CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

Methodology refers to a system of principles, practices, and procedures applied to a specific branch of knowledge used by people when studying a given phenomenon. They are planned, scientific, and value-neutral. It is deliberately employed in a way that is designed to maximize the accuracy of the results (Wikipedia).

Methodology includes the following concepts as they relate to a particular discipline or field of inquiry (Wikipedia):

1. a collection of theories, concepts or ideas;
2. comparative study of three stand alone BPR case tools

Methodology refers to more than a simple set of methods; it refers to the rationale and the philosophical assumptions that underlie a particular study (Wikipedia). Therefore it is very important to choose the appropriate research methodology as it involves data collection which needs to fulfill the objectivity of the study, time constraint, cost involvement to produce and conduct the survey, accuracy of the data, availability of the data, accessibility of the data, confidentiality of the data and integrity of the data.

The methodologies adapted for this research is for the purpose of fulfilling the objectives discussed in the Chapter 1. The research will use a combination of different methods in order to fully explore the existing BPR case tools. The details of the adopted methodologies and the reasons for selecting them will be discussed comprehensively in this chapter. The table below summarizes the methods:
Table 3.1 Summary of Methodologies

<table>
<thead>
<tr>
<th>Methodology</th>
<th>How the methodology was conducted</th>
<th>What was conducted/chosen?</th>
<th>Research Objective</th>
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<tbody>
<tr>
<td>Literature Review</td>
<td>• University of Malaya Library’s (UML) online public access catalogues (OPAC)</td>
<td>• Research and review on various write-ups about BPR as well as BPR Case Tools</td>
<td>• Understand the term BPR as well as related issues.</td>
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<td></td>
<td>• ACM Digital Libraries, Books on BPR and related articles</td>
<td></td>
<td>• A comparative analysis on existing 3 stand alone BPR Case Tools.</td>
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<td>• Work papers of various writers/researchers</td>
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<td>• Dissertation Abstracts Online (DAO)</td>
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<td></td>
<td>• online citations</td>
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<td></td>
<td>• World Wide Web (WWW)</td>
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<tr>
<td>Case Tool Testing</td>
<td>• Questionnaire</td>
<td>• Close ended questionnaire</td>
<td>To test the module and identify errors in order to find whether BPR4U runs successfully.</td>
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<tr>
<td></td>
<td></td>
<td>• Convenience sampling</td>
<td></td>
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<tr>
<td>Software Process Models</td>
<td>• Research</td>
<td>• Prototype</td>
<td>Develop the first phase of the web-based BPR Case Tool which is the modeling of AS-IS process and analysis component</td>
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3.1.1 Literature Review

The first objective in section 1.6 of Chapter 1 of this research focuses on comparison of three stand alone BPR Case tools. To achieve this objective, literature review was conducted. To ensure that the researcher obtains the appropriate data from this research and achieves accurate results, the researcher must choose the right methodologies. The research instruments used in the collection of data are described below:
Literature analysis which include the following sources:

a) Websites

Websites are the primary source to gather information on BPR. Some professional and well-known websites such as brint.com, kmbook.com, science-direct.com contributed a lot of articles on debatable issues, white papers, facts, previous research papers, case tools line up, statistics on survey done and provide forums for researchers to explore more knowledge. The researcher will access these websites to search for helpful information.

b) Journals and magazines

Journals and magazines are very important sources to find helpful and reliable secondary information. University libraries subscribe many journals related to case tools like Process modeler and Smart Draw. The researcher searched in the library of University of Malaya (UM) or other research centers to get these journals and magazines. The papers obtained from the journals and magazines gave the researcher the latest information and issues about BPR case tools. After reading and analyzing these papers, the researcher will be able to get accurate and very clear knowledge about the study of BPR and case tools used.

c) Academic reference books

Reference books are a main resource to the researcher. Reference books give more complete and accurate definition about this study. The researcher selected some references as secondary information too.

Literature review one of the ways of obtaining information about the topic under study as it gave the researcher a thorough knowledge of the subject area being studied which involves BPR. It provides the researcher detailed knowledge of previous studies and
a conceptual framework of BPR. As such, the review has helped the researcher to identify the controversies and gaps in the previous studies. The literature review has also indicated the potential directions for future research.

3.1.2 Case Tool Testing

Testing is very important step to ensure that BPR4U runs successfully. This is described in detail in Chapter 5 of this research.

3.1.3 Software Process Models

When a product is developed, a sequence of steps is always followed to accomplish a set of tasks. These set of tasks forms a process which involves a series of steps involving activities, constraints and resources that produce an intended output which is classified into various models. Three models were studied and reviewed for the purpose of this research. These includes waterfall model, prototype model and spiral model. All software process models share four fundamental process activities, and differ primarily in how these four are organised and interleaved. The four fundamental process activities include the following:

- Specification which define requirements, functionality and constraint
- Development which build the system to meet the specification
- Validation validates that the system does what the users require
- Evolution evolves to meet the changing needs and expectations
**Waterfall Model**

The waterfall model that was developed in the 1970 is commonly used for software engineering (Davidson, 2002). The waterfall life cycle model divides the development process into a series of sequential steps. These steps (Davidson, 2002) are typically defined as:

- Requirements definition
- Preliminary design
- Detailed design
- Implementation
- Unit testing
- Integration testing
- System testing
- System rollout
- Maintenance

One of the fundamental aspects of the waterfall model is that each step is assumed to stand alone and must be completed 100% before moving to the next step.

![Figure 3.1: Steps of the Waterfall Model](image-url)
The Waterfall model as depicted in Figure 3.1 is comfortable in large, formal organisations and on projects that have high risk in the areas of budget and schedule predictability and control. The original model did not allow for returning to earlier stages and making modifications (Davidson, 2002). Later, when this was found to be too restrictive, a feedback cycle was incorporated which allowed the team to revisit and modify earlier phases. However, allowed only for changes, and not enhancements, to be made, and the affected step had to be “closed out” and assumed to be complete before the changes were propagated to next steps. This implies, for example, that the requirements analysis is 100% complete before moving into any design or build work (Davidson, 2002).

**Prototype Model**

A prototype is a form of design specification, and the final implementation of a user interface is often performed with the prototype as a major way of communicating the design to developers. It is an easily changeable draft or simulation of at least part of an interface. It is similar in concept to having a paper mockup of a document to show the approximate size, shape, binding and page layout (Hackos and Redish, 1998).

Prototyping is a critical tool in the design of an effective interface because prototyping allows testing of designs with the users. Organisations of all types use this model. For example, Microsoft, Disney, and Boeing uses it with several names such as simulate, model, prototype (Schrage, 1999). In the industry it is a process by which organisations innovate, better communicate both with their customers and with each other internally, develop and improve their products. Boeing builds digital prototypes of its aircraft allowing the detection of design conflicts before the parts are manufactured and assembled. Disney uses storyboards to work through the process of producing feature-
length films. Microsoft sends out thousands of copies of "beta" versions of its software and then uses its customers as the testers of its "prototype" (Schrage, 1999). Therefore, it is considered a powerful technique. Figure 3.2 illustrates the prototype model.

![Prototype Model](image)

**Figure 3.2: Steps in Prototype Model**

Taking into consideration that system requirements often change, employee’s change, and the system development process is very lengthy, an application to reduce the process was designed. Rapid application development (RAD) works by involving the user. (Nickerson, 2001) “The user is involved in requirements analysis, prototype development, system design, and implementation.” By involving the user there are no communication problems that occur, there are fewer changes that have to be made, and it reduces the time and cost of the development (Nickerson, 2001).

**Spiral Model**

The spiral model uses concepts of prototyping and evolutionary system implementation to primarily identify and evaluate risk and cost. In the spiral model, developers define and implement features in order of decreasing priority (Boehm, 1988).
Using this model, before any work is started, a risk analysis and cost/benefit analysis are completed and evaluated. This model divides the development activities into four quadrants through which the effort proceeds. Each time a quadrant is visited, the scope is increased based on go/no go decisions made in the previous efforts. Thus, an expanding spiral effect that finally leads to a deliverable system is created (Boehm, 1988). The four quadrants (Davidson, 2002) of activity (as illustrated in figure 3.3) are:

- Determine project objectives, such review alternatives as build or buy, and identify such constraints as time available, budget and staff talent availability
- Evaluate the defined alternatives and identify the risks, and choose alternatives to minimize those risks
- Develop a prototype based on previous work and verify its effectiveness
- Reevaluate and plan the next cycle

Figure 3.3: Steps in Spiral Model  
(Source: Davidson, 2002)
Each trip around the quadrants is called a “round” and a commitment to proceed or a decision to abandon is made at the end of each round (Davidson, 2002). Rounds zero and one are generally concerned with project feasibility and risk assessment. If there is a “go” decision at the end of round one, a more detailed analysis and concept of operations is begun (Davidson, 2002). At this point, the spiral model borrows many of the concepts of the waterfall model, and rounds two and three result in functional requirements specifications and preliminary design decisions. However, each round from here produces a working prototype and a new feasibility study and risk tradeoff analysis. Thus, the spiral model borrows several concepts from the waterfall model but incorporates them in a framework of feedback loops to assess the viability of the proposed system in an ongoing manner, adding to the flexibility of changing the implementation based on outside influences. It also borrows heavily on the rapid prototype cycle or methodology to provide end users with previews of the system quickly so that they can continue refining requirements and determining if the finished product will meet their needs (Davidson, 2002). In other words, the spiral life cycle model defines an organised approach to prototyping. This seems to work well in an environment where many of the options, requirements and constraints are not known or not well understood initially, such as a research project. If this is a development effort where the product, options, requirements and constraints are fairly well-defined and understood, the spiral approach is not as appropriate or necessary as are other less risk assessment driven techniques (Nickerson, 2001).

**Methodology Adapted for the Research**

The discussions on the three development methodologies, clearly indicates that waterfall, prototyping and spiral methodologies are very different in processes and
application. Each has its own scope, requirements, developers, users, management, level of innovativeness, development time, complexity, organisational culture, etc. However, Prototyping model was adapted to achieve Objective 2 in section 1.6 of Chapter 1 of this research which is to develop the first phase of the BPR tool which is the modeling of As-Is process and analysis component of a web-based BPR case tool. The reason is that tool development requires enhancement on an on-going basis as the needs of the users may change and the tool needs to be updated as technology advances. Therefore, prototype allows users and developers to work through the requirement when there is a requirement for change.

System development experts suggest that prototyping positively affects the outcome of a system under development in the following situations as outlined in Table 3.2 (Martin et al., 1994):

<table>
<thead>
<tr>
<th>Situation</th>
<th>Reason to consider prototyping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Users are uncomfortable with abstract models</td>
<td>Gives user something real to interact with</td>
</tr>
<tr>
<td>The project will have a long development time</td>
<td>Gives user and developers something to work with early on</td>
</tr>
<tr>
<td>The requirements are highly uncertain</td>
<td>Allows users to work through the requirements as the prototype develops</td>
</tr>
<tr>
<td>No comparable system has been previously developed - high innovation</td>
<td>Allows for experimentation</td>
</tr>
<tr>
<td>Reaching a solution calls for simulation, experimentation, or incremental evaluation</td>
<td>Allows for simulation, experimentation, and incremental evaluation</td>
</tr>
<tr>
<td>A critical system is needed quickly</td>
<td>Prototyping tools are generally designed for quick implementation. Can begin requirements gathering quickly.</td>
</tr>
<tr>
<td>Users are available</td>
<td>Allows for high user participation</td>
</tr>
</tbody>
</table>

As a result of the literature reviewed on the system development methodologies, it has been concluded that prototyping is an excellent strategy for the tool development for several reasons as following:
• Cost saving - Making changes in the prototype is much cheaper than making them in a coded product. If the problems were detected earlier, the less the cost to fix the problems.

• Concrete - The development can be shared with users, and others who are not on the design team. Miscommunication about what is going to be in the product and how it will work is less likely with a concrete example than when you have written specifications only.

• Foster alternative and iterations - Prototyping allows different alternatives to be tried out, including widely different concepts, metaphors, or approaches to an application. At the same time a design can be rapidly iterated. Users would be able to try the system, find the weaknesses in it, change it, and also allows uses to try out the changed version.

• Allow users to be actively involved at the design stage - Without a prototype, users have nothing to work with until late in development when it is often impossible to change the product.

3.2 Conclusion

In this chapter, we have considered all research methodologies, selected literature review and prototype model as the system development methodology for BPR4U. The next chapter will be discussing in detail the comparison of three existing stand alone BPR case tools which are the main guideline for the researcher to develop BPR4U.