILE2FILE_BS HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M	

Fig. 11 Screen shots SXMB_MONI output

Performance monitoring:

Component Monitoring	Message Monitoring	End-to-End Monitoring	Performance Monitoring	Index Administration	Configuration	Alert Configuration	Alert Inbox	Cache
18.02.08 00:00:00	19.02.08 00:00:00	16	238, 3,283,976, 19,348,915	0.672, 12,448, 85,642	7	XIntegrationServerIs.00.cognasq27/B	A	SAT_FILE2FILE_BS SAT_FILE2FILE_SEND_M SAT_FILE2FILE...
19.02.08 00:00:00	20.02.08 00:00:00	5	236, 6,213,769, 31,067,901	0.637, 19,917, 90,632	2	XIntegrationServerIs.00.cognasq27/B	A	SAT_FILE2FILE_BS SAT_FILE2FILE_SEND_M SAT_FILE2FILE...
20.02.08 00:00:00	21.02.08 00:00:00	13	216, 6,800,968, 53,003,294	0.781, 45,143, 494,150	5	XIntegrationServerIs.00.cognasq27/B	A	SAT_FILE2FILE_BS SAT_FILE2FILE_SEND_M SAT_FILE2FILE...
21.02.08 00:00:00	22.02.08 00:00:00	4	41,751,080, 81,390,356, 85,434,622	1.844, 45,143, 494,150	2	XIntegrationServerIs.00.cognasq27/B	A	SAT_FILE2FILE_BS SAT_FILE2FILE_SEND_M SAT_FILE2FILE...
26.02.08 00:00:00	27.02.08 00:00:00	1	216, 216, 216	1.844, 1.844, 1.844	0	XIntegrationServerIs.00.cognasq27/B	A	SAT_FILE2FILE_BS SAT_FILE2FILE_SEND_M SAT_FILE2FILE...
28.02.08 00:00:00	29.02.08 00:00:00	2	636, 92,114, 103,590	0.953, 1.953, 2.953	1	XIntegrationServerIs.00.cognasq27/B	A	SAT_FILE2FILE_BS SAT_FILE2FILE_SEND_M SAT_FILE2FILE...
04.03.08 00:00:00	05.03.08 00:00:00	1	216, 216, 216	1.297, 1.297, 1.297	0	XIntegrationServerIs.00.cognasq27/B	A	SAT_FILE2FILE_BS SAT_FILE2FILE_SEND_M SAT_FILE2FILE...

Fig. 12 Screen shots Performance monitoring output

End to End Monitoring:

Status	Start	End	Sender Party	Sender Service	Sender Interface	Receiver Party	Receiver Service	Receiver Interface
Delivering	05.03.2008 14:12:27	05.03.2008 14:33:46		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M			
System Error	05.03.2008 13:47:44	05.03.2008 13:49:15		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE...
Successful	05.03.2008 13:19:27	05.03.2008 13:38:23		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE...
Successful	05.03.2008 12:26:25	05.03.2008 12:29:46		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE...
Successful	05.03.2008 11:59:59	05.03.2008 12:00:02		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE...
System Error	04.03.2008 18:18:56	04.03.2008 18:19:47		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE...
System Error	04.03.2008 18:02:36	04.03.2008 18:02:38		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE...
System Error	04.03.2008 17:12:36	04.03.2008 17:54:15		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE...
System Error	04.03.2008 16:46:02	04.03.2008 16:46:06		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE...
Successful	04.03.2008 15:45:59	04.03.2008 15:46:00		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE...
System Error	04.03.2008 15:04:52	04.03.2008 15:05:57		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE...
System Error	04.03.2008 14:33:29	04.03.2008 14:35:02		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE_SEND_M		SAT_FILE2FILE_BS	HTTP:JHDHANA_FILE2FILE_NS SAT_FILE2FILE...

Fig. 13 Screen shots End to End Monitoring output

Different parameters to measure performance:-

a) **Time:** As mentioned in section 4, creation time for data type, mapping logic and content conversion parameters for an interface get reduced drastically, depicted in the graph in Fig 14.

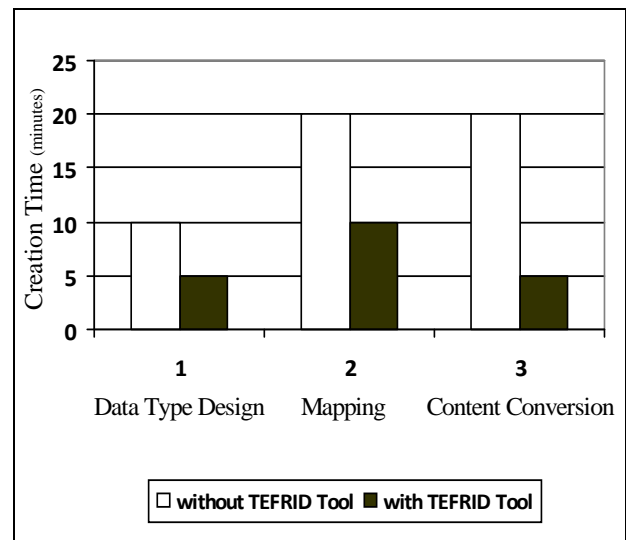


Fig. 14 Performance measure

b) **Production:** We can have greater productivity using TEFRID tool. Fig.15 indicates the number of objects produced with and without using TEFRID tool per 30 minutes. Suppose in 30 minutes, we are able to produce 3 data types, 2 message mappings and 3 content conversion parameters without TEFRID tool. We can produce 8 data types, 4 message mappings and 7 content conversion parameters with TEFRID tool in same time period.

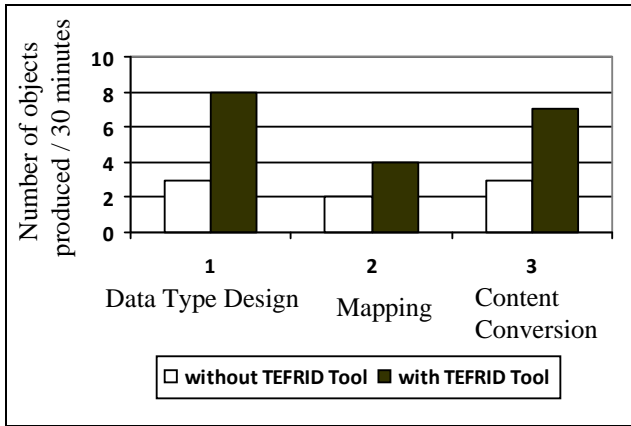


Fig. 15 Productivity measure

c) **Error Reduction:** The main advantage using the TEFRID tool is the reduction in manual errors. If we create data type, message mapping and content conversion manually, chances of manual errors are more as the complexity of the data type increases. But with TEFRID tool we are able to reduce the errors to maximum level, which will be ~0% errors for data type. Fig. 16 gives the number of errors possibility with and without using TEFRID tool

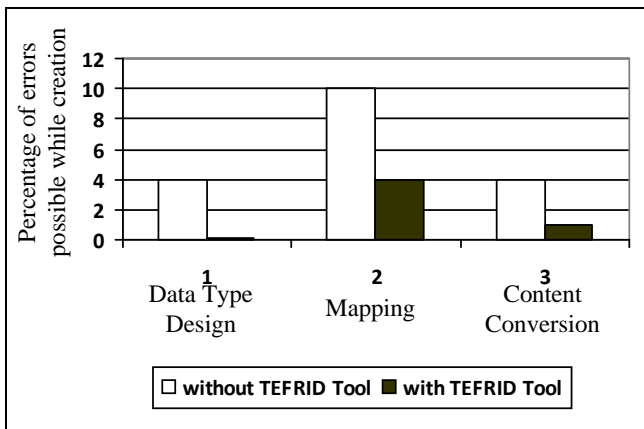


Fig. 16 Errors estimation

d) **Cost & Effort:** Suppose a project takes 5 months, 5 units of man power and 5 lakhs to complete a phase. By using this tool, we can produce the same results or even more seamless results with only one unit of man power, with 1 lakh in one month. The following graph in Fig. 17 gives the cost and effort estimation.

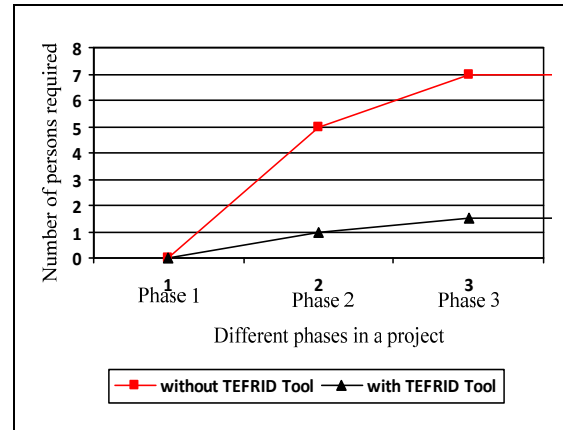


Fig. 17 Cost and effort estimation.

7. Conclusions

SAP NetWeaver offers some significant advantages in the overall visibility at enterprise level. Depending on the need for integration and the complexity of landscape, organization can choose SAP XI for implementing and adapting their integration strategies using functionalities and tools described in this paper.

8. References

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