

Outsourcing of System Integration Development

Aziz Ahmad Rais, Rudolf Pecinovsky

University of Economics, Prague, Faculty of Informatics and Statistics,

Department of Information Technologies

W. Churchill Sq. 4, 130 67 Prague 3

arais@seznam.cz, rudolf@pecinovsky.cz

ABSTRACT:

Many companies outsource the development of system integration as well as development of any information system. There are different risks connected to the outsourced development of system integration. This essay will describe and cover only architectural risks of outsourced development of system integration. This essay will analyze these risks by using agile development methodology. The proposed solution will be based on architectural design patterns, system integration design patterns and agile development methodology.

KEY WORDS:

System integration, design patterns, system integration architecture, iterative process.

1 INTRODUCTION

Since 2003 I have been involved directly and sometimes indirectly in outsourced software development. Most of the outsourced application development had similar problems. By mentioning these problems, most of the risks and the goal of this essay will become clearer. One of the common problems of out-sourced software was that the integration with external systems was handled and solved as an integration component. Such integration component sometimes had no interface that will decouple the implementation from presentation. The integration component was part of whole software development; there were cases like missing what message and data types this component should operate on. Sometimes even the external systems objects were not transformed and directly used in the application. Using external systems data objects cause that the whole software becomes dependent on external system and any change in the external system caused a lot of work for the whole software. Of course using external data objects cause that the software extensibility and flexibility is also affected.

Other very important common problem is that it is good to mention that the integrating component was not developed as one package. Access to the implementation of integrating component by other components of the software was in no way limited. This caused that system integration was difficult to secure and assure that the external system receives the messages. As last, all such system integration caused that system performance was also affected.

Why these problems happened and can they happen to outsourced development of system integration?

There are many reasons but the most important ones can be identified according to development life cycle; they are the following:

1. **Project budget (fixed price):** One of the advantages of outsourcing is finance [1]. That is why the fixed price outsourcing projects can meet this expectation. Therefore the non-fixed price outsourcing development won't be covered and analyzed in this essay. The difference between outsourcing and in-house development estimate is that the in-house development budget can be updated periodically. In order to make estimate of outsourced project budget there is need for estimation of development of system integration. Exact estimate of development before the project starts and in the

beginning of the project is not possible as there are not available enough details of the project, business scope, technical requirements, and technical solution. Besides that there are unpredictable variables that effect the development, too. These variables affect the final estimate as well. These variables can be identified based on life cycle phases of system integration [2], for example:

- a. **Systems compatibilities:** Integration of different systems needs knowledge about their compatibilities of service interfaces, technologies, protocols, data types, validation of data that the systems require. To analyze all these compatibilities and calculate their impacts on development take a lot of time.
 - b. **Proposed solution:** usually you have to make an estimate of solution of the system integration. If you estimate development without the proposed solution there is a big risk that the project goes out of budget or you have to reduce the quality of the system integration.
 - c. **Technology issues:** There are a lot of components and frameworks, commercial as well as an open source. That makes very difficult to predict all the problems that the selected technologies will work for the proposed solution.
 - d. **Business requirements:** It is very difficult to make complete business requirement analysis to identify the scope of the project. The scope of the project is important for budget estimates. So during development of the system integration requirements can change, which affects time for development. That has an impact on total budget.
2. **Lack of specialists:** Very often outsourcing companies can lack specialists or they do not want to invest in hiring specialists. Both cases affect that the outsourced development of the system integration is done by non-experts. In case of in-house development, companies can hire additional resources or postpone software delivery date. Outsourcing companies are limited by budget, SLA, sometimes by a strategy or global cost saving.
 3. **Lack of process and methodologies:** Accurate and precise process for outsourcing of software development does not exist. The processes like RUP and agile development methodologies are good for in-house development. This is due to a fact that none of these methodologies cover how to separate the responsibilities and roles of software development between customer and supplier. These development methodologies do not explain also how to divide the iterations when review of software quality should happen and there are missing relation of process to development actions. For example: what part of architecture should be built in which iteration or phases. Some of these methodologies do not recommend building software architecture and design. And none of them propose any lightweight process and methodology for developing software architecture iteratively. Also, none of these methodologies describe how to use design patterns in the development process.
 4. **Lack of requirements:** In practice it usually means having ambiguous requirements or having vague requirements. Sometimes what happens is that there is a missing clear vision of a business or a business strategy, which affects defining exact requirements. In case of in-house development during the development the requirements usually change and the project delivery date can change accordingly. The result of any unclear requirements is that the software cannot be tested and reviewed.
 5. **Lack of software architecture:** Software architecture in outsourcing of development of system integration is missing for different reasons. The reasons can be project budget because such activity is not included in the budget, lack of specialist, lack of process or a lack of requirements. Other very important reason is that there is missing lightweight methodology that would help even inexperienced architect to propose a

solution and prevent or limit the above problems. However, it can happen that the in-house development is missing software architecture. Nevertheless, this is usually covered by a specialist to watch the implementation of a system integration development.

6. **Lack of design:** According to some development methodologies system architecture is a high level design of software and the design is detailed solution of the software architecture. Some-times design is understood also as a meta-model (for example: UML class diagram) of implementation of the software. But this last definition will not be described in this essay. Many developers still do not understand how to utilize the design patterns or they still do not understand the advantages of them.

This essay will further analyze and cover topics such as system integration software architecture, design and lightweight process for building system integration software architecture iteratively.

Why lightweight process is better than the existed one?

The existed processes and methodologies are very general and open. It is because one has to be able to apply them on any types of software development. For outsourcing of system integration development is needed to have more precise processes and recommendations that limit developers from selecting from many options. This will help to quickly propose the architecture for outsourced system integration software and design. What is a good base for a budget estimate and architecture will not be a discipline for senior specialists anymore.

In this essay, a solution for the system integration based on view driven architecture, will be proposed. Many authors try to solve system integration design patterns instead of system integration architecture and how and where in system integration architecture to use these patterns. I would like to propose a different way, which will show how to build system integration architecture and where to use these design patterns. In this essay, the details of the design patterns themselves will not be described but the links will be provided in the reference list at the end of this study..

2 SYSTEM INTEGRATION ARCHITECTURE BUILDING METHOD

System integration architecture can be seen as system architecture of any other multilayer application. According to multidimensional principles of MMDIS [3] every problem needs to be analyzed from different views. System architecture 4+1 view [4] describes views that are not enough for system integration architecture. That is why in this chapter will be identified important views of system integration architecture and described what types of design patterns can be used in each view.

Of course one can assume here that the business requirements are gathered and analyzed. It is important to have identified goals that the system integration should achieve.

Some technical requirements can be defined or assumed as quality models and quality criteria in order the end system to meet them. Example of such quality model can be ISO product quality model (Systems and software Quality Requirements and Evaluation (SQuaRE)) [5].

Of course according to IT governance (COBIT) [6], every IT goal should be mapped into the business goals; so even the SQuaRE model should be mapped into the business quality model.

2.1 Logical view

This view describes whether integration is peer-to-peer, one-to-n or n-to-m and also style of integration.

The goal of this view is also to describe the layers and tiers of the integration. Because layering is architectural pattern, therefore there should be also other design patterns used like SOA and ESB or EAI [7].

Logical view describes big picture of whole integration system and can be applied also in IT strategy of the company. As one of the important aspects of IT strategy is the resource management and applications. Existing services are resources, therefore this view describes what services and systems will be reusing. Based on this view one can also make a rough estimate of the project and can also show how the implementation team will be created.

Sometimes this view can also contain main conceptual business components. Business components are understood functionality that needs to be implemented and they will be converted to technical components by component view.

2.2 Component view

Components view describes all the components in each layer and the tier of the integration architecture. Example of components can represent such design patterns like:

Pipes and Filters, Message Router , Message Translator, Point to Point Channel, Publish Sub-cribe Channel, Dead Letter Channel, Message Bus, Content Based Router, Message Filter, Recipient List, Aggregator, Resequencer, Routing Slip, Throttler, Delayer, Content Enricher, Content Filter, Messaging Mapper and so on. Because the design pattern is proven solution of a specific and repeatable case and the implementation of each design pattern can be some component, the best place for identification of components is integration design patterns [8].

2.3 Process view

This view is very important to describe how each tier, layer, and components interact with each other.

Also, here will be described when the message is going to be transformed, when the data types are mapped and how they are mapped, if a message is persisted in order to service crash and how message delivery is assured. Also, every subscriber gets only one copy of the message. In this view is also made clear whether the communication is synchronous or asynchronous or integration is batch-wised or real-time.

2.4 Data flow view

This view is about to find out what types of information is taken from what system and used for what purposes by which consumer. Also, here will be described the direction of the data streaming through components.

It is important to describe the data format of the information and provide a mapping list of transformation and mapping between systems data and their types.

2.5 Deployment view

This view will describe how each logical component, layer and tier will be deployed into infrastructure and network. It is to identify the relation of logical components described in components view to the infrastructure and network. This way we can see the runtime behavior of the whole system integration. This view also makes clear the high availability, failover, load-balancing, and security of the system integration.

2.6 Technology view

This view should solve the technology selection problem of the system integration. Of course it is important to know all the information about the logical view, physical view, and components view due to a fact that this view supports the implementation system integration.

Of course here belongs the identification of all technologies that reflects the logical view layers, tiers, protocols, and frameworks. The difference between this and the deployment view is that the hard-ware, network, operation systems of low level layers that are used by application systems for communication with each other, are not part of technology view but deployment view.

This division is important, because every view will be managed by different IT specialist. The use of both views by system integration is also different; technology view directly affects system integration but deployment view indirectly.

2.7 Implementation view

This view is going to describe how to package or group all the components and identifies how each component is constructed. It means identifying parts of each component and their associations, aggregation, inheritance, and other object oriented features.

In this view can also be used object oriented design pattern for identification of the relation between components. Example of these design patterns is gang of four [9].

3 PROPOSED PROCESS

Developing system integration architectural view can be achieved in many ways. However, the optimal one is to iterate on all the steps of integration method - see the chapter (2- System Integration architecture building method).

To have complete process we need inputs for this process and assume the inputs are prepared in other phases of the system integration project before starting the elaboration and construction phase. Assume the project has four phases: inception, elaboration, construction and transition [10]. The main inputs for this process are:

1. Business strategy
2. Business goal of the system integration
3. Business analysis (use cases)

The output is quite clear and is not necessary to explain - it is proper architecture document. Because the responsibility of the identification and describing is responsibility of architect [6], so the actor is architect.

Loop 1 {

1. Logical view: To describe this view there is a need to follow the following process:
 - a. Take the business goals and convert them to the system goals.
 - b. Identify what services the system integration should provide.
 - c. Identify all the systems that provide services that are important for building new service.
 - d. Identify tiers and layers of the system.
 - e. Identify how each layer and tiers communicate with each other.
2. Component view: As described above, this view describes technical components of the system integration. Here we need to find out how to identify these components.
 - a. In order to identify the components there is a need to analyze the business provided by the current service. The result of such analysis is that it sometimes describes the ad use case based on RUP methodology [10].
 - b. How to reuse current services, that means what data the services provide and which data are needed to extract and how these extracted data together are merged and provided to the new service.
 - c. How to interact with the current system.
 - d. Based on these information, reuse the proven solutions like design patterns.
3. Process view: In order to identify how the components will interact with each other and their dependencies we should follow the following steps:

- a. Identify all the use cases based on business requirements.
 - b. For each use case there are already identified components in the component view and identify interaction between the components for each used case.
 - c. Skip used cases that has similar scenario of interaction, in order to have effective documentation and architecture describing does not become time consumer.
4. Data flow view: to identify this view we need:
 - a. To identify all the data needed for the new service.
 - b. All the systems that provide the needed data.
 - c. Identify format of the data that are needed in order to identify the interaction message format between the services.
 - d. Identify the data flow direction.
 5. Deployment view: For this view the important steps for describing are:
 - a. Identify whether the system should be in cluster.
 - b. Identify whether the system use load-balancer.
 - c. Identify whether the system should use database.
 - d. Identify the system requirements on hardware.
 - e. Identify hardware size.
 - f. Identify the location of the hardware and under which domain they will be placed.
 - g. Identify how the whole system will be secured. Whether the system will use external authentication system like LDAP, internal authentication components, access to the system from different networks.
 6. Technology view: This view is about mapping of layers, tiers and sometimes components to the technologies, so to describe them we need minimal of the following steps:
 - a. Identify list of technologies for each tier and layer.
 - b. Identify the list of technologies, frameworks or open a source component that matches the components view.
 - c. Analyze all alternative or combination of technologies, components and evaluate the best alternative. A brain storming method could be used here or any other quantity base method.
 - d. Make proof of concept of the best or optimal alternative.

Loop 2 {

7. Implementation view:
 - a. Identify how each component will be packaged.
 - b. Identify the physical interfaces of each component.
 - c. Identify how implementation of each interface will be invoked.

}//END of loop 2

}//END of loop 1

Every loop means that we can iterate over all views and the sequence diagrams describe that when we can start and with what type of view. This means that we can work parallel on some views and as you can see in diagram, we can identify the components in iterations and every change in components view can affect all other views except the logical view.

In order to achieve optimal process there is need for correct business requirements engineering process, and change management process [11]. Both of these processes are needed in order to better identify the functional defect and implement the change in new iteration and release of the system.

4 SUMMARY

This paper was assumed that there are different problems with system integration and when outsourcing such software development project. The main goal of this paper was to solve architectural risks by identifying architectural and design problems.

There could be identified many ways to prevent them but this essay proposed solution that most problems can be solved with identifying the big picture of the system integration. The big picture means describing the architecture of the system; use the appropriate design patterns to describe what should be integrated with what and how. Describing and using architecture and design patterns are the right media for interpreting business requirements into technical and model requirements in diagrams. Software architecture has some similarity with architecture of buildings and machines. The similarity is that in order to better imagine the end product; we need to see a building or machine from different insights. That is why for better understanding and reducing problems and misunderstanding, there were provided integration architecture method with different views. In order to better understand each view there was need for providing overview of architectural and integration design patterns that are used in each view.

Finally this paper provided a process that makes the building of the architecture and design easy and cost effective.

Based on this essay, the recommendation is that every system integration project has to separate integration layer. It does not matter whether it will be deployed on middleware or together server with business logic of system consumer. The reason for this is that this layer can be easily decoupled from the system and deployed on middleware in case of the need for extending the system integration to n-m integration type.

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