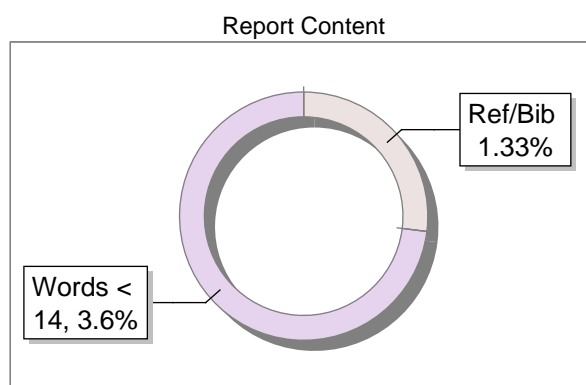
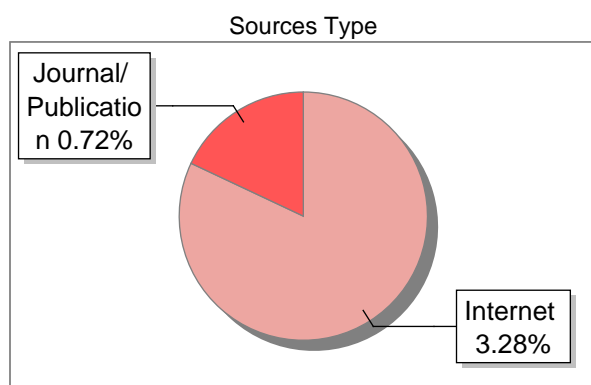


Submission Information

Author Name	Dhanush shetty
Title	Task
Paper/Submission ID	3331930
Submitted by	nnm23is030@nmamit.in
Submission Date	2025-02-14 13:39:34
Total Pages, Total Words	12, 2637
Document type	Project Work

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PROJECT REPORT

ON

Enterprise Resource Planning (ERP) ⁴System

Which will allow you to explore the impact of different software process models

Submitted to

NMAM INSTITUTE OF TECHNOLOGY, NITTE

(Off-Campus Centre, Nitte Deemed to be University, Nitte-574110, Karnataka, India)

In partial fulfilment of the requirements for the award of the

Degree Of Bachelor of Technology

In

INFORMATION SCIENCE AND ENGINEERING

By

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NNM23IS053

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**NMAM INSTITUTE
OF TECHNOLOGY**

Comparative Analysis of Software Development Lifecycle Models for Toyota Industries Corporation's ERP System

1. Introduction

SDLC functions as a structured development methodology for creating software systems of high standard. The software development lifecycle (SDLC) includes the Waterfall Model yet also incorporates Incremental Development and Spiral Model which implement separate management frameworks. This document evaluates these evaluation models when applied to Toyota Industries Corporation's ERP system which brings together multiple business operations to increase operational effectiveness. The evaluation considers model suitability through an examination of functional needs together with non-functional ones and risk and change strategies and time and budget limitations.

2. Case Study Overview

Toyota Industries Corporation established an ERP system to transform their operations while improving their production efficiency across the global operations. The deployment of SAP ERP allowed the company to unite its supply chain management with financial management and human resource functions. Through the new implementation Toyota gained the ability to enhance its supply chain operations and enhance inventory tracking while enabling smooth communication between all departments. The ERP system enabled agile market responses together with quick customer demand fulfilment through providing instant access to real-time data.

Background of Toyota's ERP Implementation

- The ERP implementation at Toyota took place as a solution to various critical business problems.
- Toyota operates a complex global supply system with multiple suppliers that manufactures throughout various production sites. Managers must handle this supply chain efficiently as it enables production schedule maintenance while cutting expenses.
- The lean manufacturing practices of Toyota rely on principles that work toward waste elimination and process improvement. The organization achieves its principles through the ERP system which minimizes operational issues and makes production methods more efficient.
- Toyota must guarantee that its ERP system meets different regulatory requirements in a highly controlled automotive industry.

- The company needs to focus on maximizing customer demand responses by creating flexible scheduling and inventory management systems.

Objectives of the ERP System

The main goals Toyota pursues with its ERP system include:

- The system needs to create an integrated environment which joins together supply chain supervision with financial operations together with personnel administration and resource scheduling as well as inventory oversight and customer relationship capabilities.
- Operational efficiency improvements through process optimization together with minimal manual interferences constitute one of the system's core objectives.
- Real-time data access forms part of the system's capabilities to support quick market adaptation and customer-driven operational changes.
- The system requires design features to handle expansion related to future growth and extra operational capabilities.

3. Software Development Lifecycle Models

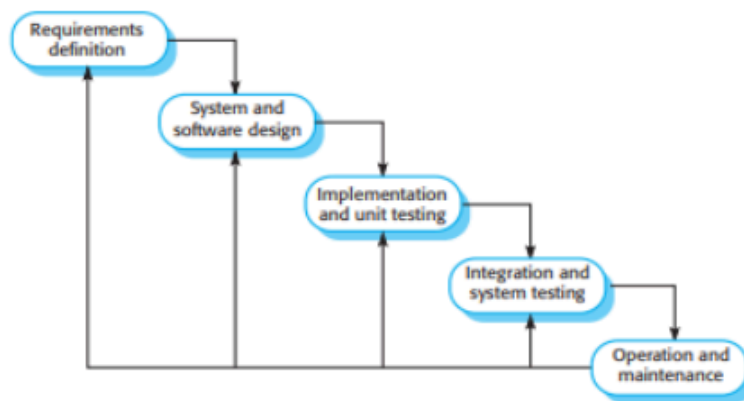
Waterfall Model

The Waterfall Model delivers software development by using a time-based sequential process. A successive progression must complete one phase before it starts the next phase. The project needs predictable requirements and small/no alterations to benefit from this model structure. The model becomes problematic during requirement adjustments which also establishes high risk when initial project requirements are unclear.

Phases of the Waterfall Model:

- 1.System requirement gathering begins with analysing the necessary needs of the system. At this stage companies must establish a comprehensive understanding of requirements to guarantee project success.
- 2.The design section commences after requirements definition through which the system design emerges. System architecture together with hardware specifications and software components and all other design elements form part of this stage.
- 3.The system developers perform actual programming activities during the implementation phase. The developers adhere to the design specifications when writing the program code.

4. The system receives testing through which experts confirm its operational accuracy and adherence to its specified requirements. System testing and acceptance testing combine with unit testing and integration testing to be performed during this phase.
5. The system operates from a deployment into the production environment which enables users to access it.
6. During the maintenance phase the team involves fixing system issues while carrying out required updates to keep the system operational.



Incremental Development

Software development through Incremental Development requires builders to create the program by dividing tasks into individual blocks. New functionality appears in the system after every implemented increment. Early implementation of functional products combined with easier accommodation of changes becomes possible through this development model. Projects consisting of easily dividable requirements can utilize this development approach for obtaining valuable early feedback.

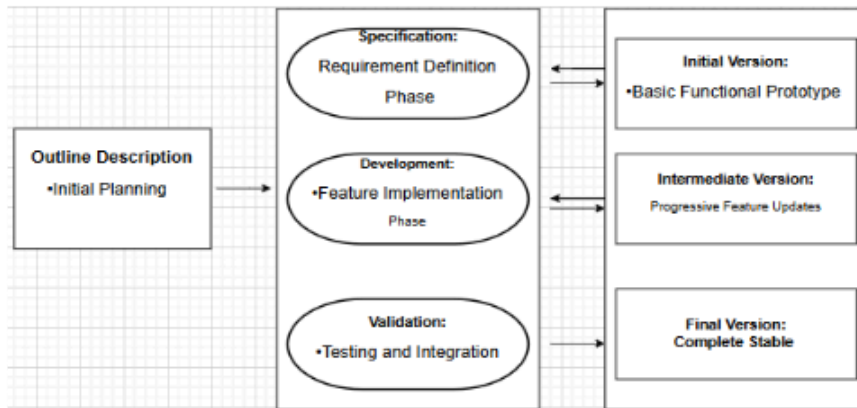
Phases of Incremental Development 1. *Similar to the Water Fall Model, this phase requires Requirement Gathering and Analysis of the system to run.*

2. **Implementation and Design:** *The implementation and design are done in the increments. The addition of each increment adds more and more features to the system.*

3. **Also testing and Integration with existing system:** *Each increment is tested and integrated with the existing system. This enables early identification of problems and that the system works accordingly.*

4. **System deployment:** *The system is deployed in phases, whereby users can use the system early during the development process.*

5. System is maintained and updated as and when needed. It is fixing any issues that will come and putting any new features-based user feedback.

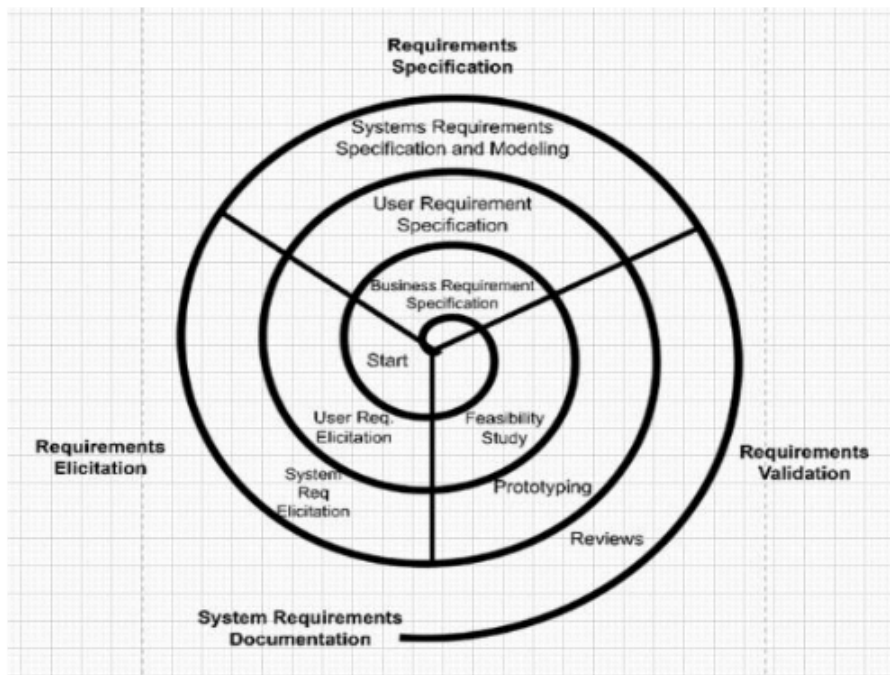


Spiral Model

It is a variant of Waterfall Model and iterative development model. It focuses on risk, and facilitates several iterations of the development process. ⁶ During each iteration, there are planning, risk analysis, engineering and evaluation phases. Such a model is appropriate for large and complex projects with high risk and uncertainty.

Phases of the Spiral Model

1. This phase is known as planning, which includes the planning of requirements and objectives of the system. This consists of defining the scope of the project and items necessary.
2. Risk analysis is a major part of the Spiral Model. During this phase, we try to determine what risks we have in place from which we can develop strategies to mitigate.
3. Requirements and risk analysis are identified and engineering complete, designed and implemented based on the requirements. Coding, testing and integration of the system are all included.
4. System evaluation: To assure that the system fulfils the need and works properly. It involves user feedback, possible alteration in the system.
5. System: The system includes those entities and resources considered capable of supporting the project and mitigating risks.



Comparison of SDLC Models

The following table provides a comparative analysis of the three SDLC models based on key aspects such as approach, flexibility, risk management, and user involvement

Aspect	Waterfall Model	Incremental Model	Spiral Model
Approach	Linear, sequential process	Develops in multiple parts	Iterative with continuous risk analysis
Flexibility	Low	Medium	High
Risk Management	Minimal	Moderate	High
User Involvement	Low	Medium	High

. 4. Comparative Analysis

Functional and Non-Functional Requirements

It is obvious that an ERP system need a rich set of functional requirements such as Supply Chain Management, Financial Management, Human Resource Management, Production Planning, Inventory Control etc., for a vehicle manufacturing company. Performance, security, usability, reliability and scalability are all non-functional requirements. This requirement can be fulfilled using the Incremental Development model because it supports incremental implementation and refining functionalities. The advantages of the Spiral Model are the flexibility it offers for functional and nonfunctional requirements by iterative

risk analysis and evaluation. However, the Waterfall Model might face difficulties in meeting up with the changes of non-functional requirements when the project is underway.

Detailed Analysis of Non-Functional Requirements

•**Performance:** *The system must go through a specified number of transactions per second. This encompasses to guarantee the system to sustain huge volumes of data, and for transactions and it will perform good in terms of performance.*

•**Security:** *NEWTIPS should provide safety for data and adhere to lawfulness. This is such as security measures such as, software and hardware encryption, access control and security auditing on regular basis.*

•**Task Efficiency:** *The system must be easy to use and easy to access by all users. This includes developing an easy-to-use user interface and training and supporting the use of system.*

•**Reliability:** *The system must be operational all the time without any failures to maintain the data integrity. Such measures as regular backups, disaster recovery procedures and system monitoring are also part of this.*

• **Scalability:** *The system will have to be capacity for future growth and further functionalities. This everything from designing the effect to be spacious and flexible, scalable, to anatomize in some particular climb of sheer business demands.*

Risk and Change Management

Risk management is required for Toyota's ERP implementation because of its high scope and required high reliability. The Spiral Model is good at-risk management because it has a risk analysis as one of the iterations, so the problem can be detected early and fixed early. Bad Practice Incremental Development likewise supports the assessment of dangers by permitting early finding of issues through iterative checking and criticism. As opposed to it, the Waterfall Model is less adaptable towards risks and changes, as it considers all the requirements to be clearly mapped out right from the beginning.

Risk Management Strategies

•**Risk Recognition:** Knowing risks prior to the development phase is crucial. That comes with risks involving technical issues, project management, and beyond.

•**Risk Mitigation:** Having approaches to mitigating determined dangers is fundamental. This involves technical solutions such as implementing, Developing Contingency plans and Hubbard's Regular Risk Assessment.

•**Risk monitoring:** Continuous risk monitoring throughout the development process enables new risks to be identified and tackled on time. This includes routine risk reviews and updating the risk management plans.

Time and Cost Constraints

Time and cost limitations are the main constraints in developing of Toyota's ERP system. However, Waterfall Model can be more budget-friendly for projects which have very well defined and less changing requirements because it works out in the way in which follows linear and Predictable way. It may not be not perfect for projects with very short timelines or where deadlines are almost overdue. Incremental Development enables quicker delivery of an operational product and also is more cost-effective over time by allowing early discovery of issues and less rework. However, in Spiral Model which is more flexible and risk-averse, takes more time and is costly due to its incremental development.

Time Constraints

- Project Timeline:** *Project timeline should be realistic and possible to meet. This means setting out by phases, setting milestones and deadlines each phase through the development process*

- Early Delivery:** *Early delivery of tested/tested product is extremely important for the projects that tight. This enables users to get on the system sooner, and gives feedback for develop further.*

- Time Management:** *Proper time management is must for the project to run according to the schedule. This will also include, regular project consultation reviews and adjustments to project plan as required.*

- Budget Control:** *The project budget is to be managed tightly so as to ensure the project does not overrun budget. This is about being able to estimate accurately, to identify accurately costs, and to track expenses ongoing throughout the development of the project.*

- economics realisation:** *Locating areas to economise is important. This involves a process of streamlining processes, reducing waste, and eking out every bit from current resources.*

- return on Investment:** *hoping for a nice return of investment is critical to the achievement of the venture. This involves sizing the benefits of ERP system to see whether it outweighing the costs.*

5. Requirements Engineering Process

Simplified Requirements Document

A high level and simplified requirements document for Toyota's ERP system should involve the following principal sections:

System Overview

- Objective: Para rationalizer loss process de Toyota y para menorah la efficiency a travel de la integration de loss processes de gestion de la Cadena de subminister, administration Financiera, gestion de recourses humans, planification de la production, control de inventories y gestion de relations con ell client.
- SCOPE: The system will incorporate all the operational activities of Toyota, such as manufacturing process, logistics, finance and customer service areas.

Functional Requirements

- Financial Management: Like Transaction data entry, Prepare Managing budget, Reports & Reporting.
- Human Resource Management: Store Employees record, payroll, training.
- Production Planning: Plan and control production procedures.
- Inventory Management: Maintain and manage the inventory levels.
- Customers Relationship: Deal with, assist in & affirmative of clients.

Non-Functional Requirements

Performance: Facilitate a particular number of transactions per second.

Security: Ensure data protection and compliance with regulations.

Usability: Be user-friendly and accessible to all users.

Reliability: Be able to operate without failures and make sure data is legitimate.

Scalability: Accommodate future growth and additional functionalities.

Requirements Validation Strategy

Requirements validation verifies whether the documented requirements fairly reflect the needs of those that must satisfy those needs. This can be achieved through:

- Reviews:** Obligations: Conducting regular reviews with stakeholders to ensure understanding of the requirements and to meet the needs of the stakeholders.
- Inspections:** Conducting inspections of detailed requirement document to confirm any missing or inconsistency within the requirement document.

- Walkthroughs:** Accompanying developers and stakeholders through walkthroughs to confirm that requirements are accomplishable and can be embraced properly.

6. Potential Challenges

Creating a requirements document for Toyota's ERP can be quite challenging:

- Business Process Involvement:** It is hard to gather all the requirements properly due to the highly complex operations of Toyota.
- Risk & Regulatory:** Regulatory compliance audits (e.g. compliance audit, pretesting, security & policy enforcement) is extra complex when done.
- Older Systems:** Integration with current Toyota system may be difficult and needs to be well planned.
- User Acceptance:** Creating a user-friendly interface and delivering proper training to guarantee end-users will accept and use the system effectively.

Strategies to Address Challenges

- Extent and Distribution of Business Processes:** Ensure the process of elicitation involves interviews and focus groups and or questionnaires. Identify activities and tasks that the new methods will replace, avoiding comprehensive system jobs.
- Regulations of which specifies that,** ensure it highlights all the requirements of the regulations of the specific country. As part of a best practice, compliance on the system should be checked and updated from time to time for its compliance status to be okay.
- System Integration:** Apart from the integration of the proposed system, a detailed integration plan should show how the integrated system will be tested and validated. Utilize existing software middleware's and APIs in order to integrate with the current systems.
- User:** Engage the users when coming up with the requirements in order to develop a system that they can use comfortably. As a result, the features and functionalities of the system must be properly explained so the users will maximize the use of the program

7. Conclusion

The following paper presents Toyota Industries Corporation as an example of how the application of enterprise resource planning systems positively affects organizational operations and outcomes. This paper draws a contrast between the Waterfall Model, Incremental Development, and Spiral Model to ascertain how each is appropriate for given phases of the project. The Incremental Development model is suitable for implementation of both functional and non-functional requirements and give an opportunity for early releases. The final two models are the Spiral Model for high risk/ high uncertainty projects due to the flexibility of the technique adopted by the model. The Waterfall Model is logical, simple, and could be cheaper as compared to other models especially when handling well-defined projects; however, they have major problems in issues of change and risk management.

The following are the recommendations that may be useful when developing this Toyota's ERP system: Requirement engineering process is an essential aspect of system development, and hence, the following should be done: Mitigating the risk of characterised issues, for example, in areas like complexity, compliance, integrated system and user acceptance the system is likely to satisfy the customers and deliver better operational results.

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