AMIA
INFORMATICS PROFESSIONALS. LEADING THE WAY.

5D: Project Management

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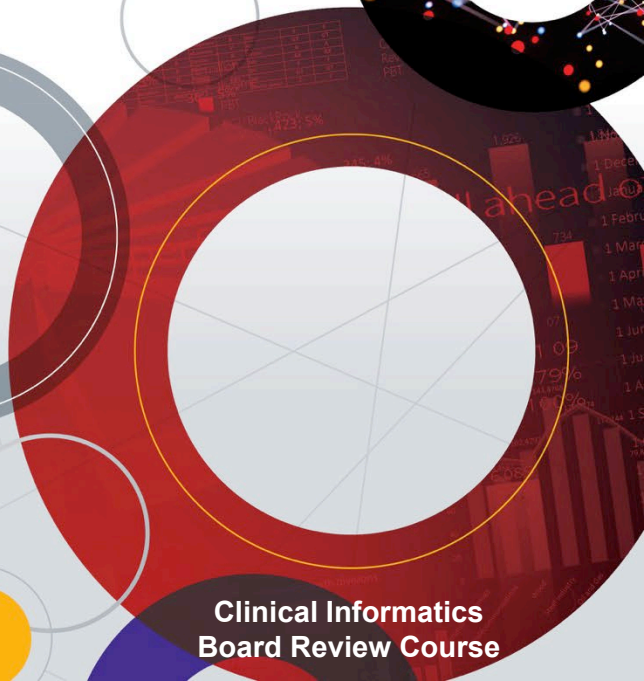


Clinical Informatics
Board Review Course

Clinical Informatics Subspecialty Delineation of Practice (CIS DoP)

Domain 1: Fundamental Knowledge and Skills (no Tasks are associated with this Domain which is focused on fundamental knowledge and skills)

Clinical Informatics

K001. The discipline of informatics (e.g., definitions, history, careers, professional organizations)
K002. Fundamental informatics concepts, models, and theories
K003. Core clinical informatics literature (e.g., foundational literature, principle journals, critical analysis of literature, use of evidence to inform practice)
K004. Descriptive and inferential statistics
K005. Health Information Technology (HIT) principles and science
K006. Computer programming fundamentals and computational thinking
K007. Basic systems and network architectures
K008. Basic database structure, data retrieval and analytics techniques and tools
K009. Development and use of interoperability/exchange standards (e.g., Fast Health Interoperability Resources [FHIR], Digital Imaging and Communications in Medicine [DICOM])
K010. Development and use of transaction standards (e.g., American National Standards Institute X12)
K011. Development and use of messaging standards (e.g., Health Level Seven [HL7] v2)
K012. Development and use of ancillary data standards (e.g., imaging and Laboratory Information System[LIS])
K013. Development and use of data model standards
K014. Vocabularies, terminologies, and nomenclatures (e.g., Logical Observation Identifiers Names and Codes [LOINC], Systematized Nomenclature of Medicine --Clinical Terms [SNOMED-CT], RxNorm, International Classification Of Diseases[ICD], Current Procedural Terminology [CPT])
K015. Data taxonomies and ontologies
K016. Security, privacy, and confidentiality requirements and practices
K017. Legal and regulatory issues related to clinical data and information sharing
K018. Technical and non-technical approaches and barriers to interoperability
K019. Ethics and professionalism

The Health System

K020. Primary domains of health, organizational structures, cultures, and processes (e.g., health care delivery, public health, personal health, population health, education of health professionals, clinical research)
K021. Determinants of individual and population health
K022. Forces shaping health care delivery and considerations regarding health care access
K023. Health economics and financing
K024. Policy and regulatory frameworks related to the healthcare system
K025. The flow of data, information, and knowledge within the health system

Domain 2: Improving Care Delivery and Outcomes

K026. Decision science (e.g., Bayes theorem, decision analysis, probability theory, utility and preference assessment, test characteristics)
K027. Clinical decision support standards and processes for development, implementation, evaluation, and maintenance
K028. Five Rights of clinical decision support (i.e., information, person, intervention formats, channel, and point/time in workflow)
K029. Legal, regulatory, and ethical issues regarding clinical decision support
K030. Methods of workflow analysis
K031. Principles of workflow re-engineering
K032. Quality improvement principles and practices (e.g., Six Sigma, Lean, Plan-Do-Study-Act [PDSA] cycle, root cause analysis)
K033. User-centered design principles (e.g., iterative design process)
K034. Usability testing
K035. Definitions of measures (e.g., quality performance, regulatory, pay for performance, public health surveillance)
K036. Measure development and evaluation processes and criteria
K037. Key performance indicators (KPIs)
K038. Claims analytics and benchmarks
K039. Predictive analytic techniques, indications, and limitations
K040. Clinical and financial benchmarking sources (e.g., Gartner, Healthcare Information and Management Systems Society [HIMSS] Analytics, Centers for Medicare and Medicaid Services [CMS], Leapfrog)
K041. Quality standards and measures promulgated by quality organizations (e.g., National Quality Forum [NQF], Centers for Medicare and Medicaid Services [CMS], National Committee for Quality Assurance [NCQA])
K042. Facility accreditation quality and safety standards (e.g., The Joint Commission, Clinical Laboratory Improvement Amendments [CLIA])
K043. Clinical quality standards (e.g., Physician Quality Reporting System [PQRS], Agency for Healthcare Research and Quality [AHRQ], National Surgical Quality Improvement Program [NSQIP], Quality Reporting Document Architecture [QRDA], Health Quality Measure Format [HQMF], Council on Quality and Leadership [CQL], Fast Health Interoperability Resources [FHIR] Clinical Reasoning)
K044. Reporting requirements
K045. Methods to measure and report organizational performance
K046. Adoption metrics (e.g., Electronic Medical Records Adoption Model [EMRAM], Adoption Model for Analytics Maturity [AMAM])
K047. Social determinants of health
K048. Use of patient-generated data
K049. Prediction models
K050. Risk stratification and adjustment
K051. Concepts and tools for care coordination
K052. Care delivery and payment models

Domain 3: Enterprise Information Systems

K053. Health information technology landscape (e.g., innovation strategies, emerging technologies)
K054. Institutional governance of clinical information systems
K055. Information system maintenance requirements
K056. Information needs analysis and information system selection
K057. Information system implementation procedures
K058. Information system evaluation techniques and methods
K059. Information system and integration testing techniques and methodologies
K060. Enterprise architecture (databases, storage, application, interface engine)
K061. Methods of communication between various software components
K062. Network communications infrastructure and protocols between information systems (e.g., Transmission Control Protocol/Internet Protocol [TCP/IP], switches, routers)
K063. Types of settings (e.g., labs, ambulatory, radiology, home) where various systems are used
K064. Clinical system functional requirements
K065. Models and theories of human-computer (machine) interaction (HCI)
K066. HCI evaluation, usability engineering and testing, study design and methods
K067. HCI design standards and design principles
K068. Functionalities of clinical information systems (e.g., Electronic Health Records [EHR], Laboratory Information System [LIS], Picture Archiving and Communication System [PACS], Radiology Information System [RIS] vendor-neutral archive, pharmacy, revenue cycle)
K069. Consumer-facing health informatics applications (e.g., patient portals, mobile health apps and devices, disease management, patient education, behavior modification)
K070. User types and roles, institutional policy and access control
K071. Clinical communication channels and best practices for use (e.g., secure messaging, closed loop communication)
K072. Security threat assessment methods and mitigation strategies
K073. Security standards and safeguards
K074. Clinical impact of scheduled and unscheduled system downtimes
K075. Information system failure modes and downtime mitigation strategies (e.g., replicated data centers, log shipping)
K076. Approaches to knowledge repositories and their implementation and maintenance
K077. Data storage options and their implications
K078. Clinical registries
K079. Health information exchanges
K080. Patient matching strategies
K081. Master patient index
K082. Data reconciliation
K083. Regulated medical devices (e.g., pumps, telemetry monitors) that may be integrated into information systems
K084. Non-regulated medical devices (e.g., consumer devices)
K085. Telehealth workflows and resources (e.g., software, hardware, staff)

Domain 4: Data Governance and Data Analytics

K086. Stewardship of data
K087. Regulations, organizations, and best practice related to data access and sharing agreements, data use, privacy, security, and portability
K088. Metadata and data dictionaries
K089. Data life cycle
K090. Transactional and reporting/research databases
K091. Techniques for the storage of disparate data types
K092. Techniques to extract, transform, and load data
K093. Data associated with workflow processes and clinical context
K094. Data management and validation techniques
K095. Standards related to storage and retrieval from specialized and emerging data sources
K096. Types and uses of specialized and emerging data sources (e.g., imaging, bioinformatics, internet of things (IoT), patient-generated, social determinants)
K097. Issues related to integrating emerging data sources into business and clinical decision making
K098. Information architecture
K099. Query tools and techniques
K100. Flat files, relational and non-relational/NoSQL database structures, distributed file systems
K101. Definitions and appropriate use of descriptive, diagnostic, predictive, and prescriptive analytics
K102. Analytic tools and techniques (e.g., Boolean, Bayesian, statistical/mathematical modeling)
K103. Advanced modeling and algorithms
K104. Artificial intelligence
K105. Machine learning (e.g., neural networks, support vector machines, Bayesian network)
K106. Data visualization (e.g., graphical, geospatial, 3D modeling, dashboards, heat maps)
K107. Natural language processing
K108. Precision medicine (customized treatment plans based on patient-specific data)
K109. Knowledge management and archiving science
K110. Methods for knowledge persistence and sharing
K111. Methods and standards for data sharing across systems (e.g., health information exchanges, public health reporting)

Domain 5: Leadership and Professionalism

K112. Environmental scanning and assessment methods and techniques
K113. Consensus building, collaboration, and conflict management
K114. Business plan development for informatics projects and activities (e.g., return on investment, business case analysis, pro forma projections)
K115. Basic revenue cycle
K116. Basic managerial/cost accounting principles and concepts
K117. Capital and operating budgeting
K118. Strategy formulation and evaluation
K119. Approaches to establishing Health Information Technology (HIT) mission and objectives
K120. Communication strategies, including one-on-one, presentation to groups, and asynchronous communication
K121. Effective communication programs to support and sustain systems implementation
K122. Writing effectively for various audiences and goals
K123. Negotiation strategies, methods, and techniques
K124. Conflict management strategies, methods, and techniques
K125. Change management principles, models, and methods
K126. Assessment of organizational culture and behavior change theories
K127. Theory and methods for promoting the adoption and effective use of clinical information systems
K128. Motivational strategies, methods, and techniques
K129. Basic principles and practices of project management
K130. Project management tools and techniques
K131. Leadership principles, models, and methods
K132. Intergenerational communication techniques
K133. Coaching, mentoring, championing and cheerleading methods
K134. Adult learning theories, methods, and techniques
K135. Teaching modalities for individuals and groups
K136. Methods to assess the effectiveness of training and competency development
K137. Principles, models, and methods for building and managing effective interdisciplinary teams
K138. Team productivity and effectiveness (e.g., articulating team goals, defining rules of operation, clarifying individual roles, team management, identifying and addressing challenges)
K139. Group management processes (e.g., nominal group, consensus mapping, Delphi method)

Knowledge Statements from the DoP

- K129. Basic principles and practices of project management
  - Basic Principles
  - Identifying Resources
  - Resource Allocation
  - Managing expectations
  - Balancing competing priorities
- K130. Project management tools and techniques
  - Project Management Tools
  - Scope Creep

K129. Basic Principles

Project Management Institute

https://www.pmi.org/

Certifies project management professionals (PMP)

Produces standards which are considered the *de facto* standards for project management by many

Primary resource:

- *A Guide to the Project Management Body of Knowledge (PMBOK Guide).* 5th ed. ANSI Standard ANSI/PMI 99-001-2013. Newtown Square, PA: Project Management Institute; 2013.
- NOTE: There is also a software extension for this guide, but it focuses on software development rather than installation and configuration informatics projects.

Project

Definition

- Temporary endeavor
- Defined beginning and end
- Goal to complete specific objectives that bring beneficial change or added value
- PMI: a temporary endeavor undertaken to create a unique product, service or result

Project

A successful project…

- Has high quality
- Completes expected deliverables to the satisfaction of stakeholders and customers
- On time
- Is within budget

Organizational Project Management

- Strategy execution framework utilizing project, program and portfolio management as well as organizational enabling practices
- Goal: consistently and predictably deliver organizational strategy
- Produce better performance, results and a sustainable competitive advantage

Terms

Portfolio

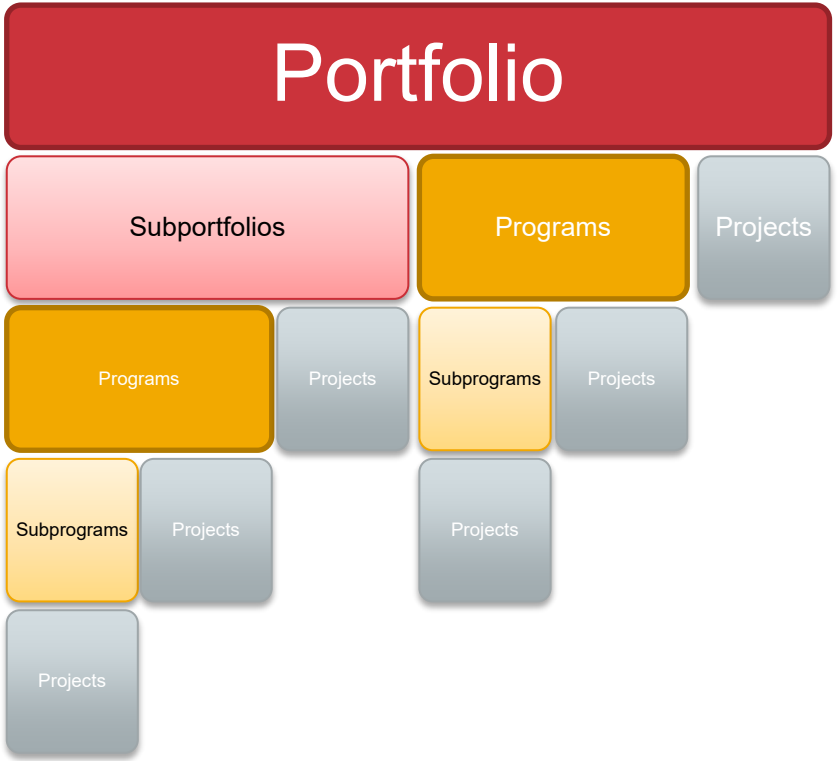
- Collection of projects, programs, subportfolios and operations managed as a group to achieve strategic objectives

Program

- Collection of subprograms, projects and other work that are managed in a coordinated fashion in support of the portfolio

Project Governance

- Process of ensuring that the project is in alignment of the project with stakeholders' needs or objectives
- Provides framework for project manager and sponsors to make decisions



Project Management

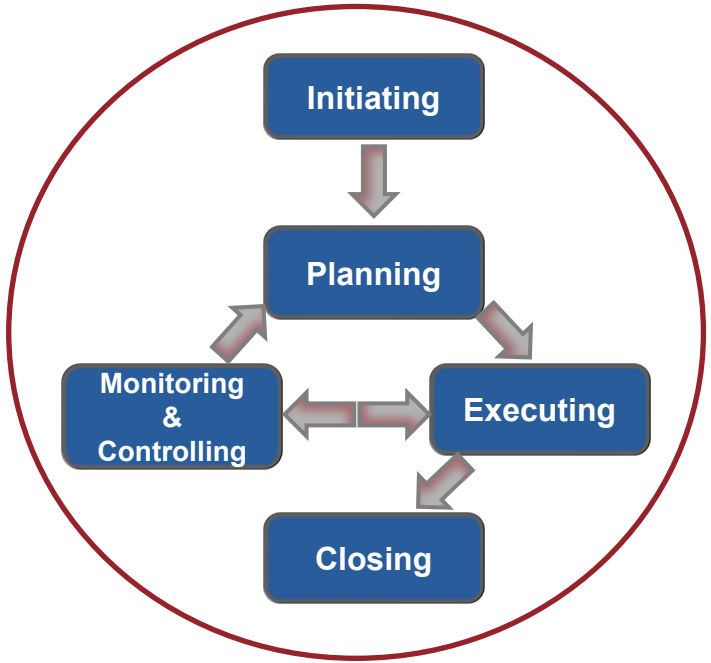
- Application of knowledge, skills, tools and techniques to project activities to meet the project requirements
- Accomplished through application and integration of many distinct project management processes

Project Management

These processes are categorized into 5 groups (**Process Groups**)

- Initiation
- Planning
- Execution
- Monitoring and Controlling
- Closing

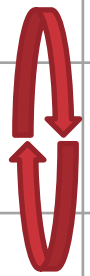
Project Life Cycle



Modified from: https://en.wikipedia.org/wiki/File:Project_development_stages.jpg in Project management – Wikipedia; last accessed July 22, 2021.

Project Life Cycle

Order	Process Group	Cost and Staffing Level	Project Management Output	Risk and Uncertainty
1	Initiation	+	Project Charter	++++
2	Planning	++	Project Management Plan	+++
3	Executing (Carrying out the work)	++++	Accepted Deliverables	++
4	Monitoring and Controlling	++++	Quality Assurance Documentation; Successful Testing	++
5	Closing the project	++	Archived Project Documents	+



Types of Project Life Cycles

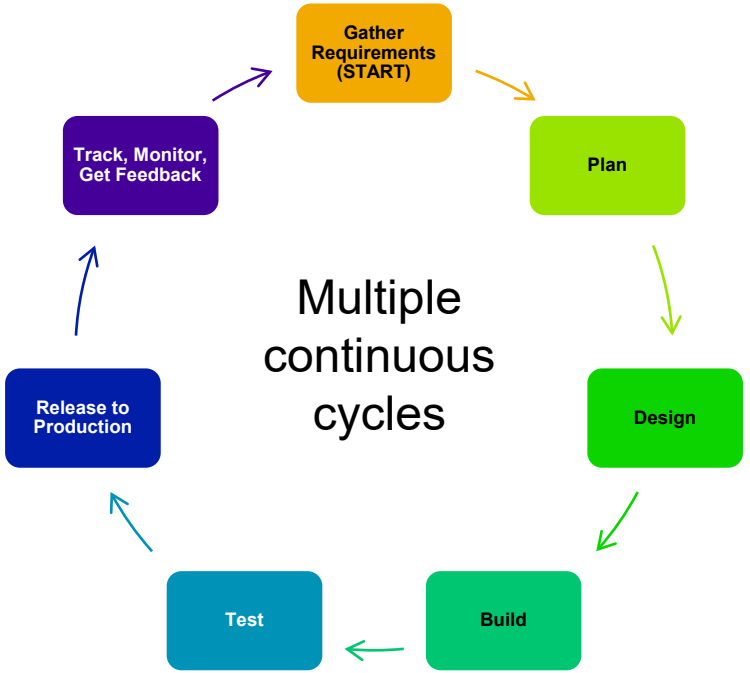
Predictive	• Project scope, time and cost required to deliver that scope are determined early and are predictable • Phases progress in **Waterfall** fashion (see diagram next slide) • Focus on planning and design • Scope is relatively fixed (assumes little/no changes to requirements over time)

Iterative and incremental	• Project phases repeat iteratively over a relatively long period of time (months)
	• Each iteration brings the project towards its defined deliverables in an incremental fashion
	• Scope is elaborated with each iteration (assumes changes over time)
	• **Adaptive/Agile Project Management** is a subtype
	  • a.k.a. **change-driven project life cycles**
	  • Rapid iteration version → project life cycle 2-4 weeks per iteration
	  • Used when high level of change/adaption anticipated throughout project
	  • Utilizes **rolling wave planning**
	  • Near term iterations are planned in detail
	  • Future iterations are planned at a higher level
	  • Examples: Scrum, XP, Kanban, Crystal

IT Project Life Cycles

Waterfall

Agile / Adaptive



Agile / Adaptive Cycles

Pros

- Working software delivered faster and more frequently
- Closer collaboration between project team and stakeholders (highly transparent)
- Changes can be added at any time
- Teams are self-organizing and self-managing
- Enables Continuous Quality Improvement (CQI)

Cons

- Methodology is more difficult to understand
- Higher risk of inadequate documentation
- Very inefficient if implemented badly
- Easier to implement badly in large organizations
- Significant testing requirements may prohibit use of rapid change cycles

Bowes 2014

Project vs. Operations

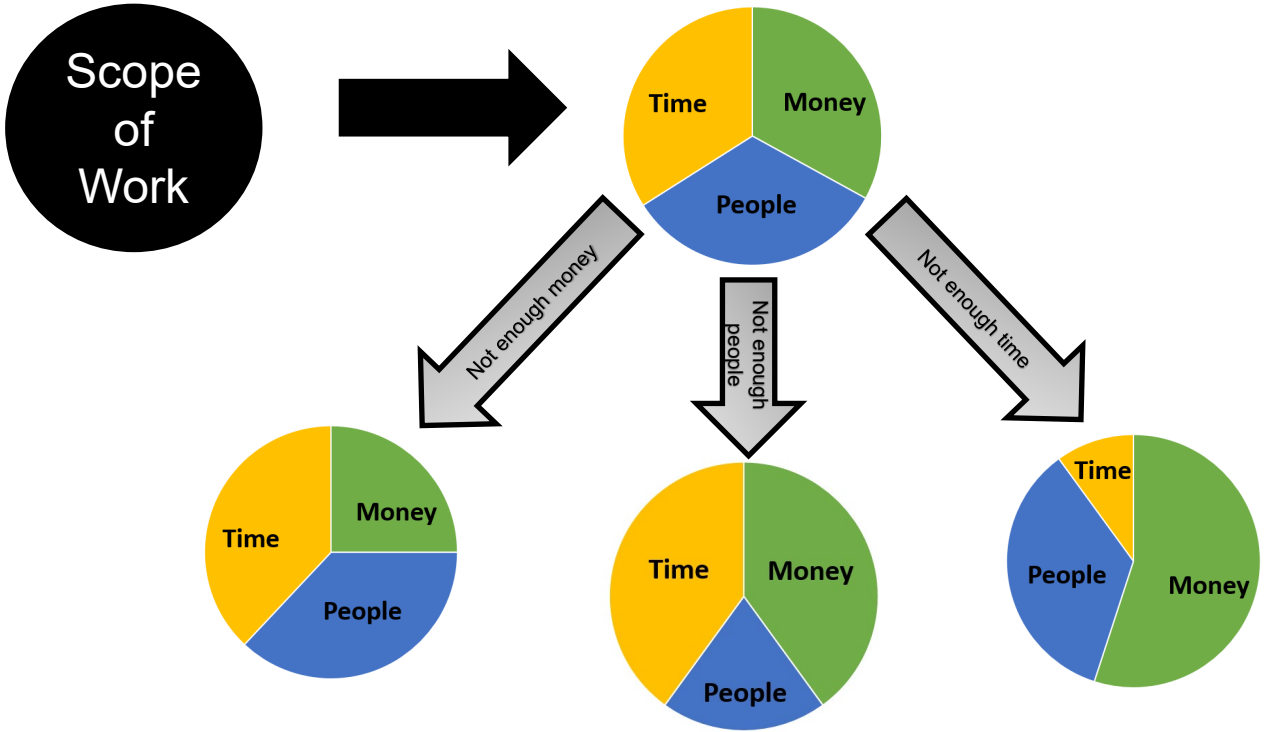
Project	Business Operations (a.k.a keep-the-lights-on or KLO)
Temporary endeavor	Ongoing and repetitive
Defined beginning and end	No defined beginning or end
Meet time-limited goals and objectives	Have ongoing objectives (produce repetitive outputs)
Uses Project Management skills	Uses Operations Management skills

A project will intersect with operations at various points in the project life cycle.

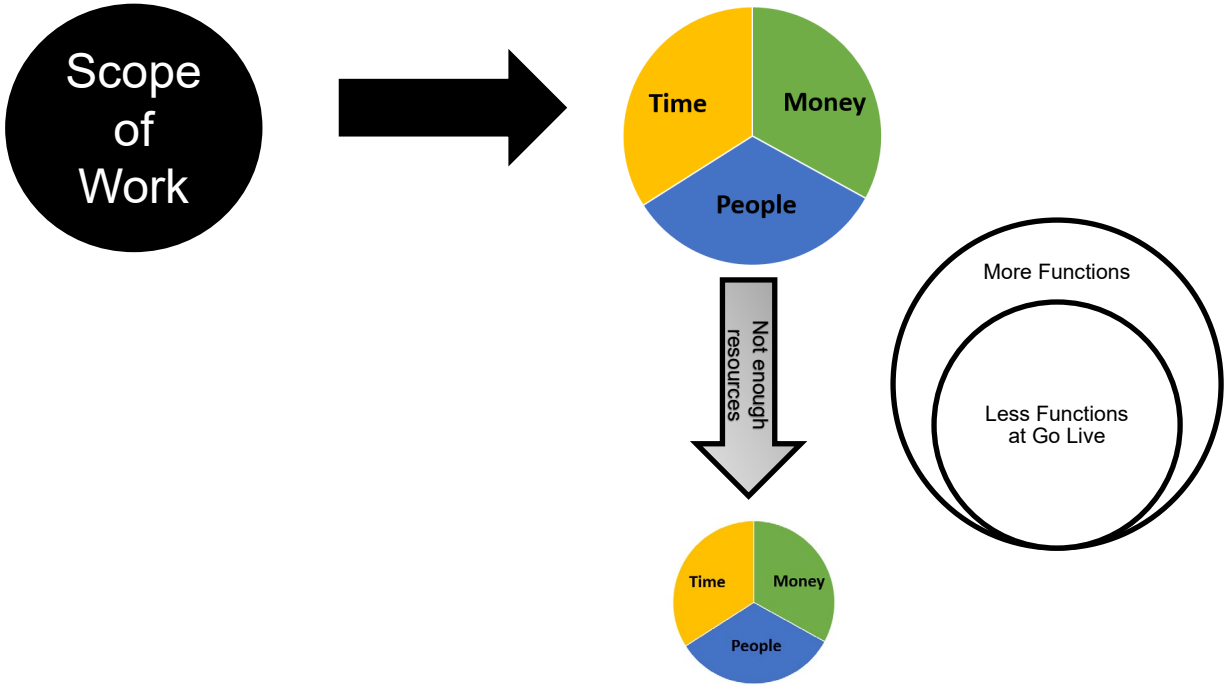
Project Terminology

Deliverable	Product, result or capability that is produced to complete a project
Scope	Work needed to deliver a product, service or result with the specified features and functions • Additional work that does not directly contribute to required deliverables is "**out-of-scope**"
Baseline	• Approved version of work product • Can be changed but needs formal change control procedures • Used for comparison to final results
Constraint	Limiting factor that impacts the execution of a project • Most projects have a **triple constraint** ○ Cost + schedule + scope = quality ○ Money + time + people = scope/quality

Project Resources



Project Resources



More terms

Milestone	A significant point in the project's execution Occurs when one or more pre-defined tasks in the project have been completed
Activity	Distinct, scheduled portion of work performed during the course of a project in order to produce project deliverables •An activity may contain one or more tasks
Task	Part of a set of actions which accomplish a job, problem or assignment
Resource	Anything needed to complete a project. This can be a person, supplies, equipment, money, facilities, etc.

And more terms

Assumption	Information in a project which is considered to be real and true without proof or demonstration
Risk	Uncertain event or condition that, if it occurs, will have a **positive** or **negative** impact on one or more project objectives
Opportunity	**Risk** that would have a **positive** effect on one or more project objectives
Threat	**Risk** that would have a **negative** effect on one or more project objectives
Issue	**Threat** to the successful completion of the project which has already occurred
Quality	The degree to which the completed project satisfies its requirements

Question

Cost and staffing levels are generally inversely proportional to which of the following in a project:

A. Time

B. Output

C. Achievement of deliverables

D. Risk and uncertainty

Answer

Cost and staffing levels are generally inversely proportional to which of the following in a project:

A. Time

B. Output

C. Achievement of deliverables

D. Risk and uncertainty

Risk and uncertainty are highest at the beginning of a project, while cost and staffing are the lowest. As time progresses, risk and uncertainty decrease while cost and staffing increase until project closure.

K129. Basic Principles

Identifying resources

Human Resources

Project Management Office	Management structure that standardizes project-related governance processes and facilitates sharing of resources, methodologies, tools and techniques
Project Manager	Person assigned to lead the team that is responsible for achieving the project objectives. •Have responsibility to satisfy needs for tasks, team and individuals
Stakeholder	Individual, group or organization who may affect, be affected by or perceive itself to be affected by a decision, activity or outcome of a project

Human Resources - *Types of Stakeholders*

Sponsor	Person or group who provides resources and support for the project Accountable for enabling project success Can be internal or external to project's organization
Customers / users	Persons or organizations who will approve and manage the project's product, service or result
Sellers	Vendors, suppliers, contractors, etc.
Business Partners	External organizations that have a special relationship with the enterprise that provide specialized expertise for installation, customization, training or support
Organizational groups	Internal stakeholders who are affected by activities of the project team
Functional managers	Key individuals who play management role within administrative or functional area of the business (e.g., human resources, finance, accounting, procurement)
Other	e.g., government regulators, subject matter experts, consultants, etc.

Human Resources - *Teams*

Project Management Team	• Leadership team for the project • For small projects, this may just be the project manager • Responsible for all project phases
Project Team	All team members involved in completing the project
Steering Committee	• Typically consists of sponsors, high-level stakeholders and the project management team • Governance for the project • Setting mission and vision for project and removing barriers

Other Types of Resources

Supplies and Equipment Resources

Facilities Resources

Funding Resources

- **Sponsor** has responsibility for allocating and releasing funds for the project

Estimating Resources

- **Bottom-up estimating**
  - Method of estimating requirements for a component of work
  - Costs (including of resources) are estimated to the greatest detail possible for each individual activity
  - These costs are summarized ("rolled up") to higher levels to estimate overall costs of the project

K129. Basic Principles

Resource allocation

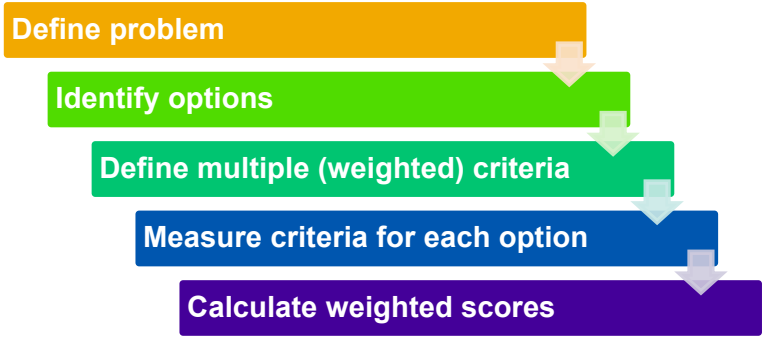
Resource Allocation

- Projects need resources
- Resources have to be reserved and allocated
- Projects without sufficient resources either fail completely or partially
- Allocation may require negotiation, especially if resources are limited
- May need to hire or subcontract for resources from another organization

Resource Allocation

Multi-Criteria Decision Analysis [Frazão et al 2018] [Janse 2018]

- More in Section 2
- Can be used to determine which resources to allocate when multiple resources are available
- Example criteria



Criteria *Independent* of Relevance to Project	Criteria *Dependent* on Relevance to Project
Availability	**Ability (competence)**
Cost	**Experience**
Attitude	**Knowledge**
Location factors (time zone, language or location constraints)	**Skills**

K129. Basic Principles

Informatics Project Challenges

Clinical Informatics - Specific Challenges

- Information systems are highly complex
  - Functionality, security, interoperability, billing, regulations must be satisfied
- Integration with many other systems
- Software vs. human workflow conflicts
- Initial requirements may be imprecise or lack sufficient detail
- Software requirements change as knowledge of the product (and particularly its constraints) increases

Competing priorities

- Risks (usually threats) to one or multiple projects
- Multi-Criteria Decision Analysis and other methods
- Strategy
  1. **Prepare a matrix of projects**
     - **Transparency is key**
     - Include each project's constraints (time, money, people)
     - Highlight projects which are in conflict, competing for same resources or which lack adequate time, money or people
     - Note expected benefits for project
     - Document project's alignment to strategic plan and vision

Competing Priorities (cont.)

- Strategy (cont.)
  2. **Engage Stakeholders**
     - Determine criteria to rank projects and (weighted) scoring methods
     - Confirm scope for each project (look for scope creep)
     - Resolve conflicts
     - Score each project by pre-defined criteria
       - Priorities should be limited in number and very clear
     - Reassign priorities and score criteria as appropriate

Competing Priorities (cont.)

- Strategy (cont.)
  3. **Calculate weighted score**
     - Compare list of ranked projects to amount of resources available
     - Discuss with stakeholders and arrive at final list of priorities
  4. **Communicate results to organization**
     - Notify those who projects are canceled/deferred FIRST

Managing Expectations [Kirk D 2000]

- Meeting expectations is the key to stakeholder satisfaction with the project
  - Managing expectations means managing stakeholders' interpretations of project success
- Important to distinguish between theoretical expectations and committed deliverables
  - **Expectation Gap Analysis**
    - Compares stakeholders' expectations to actual deliverables
    - Provides a tool to resolve gaps with stakeholders
- Periodically repeat this process throughout each project (ask → align → fulfill)
- Communicate, communicate, communicate

K130. Project management tools

Project Initiation Tools

Project Charter

- Document that formally authorizes the existence of a project
- Provides project manager with authority to apply organizational resources to project activities
- Establishes partnership between performing and requesting organization
- Should be authored by the sponsoring entity

Project Charter Components

Statement of Work

- Purpose of project
- Description of project
- Deliverables and related success criteria
- Scope (what's in and out)
- Assumptions
- Constraints
- Risks
- Summary milestone schedule
- Summary budget $$$
- Stakeholder list
- Project approval requirements
- Project manager
- Project Charter Authorization

Business Case - may include:

- Market demand
- Organizational need
- Customer request
- Technological advance
- Legal requirement
- Ecological impact
- Social Need

Agreements

- Contracts, MOUs, service level agreements (SLA), etc.

Environmental factors

- Standards, Regulations, Organizational culture/structure, Marketplace conditions

Process Assets

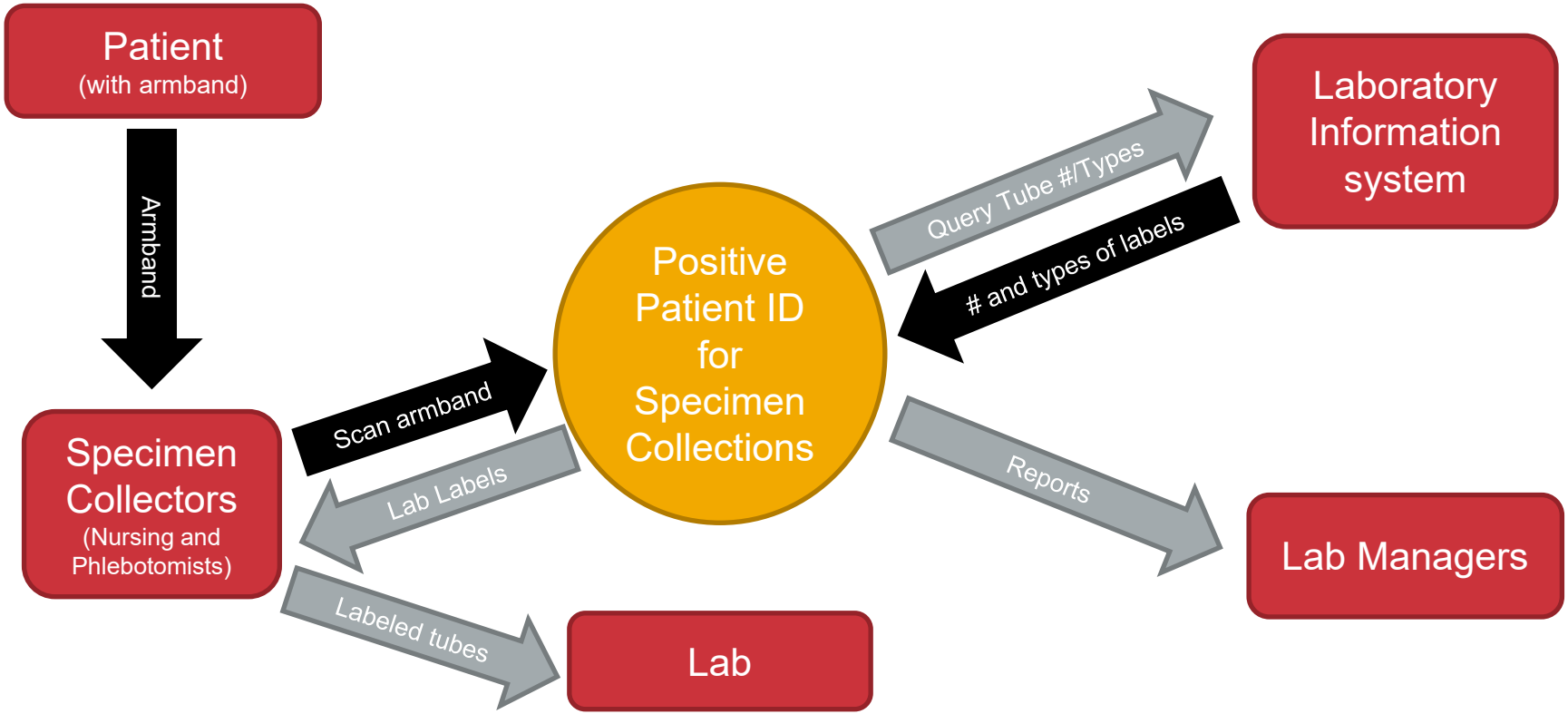
- Existing processes used (e.g., policies, procedures, templates, knowledge base)

Project Initiation Tools

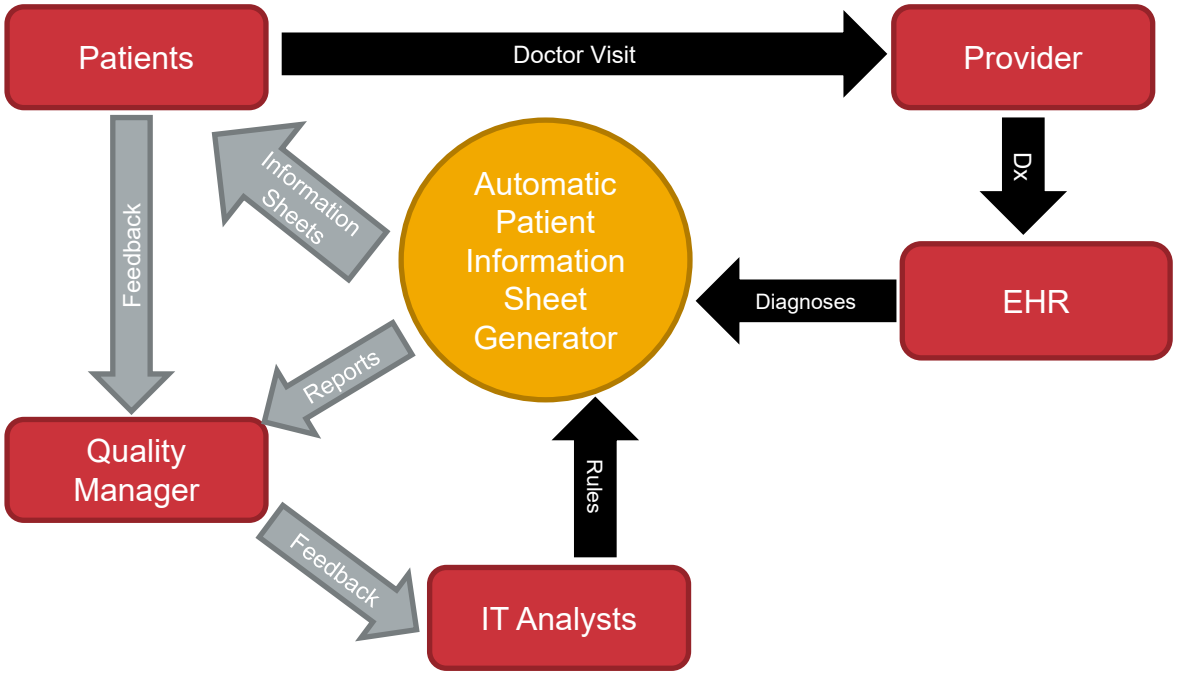
Context Diagram

- Visual representation of project scope
- Shows inputs to the system and actor(s) providing input as well as outputs to the system and actor(s) providing output

Context Diagram



Context Diagram



Project Initiation Tools

Stakeholder register: List of stakeholders including...

- Demographics: roles, departments, contact information
- Assessment information: major/minor requirements, main expectations, influence and impact levels for a particular project as well as project phase of most interest
- Classification
  - internal/external
  - **Engagement level**
    - Unaware, **Resistant**, Neutral, Supportive, Leading
- May be represented as a grid (e.g., power/interest grid, salience model)

Stakeholder Register

	Stakeholder 1	Stakeholder 2
Name	Jane Smith MD PhD	
Title	CMIO	
Role	Approver	
Description	Active supporter of project Engaged in barrier removal	
Status	Engaged	
Interest 0-5	4.5	
Influence / Power 0-5	4	
Contact Information (* Preferred contact method)	Cell: 123-456-7899 abc@123.com*	
Management Strategy	Add to weekly status meetings Add to status report distribution list	

Project Planning/Execution Tools

Project management plan

- Central document which defines the basis of all project work
- Describes how the project will be executed, monitored and controlled
- Defines baselines for scope, schedule and cost
- May contain subsidiary plans such as…
  - Communications management plan
  - Risk management plan
  - Cost management plan
  - Etc.

Project Planning/Execution Tools

Resource Calendar

- Identifies availability of each specific resource (human resources, supplies, equipment, facilities, funding)
- Used to estimate resource utilization during planning

Yellow: Resource Available	30-Jul	31-Jul	1-Aug	2-Aug	3-Aug	4-Aug	5-Aug	6-Aug	7-Aug
	Su	M	T	W	Th	F	Sa	Su	M
Gather Requirements									
Project Manager									
Sponsor									
Stakeholder - Main									
Plan Project									
Project Manager									
Develop Software									
Software Engineer									
Database Administrator									
Server Team Manager									
Server Team Resources									
Interface Analyst									
Unit Testing									
Subject Matter Expert A									
System Analyst									
Sign-off									
Physician Champion									
Sponsor									
Stakeholder - Main									
Project Manager									

Problem: Project Resources

You are implementing a project which requires multiple resources for different tasks.

- Each task is a coordinated effort and requires all of its resources to be available at the same time to be completed.
- Resources have variable availability.
- Each task must be performed in sequence from top to bottom.
- Desired go-live date is on or before 8/18.

Your project manager has put together a resource calendar for you and is looking at you expectantly.

- What does your project manager want you to notice?
- What is the estimated time of project completion?
- What things could to do or ask to facilitate an earlier go-live date?

Problem: Project Resources – Resource Calendar

Yellow: Resource Available Green: All Resources Available to complete task	30-Jul	31-Jul	1-Aug	2-Aug	3-Aug	4-Aug	5-Aug	6-Aug	7-Aug	8-Aug	9-Aug	10-Aug	11-Aug	12-Aug	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug
	Su	M	T	W	Th	F	Sa	Su	M	T	W	Th	F	Sa	Su	M	T	W	Th	F	Sa
Gather Requirements																					
Project Manager																					
Sponsor																					
Stakeholder - Main																					
Plan Project																					
Project Manager																					
Develop Software																					
Software Engineer																					
Database Administrator																					
Server Team Manager																					
Server Team Resources																					
Interface Analyst																					
Unit Testing																					
Subject Matter Expert A																					
System Analyst																					
Sign-off																					
Physician Champion																					
Sponsor																					
Stakeholder - Main																					
Project Manager																					

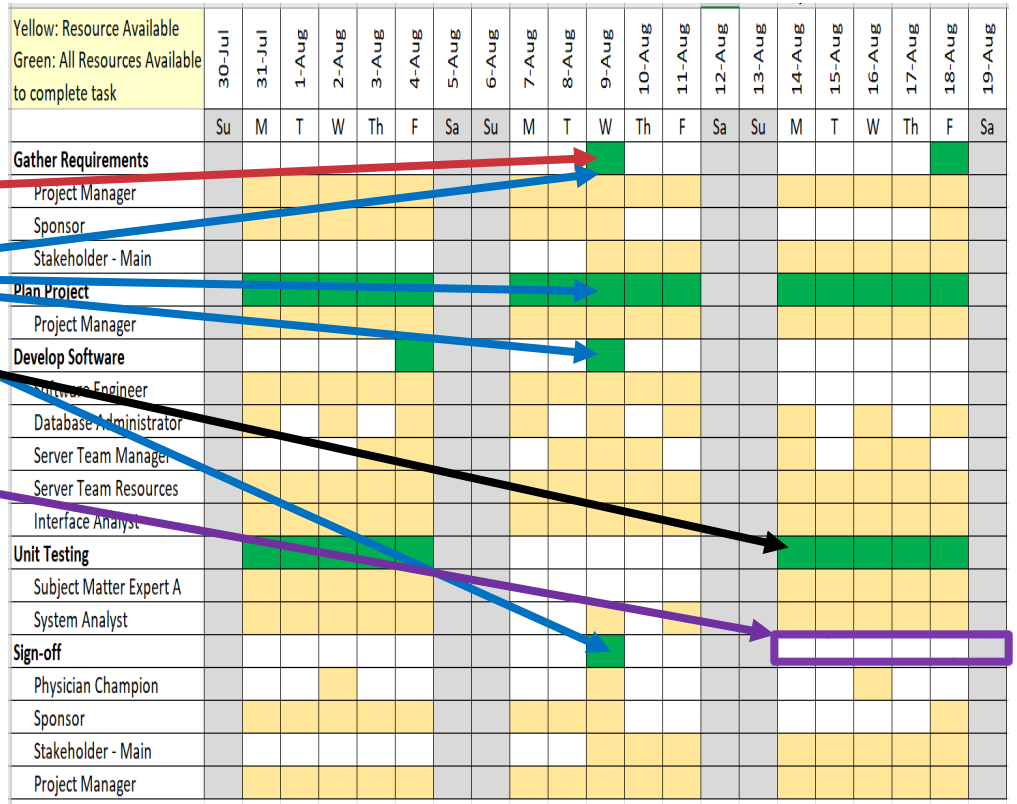
Problem: Project Resources - Answers (page 1 of 2)

What does your project manager want you to notice?

- Project cannot start until 8/9 (a week and a half into the project)
- Gather requirements, Plan Project and Develop Software must **all** occur on 8/9
- Unit testing cannot begin until 8/14
- After unit testing is completed and the project is ready for sign-off, none of the people who must sign-off are available. How will sign-off occur by the go-live date?

What is the estimated time of project completion?

- **After** the desired go-live date of 8/18 unless one of the critical resources (e.g., stakeholder) can change availability



Problem: Project Resources - Answers (page 2 of 2)

What things could to do or ask to facilitate an **earlier** go-live date?

- Ask the more limited resources if they can adjust their availability
- Gather availabilities for 1-2 weeks earlier than current start date and see if this resolves availabilities
- See if there are additional or other resources or contractors available to build
  - Build is the most constrained task set
  - Unit testing has more time and can catch errors
- Discuss delegation of sign-off with sponsor / stakeholder

Project Planning/Execution Tools

Resource Leveling

- Technique where start and finish dates are adjusted based on resource constraints
- Goal is to balance demand for resources within the resources available
- Resources may be constrained by being
  - Available only at certain times
  - Limited in number
  - Over-allocated by being assigned to multiple activities/tasks at one time
- Often causes the critical path to INCREASE (not decrease)

Project Planning/Execution Tools

Budget

- Allocation of funding resources

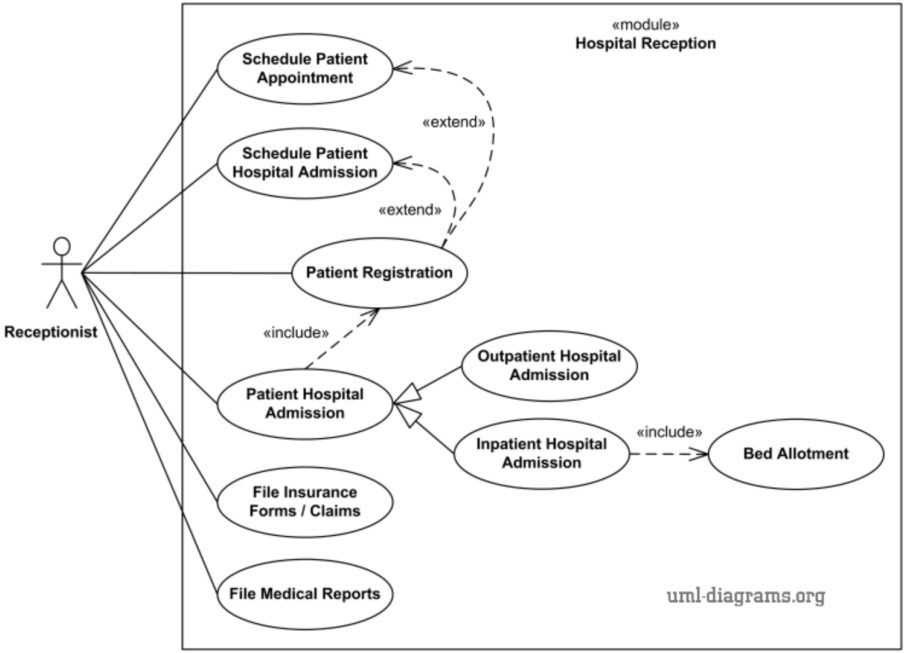
Use cases

- Scenarios of operation between a user (actor) and the software
- Can use Unified Modeling Language (UML) or SysML diagrams to visualize

Traceability Matrix

- Grid that links product requirements from their origin to the deliverables that satisfy them
  - Requirements listed in one axis
  - Tests to prove that requirement is met (i.e., validation) is in the perpendicular axis
- Helps ensure that each requirement adds value
- Used to track requirements
- Provides structure for managing changes to scope

Example UML Use Case Diagram



Website for becoming familiar with UML diagrams: https://www.uml-diagrams.org. This example is from https://www.uml-diagrams.org/examples/hospital-management-use-case-diagram-example.html, accessed July 22, 2021.

Example Traceability Matrix

Department(s):	Laboratory, Nursing
Project Manager Name:	Ms. Project Manager
Project Description:	Implement new middleware to help with quality assurance and quality control of all point of care testing devices. Help to ensure compliance with CAP accreditation.

ID	Assoc ID	Technical Assumption(s) and/or Customer Need(s)	Source	Date Received	Functional Requirement	Acceptance Criteria	Status	WBS Deliverable	Architectural/Design Document
001	1.1	CAP accreditation compliance; patient safety	Pathology Chief	1/2/2018	Instruments with failed QC are flagged in the system	Flags present for failed QC	In Progress	3.4	
002	1.2	CAP accreditation compliance; patient safety	Point of Care Supervisor	1/3/2018	Point of Care staff are alerted to failed QC flags on login to the system	Alerts present for point of care staff at login	In Progress	3.5	
003	2.1	Autoverification for posting results to LIS and EHR	LIS Manager	1/3/2018	If point of care results do not have failed QC or results outside technical range of instrument, have them post automatically to the LIS and EHR.	Results outside the technical range of the instrument will be held in the middleware system and will NOT post to the LIS or EHR.	In Progress	4.3	
004	2.2								
005	3.1								

Technical Specification	System Component(s)	Software Module(s)	Test Case Number	Tested In	Implemented In	Verified by	Verification Date	Accepted By and Date

Modified from https://www2.cdc.gov/cdcup/library/templates/CDC_UP_Requirements_Traceability_Matrix_Template.xls

Project Planning/Execution Tools

Project Evaluation and Review Technique (PERT) [PERT 2016]

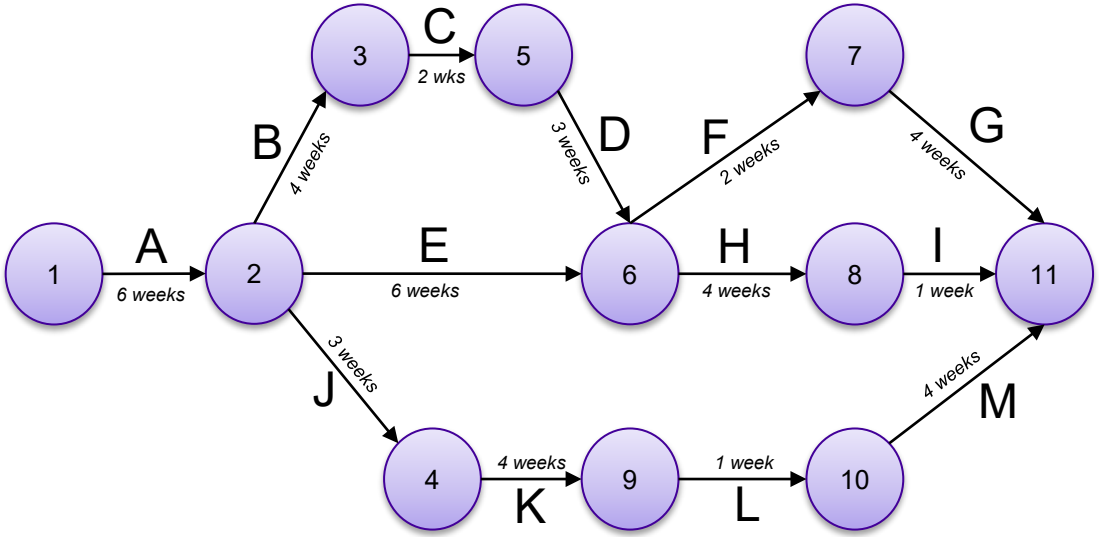
- Network model developed in late 1950s
- Estimates minimum project duration and amount of scheduling flexibility
- Allows **flexibility** in activity completion times
  - Each activity gets 3 times: Optimistic, Most likely, Pessimistic
  - Est. activity time = $\frac{optimistic+(4\ x\ MostLikely)+pessimistic}{6}$
  - Example = $\frac{4\ hours+(4\ x\ 8\ hours)+20\ hours}{6} = 9.33\ hours$
- Sequential and parallel activities are shown in the network

Project Planning/Execution Tools

PERT (continued)

- **Critical path**
  - The sequence of activities that represents the LONGEST path through a project (and therefore the shortest possible duration)
  - CAUTION: Diagrams on the boards can fool you
    - Not always the path with the most steps
    - You can have more than one critical path
  - Assumes unlimited resources!

Milestone	**Node**	numbered in rough sequence of expected completion
Activity	**Line**	time to complete activity is indicated on the line



	Activity
A	Formalize specs
B	Design hardware
C	Breadboard hardware
D	Test hardware
E	Design software
F	Release hardware
G	Manufacture hardware
H	Complete software
I	Release software
J	Layout manual
K	Finish manual
L	Release manual
M	Print manuals

	Milestone		Milestone		Milestone
1	Start Project	5	Breadboard running	9	Manual finalized
2	All specs finalized	6	Hardware fully functional	10	Manual ready for printer
3	Hardware design complete	7	PC Board released	11	Project complete
4	Manual layout completed	8	Software completed	Critical Path →	

Derived from:
http://image.slidesharecdn.com/criticalpathandpert-120912134451-phpapp01/95/critical-path-and-pert-1-728.jpg?cb=1347475822

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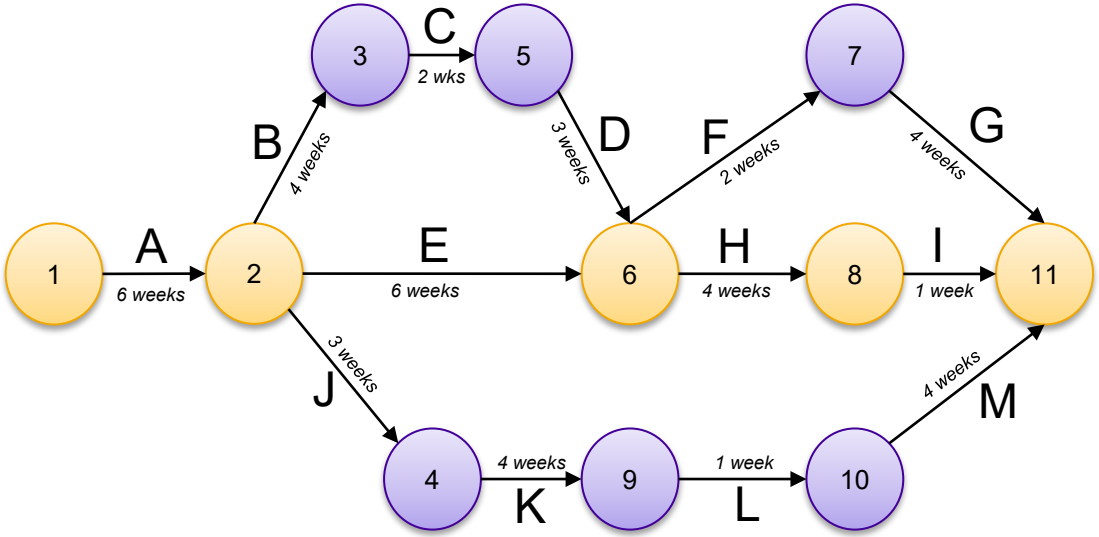

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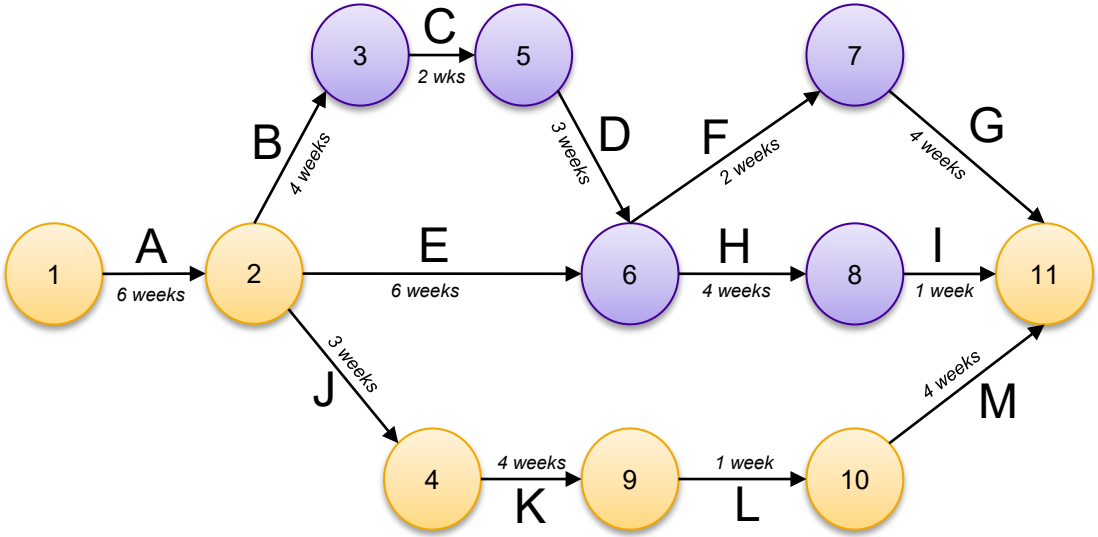

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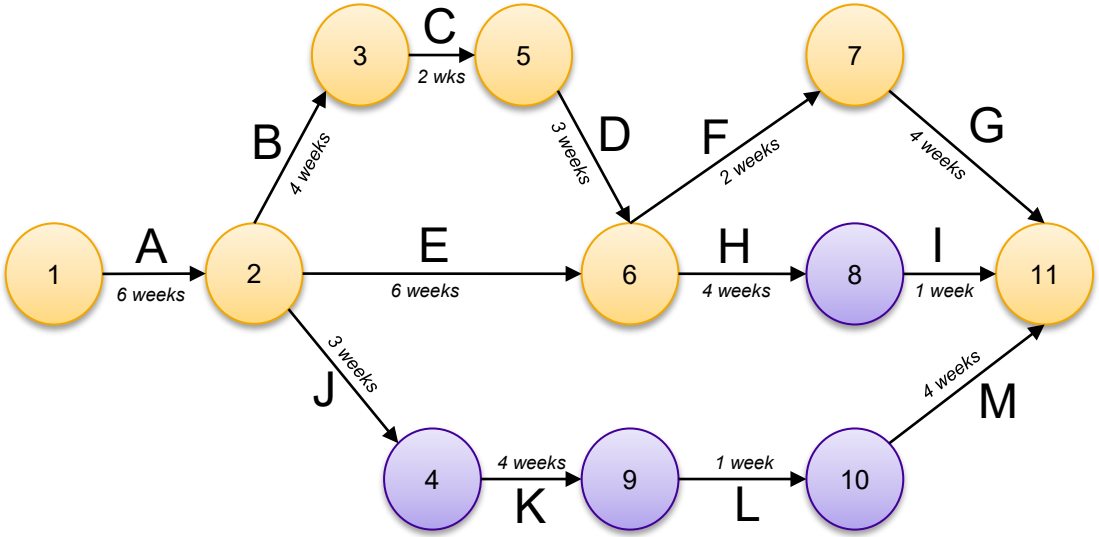

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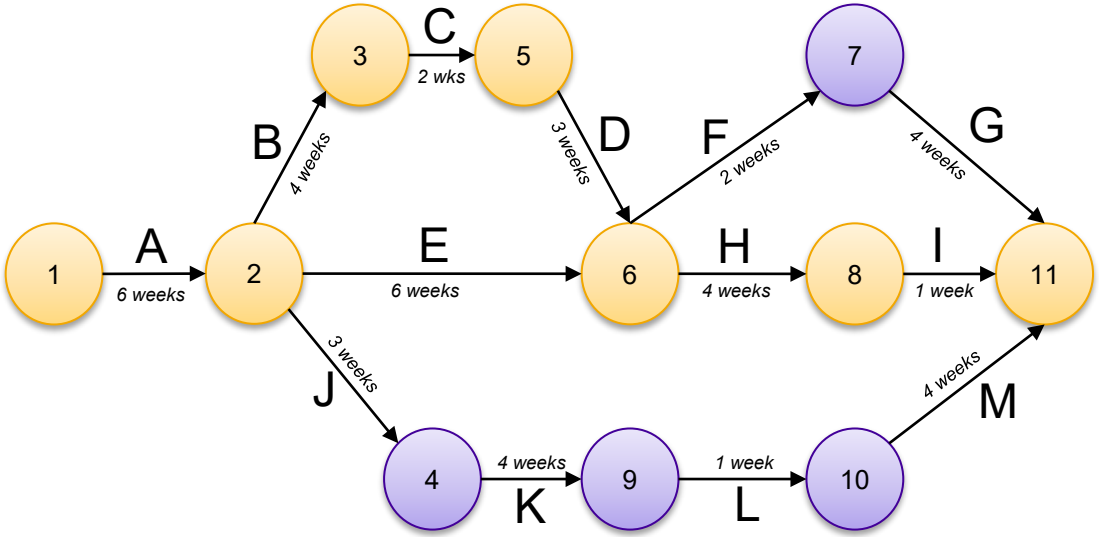

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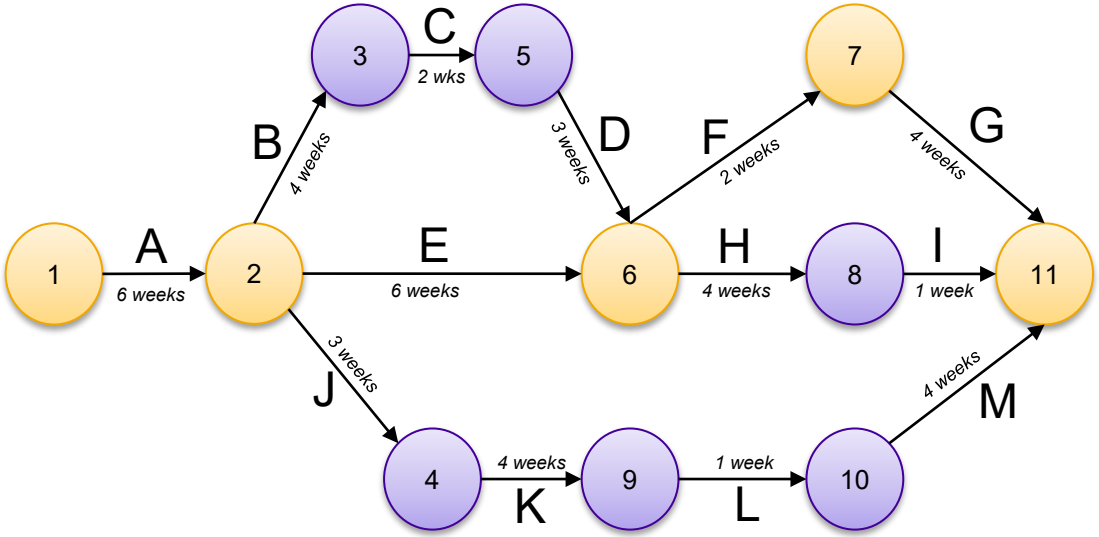

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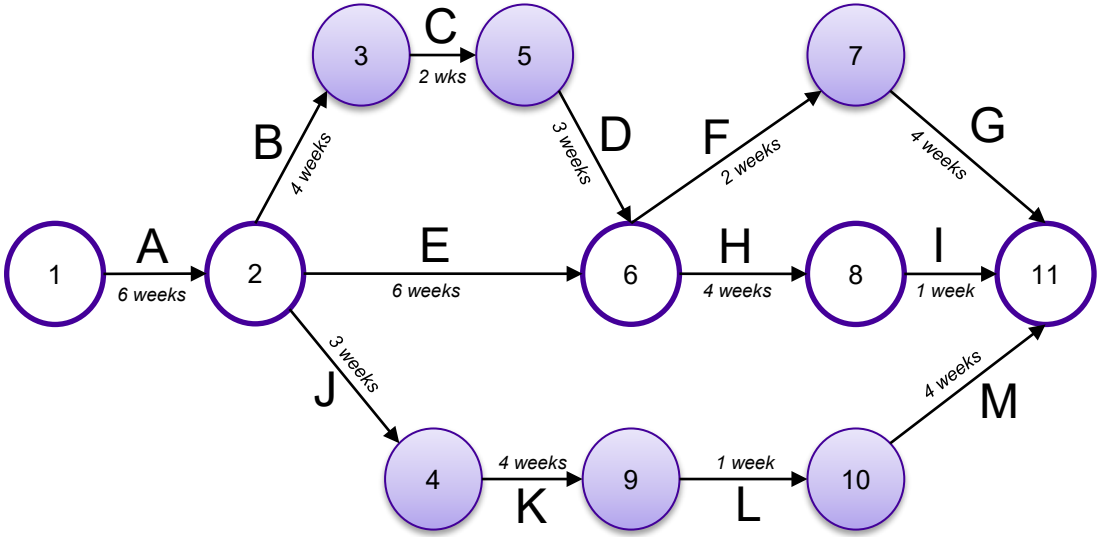

17 weeks

	Activity
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B	Design hardware
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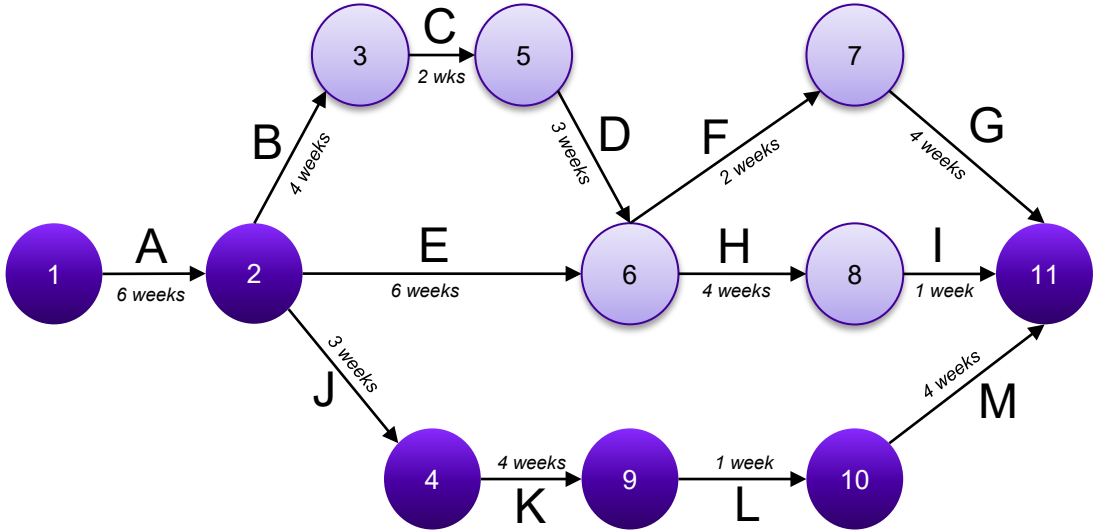

18 weeks

	Activity
A	Formalize specs
B	Design hardware
C	Breadboard hardware
D	Test hardware
E	Design software
F	Release hardware
G	Manufacture hardware
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I	Release software
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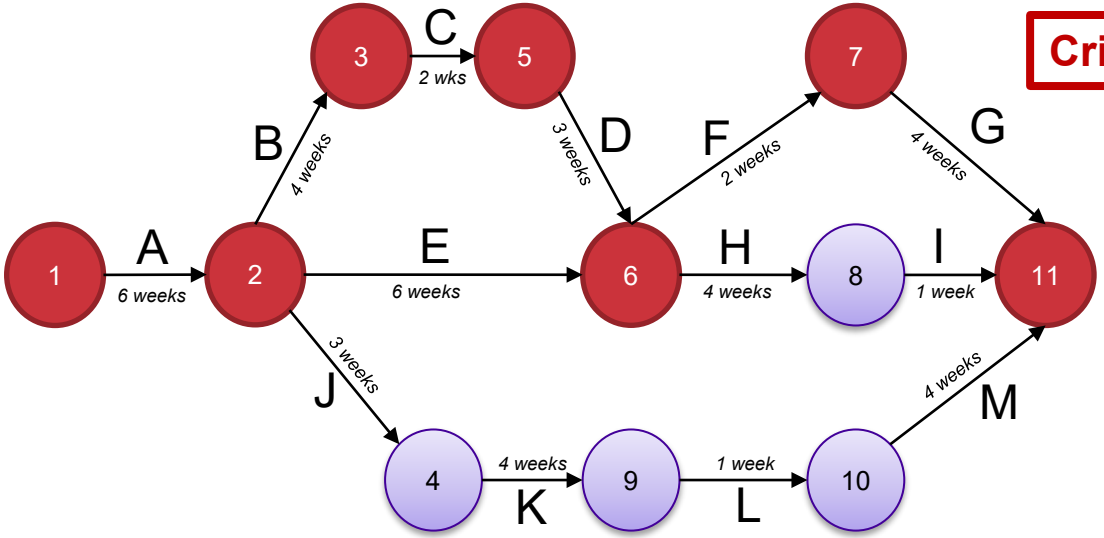

Critical Path!

21 weeks

	Activity
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B	Design hardware
C	Breadboard hardware
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E	Design software
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3 to 4 weeks of **slack** in the non-critical paths

Derived from:
http://image.slidesharecdn.com/criticalpathandpert-120912134451-phpapp01/95/critical-path-and-pert-1-728.jpg?cb=1347475822

Slack (a.k.a. Float)

- **Slack**
  - Amount of time that a task, path or project can be delayed from the start without changing the completion date of the overall project
- **Total slack**
  - Total amount of slack for an entire project
- Important when calculating whether and how much a project will be delayed by unexpected issue(s)
- Tasks which are not on the critical path will have slack available
  - By contrast, any delay in a task on the critical path will delay the project completion unless downstream tasks can compensate

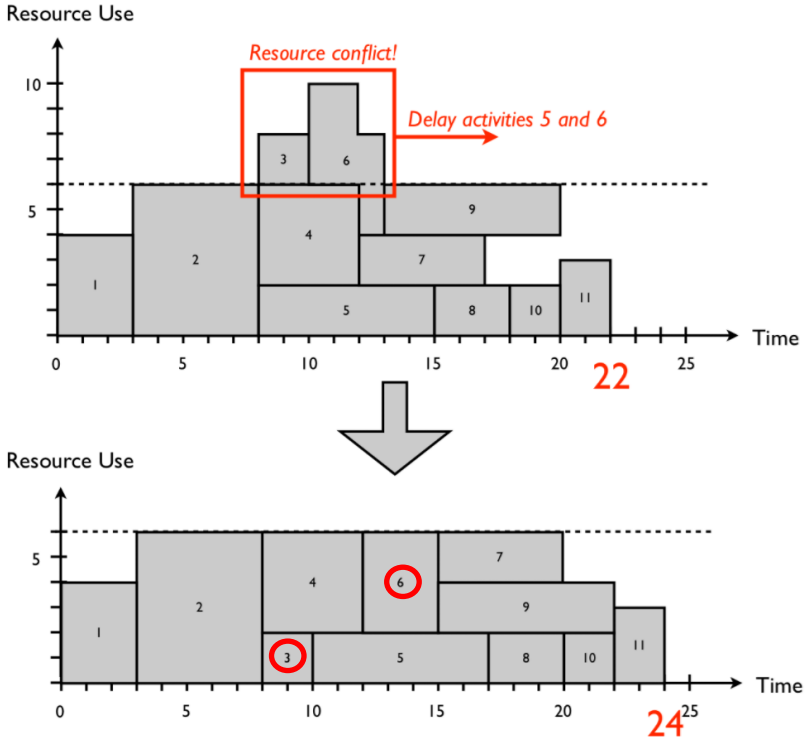
https://pm4id.org/chapter/8-3-critical-path-and-float/; Last accessed: July 22, 2021.

Project Planning/Execution Tools

Critical Chain Method

- Schedule method which presumes limited resources
- Shows where resources are limited
- Project manager shows where buffers and time extensions are incorporated to account for:
  - limited resources
  - project uncertainties
- No common visual representation for this method (above 1 example)

http://www.pmknowledgecenter.com/sites/default/files/Figure_CPM_CC.png



Project Planning/Execution Tools

Work Breakdown Structure (WBS)

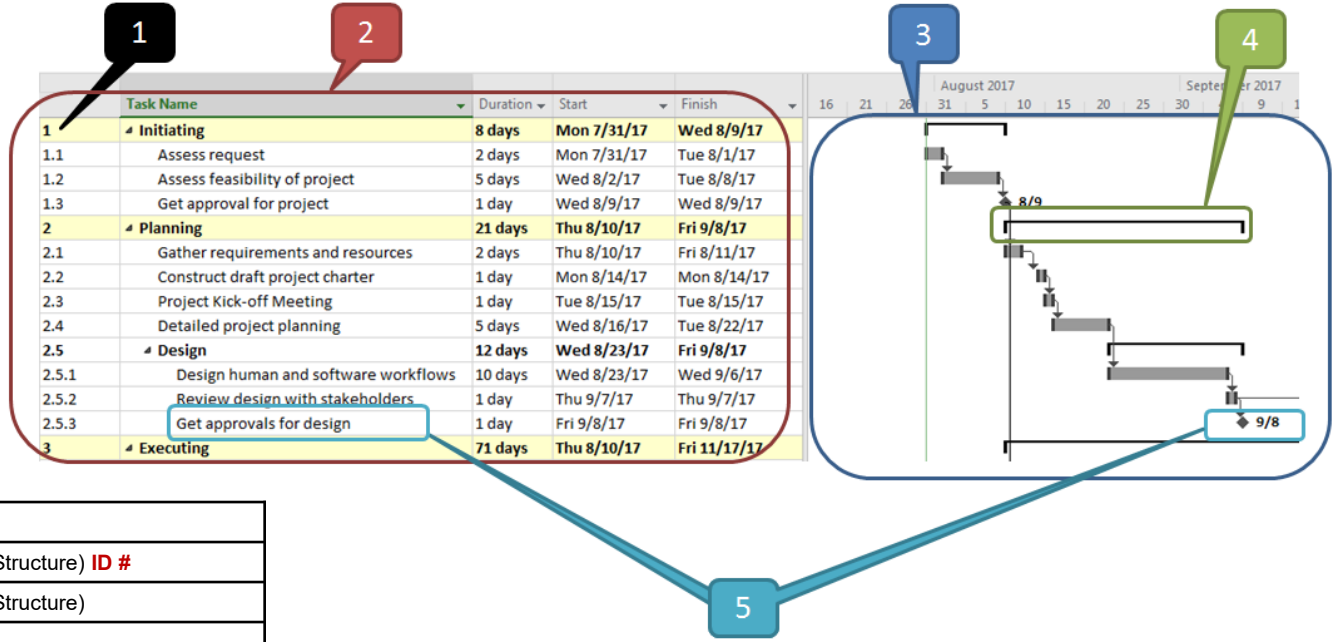
- Method of representing tasks in a project by phase and sequence
- Used to estimate task duration, assign resources, perform cost and schedule estimates
- Utilizes **Decomposition**
  - *Not just an autopsy term…*
  - The process of subdividing work into smaller, manageable and achievable components
- Typically represented via a **Gantt chart**

Project Planning/Execution Tools

Gantt charts (a.k.a. Bar charts)

- Developed by Henry Gantt in 1910
- Visual representation of tasks and their durations
- Tasks listed on the left and time scale on the right with bars indicating each tasks expected duration
- Include milestones
- Includes **Work-Breakdown Structure (WBS)**
- **Milestone chart**
  - Gantt chart where only the milestones or high level deliverables display

Work Breakdown Structure: Example with Timeline (Gantt Chart)



#	Element
1	WBS (Work Breakdown Structure) **ID #**
2	WBS (Work Breakdown Structure)
3	Gantt Chart
4	Phase / Process Group / Summary Task
5	Milestone

Project Planning/Execution Tools

Issue log

- **Issue**
  - Threat to the successful completion of the project which has already occurred
- Every project has issues that arise
- Log used to document and monitor
  - Issue
  - Person responsible for getting issue resolved
  - How the issue was resolved (or not resolved)
  - Mitigation plan if issue is not able to be resolved

Project Monitoring/Controlling Tools - TESTING

Unit testing	Testing the new software or system within itself
Integration Testing	Testing the integration of the new system or software and its communications with other systems and software • May require a Project Integration Management Plan
Regression testing	Testing current state functions that you expect to keep to ensure that they have not been altered by the new system or software
Parallel testing	Testing functions and data entry in the new system or software in parallel with using the same functions (entering the same data) into the production system you are about to replace • Usually try to do 10-20% of cases/actions through the new system in parallel with the soon-to-be-old system • See if the software performs as expected • Can help detect serious performance load issues • Hardest testing to do but the most valuable

Project Monitoring/Controlling Tools

Seven basic quality tools (7QC)

- Used within the context of the PDSA cycle (covered elsewhere)
  - Cause-and-effect diagrams
  - Flowcharts
  - Check sheets
  - Pareto diagrams
  - Histograms
  - Control charts
  - Scatter diagrams

Scope variance analysis

- Determination of the cause and degree of difference between baseline scope and current scope (project performance)
- Measure of **scope creep**

Scope Creep

A condition in which the current scope of a project has expanded beyond its baseline scope

- Often due to poor definition of scope
- Even more often due to poor/no definition of what is **out** of scope

Scope Management Plans are part of PMBOK

Question: A Gantt Chart is used:

A. To visually depict task sequence, phases, overlap and duration
B. To identify critical tasks or phases of a project
C. To evaluate project progress and deadlines
D. For project scheduling
E. All of the above

Question: A Gantt Chart is used:

A. To visually depict task sequence, phases, overlap and duration

B. To identify critical tasks or phases of a project

C. To evaluate project progress and deadlines

D. For project scheduling

E. All of the above

A Gantt chart is a visual tool that outlines the plan for and shows the progress of a project. It provides a snapshot of the progress of the various phases of a project comprised of several tasks. However, it leaves little room for uncertainty.

http://healthit.ahrq.gov/health-it-tools-and-resources/workflow-assessment-health-it-toolkit/all-workflow-tools/gantt-chart

Question: Which of the following types of testing are the most difficult yet the most valuable in the implementation of new software?

A. Integration testing
B. Parallel testing
C. Unit testing
D. Regression testing

Question: Which of the following types of testing are the most difficult yet the most valuable in the implementation of new software?

A. Integration testing

B. Parallel testing

C. Unit testing

D. Regression testing

Parallel testing is testing functions and data entry in the new system or software in parallel with using the same functions (entering the same data) into the production system you are about to replace. On a busy clinical service, it can be impossible to get people to do this because it significantly increases workload with 10-20% duplicative work. However, it is one of the best ways to discover bugs and snags prior to go-live. Unit testing is testing within the new application. Integration testing is testing the new software's communications and integration with other systems/software. Regression testing is testing current state functions that you expect to keep in the new software to ensure that they have not been altered.

That’s a wrap!

Supplemental Material

Clinical Informatics
Board Review Course

Example Problem - Slack

- You have gone to great lengths to generate the PERT diagram shown on the next page for your project.
  - Today, you were informed that the software developer has had a family emergency and is out on FMLA for the next 4 weeks.
  - In addition, your manual writer was injured in a car crash and will be out also for 4 weeks.
- All other aspects of the project remain the same.
- There are no other resources available to fill the gaps.
- You just completed/achieved Milestone 2 yesterday.
- Questions
  - What is now the critical path?
  - What impact will these absences have on the overall time of the project compared to the original critical path?

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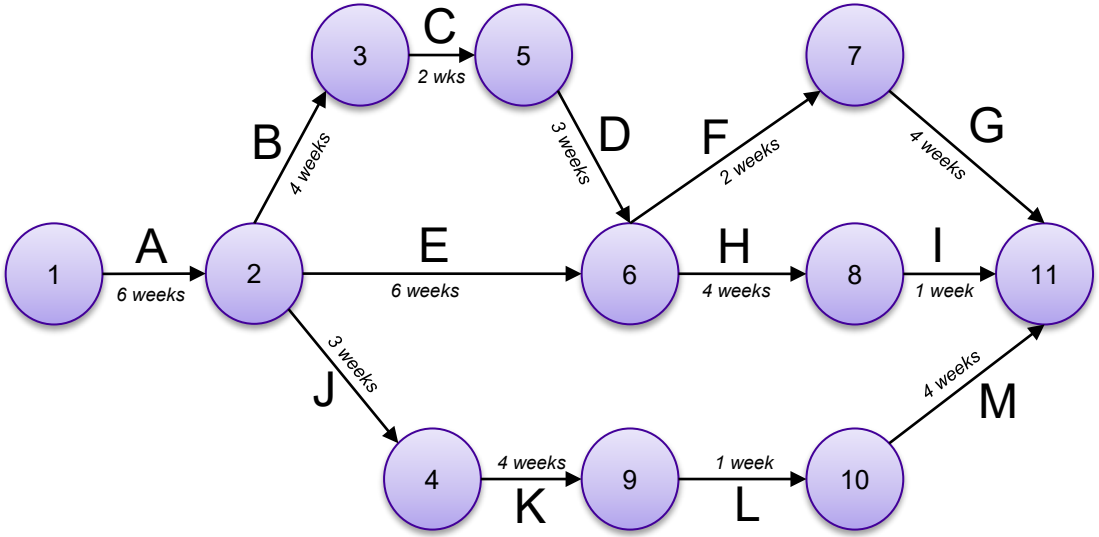

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Milestone	**Node**	numbered in rough sequence of expected completion
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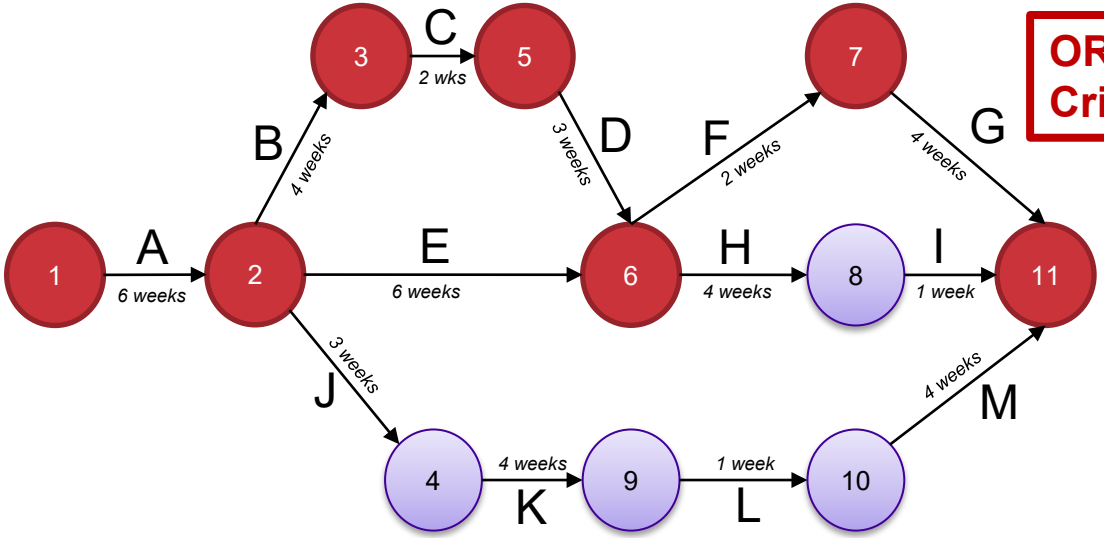

ORIGINAL Critical Path

21 weeks

	Activity
A	Formalize specs
B	Design hardware
C	Breadboard hardware
D	Test hardware
E	Design software
F	Release hardware
G	Manufacture hardware
H	Complete software
I	Release software
J	Layout manual
K	Finish manual
L	Release manual
M	Print manuals

	Milestone		Milestone		Milestone
1	Start Project	5	Breadboard running	9	Manual finalized
2	All specs finalized	6	Hardware fully functional	10	Manual ready for printer
3	Hardware design complete	7	PC Board released	11	Project complete
4	Manual layout completed	8	Software completed	Critical Path →	

Derived from:
http://image.slidesharecdn.com/criticalpathandpert-120912134451-phpapp01/95/critical-path-and-pert-1-728.jpg?cb=1347475822

Milestone	**Node**	numbered in rough sequence of expected completion
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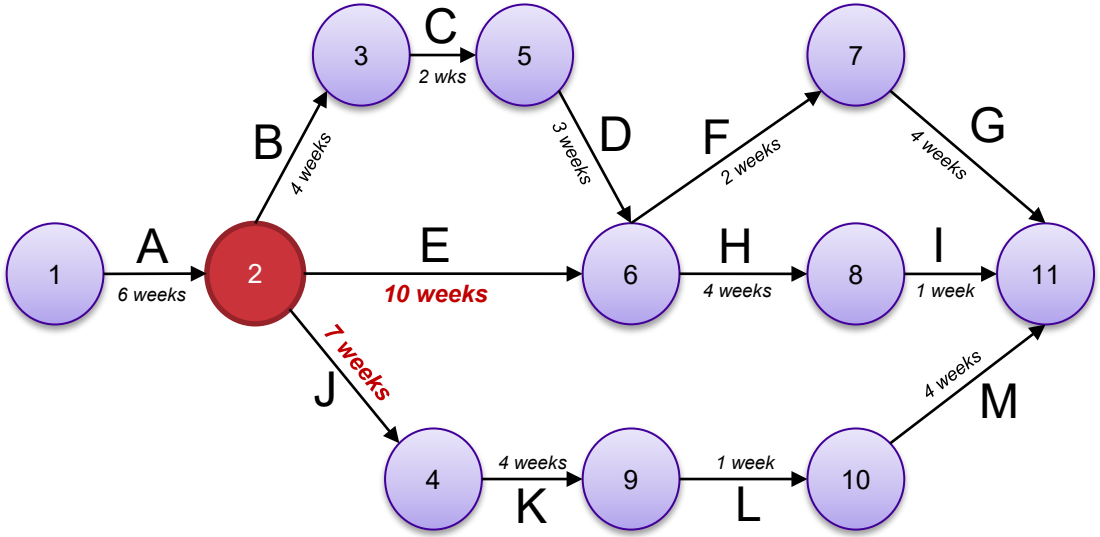

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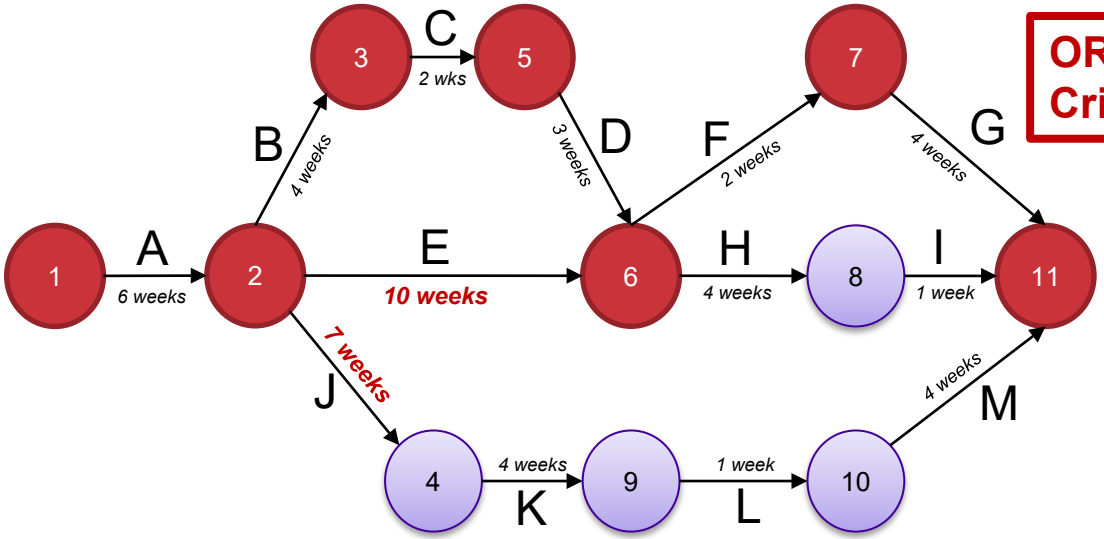

ORIGINAL Critical Path!

21 weeks

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Milestone	**Node**	numbered in rough sequence of expected completion
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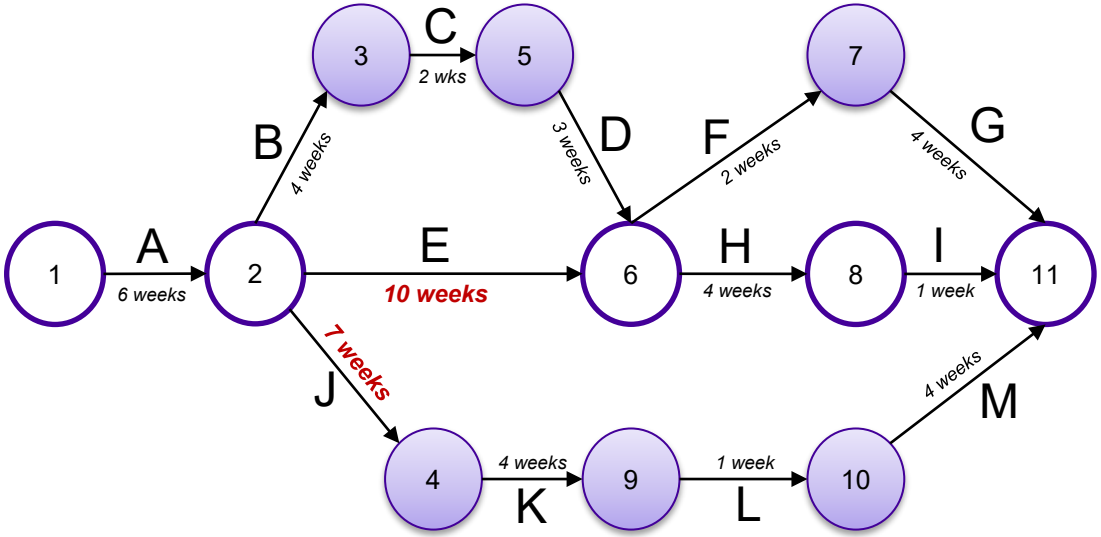

21 weeks

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Derived from:
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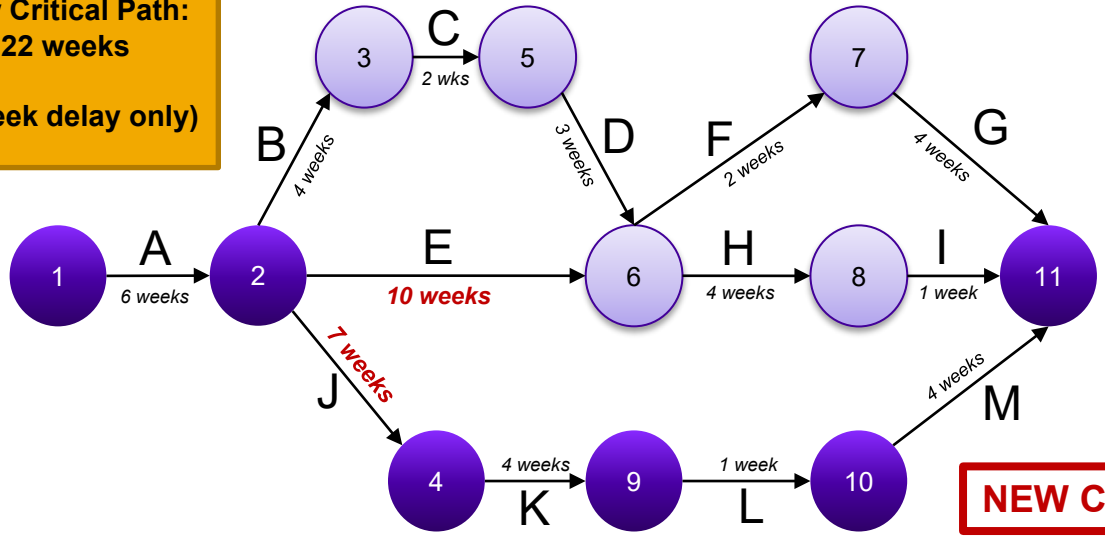
Original Critical Path: 21 weeks

New Critical Path: 22 weeks

(1 week delay only)

	Node	numbered in rough sequence of expected completion
	Line	time to complete activity is indicated on the line



22 weeks

NEW Critical Path!

	Activity
A	Formalize specs
B	Design hardware
C	Breadboard hardware
D	Test hardware
E	Design software
F	Release hardware
G	Manufacture hardware
H	Complete software
I	Release software
J	Layout manual
K	Finish manual
L	Release manual
M	Print manuals

	Milestone		Milestone		Milestone
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