National Institute of Technology, Rourkela

Name of the Examination: B. Tech. Mid-Semester (Spring 2021-22)

Branch	**: CS**	**Semester**	**: VI**
Title of the Course	**: Computer Networks**	**Course Code**	**: CS3002**
Time: 2 Hours		**Maximum Marks: 30**	

Note : (i) Answer all questions.

(ii) Write all answers of a question at one place.

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1. Answer the following questions:

(a) A large population of ALOHA users manage to generate 50 requests/sec, including both originals and retransmissions. Time is slotted in units of 40 msec. **[3 Marks]**

(i) What is the chance of success on the first attempt?

(ii) What is the probability of exactly k collisions and then a success?

(iii) What is the expected number of transmission attempts needed?

(b) Consider the delay of pure ALOHA versus slotted ALOHA at low load. Which one is less? Explain your answer. **[2 Marks]**

2. Answer the following questions:

(a) Discuss the issues in the data link layer. **[2 Marks]**

(b) Explain the key differences between OSI and TCP/IP reference models? **[3 Marks]**

3. Answer the following questions:

(a) Explain the channel allocation methods for broadcast networks. Give advantages and disadvantages of these methods? **[3 Marks]**

(b) A disadvantage of a broadcast subnet is the capacity wasted when multiple hosts attempt to access the channel at the same time. As a simplistic example, suppose that time is divided into discrete slots, with each of n hosts attempting to use the channel with probability p during each slot. What fraction of the slots will be wasted due to collisions? **[2 Marks]**

4. Answer the following questions:

(a) Sixteen-bit message are transmitted using a Hamming code. How many check bits are needed to ensure that the receiver can detect and correct single-bit errors? Show the bit pattern transmitted for the message 1101001100101101. Assume that even-parity is used in the Hamming code. **[3 Marks]**

(b) What is the maximum overhead in byte-stuffing and bit-stuffing algorithms? **[2 Marks]**

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5. Answer the following questions:

(a) Explain the following two protocols: **[3 Marks]**

(i) A Bit-Map Protocol

(ii) The Binary Countdown

(b) Give the differences between the CSMA and Adaptive Tree Walk Protocol? **[2 Marks]**

6. Answer the following questions: **[1.5 + 1.5 + 2 = 5 Marks]**

(a) Explain the differences between the Simplex protocols and Sliding window protocols?

(b) Explain the drawback of 1-bit sliding window protocol?

(c) Explain the key differences between Token Bus and Token Ring networks?

National Institute of Technology, Rourkela

Dept. of Comp. Sc. & Engg.,

Mid Sem Spring Exam FEB 2022

Course Name: DISTRIBUTED SYSTEMS

Course Code: CS3006 Time: 2.0 Hours FM: 30

Date of Exam: 23nd FEB 2022

Instruction: (1) ANSWER ALL QUESTIONS
(2) Q1 through Q3 carries 10 marks each
(3) Answers should be brief and to the point

Q1. Answer the following briefly

(a) Differentiate between transparency and concurrency in a distributed system.
(b) Diffentiate between Distributed System and Computer Network.
(c) Why it is difficult to design a distributed system?
(d) Can the distributed systems be built on the top of a LAN? Justify.
(e) Write the role of protocol and standards for communication in a distributed system.
(f) What do you mean by light weight messaging system?
(g) What are the components of a distributed system? Show using a diagram.
(h) How the various events in a distributed system can be ordered in the absence of global clock?
(i) What is syndrome decoding? Explain with examples.
(j) Differentiate between Client-server & Peer to peer protocol.

Q2. Write the answer with justification:

(i) Illustrate the protocols such as R, RR, and RRA protocol with a diagram and a comparison table.

(ii) State "TRUE" or "FALSE". "WWW is a distributed system but Internet is a computer network".

(iii) What is NIC in a distributed system? What are various components in an NIC?

(iv) What is the need of marshalling and unmarshalling in a distributed system? Give an example scenario for the marshalling and unmarshalling.

(v) Differentiate between IPC and RPC. Illustrate using a diagram.

(vi) What do you mean by RPC Call Semantics? Which is better? Justify.

(Vii) What features justify the periodic execution of diagnostic software in a large scale distributed system?

(viii) Write the classification of faults in a distributed system with respect to behavior and duration of the fault.

(ix) What is state holding time? Explain with an example.

Q3. (a) Write the similarities & difference between following using a table.

i) **Synchronous Vs. Asynchronous Distributed Systems**
ii) **Reliable Vs. Unreliable Systems**
iii) **Completely Connected Vs. Not-Completely Connected Topology**
iv) **Monolithic Vs. Microkernel Architecture**
v) **Syndrome Decoding Vs. Fault Model**

(b) A node in a distributed system can work on two types of tasks. Type-1 tasks arrive according to a Poisson process with a rate of 100 per second and type-2 tasks according to a Poisson process with a rate of 200 per second. The two arrival processes are independent. Both types of tasks have exponentially distributed service times, with a mean of 3 milliseconds. Tasks are processed in order of arrival.

(i) What is the probability that during 10 milliseconds no new tasks arrive?

(ii) Determine the mean number of tasks at the node

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Identifying the Reasons for Software Project Failure and Some of their Proposed Remedial through BRIDGE Process Models

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***Abstract*— There are enough evidences of software project failures. Starting from economic losses to live losses is caused by many software project failures. Software project failures have significant impact on both social and economic factors. Hence, it is important to identify the different reasons for project failures. If these reasons are pre-known, actions can be taken during project development to reduce project failure risks. In this paper we identify and categorized the project failure root causes based on their different sources. Then briefly we have highlighted the primary features of the BRIDGE [1] process model and explored the ways and means how these project failure reasons may be reduced or alleviated by following the BRIDGE process model.**

Keywords- Software Engineering, Project Failure, BRIDGE Process Model, SDLC Model

I. INTRODUCTION

Software project failures are one of the primary reasons for increased cost of software product and services. There are enough evidences of project failures in past and present. Any organizations have to compensate the cost of the failure projects from the success projects. For these reason, software are still beyond the scope of small and medium scale companies causing significant impact on both social and economical factors. Apart from this, starting from economic losses to live losses is also caused by software project failures. Hence, it is important to identify the different reasons for software project failures. If these reasons are pre-known, actions can be taken during project development to reduce project failure risks.

At the beginning we have discussed about the criterion to evaluate a software project to be called successful or failed. Then, we have identified, categorized and briefly discussed different the root causes of project failures based on their source areas. Next, we have briefly highlighted the primary features of the BRIDGE [1] process model and explored the various ways and means to reduced or alleviate these project failure reasons by following the BRIDGE process model.

II. RESEARCH GOAL AND OBJECTIVES

The goal of this work is to identify the different reasons for software project failure and categorization of those reasons based on their originating sources. Further, we have tried to find out the project failure risks especially

originating from software process model and to propose their remedial strategy specially through following the BRIDGE [1] process model.

III. DEFINITION OF SUCCESSFUL AND FAILED SOFTWARE PROJECTS

The primary objective of software engineering is to develop software that agreed upon functionality and:

a. Within Time
b. Within Budget, and
c. With Good Quality

Any software development project that satisfies the above criteria is to be called successful. According to Keider [2] and Saleh [3], a project should deliver agreed upon functionality on time and within estimated budget. Successful software project maybe defined as any software project that is set to support initially-approved functionality, as well as the project comfortably satisfying the stakeholders and being accepted and largely used by the end users after deployment. Hence, Software project failure is defined as any project that is set to support the operations of an organization by exploiting the resources of information technology that fails to deliver the intended output within the originally allocated cost, time schedule [4].

IV. PROJECT FAILURE STATISTICS

To highlight the importance of this study, in this section some statistical data about the software project failure are shared. The survey statistics about software project failure and project estimate overrun carried out by Standish Group International i.e. the CHAOS Manifesto [5], in 2013 are given in Table 1 and Table 2:

Table 1: Project Performance Statistics

Year	Successful	Challenged	Failed
1994	16%	53%	31%
1996	27%	33%	40%
1998	26%	46%	28%
2000	28%	49%	23%
2002	34%	51%	15%
2004	29%	53%	18%
2006	35%	46%	19%
2008	32%	44%	24%
2010	37%	42%	21%
2012	39%	43%	18%

Table 2: Project Estimates Overrun Statistics

Year	Time Overrun	Cost Overrun	% of Features Delivered
2004	84%	56%	64%
2006	72%	47%	68%
2008	79%	54%	67%
2010	71%	46%	74%
2012	74%	59%	69%

From the statistical data presented in Table 1, it is observed that the alterative year average of project successful rate is 30.3%, project challenged by 46% and project failed by 23.4%.

From the statistical data presented above in Table 2, it is observed that the alterative year average of project time overrun rate is 76%, project cost overrun 52.5% and project feature delivery rate is 68.4%.

Rupinder Kaur and Dr. Jyotsna Sengupta in their paper [6] presented the following statistical data:

- As per the Research Report of ESSU (European Service Strategy Unit), 57% of contracts experienced cost overruns, 33% of contracts suffered major delays, 30% of contracts were terminated, and 12.5% of Strategic Service Delivery Partnerships have failed.
- As per the KPMG Survey, on average, about 70 % of all IT-related projects fail to meet their objectives.
- From the presentation on software failure by Bob Lawhorn following statistics are presented:
  - Poorly defined applications (miscommunication between business and IT) contribute to a 66% project failure rate, costing U.S. businesses at least $30 billion every year.

- 60% – 80% of project failures can be attributed directly to poor requirements gathering, analysis, and management.
- 50% are rolled back out of production
- 40% of problems are found by end users
- 25% – 40% of all spending on projects is wasted as a result of re-work.
- Up to 80% of budgets are consumed fixing self-inflicted problems (Dynamic Markets Limited 2007 Study)

Research indicates that more than 50% of all IT projects become runaways--overshooting their budgets and timetables while failing to deliver the expected outcomes [4, 7].

Johnson [4] reported that the overall project success had increased from 16% in 1994 to 28% in 2000.

That makes it very curious, but probably not surprising, that according to an article in the IEEE Spectrum, about 10% of projects are abandoned either before or after completion, because the end product will not actually resolve the original business challenge [8].

V. IDENTIFYING THE COMMON REASONS FOR SOFTWARE PROJECT FAILURE AND THEIR CATEGORIZATION

Often it is easy to identify whether a software project is successful or failed. But, it is really a tough job to identify and understand the actual reasons for project failure. For example, if the delivered system fails to meet the needs of the customer or user, the first question to ask is, "Why?":

- Was it because the development group didn't do a good job? Or
- Perhaps the requirements were not properly gathered or used? Or
- May be the people responsible for supplying the requirements were inaccurate? Or
- Was it something else?

Further, being software development a people intensive job, it is more complex to identify the exact reason to failure and to provide solutions to project failure. Usually, often there are multiple factors causing a software project to fail.

Possible areas/sources of Project Failure Reasons:

Form the above discussions it is easy to understand that there are several possible areas or sources of reasons to project failure. Some of the investigated sources of causes to software project failure are explored and listed below:

- People Sources
- Technology Sources
- Process Sources
- Organizational Sources
- Management Sources
- Business Sources
- Project Sources

Some reasons for project failure are easy to classify as belonging to one area or another, but some are harder to categorize even. So far significant effort has been made to identify and analyze the causes of software project failure discussed below [4, 6, 8, 9, 10, 11, 12, 13, and 14]**.** Now we try to identify the possible project failure reasons from the different sources as identified above.

A. Project Failure Reasons Originating from People Sources

In a software development project typically three types of stakeholders are associated:

- *Users:* Some of the project failure causes originating by these types of people may be due to:
  - Poor User Input
  - Lack of User Training
- *Client:* Some of the project failure causes originating by these types of people may be due to:
  - Conflicts

  - Politics
- *Project Development and Management Team:* Some of the project failure causes originating by these types of people may be due to:
  - Poor-Quality Work by developers
  - Poor-Quality Work by Management Personals

The project failure reasons may originate from one or more of these people sources. *Firstly,* often, the users are either unable to deliver the exact requirements to be delivered by the system or even may not be clear during initial stages of the development. As a result the project may fail due to wrong or inadequate user input. *Secondly,* often the project client and system users are different. Because of poor or misunderstanding, lack of communication gap between them, the client may convey wrong information and requirement to project development team that may lead to project failure. *Thirdly,* the project may fail because of the development team itself. These days, software development teams have become distributed in nature. The lack of communication among the development team and inefficient human resources may become the bottle neck for the project success. *Finally,* insufficient and inefficient project management team may lack to provide necessary management support to the project causing project to fail.

B. Project Failure Reasons Originating from Technology Sources

The rapid technological advancements are often good, but not always. Being software development a time intensive job, very often the technology used for the project implementation becomes obsolete before completion of the project causing the project to fail. Generally, the projects get cancelled before their completion. Further, the technology used if not chosen wrong, may be new and immature failing to perform as expected causing project failure. From technology sources SW project failure may arise due to the following reasons:

- Wrong Technology selection.
- Technology too new or didn't work as expected
- Use of immature technology
- Technology planning

C. Project Failure Reasons Originating from Process Source

Process failure is the largest and potentially the most pernicious of all sources of project failure and has been at the root of problems for decades. If the goal of a process is to produce a specific outcome, then anything that either delays or prevents the achievement of that specific outcome is a form of process failure. The process might deliver something, but if it does not deliver anticipated outcomes or does not meet expectations; the result is a failed process. This form of failure usually leads to finger pointing between development groups and users, with each claiming the other did not understand [8]. The root causes of SW project failure originating from process sources may include the following:

- **Wrong Process Selection:** There are many process models, but all have their own features and limitations. Often not all process models are suitable for any kind of projects. Thus process selection is typically challenging for any project implementation. Wrong or inappropriate process selection may lead to project fail.
- **Lack of User Involvement:** Non involvement of user and customers in the development process is one of the principle reasons that software does not fully meet customer expectations.
- **Lack of Communications:** When we think about communications failure the first thing that comes to mind is, "It's their problem," and it is usually an internal dialog. However, lack of communications with end-user or customers is rarely immediately considered, and it turns out to be one of the major problems. Further, delayed communications or communications latency is blamed as the reason for failure: "They didn't get back to me in time."
- **Unnecessary Processes:** Unnecessary processes apply to wasted or duplicated effort as well as a management or reporting structure that adds "heavy-weight" reporting and accountability to the development process.

- **Careless, sloppy, or missing software development processes:** Sloppy development process is the core value for the software engineering movement, contributed to the acceptance of object-oriented programming, helped fuel the agile movement, and more. Consider the customer at every step in the development process. While that will not guarantee the development process will be free from sloppiness, it will help focus on what is important.
- **Non-adaptability of process to Changes:** More importantly, the presence of one or more of these process failures contribute to business failure if the organization is not able to respond to changing business or market conditions. They also make it difficult to respond to customer-perceived incidents that disrupt service delivery.

D. Project Failure Reasons Originating from Organizational Sources

- New to business- lack or no prior experience
- Improper Organizational Structures in respect to project need
- Poor communication among customers, developers, and users
- Reasons Related to Human Resource
- Insufficient Resources
- Organizational culture and structure

E. Project Failure Reasons Originating from Management Sources

Additional project failure reasons may originate from project management sources. Some of the identified reasons contributing to project failure in this respect are as follows:

- Poor communication among customers, developers and users with management
- Lack of leadership and effective Management
- Poor reporting of the project's status
- Insufficient involvement of Senior management
- Insufficient staff/team Size
- Inaccurate estimates of needed resources
- Lack of proper project management and control
- Sloppy development practices
- Failure to plan
- Commitment and patterns of belief
- Poor quality management and control

F. Project Failure Reasons Originating from Business Sources

In this section we focus on different causes of failures at the business level [8] that directly affect a software development project:

- **Non adaptive to changing conditions:** One of the most obvious forms of business failure also turns out to be the primary reason that *development organizations cannot readily adapt to changing conditions*: specifically, lack of management commitment.
- **Poor selection and use of a particular tool or vendor:** Another potential source of business failure is the management requirement that dictates the use of a particular *tool* or *vendor* without considering the outcomes expected by customers.
- **Commercial pressures:** Often there is commercial pressure on the project from business sources. Time-to-market, competition in business, economic breakdown, economic competency among similar products are the different sources of commercial pressures.

G. Project Failure Reasons Originating from Project Sources

Different projects are of varying nature, types and complexity. Often, there are many intrinsic reasons to the project itself causing the project to fail! These reasons may be related to the system requirements, risks, budget, schedule etc. Some of the project related reasons originating from the project itself are identified and listed below:

- Reasons Originating from System Requirements
  i. Lack of proper understanding and poor definition of system requirements
  ii. Changing system requirements and project scope
  iii. No more need for the system to be developed
- Reasons Related to Project Risk
  i. Poor project risk identification, management and control
  ii. Late project failure warning signals
  iii. Unrealistic or unarticulated project objectives and goals
- Reasons Related to System
  i. Project's complexity
  ii. Poor system architecture and specification
  iii. Critical quality problems with software
- Reasons Related to Budget and Schedule
  i. Inaccurate/over budgeting
  ii. Hidden costs of going "Lean and Mean"
  iii. Unrealistic and over schedule estimation

The Avanade Research Report (2007) [6] disclosed that 66% of failure due to system specification, 51% due requirement understanding, and 49% due to technology selection.

Further, TCS (Tata Consultancy Services) 2007 [6] reported that 62% of organizations experienced IT projects that failed to meet schedules, 49% suffered from budget overruns, 47% had higher-than-expected maintenance costs, 41% failed to deliver the expected business value and ROI, 33% file to perform against expectations.

VI. BRIDGE PROCESS MODELS: A BRIEF HIGHLIGHTS

Although the details discussion of the BRIDGE [1] model is beyond the scope of this paper, just the schematic diagram of the BRIDGE process model is given below in *Figure 1* with its analytical results.

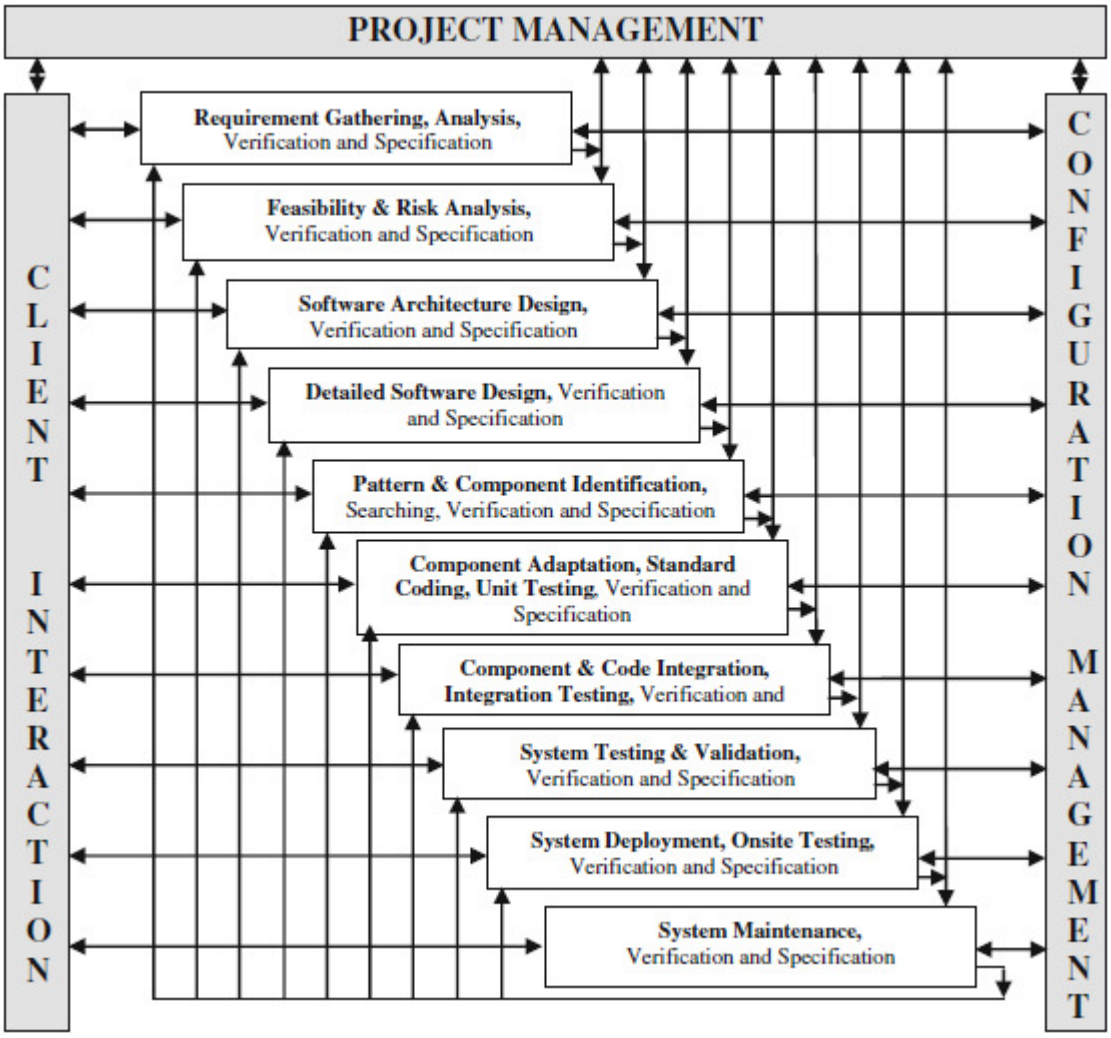

Figure 1: BRIDGE [1] Process Model

The in-depth study of the BRIDGE model discloses a lot of information that may be used to analyze the model. These are briefly discussed below [1, 15, and 16]:

- It involves the client over the entire development life cycle activities.
- It keeps continuous communication with the project management team.
- It explicit verification of individual phases.
- Separate software architecture design phase.
- Separate system deployment phase.
- Separate on-site system testing phase.
- Supports components based software development.
- It emphasizes on standard coding.
- It considers configuration management as a separate activity.
- It forces to specify all the phase deliverables.

- It explicitly instructs to validate the system.

VII. REMEDIAL TO PROJECT FAILURE RISKS TROUGH BRIDGE PROCESS MODEL

As we have discussed in the earlier sections, the project failure reasons may originate from different sources of the project i.e. people, technology, process, organizational, management business and project sources. It is not possible to address all these project failure reasons only by following any process model. However, many of these failure reasons directly or indirectly related to the software development process model. So by following any suitable process model, many of this project risk can be reduced.

In this section we discussed the remedial to some of the project failure reasons identified in the earlier sections by following BRIDGE [1] process model.

A. Remedy to Project Failure Reasons Originating from People Sources

- **Poor User Input:** In most of the process models, users are involved only during the initial phases of the development process when often the system requirements are unclear and ambiguous. Hence, the user inputs are often incorrect and poor. As the development proceeds, the requirements start getting clear. But by these times, the users are not a part of the development process. Hence, user input remains poor causing risk to project success. As in BRIDGE, the user are involved over the entire development process, the user remains the scope to provide update inputs that increases the rate of project success.
- **Lack of User Training:** Many of the organizations do think that only development and delivery of the system is the only responsibility of them. Thus they don't often take user training as serious part or their interest. But the truth is that if the users are unable to use the system easily and efficiently, the project fails irrespective of how good the developed system may be! Proper and good documentations are the key to user training but are often ignored by many organizations. In BRIDGE, special focus is given on documentations at different phases of the development process. Thus simultaneously at the end of all phases proper documents are produced that may help during the user training process and self learning.
- **Client Conflicts and Politics:** Both of these issues arise because of the lack of user involvement. The scope of these problems may be reduces only by involving the users in the development process making the user themselves to be an individual responsibility centers in the project, which is supported in BRIDGE process model.
- **Poor-Quality Work by developers and Management Personals:** There are two possible reasons for this problem to arise:
  - *Lack of Knowledge, Skill and Expertise of Developers:* In this case, the process model doesn't have any role to play; rather it is an organizational staffing and human resource related problem to be managed at organizational level.
  - *Because of Lack of Tendency to Quality-Work of Developers:* However, this reason may be handled by proper monitoring and management control efficiently by following BRIDGE as project management team is always with the development team.

B. Remedy to Project Failure Reasons Originating from Process Sources

- **Remedial to Wrong Process Selection:** The basic reasons for selecting wrong process model are unclear process objectives and goals. Further, as the different features of any process models are not distinct and ambiguous, people often selects wrong process model. In BRIDGE, the feature of the process model is very clear and unambiguous; the concerned may judge the suitability of this model for any typical project easily.
- **Remedy to Lack of User Involvement:** One of the primary features of the BRIDGE process model is the involvement of client over the entire development process that alleviates the project failure risks.
- **Lack of Communications:** This problem may also be originated from management sources. Often in no process model except BRIDGE all the stakeholders' including project management team works together. Working together by different project stakeholder in BRIDGE, the communication gap is reduced among them.

C. Remedy to Project Failure Reasons Originating from Management Sources

Remedial support to project failure causes originated from management sources are beyond the scope of any process model. For example, the quality and expertise level of the individual management and development personals don't comes under the scope of development process. Thus risks i.e. lack of leadership and effective management, poor reporting of the project's status, insufficient involvement of senior management, insufficient staff/team size, inaccurate estimates of needed resources, lack of proper project management and control, sloppy development practices, failure to plan, commitment and patterns of belief, poor quality management and control etc. depends on the quality and effective management team.

However, given an effective project management team, due to lack of direct involvement to the development process, some of the above problems may also arise, but in BRIDGE working all together under same umbrella automatically gets reduced.

D. Remedy to Project Failure Reasons Originating from Project Sources

- **Alleviating Reasons Originating from System Requirements Sources:** In BRIDGE, to alleviate reasons relate to lack of proper understanding and poor definition of system requirements, there is a dedicated phase for requirement gathering, analysis and specification that has to satisfy both the phase entry and phase exit criteria to get qualified. Further, being customer in BRIDGE always available to system analyst and developers there remains a scope to clear the doubts related to system requirements over the development process. It is also known that we may achieve the agile philosophy following BRIDGE process model [16]. Thus accommodation and adaption of changing requirement becomes easy following this process model. Moreover, as BRIDGE process model promotes Component Based Software Development (CBSD) approach [17], changing project scope becomes easy by unplugging and plugging additional software components providing services as demanded. But in case of no more need for the system to be developed, no process model can help at all, as the case with BRIDGE.
- **Alleviating Reasons Related to Project Risk:** To alleviate risks related to risk identification, management and control, and late project failure warnings signals, in BRIDGE one phase is dedicated to feasibility study and risk analysis. Further, verification activity at the end of the individual phases helps to identify and reduce these types of project failure risks.
- **Reasons Related to System Complexity:** The well known tool and technique to manage project complexity is abstraction. Using software components and CBSD approach [16], BRIDGE has the quality to handle project complexity issues. In relation to poor system architecture and specification issues, to promote CBSD, in BRIDGE there is a distinct phase for architectural design of the system apart from detailed design and at the end of the all individual phases forceful specification is mandatory.
- **Related to Software Quality Assurance:** To ensure quality system development irrespective of human related issues, BRIDGE recommends to perform verification at the end of each development phases and to perform validation and testing of the system before system deployment. Further, to ensure quality development, the organizations additionally may follow the guidelines and recommendation given by different standard bodies i.e. SEI, ISO, and Six-Sigma etc. to attain different CMM levels, ISO certifications etc.

The remedy to other project failure reasons/risks originating from other difference sources i.e. technology, organization, business are beyond the scope of capability of any process model. Further, problem related to project budget and scheduling depends heavily on the degree of expertise level of the project manager/estimator and are beyond the capability scope of any process model as the case with BRIDGE.

VIII. CONCLUSION

In this paper we have identified the different reasons contributing to project failure from there originating sources. Then we have highlighted the features of BRIDGE process model and discussed at length on how some of these project failure reasons may be reduces following BRIDGE process model. The comparative analysis of BRIDGE with some other well known process model explored the distinguished features of BRIDGE over other

[15, 18]. Thus, we conclude by recommending the BRIDGE process model to be followed for SW development projects to gain project success rate.

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Lab Sheet- 1

(Questions on Requirement Analysis)

Use case scenario 1:
The SE VLabs Institute has been recently setup to provide state-of-the-art research facilities in the field of Software Engineering. Apart from research scholars (students) and professors, it also includes quite a large number of employees who work on different projects undertaken by the institution.
As the size and capacity of the institute is increasing with the time, it has been proposed to develop a Library Information System (LIS) for the benefit of students and employees of the institute. LIS will enable the members to borrow a book (or return it) with ease while sitting at his desk/chamber. The system also enables a member to extend the date of his borrowing if no other booking for that particular book has been made. For the library staff, this system aids them to easily handle day-to-day book transactions. The librarian, who has administrative privileges and complete control over the system, can enter a new record into the system when a new book has been purchased, or remove a record in case any book is taken off the shelf. Any non-member is free to use this system to browse/search books online. However, issuing or returning books is restricted to valid users (members) of LIS only.
The final deliverable would a web application (using the recent HTML 5), which should run only within the institute LAN. Although this reduces security risk of the software to a large extent, care should be taken no confidential information (eg., passwords) is stored in plain text.
Q> identify functional requirements
Q. Identify non-functional requirements

Identification of functional requirements

The above problem statement gives a brief description of the proposed system. From the above, even without doing any deep analysis, we might easily identify some of the basic functionality of the system:

- **New user registration:** Any member of the institute who wishes to avail the facilities of the library has to register himself with the Library Information System. On successful registration, a user ID and password would be provided to the member. He has to use this credentials for any future transaction in LIS.
- **Search book:** Any member of LIS can avail this facility to check whether any particular book is present in the institute's library. A book could be searched by its:
    - Title
    - Authors name
    - Publisher's name
- **User login:** A registered user of LIS can login to the system by providing his employee ID and password as set by him while registering. After successful login, "Home" page for the user is shown from where he can access the different functionalities of LIS: search book, issue book, return book, reissue book. Any employee ID not registered with LIS cannot access the "Home" page -- a login failure message would be shown to him, and

the login dialog would appear again. This same thing happens when any registered user types in his password wrong. However, if incorrect password has been provided for three time consecutively, the security question for the user (specified while registering) with an input box to answer it are also shown. If the user can answer the security question correctly, a new password would be sent to his email address. In case the user fails to answer the security question correctly, his LIS account would be blocked. He needs to contact with the administrator to make it active again.

- **Issue book:** Any member of LIS can issue a book against his account provided that:
    - The book is available in the library i.e. could be found by searching for it in LIS
    - No other member has currently issued the book
    - Current user has not issued the maximum number of books that can

  If the above conditions are met, the book is issued to the member. Note that this FR would remain **incomplete** if the "maximum number of books that can be issued to a member" is not defined. We assume that this number has been set to four for students and research scholars, and to ten for professors. Once a book has been successfully issued, the user account is updated to reflect the same.
- **Return book:** A book is issued for a finite time, which we assume to be a period of 20 days. That is, a book once issued should be returned within the next 20 days by the corresponding member of LIS. After successful return of a book, the user account is updated to reflect the same.
- **Reissue book:** Any member who has issued a book might find that his requirement is not over by 20 days. In that case, he might choose to reissue the book, and get the permission to keep it for another 20 days. However, a member can reissue any book at most twice, after which he has to return it. Once a book has been successfully reissued, the user account is updated to reflect the information.

In a similar way we can list other functionality offered by the system as well. However, certain features might not be evident directly from the problem system, but which, nevertheless, are required. One such functionality is "User Verification". The LIS should be able to judge between a registered and non-registered member. Most of the functionality would be available to a registered member. The "New User Registration" would, however, be available to non-members. Moreover, an already registered user shouldn't be allowed to register himself once again.

Having identified the (major) functional requirements, we assign an identifier to each of them for future reference and verification. Following table shows the list:

Table 01: Identifier and priority for software requirements

#	Requirement	Priority
R1	New user registration	High
R2	User Login	High
R3	Search book	High
R4	Issue book	High

Table 01: Identifier and priority for software requirements

#	Requirement	Priority
R5	Return book	High
R6	Reissue book	Low

Identification of non-functional requirements

Having talked about functional requirements, let's try to identify a few non-functional requirements.

- **Performance Requirements:**
  - This system should remain accessible 24x7
  - At least 50 users should be able to access the system altogether at any given time
- **Security Requirements:**
  - This system should be accessible only within the institute LAN
  - The database of LIS should not store any password in plain text -- a hashed value has to be stored
- **Software Quality Attributes**
- **Database Requirements**
- **Design Constraints:**
  - The LIS has to be developed as a web application, which should work with Firefox 5, Internet Explorer 8, Google Chrome 12, Opera 10
  - The system should be developed using HTML 5

Once all the functional and non-functional requirements have been identified, they are documented formally in SRS, which then serves as a legal agreement.

Case case scenario 2:

Consider the problem statement for an "Online Auction System" to be developed:

New users can register to the system through an online process. By registering a user agrees to abide by different pre-defined terms and conditions as specified by the system. Any registered user can access the different features of the system authorized to him / her, after he authenticates himself through the login screen. An authenticated user can put items in the system for auction. Authenticated users users can place bid for an item. Once the auction is over, the item will be sold to the user placing the maximum bid. Payments are to be made by third party payment services, which, of course, are guaranteed to be secure. The user selling the item will be responsible for it's shipping. If the seller thinks he's getting a good price, he can, however, sell the item at any point of time to the maximum bidder available.

National Institute of Technology, Rourkela

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Branch	**: CS**	**Semester**	**: VI**
Title of the Course	**: Computer Networks**	**Course Code**	**: CS3002**
Time: 2 Hours		**Maximum Marks: 30**	

Note : (i) Answer all questions.

(ii) Write all answers of a question at one place.

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1. Answer the following questions:

(a) A large population of ALOHA users manage to generate 50 requests/sec, including both originals and retransmissions. Time is slotted in units of 40 msec. **[3 Marks]**

(i) What is the chance of success on the first attempt?

(ii) What is the probability of exactly k collisions and then a success?

(iii) What is the expected number of transmission attempts needed?

(b) Consider the delay of pure ALOHA versus slotted ALOHA at low load. Which one is less? Explain your answer. **[2 Marks]**

2. Answer the following questions:

(a) Discuss the issues in the data link layer. **[2 Marks]**

(b) Explain the key differences between OSI and TCP/IP reference models? **[3 Marks]**

3. Answer the following questions:

(a) Explain the channel allocation methods for broadcast networks. Give advantages and disadvantages of these methods? **[3 Marks]**

(b) A disadvantage of a broadcast subnet is the capacity wasted when multiple hosts attempt to access the channel at the same time. As a simplistic example, suppose that time is divided into discrete slots, with each of n hosts attempting to use the channel with probability p during each slot. What fraction of the slots will be wasted due to collisions? **[2 Marks]**

4. Answer the following questions:

(a) Sixteen-bit message are transmitted using a Hamming code. How many check bits are needed to ensure that the receiver can detect and correct single-bit errors? Show the bit pattern transmitted for the message 1101001100101101. Assume that even-parity is used in the Hamming code. **[3 Marks]**

(b) What is the maximum overhead in byte-stuffing and bit-stuffing algorithms? **[2 Marks]**

P.T.O

5. Answer the following questions:

(a) Explain the following two protocols: **[3 Marks]**

(i) A Bit-Map Protocol

(ii) The Binary Countdown

(b) Give the differences between the CSMA and Adaptive Tree Walk Protocol? **[2 Marks]**

6. Answer the following questions: **[1.5 + 1.5 + 2 = 5 Marks]**

(a) Explain the differences between the Simplex protocols and Sliding window protocols?

(b) Explain the drawback of 1-bit sliding window protocol?

(c) Explain the key differences between Token Bus and Token Ring networks?

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Dept. of Comp. Sc. & Engg.,

Mid Sem Spring Exam FEB 2022

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Course Code: CS3006 Time: 2.0 Hours FM: 30

Date of Exam: 23nd FEB 2022

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(3) Answers should be brief and to the point

Q1. Answer the following briefly

(a) Differentiate between transparency and concurrency in a distributed system.
(b) Diffentiate between Distributed System and Computer Network.
(c) Why it is difficult to design a distributed system?
(d) Can the distributed systems be built on the top of a LAN? Justify.
(e) Write the role of protocol and standards for communication in a distributed system.
(f) What do you mean by light weight messaging system?
(g) What are the components of a distributed system? Show using a diagram.
(h) How the various events in a distributed system can be ordered in the absence of global clock?
(i) What is syndrome decoding? Explain with examples.
(j) Differentiate between Client-server & Peer to peer protocol.

Q2. Write the answer with justification:

(i) Illustrate the protocols such as R, RR, and RRA protocol with a diagram and a comparison table.

(ii) State "TRUE" or "FALSE". "WWW is a distributed system but Internet is a computer network".

(iii) What is NIC in a distributed system? What are various components in an NIC?

(iv) What is the need of marshalling and unmarshalling in a distributed system? Give an example scenario for the marshalling and unmarshalling.

(v) Differentiate between IPC and RPC. Illustrate using a diagram.

(vi) What do you mean by RPC Call Semantics? Which is better? Justify.

(Vii) What features justify the periodic execution of diagnostic software in a large scale distributed system?

(viii) Write the classification of faults in a distributed system with respect to behavior and duration of the fault.

(ix) What is state holding time? Explain with an example.

Q3. (a) Write the similarities & difference between following using a table.

i) **Synchronous Vs. Asynchronous Distributed Systems**
ii) **Reliable Vs. Unreliable Systems**
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iv) **Monolithic Vs. Microkernel Architecture**
v) **Syndrome Decoding Vs. Fault Model**

(b) A node in a distributed system can work on two types of tasks. Type-1 tasks arrive according to a Poisson process with a rate of 100 per second and type-2 tasks according to a Poisson process with a rate of 200 per second. The two arrival processes are independent. Both types of tasks have exponentially distributed service times, with a mean of 3 milliseconds. Tasks are processed in order of arrival.

(i) What is the probability that during 10 milliseconds no new tasks arrive?

(ii) Determine the mean number of tasks at the node

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4. Answer the following questions:

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P.T.O

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(i) What is syndrome decoding? Explain with examples.
(j) Differentiate between Client-server & Peer to peer protocol.

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(i) Illustrate the protocols such as R, RR, and RRA protocol with a diagram and a comparison table.

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