Comparative Study of Software Development Lifecycle Models using AHP

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ABSTRACT

In the ever changing software development environment, the software developer faces many challenges. The trends of increasing technical complexity of the systems coupled with the need for repeatable and predictable process methodologies have driven system developers to establish system development models. This paper represents three software development models: waterfall, prototype, spiral. These models have advantage and disadvantage as well. Comparative analysis will be done using AHP.

Keywords - software development, development models, comparative analysis of models.

I. INTRODUCTION

Software development life cycle (SDLC) is a method by which the software can be developed in a systematic manner and which will increase the probability of completing the software project within the time deadline and maintaining the quality of the software product as per the standard [1]. The System Development Life Cycle framework provides a sequence of activities for system designers and developers to follow for developing software. A software development process, also known as a software development life cycle (SDLC), is a structure imposed on the development of a software product [3] [4].

Waterfall model- The Waterfall model is a conventional, linear, sequential software life cycle model. It is a sequential development approach, in which development is seen as flowing steadily downwards through the phases of requirements analysis, design, implementation, testing (validation), integration, and maintenance.
1) Project is divided into sequential phases, with some overlap and splash back acceptable between phases.
2) Emphasis is on planning, time schedules, target dates, budgets and implementation of an entire system at one time [2] [5].

Prototype model- Software prototyping is the development approach of activities during software development, the creation of prototypes, i.e., incomplete versions of the software program being developed. Attempts to reduce inherent project risk by breaking a project into smaller segments and providing more ease-of-change during the development process. User is involved throughout the development process, which increases the likelihood of user acceptance of the final implementation [2].

Spiral model- The spiral model is a software development process combining elements of both design and prototyping-in-stages, in an effort to combine advantages of top-down and bottom up concepts. Focus is on risk assessment. Each cycle involves a progression through the same sequence of steps, for each part of the product and for each of its levels of elaboration, from an overall concept-of-operation document down to the coding of each individual program. Each trip around the spiral traverses four basic quadrants: (1) determine objectives, alternatives, and constraints of the iteration; (2) evaluate alternatives; Identify and resolve risks; (3) develop and verify deliverables from the iteration; and (4) plan the next iteration [2] [5].

AHP- Analytic Hierarchy Process (AHP) is one of Multi Criteria decision making method that was originally developed by Prof. Thomas L. Saaty. In short, it is a method to derive ratio scales from paired comparisons. The input can be obtained from actual measurement such as price, weight etc., or from subjective opinion such as satisfaction feelings and preference. AHP allow some small inconsistency in judgment because human is not always consistent [6].
II. PAIR WISE COMPARISON OF FACTORS

III. COMPARISON OF MODELS WITH RESPECT TO FACTOR COST

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<th>RISK</th>
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<tr>
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<td>1/7</td>
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\[
W = \begin{bmatrix}
COST & FLEXIBILITY & RISK \\
\end{bmatrix} = \begin{bmatrix}
0.3228 & 0.6434 & 0.0726
\end{bmatrix}
\]

\[W = \begin{bmatrix}
\text{WATERFALL} & \text{PROTOTYPE} & \text{SPIRAL}
\end{bmatrix} = \begin{bmatrix}
1/3 & 21/31 + 7/11 + 5/13 & 3/31 + 1/11 + 1/33
\end{bmatrix} = \begin{bmatrix}
0.6466 & 0.6661 & 0.1460
\end{bmatrix}
IV. COMPARISON OF MODELS WITH RESPECT TO FACTOR FLEXIBILITY

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<td>1/21</td>
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<tr>
<td>PROTOTYPE</td>
<td>7/13</td>
<td>21/31</td>
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<td>7/31</td>
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<td>0.09677</td>
<td>0.04952</td>
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<td>PROTOTYPE</td>
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<td>0.67742</td>
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<td>0.35462</td>
<td>0.22501</td>
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W = \begin{bmatrix}
0.22131 & 0.0737 \\
0.93017 & 0.6433 \\
0.64653 & 0.2830
\end{bmatrix}
\]

V. COMPARISON OF MODELS WITH RESPECT TO FACTOR RISK

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<td>5/21</td>
<td>3/15</td>
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<tr>
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<td>1/15</td>
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\sum = 1/15
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\[
W = \begin{bmatrix}
1/13 & 0.200659 & 0.6688 \\
0.0219 & 0.2673
\end{bmatrix}
\]

GOAL

COST  
0.2673

FLEXIBILITY  
0.6688

RISK  
0.0736

WATERFALL  
0.6688

SPIRAL  
0.2430

WATERFALL  
0.0737

SPIRAL  
0.2628

WATERFALL  
0.6688

SPIRAL  
0.0637

PROTOTYPE  
0.0881

PROTOTYPE  
0.6433

PROTOTYPE  
0.2673
VI. COMPOSITE WEIGHTS

1) WATERFALL MODEL

\[ 0.6686 \times 0.2828 + 0.0737 \times 0.6434 + 0.6688 \times 0.0738 \]
\[ = 0.1890 + 0.0474 + 0.0493 \]
\[ = 0.2857 \]

2) PROTOTYPE MODEL

\[ 0.0881 \times 0.2828 + 0.6433 \times 0.6434 + 0.2673 \times 0.0738 \]
\[ = 0.0249 + 0.4138 + 0.0197 \]
\[ = 0.4584 \]

3) SPIRAL MODEL

\[ 0.2430 \times 0.2828 + 0.2828 \times 0.6434 + 0.0637 \times 0.0738 \]
\[ = 0.0687 + 0.1819 + 0.0047 \]
\[ = 0.2553 \]

Waterfall = 0.2857
Prototype = 0.4584
Spiral = 0.2553

VII. CONCLUSION

We have done analysis of these models using AHP. According to our requirement and characteristics of these models prototype model is best.

REFERENCES