Open Source Power on BPM - A Comparison of JBoss jBPM and Intalio BPMS

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Abstract. This paper presents a comparison of two open source products in Business Process Management: Intalio BPMS and JBoss jBPM. A framework for their comparison is constructed based on expert advice and a literature analysis. We implemented a simple process with both tools to gather experience of using the tools and combined this knowledge with information from official documentation, tutorials, research and any available third-party documentation. With this knowledge, the two tools were compared using the comparison framework. In the end, we score the two tools across the categories identified in the comparison framework and provide further discussion for future work.

Keywords: BPMS, BPM, jBPM, Intalio, JBoss, Redhat, evaluation, comparison framework, open source

1 Introduction

Business Process Management (BPM) is gaining increasing attention and consideration in organization and enterprise architecture as a bridge between information technology (IT) and business. BPM is a holistic management approach that promotes business effectiveness and flexibility on the basis of a set of standardized IT technologies and tools. The technology solutions that address the need for BPM are called Business Process Management Systems (or suites), or BPMS. There are various definitions for Business Process Management (Smith & Fingar, 2003; Hill et al., 2006). A recent and influential definition is given by Mathias Weske: "A business process management system is a generic software system that is driven by explicit process representations to coordinate the enactment of business process." (Weske, 2007)

However, most of the BPM tools and software employed today are expensive commercial products. On the other hand, the open source community is achieving increasing importance in the business software and services sector. Open source projects have not been viewed as viable options in the past because the business logic behind them is different than for conventional players. The recent financial crisis and the resulting cost pressures have shifted more focus and interest to open source projects, which may provide cost savings.

Open source BPM tools are attracting more attention in the market due to the possible cost savings and more flexible license terms. Users can also extend the products and scalability without extra costs. Moreover, it is possible for a third party

to fix bugs itself or with the help of the open source community, rather than holding up for vendor's slow response times. In addition, open source software has proven to be a great source of innovativeness, and by the novel use of open source software companies can expect to create competitive advantage.

jBPM from JBoss (Redhat) and Intalio BPMS are two pioneer examples of open source products that are gaining more and more attention. In a Gartner review (Hill & Dracos, 2006) Intalio BPMS is described as a venture to bring business process modeling to the mainstream. They describe the objective of Intalio as "increasing the availability of process modeling and development skills and moving the software to mainstream users." In the JBoss jBPM whitepaper (Benbasat et al., 2007) JBoss is described as a response to the wide disappointment in industry towards workflow and BPM. JBoss describes that they are "focused on making BPM technology more accessible and easier to apply."

The two tools clearly have the same objective, despite some ideological differences, and make an interesting pair for comparison as representatives of up-and-coming technology. The ideological differences will be discussed later in the paper.

Our objective is to provide a practical comparison of these two tools for use in banking companies in integrating their legacy systems, business rules and other repositories to web interfaces.

Based on expert advice and a literature study we create a framework of evaluation categories for the comparison of the BPM tools. We then implement an exemplary business process with the tools to be able to cover all categories. Based on the experience gained and the resources we have had to use for the implementation, official documentation, tutorials and research papers we compare the two tools across the categories that have been identified in constructing the comparison framework.

1.1 Research Problem and Objectives

The objective of our study is to be able to provide a practical comparison of JBoss jBPM and Intalio BPMS. The comparison should be able to be used as a starting point for decision making if either jBPM or Intalio BPMS could be used as a BPM solution. According to our objective we have formulated the research problem and its sub-problems as follows:

1. How do Intalio BPMS and JBoss jBPM compare in practice?
    1. By which categories should a practical comparison of BPM tools be made?
    2. How do Intalio BPMS and JBoss jBPM compare within these categories?

1.2 Project Scope

The target domain of this research paper is the banking industry. The banking industry demonstrates some particularities, for example legacy systems that still have

to be used and the importance of verifications using services external to the main process.

The scope of our project is directly connected to this domain, since the categories of our comparison framework are derived directly from experts in this domain and is constructed as a basis for their decision making.

To implement a complete business process in our domain requires broad and deep understanding of the specific system, underlying platform and the process in question. A complete process is outside of the objectives of this research. Therefore, we build a skeleton of the process with most intermediate processes, activities and attributes. The overall structure and detailed process interactions are illustrated in the diagrams created for the implementation. We have chosen JBoss jBPM and Intalio BPMS for this comparison as they are the two most competitive BPM suites according to industry experts on whose initiative this research has been conducted.

The versions of the tools used in this study are Intalio BPMS 5.2 community edition and JBoss jBPM 3.2.2. The Intalio BPMS is used in conjunction with Apache Geronimo 2.0.1 as web server and Intalio Designer 5.2 as process modeller. JBoss jBPM is used in conjunction with JBoss Application Server 4.2 and Eclipse EE 3.4.1 with JBoss Tools 2.1.2 plug-in as process modeller.

1.3 Methodologies

The research method to answer sub-question 1 is conducted through a case study approach with the collaboration of experts in the field and validating the findings through a literature review. The experts are Tuomo Sahipakka from Logica Finland, which later in this study is referred to as the client, with experience on the practical issues within our domain and Janne Korhonen from the Helsinki University of Technology with expertise in enterprise architectures and business process management. Because very little research has been conducted in comparing BPM tools, we rely on the conceptual understanding of experts in constructing a comparison framework which covers the most important areas of BPM implementation in our domain. The experts were interviewed 3 times during the study to iteratively elaborate the framework. The framework is compared to earlier research on BPM, and we discuss the different important areas that have been covered before, and how our framework fits with the criteria of earlier research. After the construction and validation of the research framework, we implement an exemplary process with both BPM tools in order to assess the tools in the categories our comparison framework covers. The tools are also evaluated by extensive research in documentation and tutorials etc., in order to give a more in-depth knowledge of the capabilities of the tools. This is a hands-on approach, and both tools will be given points in each category. Explanations will be given for why a tool either performed as expected, exceeded expectations or did not meet expectations.

2 Comparison Framework

2.1 Criteria for the Comparison of Two BPM Tools According to the Needs of the Banking Industry

Howard Smith and Peter Fingar (2003) define Business Process Management systems in the following way: "A business process management system enables companies to model, deploy and manage mission-critical business processes that span multiple enterprise applications, corporate departments and business partners - behind the firewall and over the Internet." Our objective is to compare two tools that enable the actions defined by Smith and Fingar for the banking industry. In creating the comparison framework, the particularity of banking companies has to be taken into account. In addition, we will focus on the enabling of modeling, deploying and managing business processes, which is a very practical approach.

To create the framework and criteria according to which JBoss jBPM and Intalio BPMS are being evaluated, experts in the field were interviewed, after which we performed a literature analysis to verify the framework. The interviewed experts identified the key functional faculties which would be needed as support for decision making on using a BPM tool. The key categories that were decided to be the most critical were evaluated, and can be seen in Figure 1. Several criteria within the identified categories were also created as a help for the evaluation which have been documented in figure 1. Further explanation of the categories can be found in Appendix 5.

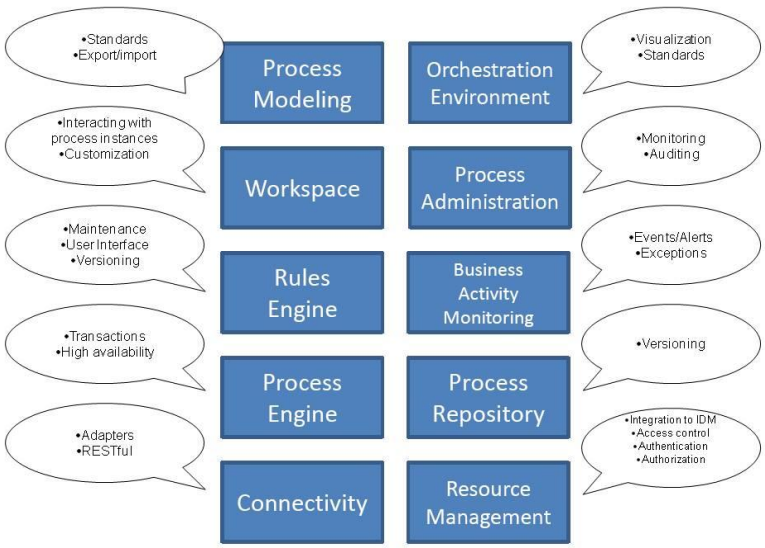

Figure 1: Evaluation Framework Categories

2.2 Evaluating the Comparison Framework

The target of the comparison framework is to enable a comparison between BPM tools. At the end of the comparison, we will be able to show relative strengths of the tools compared in different key areas.

The target in building the comparison framework is to ensure that the key categories for the comparison have been identified and understood. The client identified some aspects as very important in the comparison of the two tools, e.g. auditing, easy process definition and modification, rules assignment, testing of the process and monitoring the process. These were given special attention when defining the comparison framework.

The comparison of key categories also has to take into account different users in all the categories. The programmer has to be able to work with the connectivity, while a business analyst has to be able to define a business process in the orchestration environment. These roles have also been taken into account in the research and in building the framework.

In their research "Evaluation of Intalio BPM tool" (2006), Helkiö, Seppälä and Syd evaluate the Intalio BPM tool. Their focus is on Intalio designer, its compliance to standards and ability to function as a modeling tool. The framework used by Helkiö, Seppälä and Syd for the comparison is derived from an article by YeongSeok et al.: "Development of Quality Evaluation Metrics for BPM (Business Process Management) System"

In their research, Helkiö, Seppälä and Syd argue that a comparison with another BPMS would complement their research in an important way. The characteristics that Helkiö, Seppälä and Syd have tested in their research are covered by our comparison framework.

Gartner research conducts a survey of the leading BPMS tools every year. The criteria used in Gartner's research are useful in evaluating our framework. We have compared and evaluated our criteria against those set out by Gartner Research. (Hill et al., 2006)

The tools that Gartner research has identified as core-tools for a BPMS are all covered in the categories and sub-questions of the comparison framework. In addition to these core tools Gartner specifies BPMS selection criteria. (Sinur et al. 2005)

The Gartner criteria have a strong business analyst point of view, whereas our framework takes a viewpoint which evaluates the tools from both the developer point of view as well as from the business analyst point of view. Gartner's goals are to make it easy for institutions to choose the right tools for them. We, on the other hand, have a more specific set of objectives gathered from experts and congruent with the need of the banking sector.

In conclusion, the comparison framework we have built covers the research on the subject that we found was related to our subject. We discovered that a lot of research has been done on business processes and information systems from a strictly business point of view (McCoy 2002; Scheithauer & Wirtz, 2008; Wang et al., 2005)

These research papers are more general about a product category, such as MRP, MRPII or BPM. The research lacks the more technical side of the categories they evaluate, and are concentrated on what a product should be able to do in general, not on what specific products are able to perform. Some research similar to ours has also

been conducted, with similar goals to ours (Silver, 2008). This was used to evaluate our framework. By combining the knowledge we have gathered from product whitepapers, research on BPM and expert advice, we have collected a set of categories and sub-criteria that constitute a comparison framework for the comparison of two BPMS's.

3 Overview of the Tools

This section introduces the tools we are going to compare on a general level. This section also presents the architectural overview of the components in the JBoss jBPM and Intalio BPMS packages.

3.1 JBoss jBPM

In the jBPM whitepaper, it is stated: "JBoss jBPM is a workflow, process automation, and pageflow platform that enables coordination between disparate applications and services, resulting in the deployment of new revenue generating business processes."

Figure 2 in Appendix 1 illustrates the jBPM structure and its connections with process library and process requests. The box "jBPM Process Engine" is the core package which manages the defined processes and their interactions with external events automatically.

To facilitate the process definition, jPDL is provided on the top of jBPM framework as a graph based process language, which can be easily understood by business people for their applications. Figure 3 in Appendix 1 shows the overview of the jPDL components.

3.1 Intalio BPMS

In the paper "BPM 2.0", Intalio BPM is described as a set of services and tools that provide process management (e.g., process definition, analysis, execution, modeling…) and various support functions for human workflow interactions (e.g., rules engine, BAM). Figure 4 in Appendix 2 gives an overview of the architecture of Intalio BPMS. For its internal components, Intalio has a process design tool based on Eclipse; Corticon, Celequest and Alfreso as preferred partners for business rules, business activity monitoring (BAM) and content management, respectively; ServiceMix, Infravio and Pentaho for Enterprise Service Bus (ESB), metadata repository and business intelligence suite respectively. Intalio also has support for Apache AXIS 2.0.

4 Business Process Implementation

Based on the client's requirements, we chose a simple part of a Loan Application process as the target business process for our implementation. We implemented the simple process to gain experience on creating processes using the different tools and how they are visualized in them.

4.1 Loan Application Process

According to our customer, we defined a simple Loan Application process to be implemented. The basic workflow is illustrated using the designers of both tools in Appendix 4 in Figure 6 and 7. The basic procedure sequence is listed below:

1. User applies for a loan
2. Process evaluates the loan application
3. Process requests for more information
4. Process provides more information
5. Process approves/disapproves loan application

5 Evaluation

Explanations of the categories and what we are focusing in our evaluation can be found in Appendix 5. In section 5.1 we discuss the designers in general. In sections 5.2-5.10 we discuss what the tools support and facilitate in the different categories.

5. 1 Comparison of designers

The jBPM designer does not implement swimlanes in the visualization even though it is possible to define swimlanes also in jBPM designer. Compared to Intalio Designer, jBPM designer is more targeted towards developers. Similar to the UML diagrams, the diagram provided in jBPM designer window is more like a "static class diagram", presenting main elements and their relationships. Intalio on the other hand implements BPMN notation and is therefore a more familiar concept for business people. The Intalio diagram gives a better overview of the whole process, also the details.

The process diagram of JBoss jBPM is illustrated in Appendix 4. Drawing the diagram according to our process definition is quite easy and making the different transactions as well. However, using swimlanes or pools in the diagram is not as intuitive and by default the tasks are not defined to any specific pool. In the task node "Give applicant information" we made a database query and in jBPM that is not

possible without a developer doing some code. Here the difference between JBoss jBPM and Intalio ideologies becomes clear as a developer is required to make the database query and implement it into the process. The forms for the task nodes in the process have to be generated separately but after that it is easy to deploy the process and test it in the jBPM-console.

The process diagram of Intalio BPMS is also illustrated in Appendix 4. Drawing the diagram according to our process definition was a little bit harder than in jBPM but after we got used to the designer it went well. In Intalio there is no need to write any code to make a database connection but it is not easy to find out exactly how to do the database query. The tools data mapper and xml schema elements have to be used to get it working but everything can be done in the designer. After making the right schemas and data mappings the process can be deployed. The forms do not have to be generated separately to be able to test the process in the BPMS-console provided by the Geronimo server.

5. 2 Process Modeling and Orchestration Environments

We discuss two alternative options that are native for the evaluated tools in regard to process modeling: jPDL for JBoss and BPEL for Intalio. The process modeling is executed in the orchestration environment. These two faculties are evaluated at the same time since they are interrelated.

In general jPDL enables integrating state machine capabilities in a Java environment. BPEL is based on web services and a web services environment, which means that it is used to script new services and use other web services in a web service environment. It is possible to cross-use these technologies (jPDL for WS and BPEL for Java) but that would necessarily make the execution more difficult.

JBoss uses jPDL for process modeling. The process definition is made up of nodes and transitions which are visualized in the user interface. Whereas BPEL uses web services to interact inside the process and with services, jPDL uses JBPM API and ActionClasses in Java, respectively.

The symbols in jPDL do not differ much from the basic ones in for example BPMN. The process modeling is done in the GPD, Graphical Process Designer, which is a plug-in for Eclipse. GPD supports swimlanes for the creation of different roles; however, the swimlanes are not visualized. The lack of visual support for swimlanes causes the developer to click back and forth a lot, making the development slower and less visual. It might also lead to difficulties with more complex processes. The modeling notation uses names for different transitions and nodes. According to our experience the GPD does not visualize what is actually happening in the process very well.

Intalio uses Intalio Designer**,** built on top of Eclipse**,** for process modeling. Designer supports BPMN and the designer converts the BPMN to BPEL(Helkiö et al, 2006) Whereas the number of symbols for modeling in jPDL is 10, BPMN has 52. According to BPM research (http://www.bpm-research.com, 2008) only 12 of these are used in over 25% of diagrams. The large number of symbols supports the goal of zero code process modeling. It is meant that even business analysts could design and

execute processes when the environment is set up. Intalio Designer organizes the BPMN symbols in the palette. They are grouped under different headings than normally in BPMN, but all the symbols can be found easily. Intalio Designer does not support all the transitions and symbols that are included in BPMN. Partly this is because every BPMN cannot be converted to BPEL, for example loop transitions cannot be supported in BPEL, but are supported in BPMN. However, we did not find any evidence of the symbol support in Intalio to be lacking. The overall visualization and creating a process in Intalio is intuitive and the process can be understood quite well based on the visualization. We could not readily find any shortcomings with the visualization of Designer. Intalio Designer supports swimlanes and pools which is intuitive because it is a standard way of visualizing processes according to UML. Intalio supports import for ARIS, BPEL4WS, BPML and WS-BPEL.

jBPM and Intalio have clearly different goals in terms of process modeling. jBPM is meant to allow a graphical presentation of a process in which it is easy to code functionality. When the modeling is done, it can still be changed by a non-developer. However, it is not meant to be a zero code deployment. Intalio on the other hand, aims for zero code deployment. BPMN includes a lot of symbols for different tasks which can be found in Designer. Intalio wants it to be possible for a non-developer to create a process and deploy it from scratch. The visualization of the process is more intuitive and more suitable for a non-developer in Intalio. Neither of the tools have sufficient documentation or tutorials online for just anyone to start working with them. There are several gaps in the tutorials. In going from deploying your first process to try and integrate a database call into it, demands a lot of work and searching for answers on discussion forums. Therefore, we do not believe that Intalio has reached it goals in terms of non-developer deployment.

Because of the difference in approaches to process modeling, it is difficult to say which one is better. It seems that jBPM is going against the stream not supporting BPMN, the most widely used modeling standard today. The ideology of the two vendors is different: Intalio BPMS involves the Business Analyst in the full process management lifecycle, whereas jBPM wants to keep the control of deploying the process to the developers. The Intalio philosophy is more ambitious, although we do not feel that the development is far enough to reach it.

In terms of visualization, Intalio is the stronger tool. In terms of modeling processes, it is difficult to say because of the different approaches. Because of the superior visualization, Intalio receives 3 points for process modeling.

5.3 Workspace

The workspaces in JBoss and Intalio allow for users and administrators to interact with processes. Users are the individuals whose input is needed for the process to finish, the administrators the ones who choose, deploy and monitor processes. The workspace shows tasks (that a user should respond to) and processes and displays forms. Users can interact with processes through the forms which are generated from the orchestration environment.

In addition to the user interface, the workspace allows administrators to monitor, choose, initiate and intervene in executing processes. More about monitoring is discussed in the section 5.6 "Business Activity Monitoring".

Both workspaces are customizable in terms of appearance through CSS sheets. The Intalio interface is more visually attractive, but a new workspace for JBoss is under construction, which will make use of web 2.0 effects to create a visually pleasing experience.

For the user interface, the two tools are easy to integrate into any web environment, but of course, this requires the necessary skills.

It is possible to define different workspaces for different users. Processes are connected to users, and the user can only see the processes relating to his/her work.

Both tools also have versioning of processes available directly from the workspace; it means that it is possible to initiate different processes directly from the workspace.

The workspace functionalities of JBoss and Intalio are similar. They support all the basic functionalities, and no clear difference can be found in the basic functionality. The support for visually seeing what part of a process is in action is a benefit of JBoss. On the other hand, the running of processes is more intuitive in Intalio, as it requires less clicking back and forth. Both tools cover the requirements of our evaluation framework. However, according to our experience, Intalio is more intuitive to use. Both tools receive 2 points.

5.4 Process administration

There are no direct metrics or reports from either tool in the workspace. Metrics and reports require the use of a BAM module. Process administration is somewhat similar in both tools, but Intalio has one key advantage, it is possible to retire any process and choose another instance of it to run. This is not supported in JBoss.

Both tools support audit trails for changes to the business processes, however the question of audit trails for process instances is more complex, as the tools do not provide any support out of the box.

Both Intalio and JBoss only support audit trails constructed from instance data stored in the database. Both tools store the data, but according to practical evidence, it is very difficult to create the audit trails from this data. In addition, revoking which user did what in the process is a separated task, it is not included in the log data. Creating an audit trail is difficult, it can be done but it must be built from scratch using the logs.

Neither Intalio nor JBoss offer the same functionality of automatic audit trails as some non-open source alternatives.

Intalio stores XML data of process instances to the database. It is accessible through a SQL and XML query interface. The data is planned to support Business Activity Monitoring, not audit trails. The JBoss instance data can be queried from a SQL interface. Both tools receive 2 points for this category.

5.5 Business Rules Management

Neither of the tools incorporates a rule engine out of the box in order to keep the rules engine separate from the process management system.

JBoss provides a powerful tool to be used for Business Rules Management; JBoss Rules or Drools. Drools comes with the JBoss Enterprise SOA Platform, so in the case of having the platform there is no need to download or install anything separately. Drools also uses the Eclipse IDE so it is easy to define the rules with the same designer as the one of the process. The IDE makes it easier for business analysts to view and change business rules. JBoss Rules supports a variety of languages and decision table inputs, making it easy to quickly modify business policies.

As of Intalio BPMS 5 the Intalio tool has integrated to the OpenLexicon Business Rule Engine. OpenLexicon has to be installed separately but it is integrated to work with Intalio BPMS 5. The OpenLexicon uses a web interface for defining the rules. The OpenLexicon web interface is easy to use for business people as well and we believe that there is a benefit in not being obligated to have Eclipse for defining the rules.

Both JBoss Rules and OpenLexicon are mature packages for rule management and we could not find any significant benefits in either of them. Therefore we give them 2 points each.

5.6 Business Activity Monitoring

JBoss does not provide any good business activity monitoring but SeeWhy has made an advanced BAM package “SeeWhy for JBoss”. There is a free edition but it is restricted to one instance. Businesses would have to buy the enterprise edition. SeeWhy will have to be setup but once the program is running business managers are easily able to view the business activity through the web interface. The SeeWhy package is not difficult for a developer to setup with default settings.

As of Intalio BPMS 5.2 an Intalio BAM is included in the package. With this improvement, Intalio provides advanced business activity monitoring out of the box. However, it is not included in the community edition, only the platinum and gold editions. The developer is responsible for defining what is monitored but the results are easily accessible through a web interface, just as with SeeWhy.

Neither tool provides BAM in the versions that we have used. Therefore we give them 1 point for not meeting our expectations.

5.7 Process engine

JBoss jBPM itself does not provide any high availability services and leaves that to the surrounding application server. JBoss jBPM can e.g. be deployed with JBoss Enterprise Application Platform and benefit from its high-availability services such as clustering, caching, fail-over, load balancing, and distributed deployment features.

JBoss jBPM enables flexibility by supporting multiple process languages with the same process engine platform. jBPM supports jPDL (Java based), WS-BPEL, which complies with the WS-BPEL 2.0 standard, and Seam pageflow. With jBPM it is possible to use JMS (Java Message Service) to have guaranteed execution of an event. jBPM with JMS can be configured to resend the request a number of times, the default is 10. jBPM does not facilitate compensating transactions in other ways than through a simple database rollback.

The community edition of Intalio BPMS is designed to be deployed on top of Apache Geronimo server and deployed alongside a MySQL database. To get support for advanced clustering and transaction processing the Enterprise Edition of Intalio BPMS is needed. The Enterprise edition also works with other application servers and databases. Intalio supports imports of several process definition languages but the engine itself supports BPEL.

In Intalio designer it is possible to define compensating transactions and exception handlers so Intalio has a benefit over jBPM in that area. JBoss on the other hand provides more information on high-availability services. We give Intalio BPMS 3 points for having better support for compensating transactions and 2 points to JBoss jBPM.

5.8 Process repository

Neither jBPM nor Intalio offers comprehensive process version control. Current active versions can only be identified by the file name or version title in the log. However, both tools are built on the top of Eclipse, which supports CVS and SVN for primitive text files version control and limited project version control based on the customized naming convention.

From our experience, jBPM does provide some basic process versioning features. For example, the new process deployment will have a new version number and it is possible to choose which process version to start.

In deploying a new version of a process in Intalio, the older versions are put in a retired state and the newest version becomes active. In both tools it is possible to activate an older version of a process.

More advanced version control features such as process comparison, context analysis and process rollback, have not been built yet.

Concerning process reuse, jBPM component based mechanism provides limited reuse (Wang & al. 2005) Intalio does not support diagram repository and cannot reuse nodes (Scheithauer & Wirtz, 2008). For not supporting any SVN-type repositories for processes out of the box we give both tools only 1 point in this category.

5.9 Resource Management

Security infrastructure: Intalio supports LDAP RBAC for access control. jBPM may be extended with LDAP support after some configurations on JBoss (http://www.developer.com , 2008).

Concerning IDM (Identity Management), we could not find any relevant material on jBPM and Intalio. Both tools have identity model for process components control and management. However, these are not considered to be an IDM standard or protocol (Liberty Alliance, OpenID, Shibboleth…). Neither tools had impressive features in this category but Intalio receives 2 points for better support for LDAP and JBoss only 1 point.

5. 10 Connectivity

Regarding adapters Intalio has support for various adapters such as Apache AXIS 2.0 for XML based web services, Apache ServiceMix for ESB and SOA, Infravio for metadata repository and Pentaho for business intelligence suite (e.g. reporting, analysis, dashboard, workflow, ETL…) (Ghalimi, 2006). jBPM is interoperable all of the J2EE-based integration technologies Java Messaging, JCA, JDBC and EJB. It can be further embedded on other Java application framework, such as JBoss Seam (http://www.jboss.com, 2008a).

Intalio Tempo (a set of runtime components) supports REST and various SOA workflows, including BPEL and XFroms (http://www.intalio.org, 2008). We could not find any REST support on jBPM.

Based on our practical experience, the implementation is really demanding at the beginning when all related software are not installed and configured yet. For example, database, rule engine and web server need to be installed separately for a fully functional BPM testbed. Neither Intalio nor jBPM provide an "All-in-one" package for plug-and-play. Therefore, it is not easy to create a full-fledged process from scratch, unless the web server has been well built and tested against the process import operation. Otherwise, it is likely to encounter many technical problems.

Since JBoss provides a more flexible approach to connectivity, we have evaluated it to be more valuable in this category and give it 3 points and Intalio 2 points.

5.11 Overview of the Evaluation

BPM systems in general are in a growth stage at the moment. In this stage, concepts and conventions for BPM are still to be set. This has caused some challenges for our research. The same concepts are still discussed with different terms and different stakeholder viewpoints are mixed. Moreover, the tools we are evaluating, JBoss jBPM and Intalio, are still catching up to traditional non-open source vendors and are under constant development. The fact that these two tools are still under development has caused challenges in the implementing of a sample process. We found a lot of tutorials and discussions that were no longer relevant for the versions we were using. Even the official documentation and tutorials are not mature and often include gaps. Moreover, the community documentation and discussions are widespread over the web without comments on the version used. We were forced to combine a lot of documentation from new and old versions in order to get a complete understanding of a domain. It was impossible to find a thorough tutorial. The fact that the tutorials and

documentation are still immature also reflects the fact that these tools should not be taken into use without considerable consideration. The maturity of documentation and difficulty of deployment reflect that the tools are not ready for widespread use yet. According to our experience, a lot of development experience is needed to manage the tools.

We evaluated the tools based on the material available for community-edition users, not the enterprise packages. Although we did have some access to enterprise-edition documentation, the support from these was left to the stage of configuring the tools. The amount of resources it would take to take full advantage of the documentation was outside the scope of our project. In addition, we wanted to make the evaluation as impartial as possible. Therefore, since we did not have the resources available to take advantage of full vendor support for the both tools, we had to rely on materials available to the community. According to our experience, the support from the vendors for the enterprise editions would be invaluable for the use of the tools for anyone not willing to spend a lot of resources just to deploy the tools.

We discovered that some research concerning our subject was contradicting. On top of this, BPM systems in general are complex, involving different stakeholders and different levels of control (code, instance process). These concepts are often confused in the documentation. This all leads to a problem that nothing that is read from documentation can be taken as granted without verification and scrutiny.

We have conducted an evaluation by combining literature and implementation. To the best of our ability, we have tried to map out the most important differences between these two tools. The research should however only be considered as a snapshot in time, since every day that passes might bring a novel solution to any of the problems we have stated in our report.

5.12 Overview of the Results

The scale for our results is 1(does not meet expectations) – 3(exceeds expectations).

Criteria	**JBoss jBPM**	**Intalio BPMS**
Process modeling	2	3
Workspace	2	2
Process Administration	2	2
Business Rules Management	2	2
Business Activity Monitoring	1	1
Process Engine	2	3
Process repository	1	1
Resource Management	1	2
Connectivity	3	2
Total	16	**18**

6 Conclusions and further work

The goal of our research was to provide a practical comparison of JBoss jBPM and Intalio BPMS. We conducted the research by following an evaluation framework that we constructed by combining research, documentation and expert advice on BPM systems.

We implemented a simple process with both tools to gather experience of using the tools. We combined this knowledge with information from various resources and were able to cover the categories set out by our framework. In the implementation, we had to gather a lot of information from different sources, and we got a comprehensive picture of how it would be to actually work with these two tools.

Even by taking into account the fact that we were using the community editions and relied on community edition documentation and tutorials, we can draw the conclusion that neither of these tools is mature enough to be taken into use in companies without extensive IT resources. The tools are complicated and sophisticated and require expert knowledge to get them working.

The study revealed a difference in philosophy regarding BPM between JBoss and Intalio. According to the JBoss philosophy, it is always the technical developer that implements the process according to the specification set by the business side. Intalio has a more ambitious goal, where the business side could change and execute processes themselves, without always having the technical developer translating the business view to functioning code. See Appendix 3 for a graphical representation of the ideology or the two tools regarding BPMS and the role of the business analyst and the developer.

Apart from this philosophical difference, the differences between the two tools in terms of functionality are minor. We found the Intalio orchestration environment and workspace to be more descriptive. On the other hand, Intalio is completely reliant on a web-services environment, whereas JBoss leaves more room for independent development and choices regarding integration.

The scope of this study was to compare two open-source BPM tools regarding the most important aspects for the banking industry. A more comprehensive analysis by implementing some core processes that integrate to the legacy systems and web interface would be crucial to be able to determine the value of these tools. In addition, the lack of support for some crucial functions, such as the audit trail, makes a study more rigorously focused for the banking industry necessary to be able to assess the possibility of taking one of these tools into use. Furthermore, a comparison between an open source tool and a closed source tool would be valuable in terms of defining the actual benefit of adopting an open source tool.

In terms of comparison, there is not an advantage to be found on either side.

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Appendix 1: JBoss Architecture

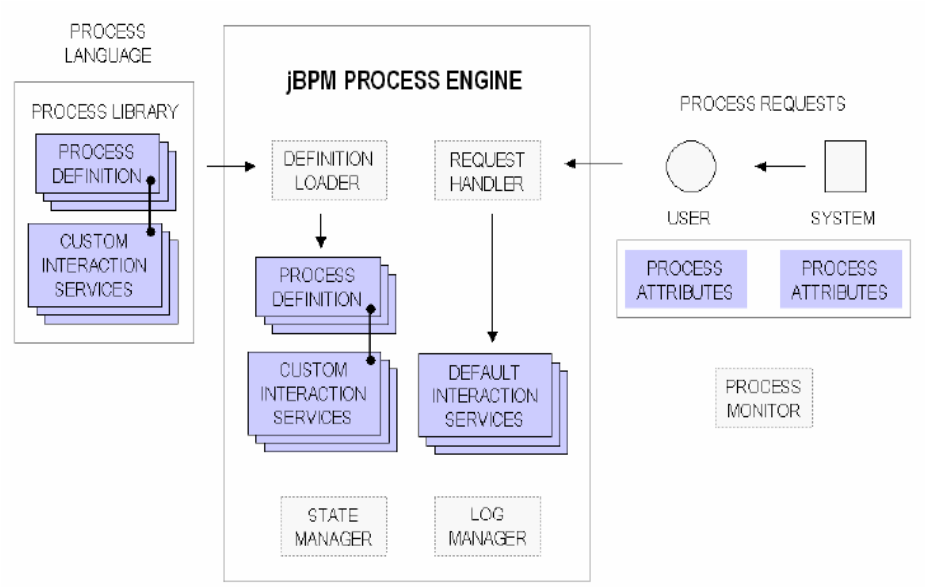

Figure 2 jBPM Components Structure

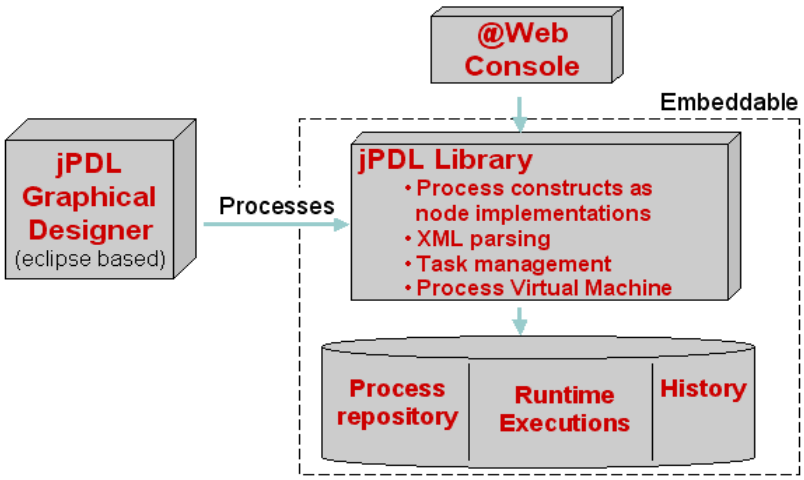

Figure 3 jPDL Components Overview

Appendix 2: Intalio BPMS Architecture

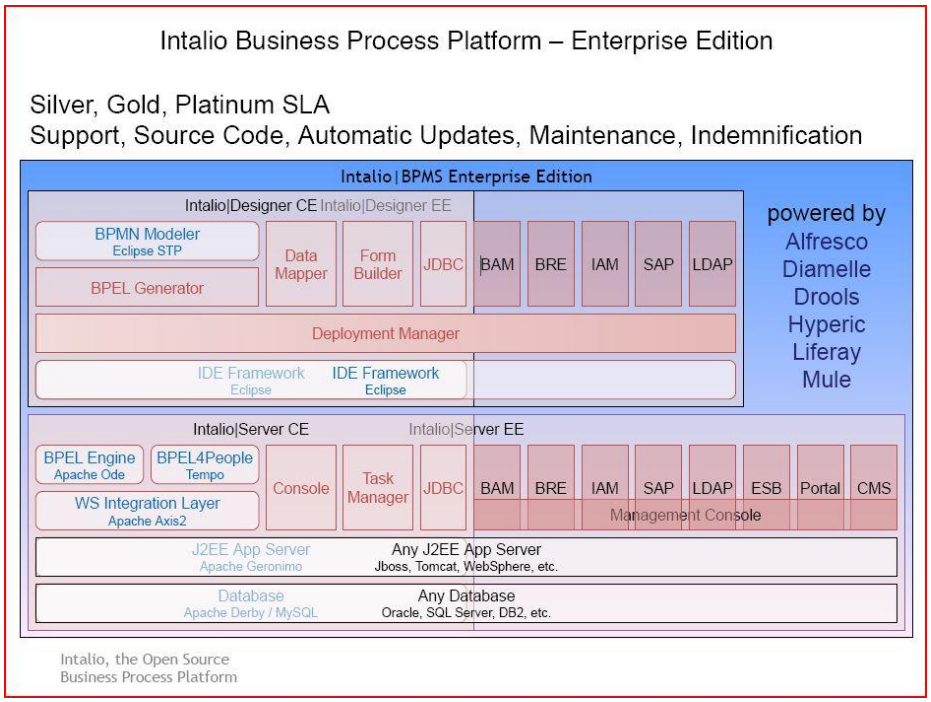

Figure 4 Intalio Architecture

Appendix 3: BPM ideology

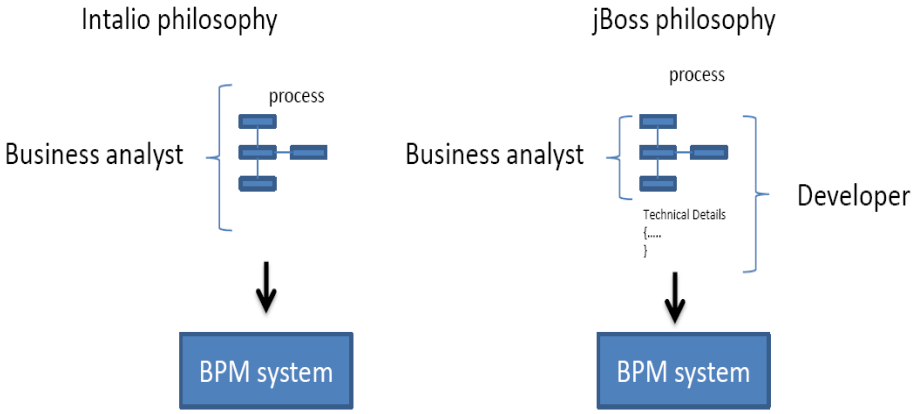

Figure 5 Ideology comparison

Appendix 4: Process Diagrams

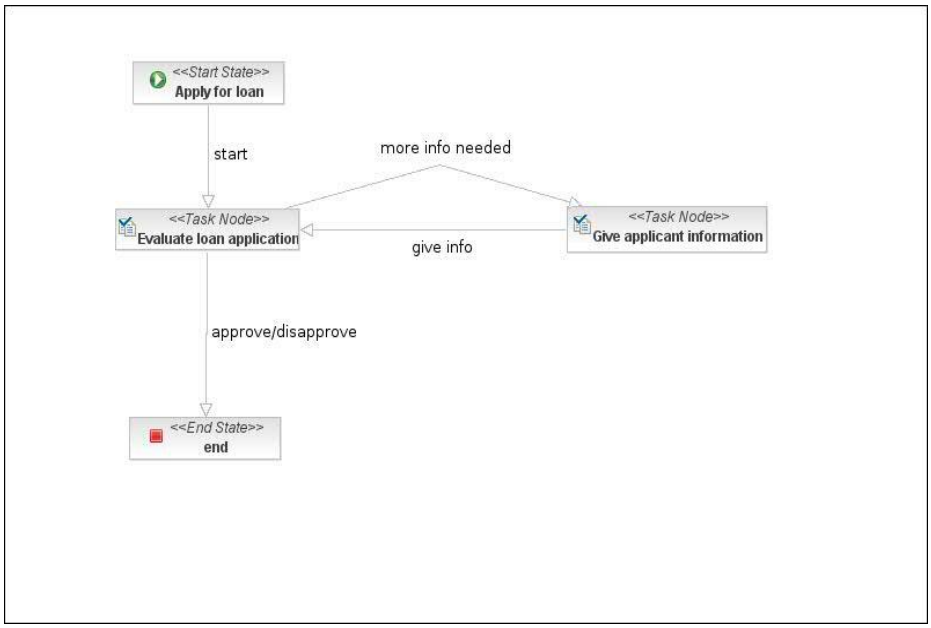

Figure 6 jBPM Process Diagram

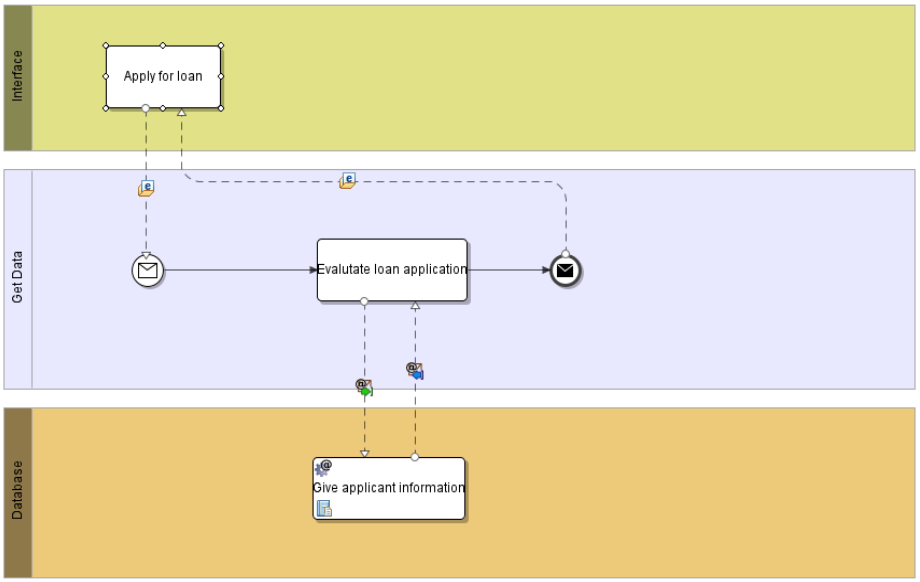

Figure 7 Intalio BPMS Process Diagram

Appendix 5: Evaluation Framework Categories

1. Process modeling

Process models are used to facilitate the understanding of the actual processes especially by business managers but also IT managers. Process visualization enables managers to find flaws in the processes and improve them. The models therefore enable cross-organizational collaboration, including non-developers, who can focus on different parts of the process. (Hill et al. 2006)

We are focusing on comparing the tools' Export/Import facilities and regarding to that also support for standards. It should be possible to import e.g. a model made in Aris into JBoss or Intalio. We also evaluate the support for simulation of the process. The simulation is important to test whether the process is valid at all before actual implementation of the process. To enable simulation it is important that the models embrace some characteristics such as availability of the resources that perform the process.

2. Orchestration Environment

Orchestration refers to an executable business process that can interact with internal and external services. The interactions occur at message level and include business logic. Orchestration represents control from one party's perspective.(Peltz 2003) The orchestration environment therefore refers to how the tools define the executable business processes. We are focusing on whether the tools have support for BPEL, which is an executable language for specifying interactions between web services. We also look at the Export/Import facilities on this level as well ie. is it possible to export and import executable BPEL defined business processes?

3. Workspace

Workspace includes the support for having different user interfaces for different roles. The workspace should ideally look different for a business manager than for a software developer. Also the business manager should in some cases not be authorized to make a change to code and vice versa the software developer in some cases should not be able to make change in overall process design. What different roles are able to do depends highly on the organization and we are therefore

concentrating on how the tools enable authorization and authentication of different actions in the shared workspace.

4. Process Administration

The processes are most likely not solely working in its own environment but acting with several parties e.g. cross-organizational services. Process administration is generally easier in a hierarchical process structures than in peer-to-peer interactions because in a hierarchical process there is a single point of entry and the user has access to details and find out more about the process. In many cases the process is a mixture of hierarchical process and peer-to-peer interactions. (Layman et al., 2002) Administration refers to what kind of information the administrator or user can gain from the process that is already being executed.
We are focusing on evaluating how the two tools monitor and audit the process. Monitoring refers to information about the health of a process. Auditing refers to the possibility of afterwards being able to find out exactly what has happened during a process execution. Auditing is important when someone claims to have done something that they have not.

5. Business Rules Management

One of the key elements of a process is the rules used in and between the sequence steps of the process. (Hill et al., 2006) The rules are very important in our exemplary loan application process as a key feature is the possibility to define a set of rules according to which a loan is approved or disapproved. A rule might be e.g. that the customer needs to have an income of at least 3000€/month. The management of the rules is essential to business managers as they might need to change the rules continuously. We are focusing on the maintenance, user interface and versioning of the rules. At least the tools should provide a means for business managers to change some parameters of the rules.

6. Business Activity Monitoring

Business Activity Monitoring refers to how we can provide real-time access to critical business performance indicators to improve the speed and effectiveness of business operations. (McCoy, 2002) In our research we need to focus on how these tools facilitate the monitoring of business activity. We will look at if the tools provide means to define alerts when some event happens. We can e.g. define an alert when some part of the process takes longer than a predefined time span. It is important to look at the ways the tools can alert business managers of the activities, is it e-mail or do they provide some sort of visualization of the events.

7. Process Engine

The process engine, also called the orchestration engine, coordinates the sequence of the activities according to the flows and rules of the process model. (Hill et al., 2006) In a service environment the engine handles the overall process flow, calling the appropriate services and determining what steps to complete. (Peltz, 2003)
In this research we are focusing on the transactions. In addition to normal transactions we are also investigating whether the tools have any support for compensating transactions for example if a process has started and it needs to be aborted during execution, there might be some need to do some compensating transaction to restore the process to its initial state. High availability of all parts of the process is generally a high concern for businesses so this is of special interest as well. High availability might require clustering and automatic fail-over in case of failure. The transactions should also have exception handling, and safe and automatic re-try of transactions in case of technical problems.

8. Process repository

Process repositories contain process definitions, process components, process models, business rules etc. (Hill et al., 2006). The repositories enable organizations to reuse processes parts across multiple processes and therefore makes it easier to develop new processes with lesser effort.
We are focusing on how the tools handle the repositories. The user should be able to have different versions in the repository and security of the repositories is also an issue. We want to be able to fetch different parts from the repository securely to our new process.

9. Resource Management

Resource management is concerned with how the system handles different resources such as users, roles and audit trails. In this research we are looking at a loan application and special attention needs to be given to the resource management due to the facts that banks use centralized identity management systems for user and role management. As a result of this we are focusing on the ability of the tools to integrate into existing identity management systems and how access control to the resources is defined. We are also specifically interested in how the tools handle the management of the audits as it is an important part of a loan application process..

10. Connectivity

Connectivity refers to how the system is able to connect using different standards e.g. web services, different adapters etc. In our case the most interesting parts of

connectivity are adapters e.g. whether the tools support standard based JCA-adapters, which can save a lot of money and time. We are also looking into the more and more used RESTful web services and how the tools facilitate interaction with them. REST architectural style is lightweight and scalable and the number of services using REST is growing so therefore they are of special interest.

Appendix 6: Glossary Table

Abbreviation	Full Name
BPM	Business Process Management
MRP	Manufacturing Resource Planning
PDL	Process Definition Language
BAM	Business Activity Monitoring
ESB	Enterprise Service Bus
BPEL	Business Process Execution Language
GPD	Graphical Process Designer
ARIS	Architecture of Integrated Information Systems
JMS	Java Message Service
CVS	Concurrent Versions System
SVN	Subversion
LDAP	Lightweight Directory Access Protocol
RBAC	Role-Based Access Control
SOA	Service Oriented Architecture
JCA	Java EE Connector Architecture
REST	Representational State Transfer