

System Analysis and Design

18/11/2021lec1

Systems analysis

→ those activities that enable a person to understand and specify what the new system should accomplish.

Systems design

→ those activities that enable a person to define and describe in detail the system that solves the need.

Q] Identify skills needed by a systems analyst to efficiently perform his/her role.

- ❖ Teamworking skills
- ❖ Ability to learn quickly
- ❖ Analytical skills
- ❖ Business awareness
- ❖ Knowledge of hardware, software, and programming.

25/11/2021lec2

Systems Development Life Cycle (SDLC)

The collection of activities that we performed to come up with a system is called SDLC. This SDLC have 4 set of activities.



System vision document

Defines the high-level scope and purpose of a program, product, or project.

System Vision Document

Problem description

The majority of people who live in urban areas do not live a healthy lifestyle. With their hectic schedules, many folks rely heavily on fast food. The primary disadvantage of quick meals is that it is unhealthy. If individuals become reliant on it, it may result in death. HFD is a meal delivery service, but it's unique in that it exclusively delivers healthy food. This will be extremely beneficial to parents since they will be able to prevent their children from ordering fast food by utilizing this service. This initiative allows people to sign up for the service online and make a healthy meal order for a certain day and time. That concludes our discussion. HFD is simple and inexpensive. As a result, the problem of an unhealthy lifestyle is resolved.

System Capabilities

The new system should be capable of:

- ❖ Collecting and storing information of customers.
- ❖ Taking pictures of products.
- ❖ Uploading stock images of products.
- ❖ Collecting the location.

Business benefits

This system will provide the following business benefits:

- ❖ Maintain correct and current information about food suppliers.
- ❖ Maintain correct and rapid information about the food we're delivering.
- ❖ Increase communication between food suppliers and the customer.

Phase	Planning	Analysis	Design	Implementation
Definition	The fundamental process of understanding.	who will use the system? what the system will do? where and when it will be used?	Decides how the system will operate.	The system is either developed or purchased (in the case of packaged software) and installed.
Steps	<ol style="list-style-type: none"> 1. Project identification 2. Project initiation and planning 	<ol style="list-style-type: none"> 1. Study of the current system (as-is-system) 2. Requirements gathering 	<ol style="list-style-type: none"> 1. Design strategy 2. Architecture design 3. Database and file specification 4. Program design 	<ol style="list-style-type: none"> 1. System construction 2. Installation 3. Support plan
Outcome	Feasibility report	System proposal	System specification (SRS)	Finalist system User manual Other related documents
The responsible person	Project manager, system analyst	System analyst	System analyst	Developers Testing people Technical experts Quality assurance

Under “Planning” what we do?

- 1) Feasibility analysis
 - Create a GANTT chart
- 2) Selecting project methodology
- 3) Time estimation
- 4) Managing the project scope
 - Work breakdown structure (WBS)
- 5) Staffing the project

1) Feasibility analysis

Guides the organization in determining whether to proceed with a project.

Importance of feasibility study

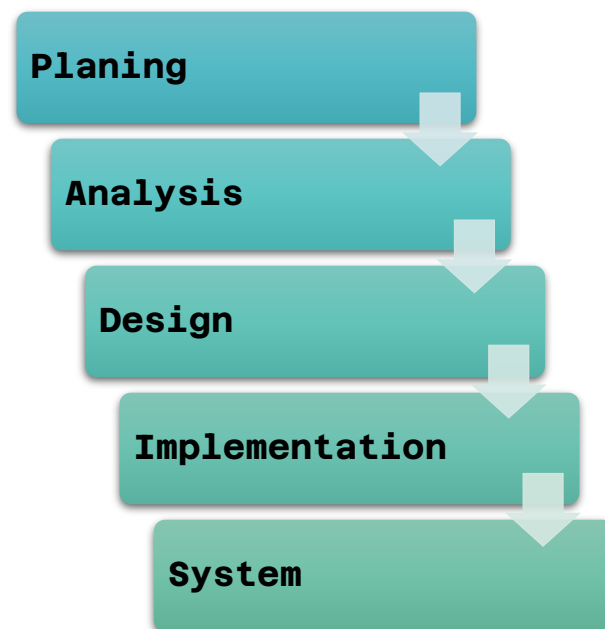
- 1) Exploring reality
- 2) Possibilities of alternate ways
- 3) Knowledge of financial risks
- 4) Understanding possibility of business operation
- 5) Identify the legal risks
- 6) Estimate time and arrange the work
- 7) Identify valid reasons to not to proceed the work
- 8) Identify resource, labor requirements

Key areas	Technical feasibility	Operational feasibility	Economic feasibility	Schedule feasibility
Question	"Can we build it?"	"If we build it, will they come?"	"Should we build the system?"	"Is it possible to complete on time?"
considerations	1) Technical knowledge 2) Required software availability 3) Required hardware availability	1) Stakeholders (In the perspective of client organization) 2) legal feasibility	1) cost 2) benefits	1) Time
People who are familiar with	Users Analysts	Project champion System users Organizational management Other stakeholders	Users	Analysts

2) Project Methodology

A methodology is a formalized approach to implementing the SDLC.

Waterfall development

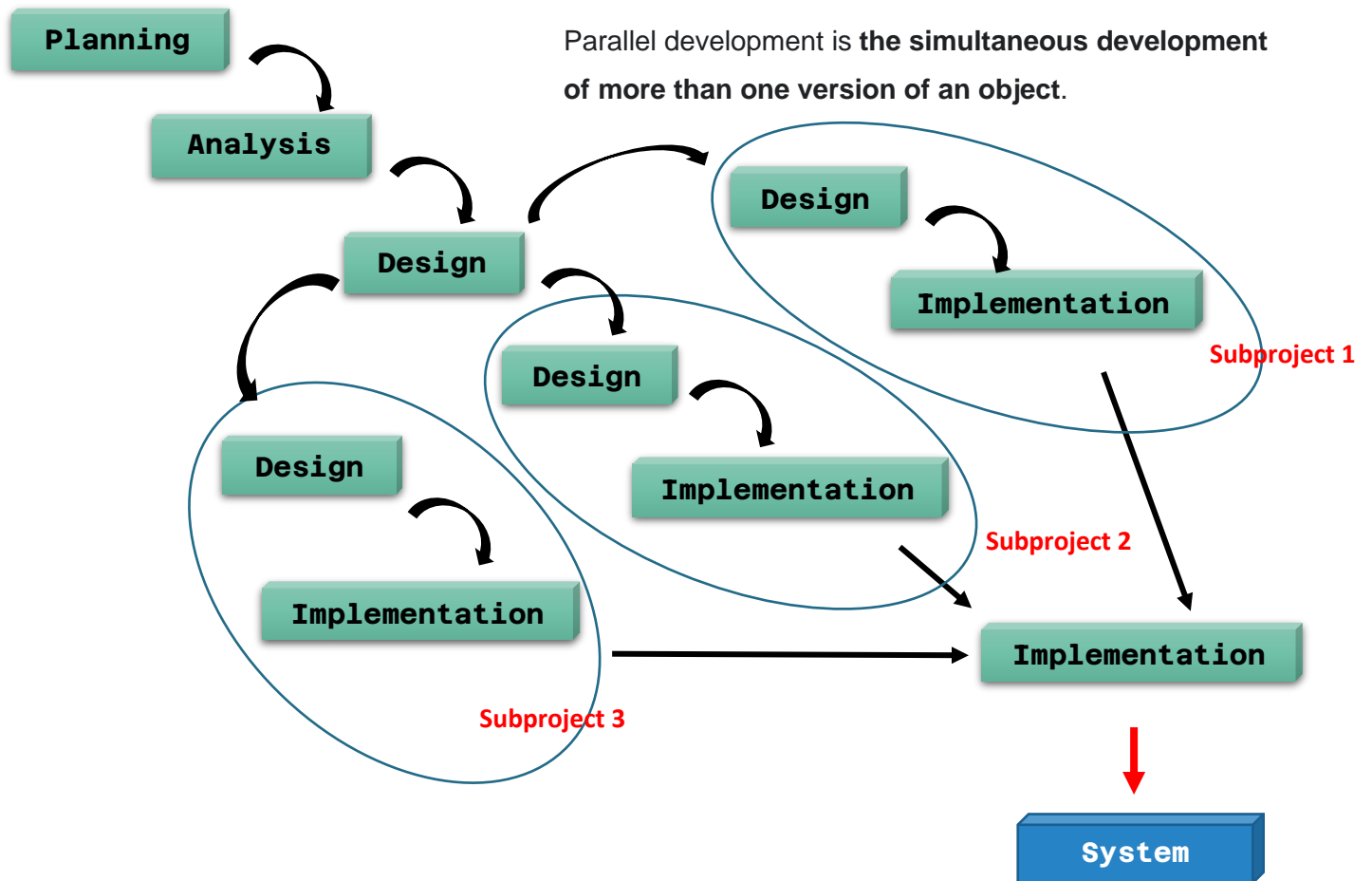


The waterfall methodology is a project management approach that emphasizes a linear progression from beginning to end of a project.

In a waterfall model, each phase must be completed before the next phase can begin and there is no overlapping in the phases.

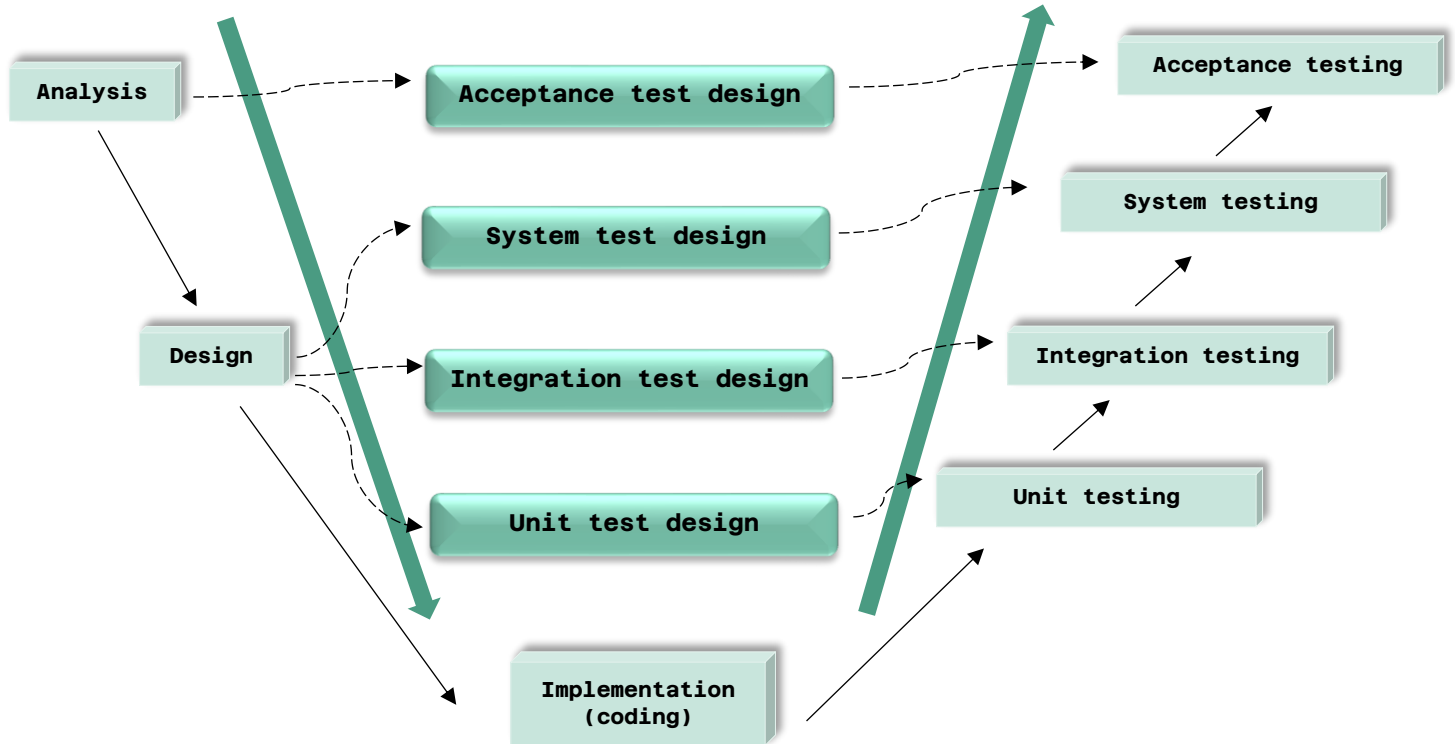
Advantages	Disadvantages
Simple and easy to understand and use.	Makes changes difficult. Waterfall is based entirely on following a set of steps that keep teams always moving forward.
Easy to manage due to the rigidity of the model.	Excludes the client and/or end user.
Phases are processed and completed one at a time	Delays testing until after completion.
Works well for smaller projects where requirements are very well understood.	Not suitable for too long or too short projects.
Clearly defined stages	
Well understood milestones.	
Easy to arrange tasks	

Parallel development



Advantages	Disadvantages
Minimize the time	Integration issues
Reduce the re-working time.	High cost of context switching.
Enables teams to work simultaneously.	Can cause delays in production if changes aren't integrated often enough.
Empowers teams to build on each other's work.	Difficult to manage and track all the active branches.
Accelerates development.	Often causes late-stage defects and quality issues.

V Model



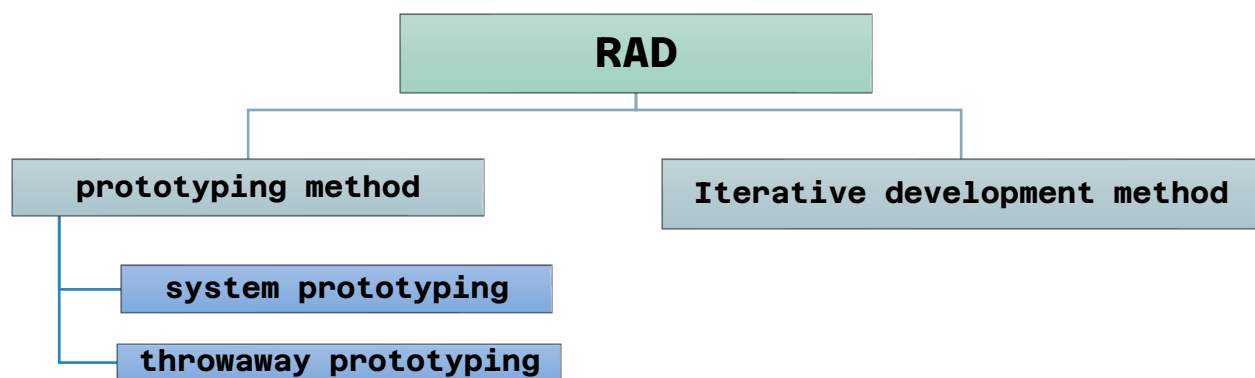
The V-model is an **SDLC** model where execution of processes happens in a sequential manner in a V-shape.

Advantages	Disadvantages
Easily track the defense	Less flexibility
Save the time	Document change is required.
Minimize the re-work time	Risky
Uncomplicated use	Mass updating
Straightforward design	Highly rigid

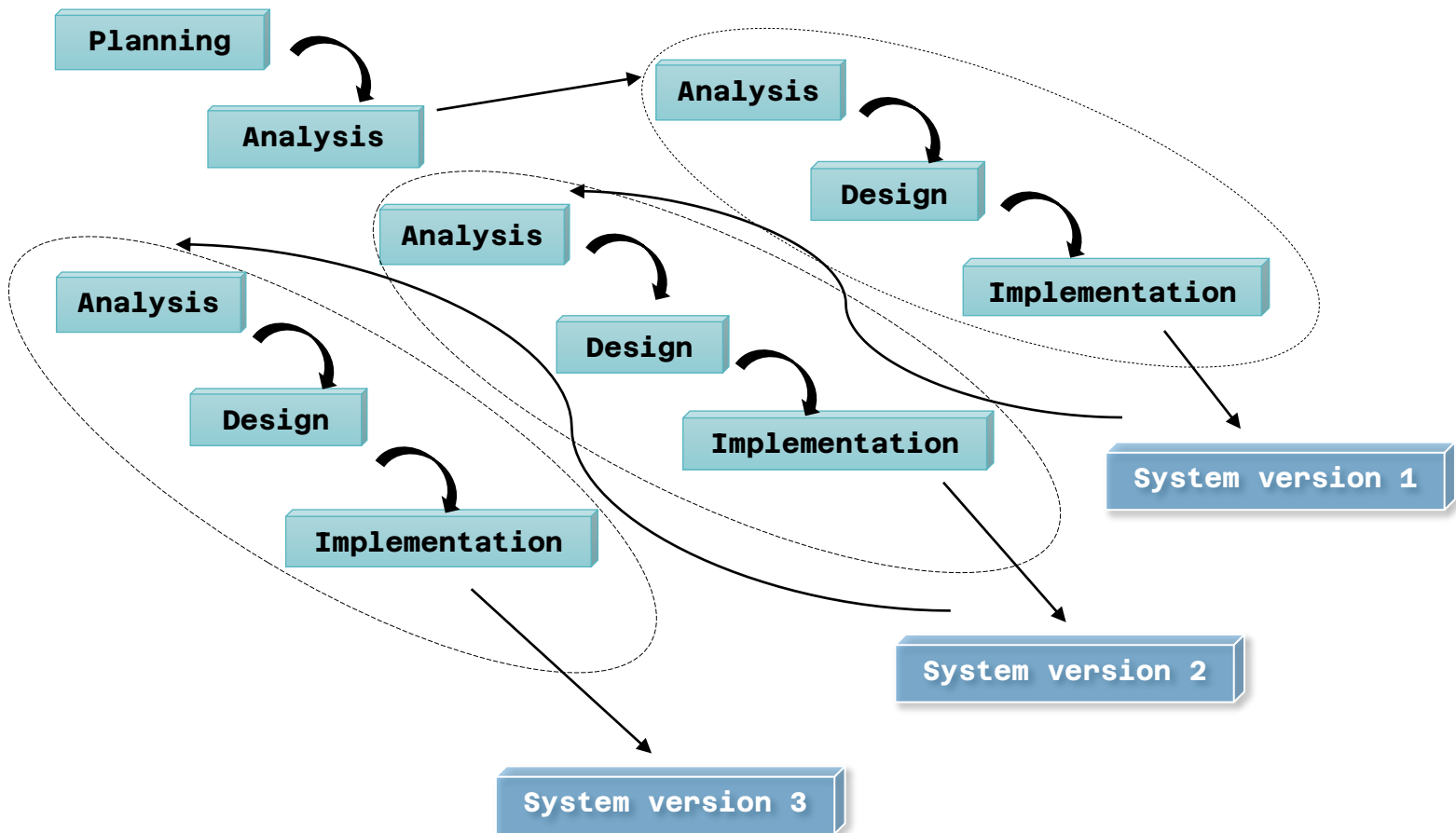
Rapid application development (RAD)

A combination of

- ♣ CASE (computer-aided software engineering) tools
 - It is a specifically designed tool to help requirement analysis and designing. Also, to develop the codes based on your design. There are 3 types of case tools.
 - Lower case tools – facilitate the initial stages of the SDLC. (Planning, analysis, and initial design)
 - Upper case tools – facilitate the actual designing and the development.
 - Integrated tools – all the stages of SDLC
 - Ex: rational rose
 - Case tools help to automatically compare the diagrams, and if there are any mismatches it can recognize that.
 - It can convert your diagram to the source code.
- ♣ JAD (joint application development) sessions
- ♣ Fourth generation/ visual programming languages
- ♣ Code generators



RAD: Iterative development



Advantages	Disadvantages
Changing requirements can be accommodated.	Need to identify all the requirements
Progress can be measured.	Need lot of resources
Reduced development time.	High dependency on Modelling skills.
Increases reusability of components.	Management complexity is more.
Quick initial reviews occur.	Requires highly skilled developers/designers.

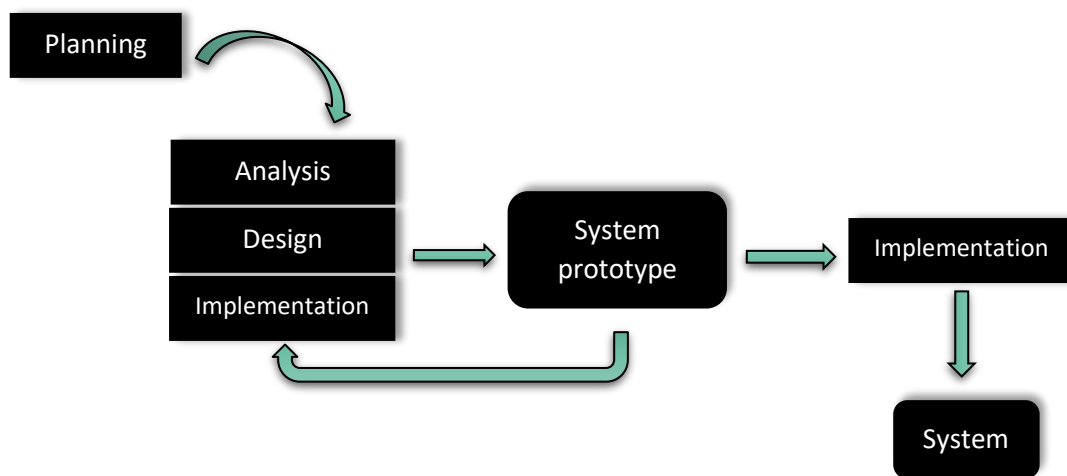
Prototyping method

Prototype is a model of the final system that you develop.

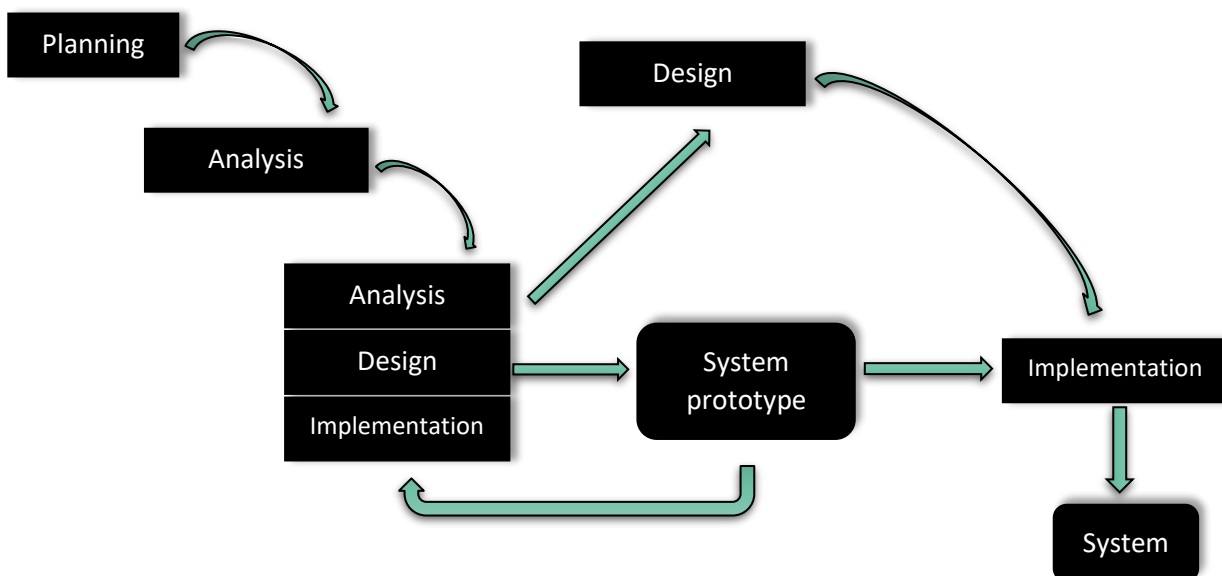
Difference between system prototyping & throwaway prototyping

In system prototyping, the prototype is directly converted into the final system. But in throwaway prototyping, after verifying the requirements the prototype will be discard and a new system will be developed in the beginning.

RAD: System prototyping

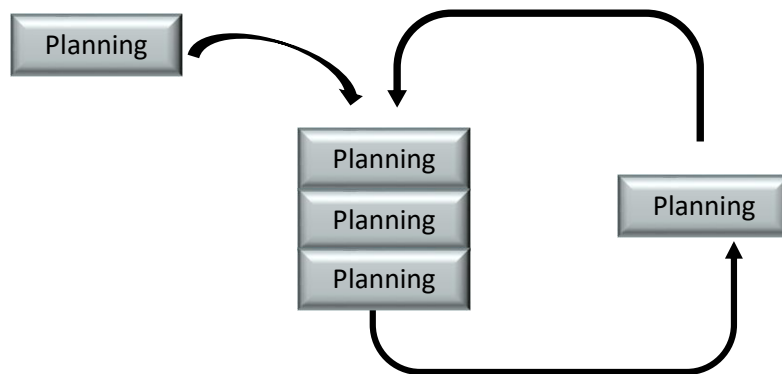


RAD: Throwaway prototyping

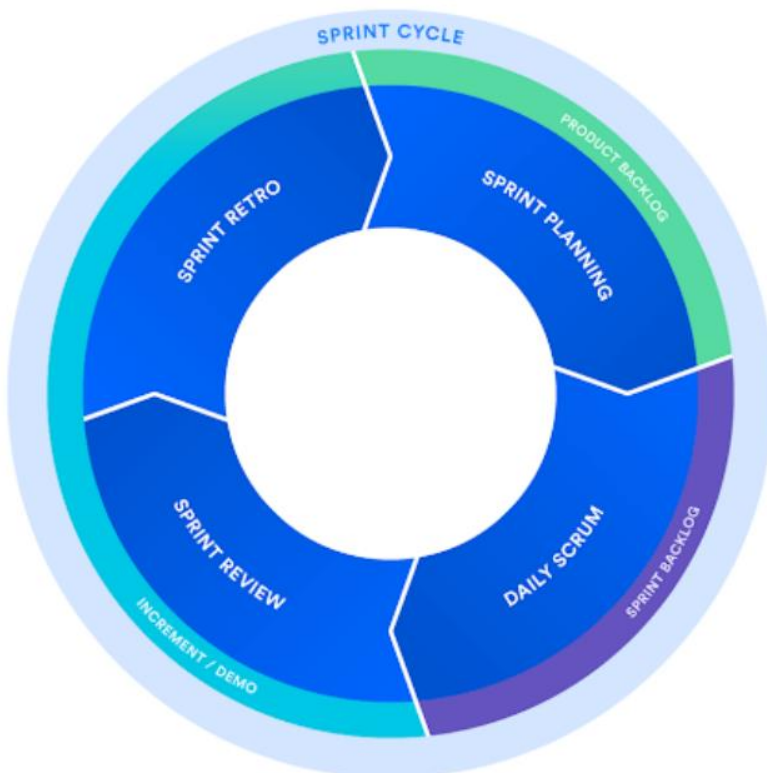


Agile development

- These are used for projects where you have short time period.
- As soon as you identify a requirement, they will be designed, developed, tested and the requirement will be completed. After that, another set of requirements will be identified, analyzed, developed and it will be plugged in with the previously developed system. And then next requirements will identify.
- There are different methods.
 - Extreme programming (XP)
 - Scrum
 - Dynamic systems development method (DSDM)



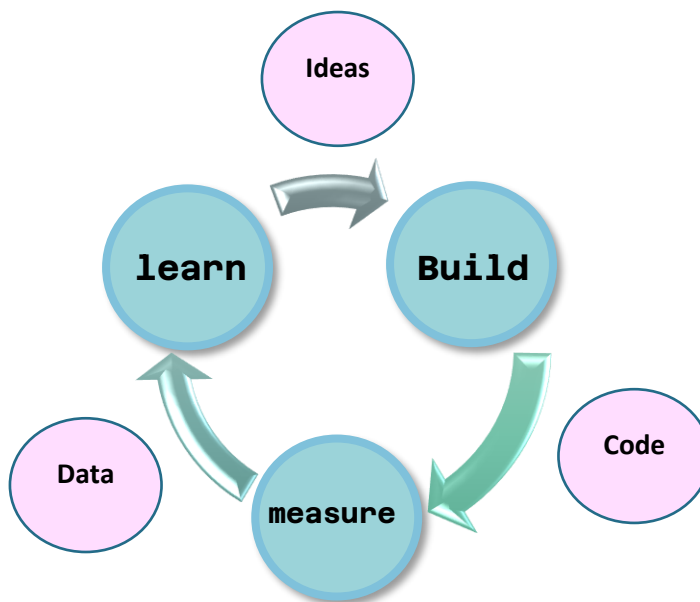
Scrum methodology



- ♠ Scrum methodology is a cyclical approach.
- ♠ Requirements are identified → design → develop. This is happening again and again.
- ♠ One cycle is called “sprint”. This one sprint will last only 2–4 weeks.

- ♣ First, the project manager will identify what are the resources that we need, how many employees are needed, what are their skills, what are the timings that we need them in work, what are their deliverables should be. And everything will be plan.
- ♣ Entire sprint will be planned at the very first step.
- ♣ Once everything is planned, they will execute the plan.
- ♣ When they execute the plan, one important thing that they do is, having the daily scrum meetings.
- ♣ after that, the sprint review starts. (What are the places that we have to improve, what are the time allocation changes that we have to do, what are the resource allocation changes that we have to do in the next sprint) what are the things we need to improve in the next sprinter?
- ♣ Finally, sprint retro comes. Here, they will present the work to the client.

Lean methodology

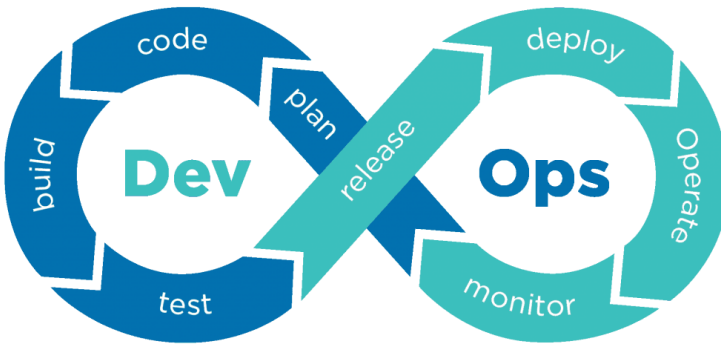


The Lean model follows a set of seven principles

- Eliminate waste
- Amplify/Refine learning
- Decide as late as possible
- Deliver as fast as possible
- Empower the team
- Conceptual integrity
- See the whole/Operating from the top-level

Lean methodology is a means of directing your organization's people, resources, effort, and energy toward delivering value to customers. It is founded on two guiding principles: constant progress and human respect. Lean methodology ideas are being used by teams all around the world, from sales to software development, to offer greater value to consumers in a sustainable way while also developing healthier, more resilient businesses.

DevOps methodology



DevOps is a software development methodology that **aims to bring software development teams and information technology operatives together.**

Features:

- Updates to products are small but frequent
- Continuous feedback and process improvement
- Automation of manual development processes

It emerged from two trends:

- application of Agile and Lean practices to operations work
 - collaboration between development and operations staff
- at all stages of the SDLC

Selecting the appropriate development methodology

1) Clarity of user requirements

- You can think of how clear the requirements are.
- If you are very confident of what they are expecting from us, you can go for waterfall development method.
- If user requirements are not very clear and you need time, you can go for agile development.

2) Familiarity with technology

- For an example, if the client asks you to do the system using Java, you have to be familiar with java.

3) System complexity

- If the client's expectations are very complex, you have to do lot of analysis.
- In such case, you can go for waterfall development. (Because there, you use lot of time to analysis)

4) System reliability

- For an example, if we think of transaction processing system and rocket launching system, the rocket launching system is more reliable. So, we need to study a lot and map all the security concerns as well. In that case, something like agile development is not suitable.

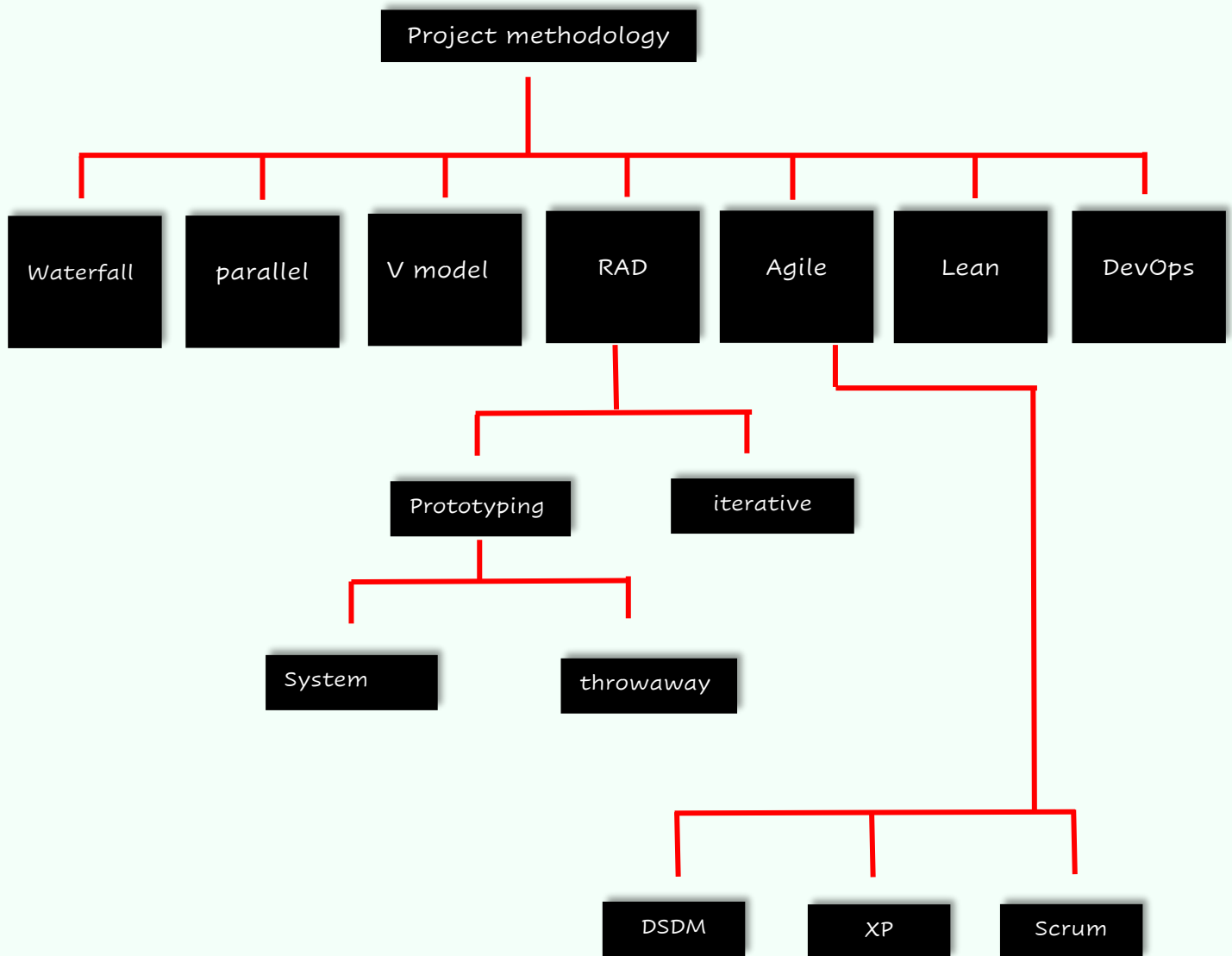
5) Short time schedules

- If the client gives you 6-12 months you can go for waterfall development. (Not for too lengthy projects)
- If the client wants the system very quickly you can go for agile development.

6) Schedule visibility

- If the client needs frequent updates and your team members want to see what each and every member is doing you can go for agile development.

SUMMARY



Tutorial: Project Methodology 2

Question 01:

Following table displays the criteria that you can use for selecting the appropriate project methodology. You are required to complete the table according to the discussion had in the lecture.

	waterfall	parallel	V-model	Iterative	System prototyping	Throwaway prototyping	Agile development
With unclear user requirements	X	X	X	✓	✓	✓	✓
With unfamiliar technology	✓	✓	✓	✓	X	✓	X
That are complex	X	X	X	X	X	X	✓
That are reliable	✓	✓	✓	✓	X	✓	X
With short time schedule	X	✓	✓	✓	✓	X	✓

Question 02:

Suppose that you are a project manager using the waterfall development methodology on a large and complex project. Your manager has just read the latest article in Computerworld magazine that advocates replacing the waterfall methodology with prototyping and comes to your office requesting you to switch. What is your response to this request? Justify your answer.

Any project's development needs long or short-term investment. The project's aim is determined by the decision makers, and it must be met within the budgeted time frame, with all risks and obstacles considered. People size, cost, purpose, length, risk, scope, and economic value are all used to classify projects. The project manager will direct that the new prototype model be implemented. The advantages of the waterfall technique must be explained; it is effective and dependable for complicated and huge projects. As a result, the model has been applied to this project, making it easier and simpler to complete. Prototyping is a time-consuming process. Prototyping approach is a sophisticated one that is not beneficial in big projects. Without prior knowledge with prototyping methodology, application of this technique may cause complications and complicate the process. The system's initial development decisions may also be ineffective, as it is merely a feature of the project, and this strategy may be ineffective. As a result, I'll attempt to make a judgment about the waterfall methodology's adoption.

3) Time estimation

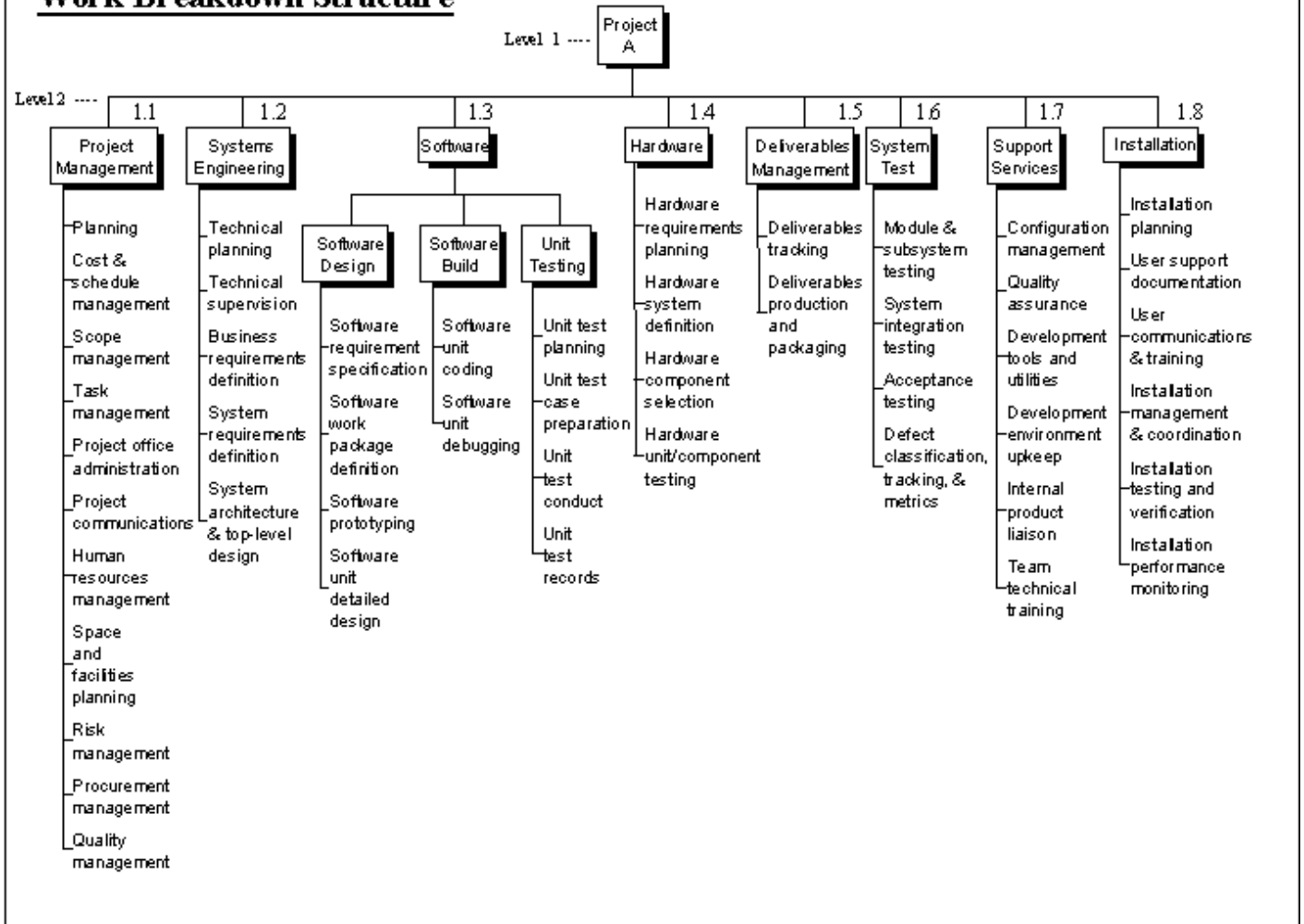
	Planning	Analysis	Design	Implementation
Typical industry standards for business applications	15%	20%	35%	30%
Estimates based on actual figures for first stage of SDLC	Actual: 4 person-months	Estimated: 5.33 person-months	Estimated: 9.33 person-months	Estimated: 8 person-months

- ♣ In planning stage, we have to do feasibility study and several other things.
- ♣ In analysis stage we have to gather requirements, collect requirements, analyze requirements, evaluate requirements.
- ♣ In design stage, we have to do database design, interface design, network structures.
- ♣ In implementation stage we have to do, coding, testing, integrating the units, UI testing.

First, we have to identify what are the deliverables. What are the work load that you have to perform. Then we're going to come up with a hierarchical structure. Every time we have to ensure that we have covered all the content of our project.

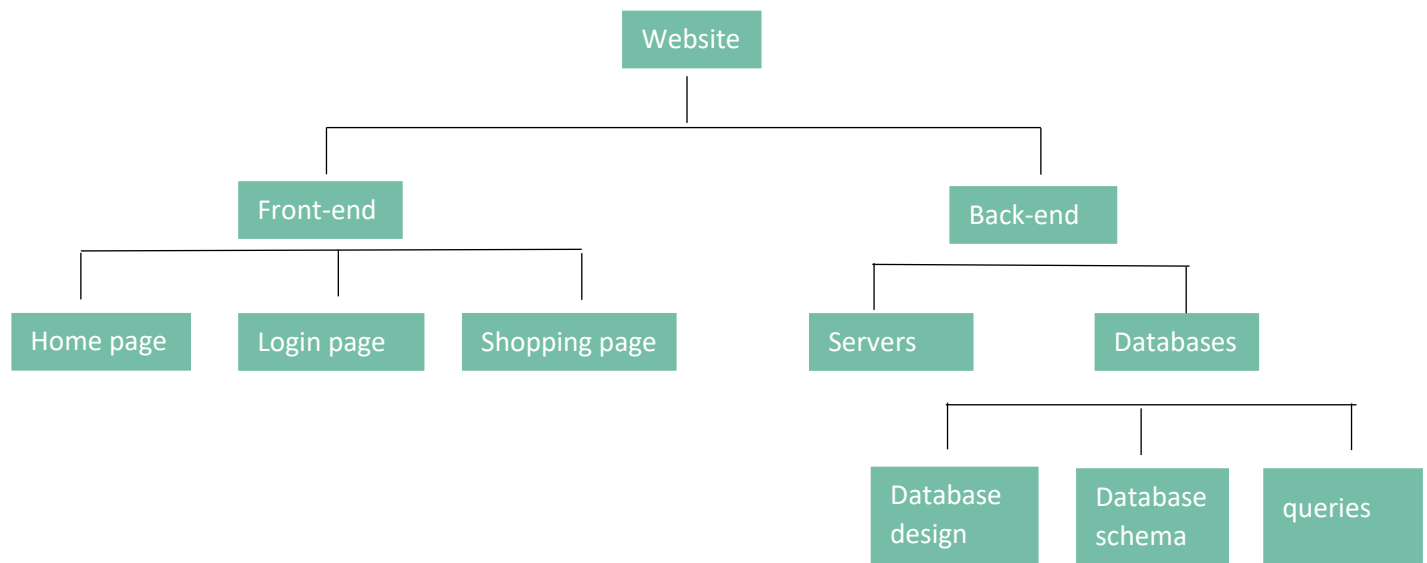
"Deliverable oriented hierarchical decomposition of the work to be executed by the project team. " is called a Work Breakdown Structure (WBS)

Work Breakdown Structure



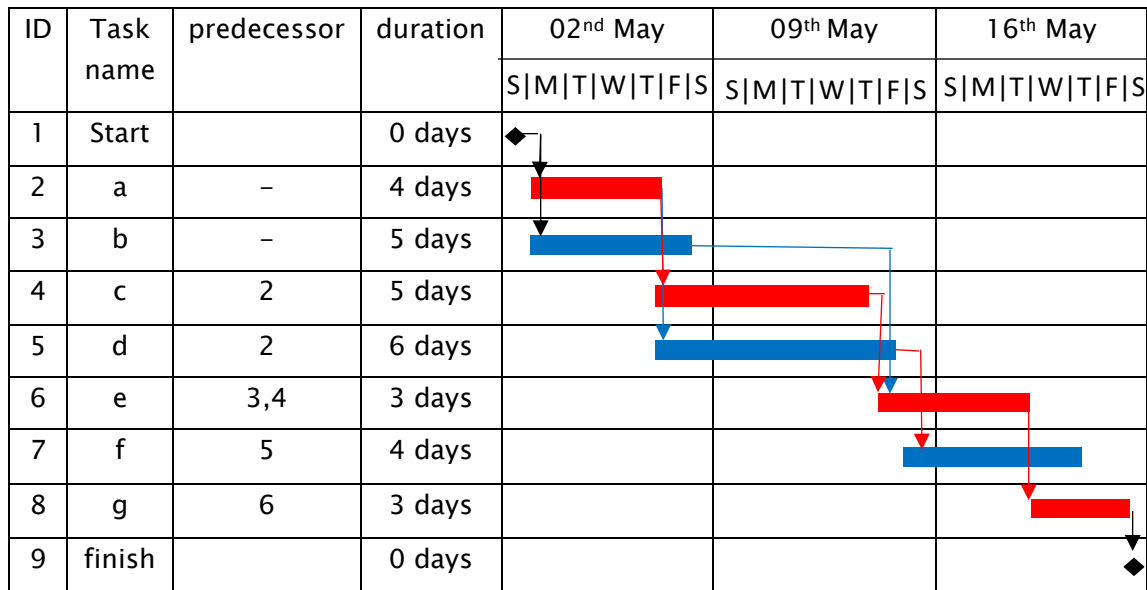
Exercise:

Imagine you are a project manager that is working with a web site development project. Create a simple WBS for this project. You are allowed to make any assumption.



GANTT chart

A type of bar chart that illustrates a project schedule. We can use “MS Visio” tool to draw the GANTT chart.



13/01/2022lec7

4) Staffing the project

- ♣ Staffing levels will change over a project's lifetime.
- ♣ Adding staff may add more overhead than additional labor.
- ♣ Using teams of 8–10 reporting in a hierarchical structure can reduce complexity.

Staffing plan – the kinds of people working on the project

Project charter – the project's objectives and rules

Functional lead – manages a group of analysts

Technical lead – oversees progress of programmers and technical staff members

Analysis

- ♣ Analysis involves three steps.
 - ☑ The as-is system (understand the existing situation)
 - ☑ Identify improvements
 - ☑ The to-be system (define the requirement for the new system)

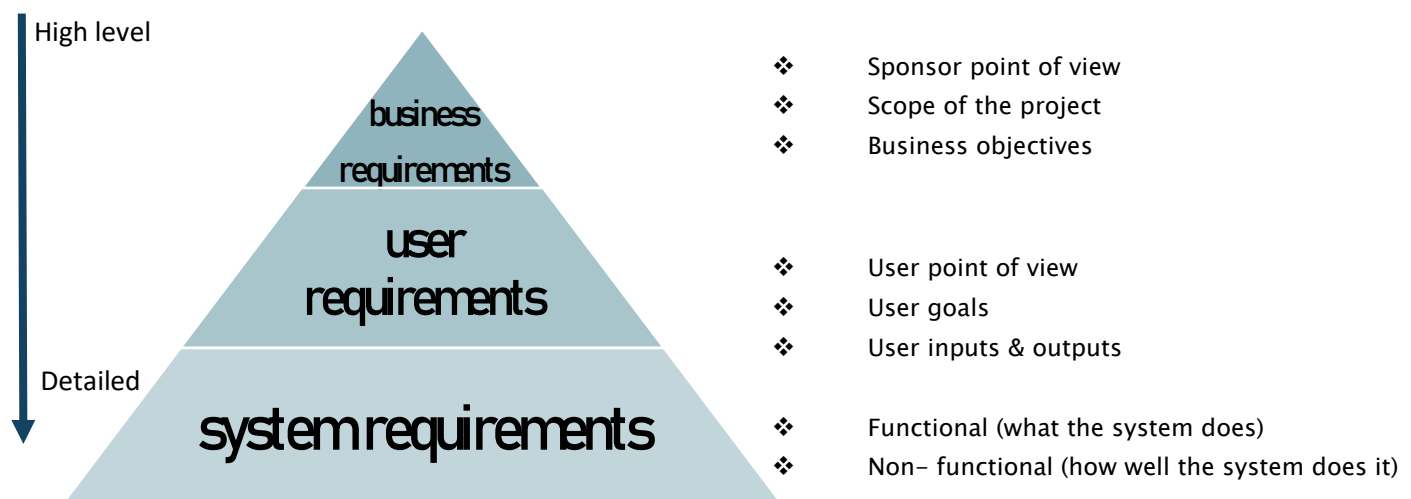
The final deliverable of the analysis phase is **system proposal**.

- ♣ A requirement is a statement of what the system must do or what characteristics it needs to have.

- ♣ Requirements describe,
 - ✚ Business requirements – what the business needs
 - ✚ User requirements – what the users need to do
 - ✚ Functional requirements – what the software should do
 - ✚ Non-functional requirements – characteristics the system should have

Functional requirements can divide into 2 types.

- I. Process oriented – a process the system must perform
- II. Information oriented – information the system must contain



Exercise

Requirements for Proposed System:

The system should..... Categorize these requirements into business, user, functional, and non-functional requirements.

- | | | |
|---|---|-----------------------|
| 1. Serve the web users. | - | <i>business</i> |
| 2. include the company logo and color scheme. | - | <i>non-functional</i> |
| 3. connect all the branches. | - | <i>business</i> |
| 4. include actual and budgeted cost information. | - | <i>functional</i> |
| 5. provide management reports. | - | <i>functional</i> |
| 6. have 2-second maximum response time for predefined queries and 10-minute maximum response time for ad hoc queries. | - | <i>non-functional</i> |
| 7. display information from all company subsidiaries. | - | <i>functional</i> |
| 8. print subsidiary reports in the primary language of the subsidiary. | - | <i>non-functional</i> |
| 9. provide monthly rankings of salesperson performance. | - | <i>functional</i> |
| 10. include sales information that is updated daily. | - | <i>functional</i> |
| 11. increase market share | - | <i>business</i> |
| 12. shorten order processing time | - | <i>business</i> |
| 13. reduce customer service costs | - | <i>business</i> |
| 14. lower inventory spoilage | - | <i>business</i> |
| 15. improve responsiveness to customer service requests | - | <i>business</i> |
| 16. schedule a client appointment | - | <i>user</i> |
| 17. place a new customer order | - | <i>user</i> |
| 18. re-order the inventory | - | <i>user</i> |
| 19. determine available credit of clients | - | <i>user</i> |
| 20. look up account balances | - | <i>user</i> |

Tutorial- Requirement Gathering and Analysis 1

Review an online shopping website you prefer e.g.: amazon.com, ebay.com, kapruka.com, daraz.lk.

Create a list of user requirements and functional requirements that the system meets. What different kinds of nonfunctional business requirements does the system meet? Provide examples for each kind.

User requirements

- ✚ Login facility
- ✚ Sign up facility
- ✚ Facility to Place the order
- ✚ Join as a seller
- ✚ Bulk purchasing facility
- ✚ Customer care

functional requirements - process oriented

- ✚ Input phone no or email
- ✚ Input password
- ✚ Forgot password
- ✚ Facebook / google login
- ✚ Capture the birthday, gender
- ✚ Receive offers and promotions

Information oriented

- ✚ Make a database containing phone no, email, and passwords
- ✚ Read the credentials

REQUIREMENTS ELICITATION TECHNIQUES

1. Interviews

Structured interviews	Unstructured interviews
Before starting the interview, you have to set up a list of questions. According to the list you ask questions one by one.	There are no any pre-defined questions. It depends on the situation. Based on the discussion that you built.

Basic steps

- Selecting interviewees
- Designing interview questions
- Preparing for the interview
- Conducting the interview
- Post-interview follow-up

Types of questions

1. Closed-ended questions – no need of explanation for these kinds of questions. Specific answer is needed.
 Ex: how many telephone orders are received per day?
 How many cashier girls do you have?
2. Open-ended questions – has freedom to give an explanation. You can receive different answers from different interviewees.
 Ex: what do you think about the way invoices are currently processed?
3. Probing questions – you give the freedom to the respondents to raise some questions again. Interviewer also can ask more questions based on that.
 Ex: why?
 Can you give me an example?

2. Questionnaires

A questionnaire is a set of written questions for obtaining information from individuals.

Advantages	Disadvantages
You can distribute questions to many people at once. And you can collect the answers soon. So, it saves the time.	The responses totally depend on how the respondents understand the question. There's no one to explain the question. So, you may receive wrong responses.
You can reach the large audience.	

3. Joint Application Development (JAD)

- ♣ Here, you will have a group discussion. You have a group of people participating in a specific location and you have a group discussion with them.
- ♣ There are two parties here. One is client side and other side is IT team.
- ♣ JAD allows the project team, users and management to work together to identify requirements for the system.
- ♣ It can reduce scope creep by 50%.
- ♣ JAD is a structure process in which 10 to 20 users meet under the direction of a facilitator skilled in JAD techniques.

4. Document analysis

- ♣ Document analysis is used to understand the as-is system.
- ♣ This can be used combining with another type of requirement collection method.
- ♣ Forms, reports, policy manuals, organization charts describe the formal system that the organization uses.

5. Observation

- ♣ You are going to stay physically where the business process is happened. You observe everything and collect all the information by yourself.
- ♣ Here you can't get the information about history or future.
- ♣ We can't identify weaknesses here. The reason is if someone is watching you, we don't do any mistakes.
- ♣ However, you can collect correct information because you observe everything.

Exercise:

Identify the pros and cons of each requirement elicitation technique discussed in the lecture.

1. Interviews

Pros	Cons
Can collect very detailed information.	Takes a lot of time.
Easy to collect information.	There's no way to compare data.
Can verify that you have collected correct data.	You can't reach a large number of respondents at once.
You can build the trust.	

2. Questionnaires

Pros	Cons
You can collect data from large amount of people at once.	You have to be very careful when you are preparing the questions.
You can easily reach different types of segments.	Respondents may not understand the questions properly.
	You can't ensure all the people who receive the questionnaire will provide the answers.

3. JAD

Pros	Cons
You can gather and validate data.	Need the support of the facilities.
Can reach multiple people at once.	Difficult to arrange the time.
Can efficiently spend the time.	
You can collect data from different perspectives at once.	

4. Document analysis

Pros	Cons
Don't have to spend much time. No need to prepare anything.	The data may not be correct.
Don't have to discuss.	You will miss important data if there are much information.
Can easily collect data.	Waste your time.
You can collect data by yourself.	

5. Observation

Pros	Cons
You can collect the real time data.	Have to send a lot of time.
Avoid the biases.	You have to spend resources.
	Can collect only as is data. No future predictions.
	Cannot identify limitations.

18/02/2022lec10

Process Modeling using DFD

A process model









- Further clarifies the requirements definition and use cases.
- A graphical way of representing how a business system should operate.
- Can be used to document the as-is system or the to-be system, whether computerized or not.

Different techniques

- Business process modeling notation (BPMN)
- Flow chart
- Data flow diagrams
- Integration definition for function modeling (IDEF)

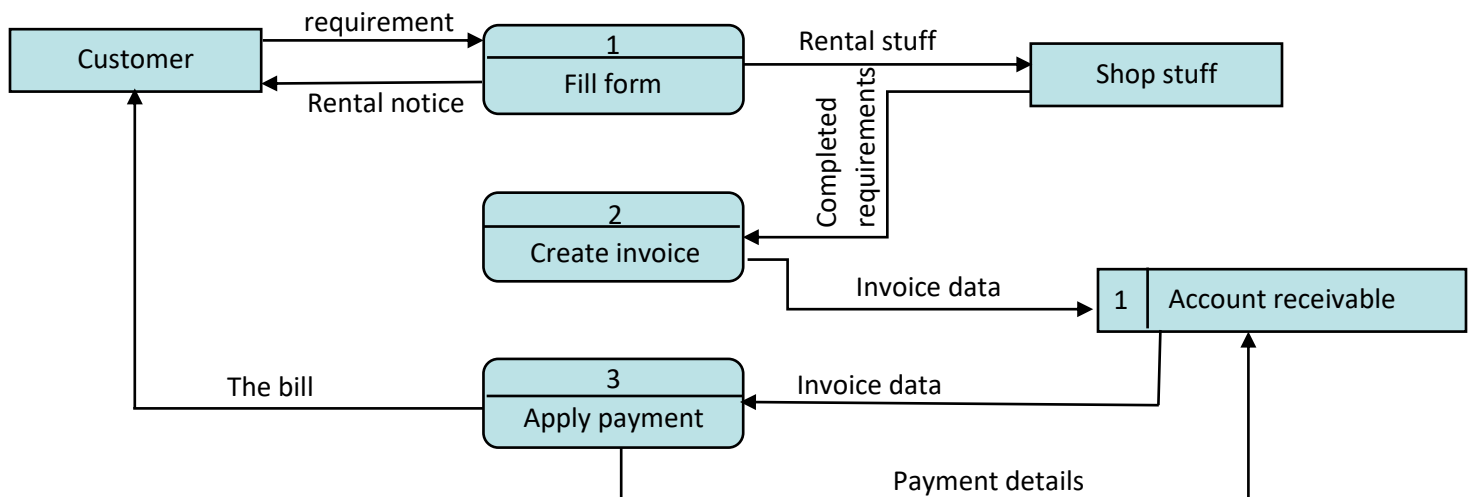
DFD

- ♣ Data flow diagramming (DFD) is a technique that diagrams the business processes and the data that pass among them.
- ♣ There are 2 types.
 1. Logical DFD – no need to mention hardware infrastructure. Just explain the data sources, processing, and receiver's data ins & data outs.
 2. Physical DFD – in your graphical model you present what are the physical devices that you use to collect the data.

	Gane and Sarson symbol	DeMarco and Yourdan symbol
Process		
Data flow		
Data store		
External entity		

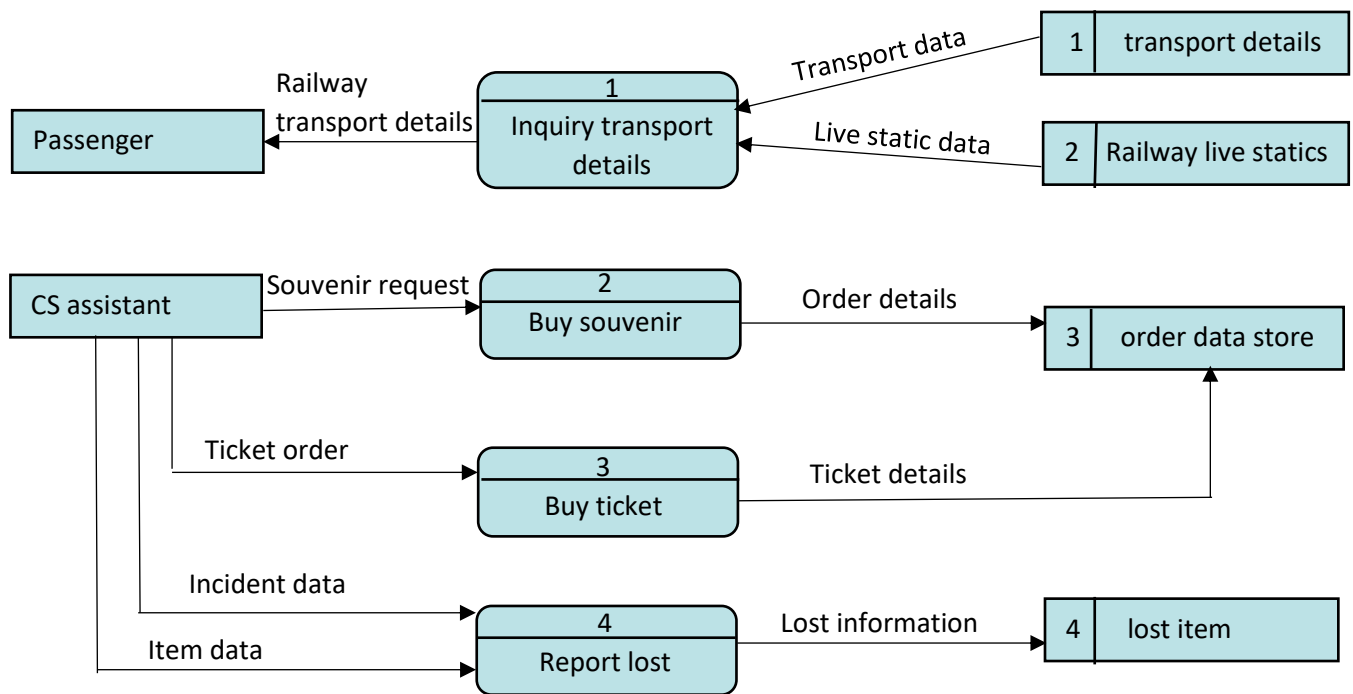
Exercise 1:

The system has three processes; Fill Form, Create Invoice, and Apply Payment. Fill Form process receives the requirement from the customer. Then, Fill form process processes the requirement and sends rental details to the shop staff and rental notice to the customer. The shop staff forwards a completed requirement to Create Invoice process. The process generates the invoice and store it in the Accounts Receivable data store. The Apply Payment process retrieve Invoice details from the Accounts Receivable data store and generate a bill and send it to the customer. The process also stores payment details in the Accounts Receivable data store.



Exercise 2:

Customer Service (CS) System A Passenger can receive Railway Transport details from the Inquiry Transport Details process, and these details are provided by the data stores Transport Details and Railway Live Statistic. CS Assistant can initiate the Buy Souvenir process providing a Souvenir request, which will result in having the Order details stored in the Order data store. CS Assistant can also initiate the Buy Ticket process by providing Order details and the Ticket details will be stored again in the Order data store. Finally, CS Assistant can initiate the Report Lost process by providing the Incident and item details and the Lost information will be stored in the Lost Item database.



Validating DFD

There are 2 fundamental types of errors in DFDs.

1. Syntax errors – can be thought of as grammatical errors that violate the rules of the DFD language.
2. Semantics errors – can be thought of as misunderstandings by the analyst in collecting, analyzing, and reporting information about the system.

Common syntax errors

1. Always you have to pass data from external entity to other external entity **only through a process.**
2. You can't have the **same data entered to the process** as well as sent out from the process.
3. You cannot have **data stores** without data ins and data outs
4. You can't have **processes** without data ins and data outs.

Using DFDs to define business processes

- ♣ Business processes are too complex to be explained in one DFD.
- ♣ Decomposition of the business process into a series of DFDs, each representing a lower level of detail.
 1. Context diagram
 2. Level 0 DFD
 3. Level 1 DFD
 4. Level 2 DFD
 5.so on

Level 0 DFD / context level DFD

- You should have only 1 process.
- You can have external entities, and data flows.
- But no data stores.
- This one and only process that you have in level 0 DFD represents the whole information system.

→ In level 0 DFD the one and only process should be numbered as number 0.

Level 1

- We can break the level 0 diagram.
- You have to map data flows that you have identified to the respective process inside the system.

Rules of thumb:

- There should be at least 3, and no more than 7–9, processes on every DFD.
- Each lowest level process should be realized in about 25–50 lines of code.

