CPE/EE 322
Engineering Design VI
Lesson 0: Syllabus

Kevin W. Lu

2023-01-23

Outline

- Course site and engineering design spine
- Textbook and engineering design process
- Course prerequisite, corequisite, and description
- Learning objectives and student outcomes
- Assignments
- Grading weight and scale
- Work ethics and attendance
- Etiquette and participation
- Constructive feedback
- Course survey
- Summary

Course Site

https://sites.google.com/view/ece322

Engineering Design Spine

- The Design Spine courses are the major vehicle for developing a set of competencies such as creative thinking, problem solving, teamwork, economics of engineering, project management, communication skills, ethical considerations, and environmental awareness
- Total Design is the systematic activity necessary from the identification of system stakeholders to a successful product, process, or service that meets those stakeholder requirements
- The major aim of systems engineering is to develop an operational model of the system for all phases of the life cycle; the model is then used as a basis for detail design

Quick Response (QR) Code

https://www.the-qrcode-generator.com

CPE/EE 322 Requisites

Prerequisite:

ENGR 321
Engineering Design V:
Materials Selection and
Process Optimization

or

ENGR 311
Design With Materials

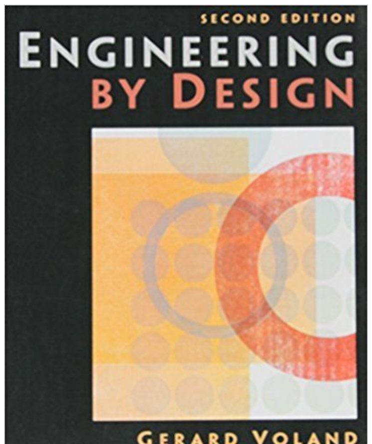
Corequisite:

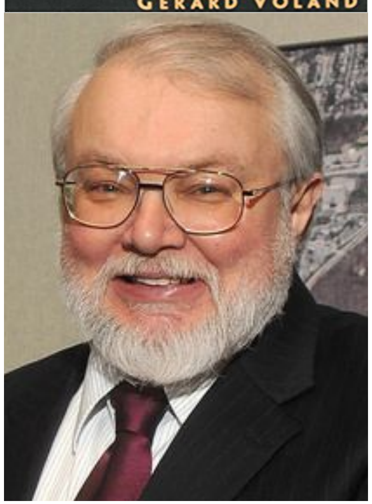
CPE/EE 345
Modeling and Simulation

Course Description

- This course introduces students to critical engineering design topics such as needs assessment, problem formulation, modeling, patents, abstraction and synthesis, economic analysis, product liability, ergonomics, engineering ethics, hazards analysis, design for X, material selection, and manufacturing processes
- Students learn that engineering is a service profession, dedicated to satisfying humanity's needs through responsible, methodical, and creative problem solving

Textbook





Prof. Gerard Voland 1949—2016, *Engineering by Design* (1st Edition 1999, 2nd Edition 2004), *Modern Engineering Graphics and Design* (1987), *Control Systems Modeling and Analysis* (1986), *Fundamentals of Engineering Design* (1981)

2010 to 2016: Provost and vice chancellor for academic affairs, professor of engineering, University of Michigan–Flint

2003 to 2010: Dean of the College of Engineering, Technology and Computer Science, director of the Center for Industrial Innovation and Design, and professor of mechanical engineering, Indiana University–Purdue University Fort Wayne

1999 to 2003: Illinois Institute of Technology

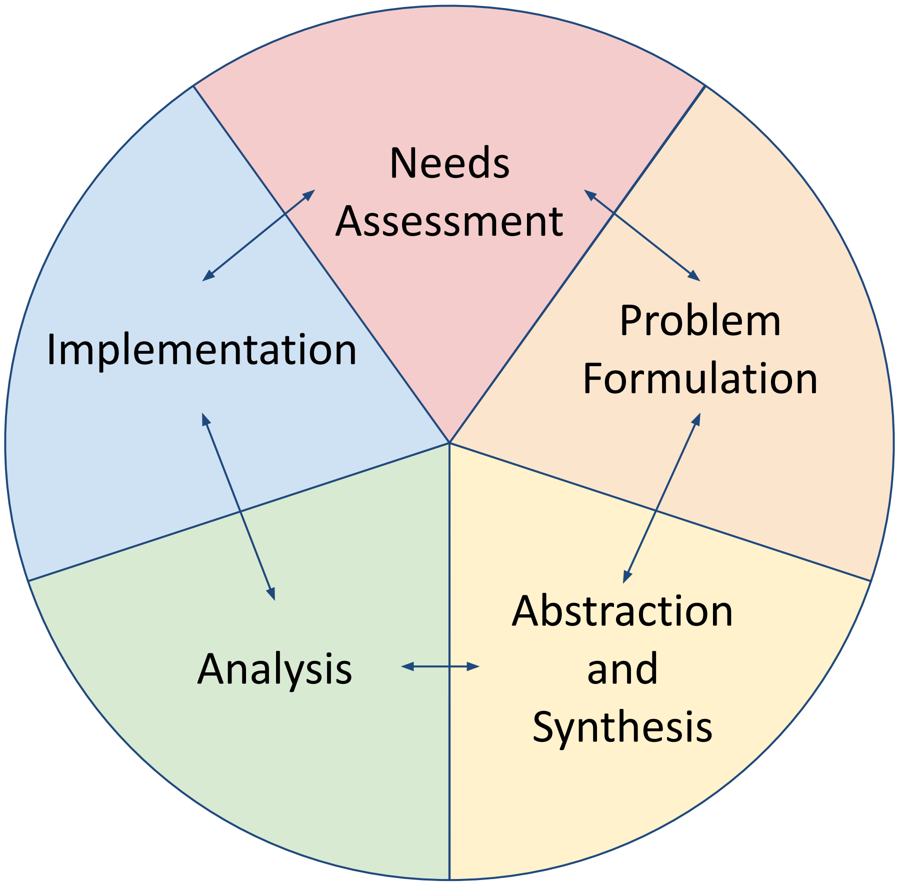
1977 to 1999: Northeastern University

1989 Ph.D., Engineering Design, Tufts University

1973 M.S. 1971 B.S., Physics, University of California, Los Angeles

Engineering Design Process

[G. Voland, Engineering by Design, Chapter 1]



Learning Objectives

- Formulate problems correctly
- Work successfully in interdisciplinary teams
- Develop creativity, imagination, and analytical skills
- Make informed ethical decisions
- Hone written and oral communication skills

Student Outcomes

Accreditation Board for Engineering and Technology (ABET) Criteria

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. An ability to communicate effectively with a range of audiences
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies
8. (IDE) A fundamental knowledge and an appreciation of the technology and business processes necessary to nurture new technologies from concept to commercialization

Assignment 0 — GitHub Repository

- Sign in (or sign up) a GitHub account
- Click "Edit profile" to add information and click "Save"
- Click "New" at GitHub Repositories to create a repository (repo) for this course
- Click "Create new file" and name it README.md
- Use Markdown to style headings, text, lists, images, quotes, code, and extras
- Click "Commit new file"
- Submit the clickable link to the GitHub repo via Canvas

Program Outcome 7: (Ability to Learn)
Course Learning Outcomes (CLOs)
1.2 (Tools) Students will be able to efficiently locate information describing and assessing software tools for exploring the mathematical algorithms and techniques that are embedded in a student project.

Grading Weight

Assignment	Weight
Attendance	15%
Outcomes	75%
Labs	10%
Total	100%

Grading Scale

Academic Grading in the US, Stevens Grading Scale

Grade	Threshold
A	93%
A−	90%
B+	87%
B	83%
B−	80%

Grade	Threshold
C+	77%
C	73%
C−	70%
D+	67%
D	63%

Work Ethics and Attendance

- Although education, training, and experience are important, employers increasingly look at the following work ethics as equally important in hiring or retaining employees
  - Attendance, dependability, perseverance, and productivity
  - Appearance, attitude, respect, and teamwork
- Either attendance or absence is marked on Canvas

Etiquette and Participation

Be here now
Be fully present

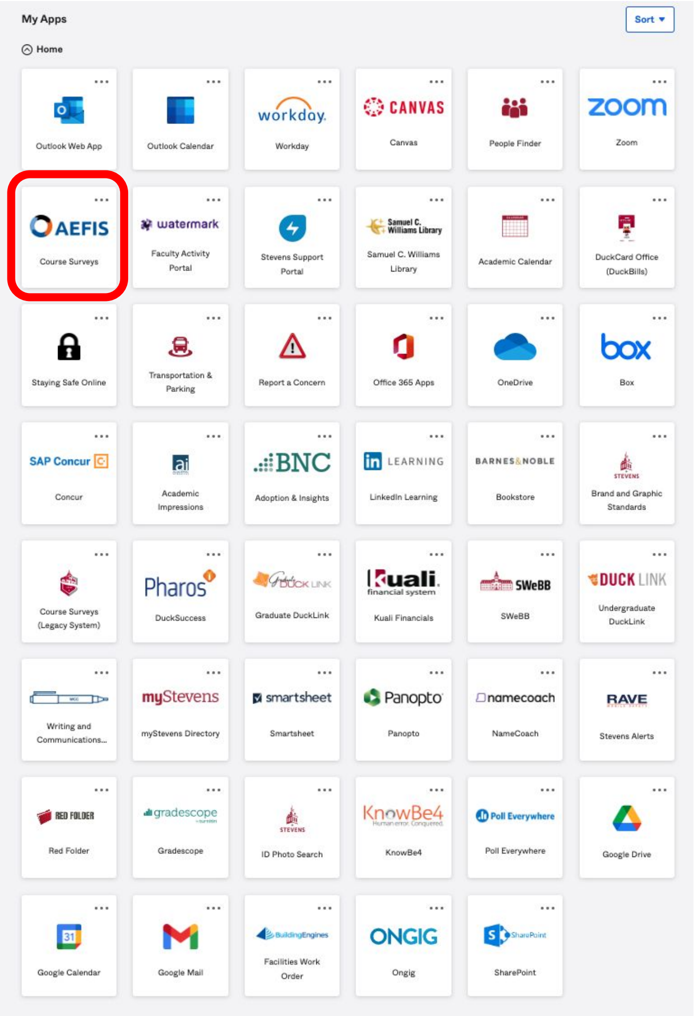
1. Arrive on time and stay for the entire class
2. Mute all devices
3. No side conversations during lecture
4. Raise hand to ask or answer questions
5. Provide constructive feedback

Constructive Feedback

1. State the constructive purpose of my feedback
2. Describe specifically what I have observed
3. Describe my reactions
4. Give the other person an opportunity to respond
5. Offer specific suggestions
6. Summarize and express my support

AEFIS Course Surveys

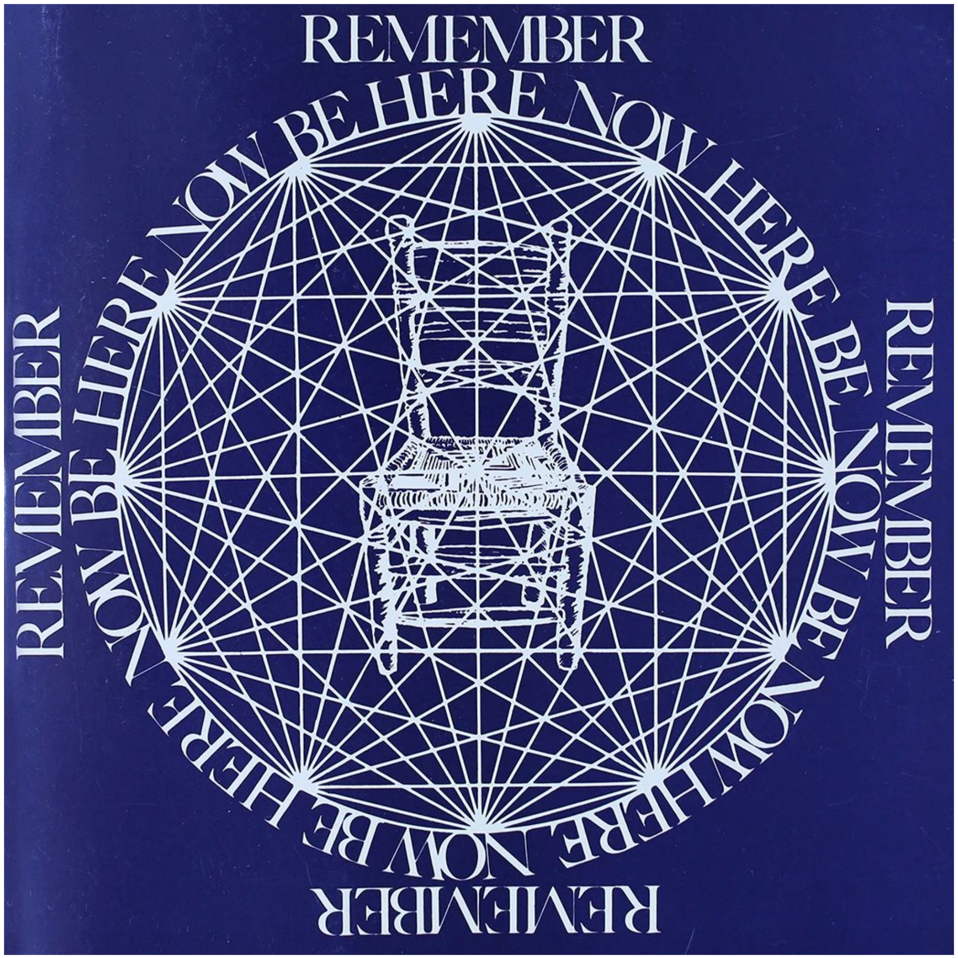
https://my.stevens.edu



Lesson 0 Summary

- Attend classes
- Create a GitHub repository
- Submit lab work via the GitHub repository
- Join a project group
- Create a project site
- Submit design exercises via the project site

Be Here Now



- Richard Alpert 1931—2019, better known as Ram Dass (means servant of God) since his 1967 trip to India, was an American academic and clinical psychologist, and spiritual teacher
- His 1971 book, *Be Here Now*, helped popularize Eastern spirituality and yoga with the baby boomer generation in the West
- The Be Here Now Network and the Love Serve Remember Foundation continue to share his teachings via the internet

CPE/EE 423/424 Requisites

Prerequisite:

Engineering Design VI
CPE/EE 322

Corequisite:

Innovation, Design, and Entrepreneurship (IDE)
IDE 400 Senior Innovation I Project Planning
IDE 401 Senior Innovation II Value Proposition
IDE 402 Senior Innovation III Venture Planning and Pitch

IDE 400 can be taken in either Term VI or the first 7 weeks of Term VII followed by IDE 401

CPE/EE 423/424 Sections

A team in CPE/EE 423/424 should attend the same time slot in IDE 401/402
09:00-10:50 AM, 12:00-01:50 PM, 02:00-03:50 PM

Section	Project	Day-Time	Instructor
A	Electrical and Computer Engineering	TR 02:30-04:20 PM	Kevin Lu
X	Biomedical Engineering	TR 02:30-04:20 PM	Vikki Hazelwood
X?	School of Systems and Enterprises	TR 02:30-04:20 PM	Gregg Vesonder
X2	Mechanical Engineering	TR 02:30-04:20 PM	Brendan Englot
X3	Mechanical Engineering	TR 02:30-04:20 PM	Eric Williams
X6	Civil, Environmental and Naval Engineering	TR 02:30-04:20 PM	Leslie Brunell

2016-2017 Advisors and Projects

Advisors*	Projects	Advisors*	Projects
Bryan Ackland	Alive	Dov Kruger	Home Power Monitoring Control System
	ChronoSTAT		Liquiz
	EZGas	Hong Man	Face Recognition and Analysis
Mukund Iyengar	HotSpot		Drone Swarms
	Intelligent Fitness Mat	Bruce McNair	Neural Network Security
	Stevens Mobile Clicker		Spectrum Sensing and Signal Identification Using USRP Sponsor: MITRE Corporation
	VentureMe	Yudong Yao	Food Friend
Dove Kruger	CSP		Parking Information System

* Advisor is commonly used for official job titles in the U.S. and Canada although adviser, the older version, is listed as the primary spelling in most dictionaries

2017-2018 Advisors and Projects

Advisors	Projects	Advisors	Projects
Bryan Ackland	AutoSpice	Hong Man	Gear Guard
	Safe Driving		SheetShow
Mukund Iyengar	Live Streaming		Smart Helmet
	Smart Router App	Serban Sabau	AutoCom
Dove Kruger	C++ Server Pages (CSP)	Yudong Yao	Cognitive Radio
	RoBoat		Spectrum Solutions
Kevin Lu	ContentButton		
	Diagnose.Me		
	WalleTracc		

2018-2019 Advisors and Projects

Advisor	Project	Advisor	Project
R. Chandramouli	Momentae	Kevin Lu	AirTrack
Jonathan Gabel	Nano Health Solutions*		Cryptophone, Crypto-Wallet
Paul Gargiulo	Remedics*		EVisualize*
Yi Guo	HAN Robot		Free-Space Assistance Drone
Mukund Iyengar	Helper-Tech		Hoboken Recreation App*
	MNRVA*		Li-Fi
	Rooms for Humanity		Ludice
	Smart Wireless Router		Machine Data Collecting System*
Dove Kruger	Hydra*		Urbonics
	Lightning Vault	Hong Man	Active Shooter Advanced Protection*
	Stevens RoBoat*		Gesture Vision
Serban Sabau	AutoCom	Yudong Yao	Deep Learning for Communications Based Systems

2019-2020 Advisors and Projects

Advisor	Project	Advisor	Project
Yi Guo	BeatBot*	Kevin Lu	Free Space Optical Communication Linux Driver*
	SAD Bird		Luxtron LiFi
Mukund Iyengar	BitBuddy		Rocket Flight Computer*
Dove Kruger	EZ Forms		SEARCH
	Grail		Smart Lock
	Web Grail		Smart Parking
	Raw CNC	Matt Wade	Contaxt*
Yudong Yao	Radio Waves	Rensheng Wang	AceAI

* Types of sponsorship

1. Sponsors provide project ideas and resources (i.e., funds and/or mentors) for students
2. Sponsors select project proposals from students and provide students with resources (i.e., funds and/or mentors)
3. Sponsors provide students with lab kits and/or workshop

2020-2021 Advisors and Projects

Advisor	Project	Advisor	Project
Rupak Chatterjee	QuantML	Kevin Lu	Oush Kisher
Joseph Farino	MILES*		POW: Python On Wii
Mukund Iyengar	Fact Finder Online		Project Sensus
	Livelog Concussion Assistant		Project Synapse
	reScribe	Hong Man	Drone Deterrence System*
Hang Liu	5G Phased Array Calibration*	Raviraj Nataraj	Project Mjolnir
Kevin Lu	BeatBot	Junjian Qi	Sustainable Modular Microgrid
	Common	Matt Wade	Contaxt*
	FAST Relief	Steve Yang	Kerdos
	GreenThumb	Yudong Yao	AI Emotion Detection
	I.O.Clean		

2021-2022 Advisors and Projects

Advisor	Project	Advisor	Project
Patrick Hill	Smart Playlist Manager	Kevin Lu	VeggieCare
Mukund Iyengar	Nautobot Circuit Diagram Plugin		WaterMate
	Real-Time ASL Transcription: sign.ml		TrackRabbit
	SecureMeeting	Hong Man	BRISC
Yanghyo Kim	Radio Tribune		GANtalk
Dove Kruger	5 Axis 3D Printer		ParkPal
	Adaptive Correlative Microscopy System	Erike Mayo	StudioPlan
	Stevens RoBoat	Raviraj Nataraj	BrainWave
Hang Liu	SuperLU-FPGA	Junjian Qi	Prometheus
Kevin Lu	IntelliVeggie	Matt Wade	Contaxt
	Joystik	Shucheng Yu	Bicameral Election Estimation for General Election in the US
	Stone Computing		Silk SoundScape

Learn How and Why

Harvard Business Review 10 Must Reads Series on artificial intelligence (AI), analytics, and the new machine age:

- Data science, driven by AI and machine learning, is yielding unprecedented business insights
- Blockchain has the potential to restructure the economy
- Drones and driverless vehicles are becoming essential tools
- 3D printing is making new business models possible
- Augmented reality is transforming retail and manufacturing
- Smart speakers are redefining the rules of marketing
- Humans and machines are working together to reach new levels of productivity

Designer Maker User

- *Designer Maker User* (the Design Museum London, 2017) traces the evolution of design, from its roots in the Industrial Revolution to its transformation by the digital explosion
- This book focuses on the continuing interaction between the three key players – designers, makers, and users – and the role of design in modern society
- Designers, makers and users are the three essential participants in the creation of any kind of design, not limited to objects or buildings, but includes environments, systems, and networks
- Exploring these relationships enables us to understand how we shape the world and how it, in turn, shapes us

Maker Culture

- The maker culture represents a technology-based extension of do-it-yourself (DIY) culture that intersects with hacker culture and revels in the creation of new devices as well as tinkering with existing ones
- The maker culture in general supports open-source hardware
- Typical interests include engineering-oriented pursuits such as electronics, robotics, 3D printing, and the use of computer numeric control (CNC) tools
- The maker culture stresses a cut-and-paste approach to standardized hobbyist technologies, and encourages cookbook reuse of designs published on websites and maker-oriented publications

Design Museums

"8 of the Best Design Museums in the World," *Galerie Magazine*, 2017-10-12

- The Design Museum, London
- Vitra Design Museum, Weil am Rhein, Germany
- Red Dot Design Museum, Singapore
- Victoria & Albert Museum, London
- Cooper Hewitt, Smithsonian Design Museum, New York City
- Bauhaus Archiv, Berlin
- Design Exchange, Toronto
- Design Museum Danmark, Copenhagen

Working Backwards Process

- Work backwards from the customer, rather than starting with an idea for a product and trying to bolt customers onto it
- Start writing an internal press release announcing the finished product to solve a customer problem, how current solutions fail, and how the new product will blow away existing solutions
- Keep iterating on the press release until they have come up with benefits that actually sound like benefits
- Iterating on a press release is a lot quicker and less expensive than iterating on the product itself
- Once the product moves into development, the product team can ask themselves "Are we building what is in the press release?" to focus on achieving the customer benefits and not building extraneous functions that takes longer to build, takes resources to maintain, and doesn't provide real customer benefit

Press Release Outline

- **Heading**: Name the product in a way the reader (i.e., target customers) will understand
- **Sub-heading**: Describe, in one sentence underneath the title, which market for the product is and what benefit target customers get
- **Summary**: Give a summary of the product and the benefit, assuming the reader will not read anything else
- **Problem**: Describe the problem the product solves
- **Solution**: Describe how the product elegantly solves the problem
- **Internal quote**: A quote from a spokesperson in the company
- **How to get started**: Describe how easy it is to get started
- **Customer quote**: Provide a quote from a hypothetical customer that described how they experienced the benefit
- **Closing and call to action**: Wrap it up and give pointers where the reader should go next

Presentation

https://www.fastcompany.com/3004484/problem-your-elevator-pitch-and-how-fix-it

- Download presentation or poster templates
- Refer to *presentation guide* for preparation
- Choose standing or sitting presentation according to the situation
  - Stand on a podium — a raised platform
  - Stand at or behind a lectern — a raised, slanted stand
  - Sit at the head of a table
  - Sit at the middle of a table
- Pay attention to posture, hand gestures, and facial expressions
- Start with an outline and conclude with a summary
- Listen to own voice and pause without distracting, repetitive vocal fillers
  - er, uh, um, like, I mean, you know, *etc*.
- Positive eye contact with each listener for no more than two seconds
- Rehearse "elevator pitch" to get points across in 30 seconds or the time span of an elevator ride — don't speak the way we write

Elevator Pitch Competitions

Quality of the "Elevator Pitch" to raise money for a venture

- Was the information presented well?
- Was the presentation logically organized?
- Did the presenter speak clearly?
- Did the presenter seem knowledgeable?

How well the team has addressed the following information:

- Product/service description
- Problem being solved
- Competitive business advantage
- Business model
- Target market

Other Competitions

- Lemelson-MIT Student Prize
- RIT maintains a list of competitions/conference opportunities
    - Stevens team took 1st in RIT IEEE 2010 design contest
- Student Poster Competitions:
    - Fairleigh Dickinson University Annual Cybersecurity Symposium
        - Stevens team took 1st in 2016
    - IEEE North Jersey Advanced Communications Symposium (NJACS)

Systems Engineering

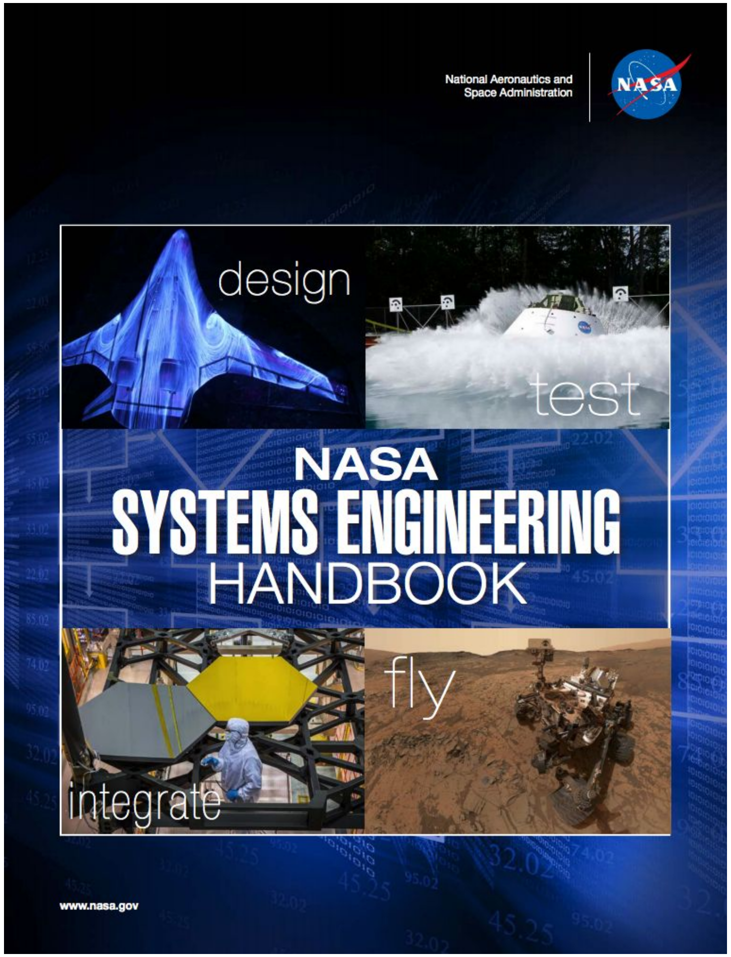
- Systems engineering is a methodical, disciplined approach for the design, realization, technical management, operations, and retirement of a system
- A system is a construct or collection of different elements that together produce results not obtainable by the elements alone
- The elements, or parts, can include people, hardware, software, facilities, policies, and documents — all things required to produce system-level results
- The results include system-level qualities, properties, characteristics, functions, behavior, and performance
- The value added by the system as a whole, beyond that contributed independently by the parts, is primarily created by the relationship among the parts — how they are interconnected
- It is a way of looking at the big picture when making technical decisions
- It is a way of achieving stakeholder functional, physical, and operational perfor mance requirements in the intended use environment over the planned life of the systems

Requirements and V&V

- How to write a good requirement in NASA *Systems Engineering Handbook*
  - Use of correct terms
    - Shall = requirement
    - Should = goal
    - Will = facts or declaration of purpose
- The International Council on Systems Engineering (INCOSE) *Systems Engineering Handbook*
  - Verification: built the thing *right*
  - Validation: built the *right* thing

NASA Systems Engineering

NASA SP-2016-6105 Rev2



1. Introduction
2. Fundamentals of systems engineering
3. NASA program/project life cycle
4. System design processes
5. Product realization
6. Crosscutting technical management

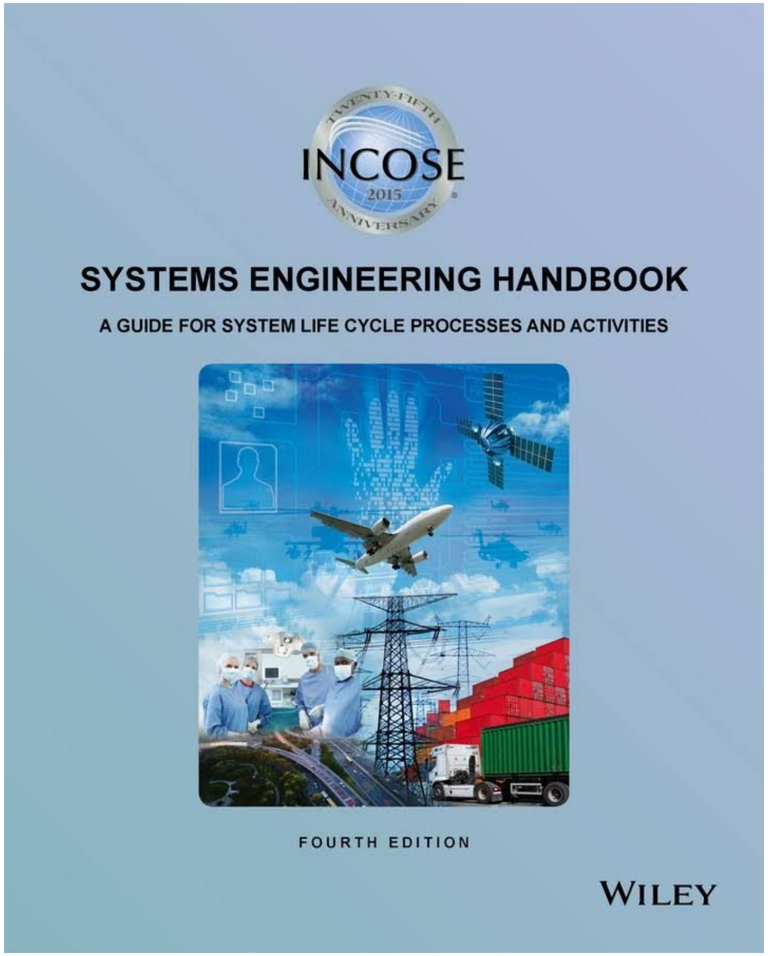
Appendices A to T

References cited

Bibliography

INCOSE Handbook

INCOSE-TP-2003-002-04 2015



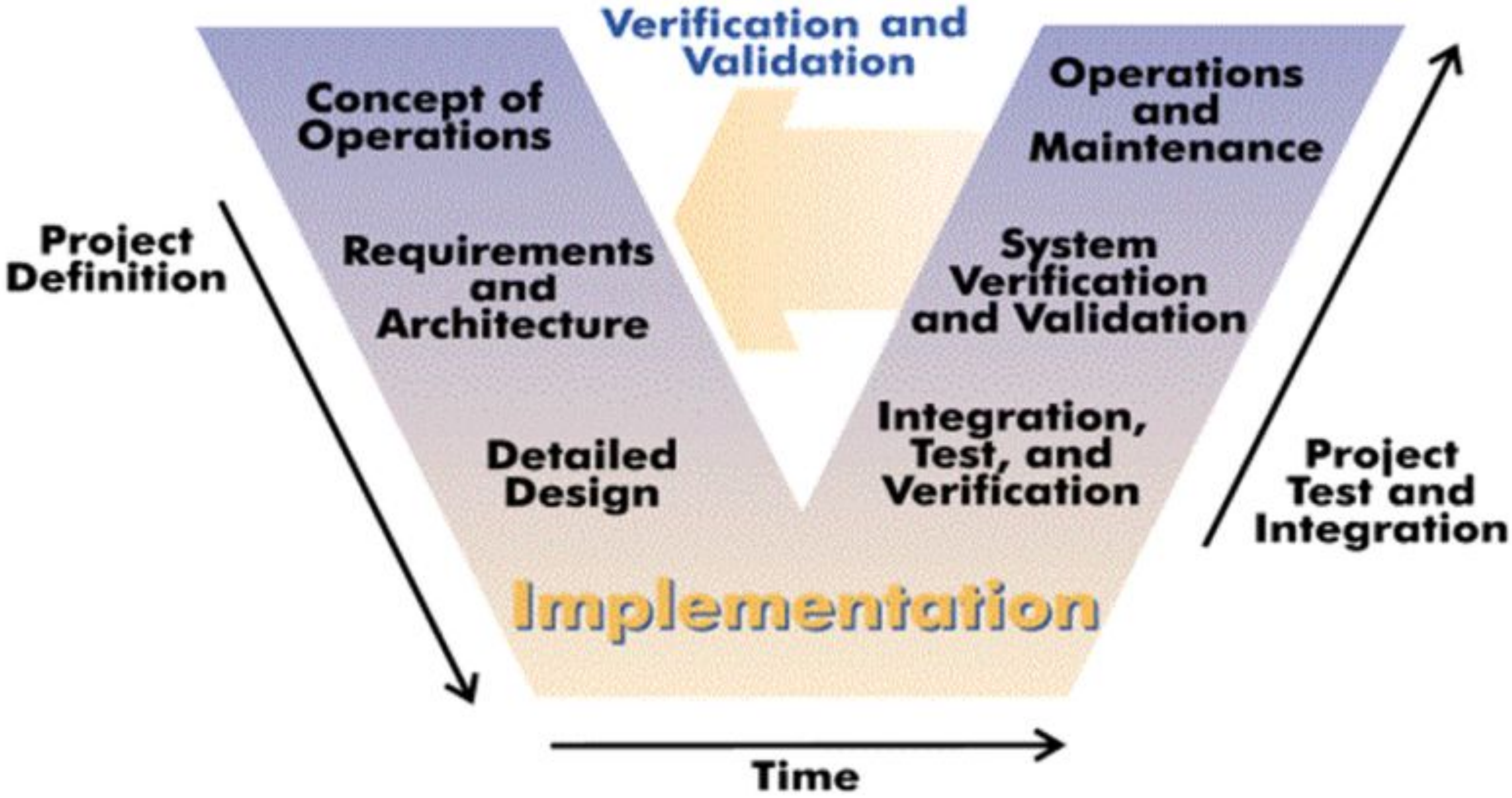
1. Systems engineering handbook scope
2. Systems engineering overview
3. Generic life cycle stages
4. Technical processes
5. Technical management processes
6. Agreement processes
7. Organizational project-enabling processes
8. Tailoring process and application of systems engineering
9. Cross-cutting systems engineering methods
10. Specialty engineering activities

Appendices A to G

Index

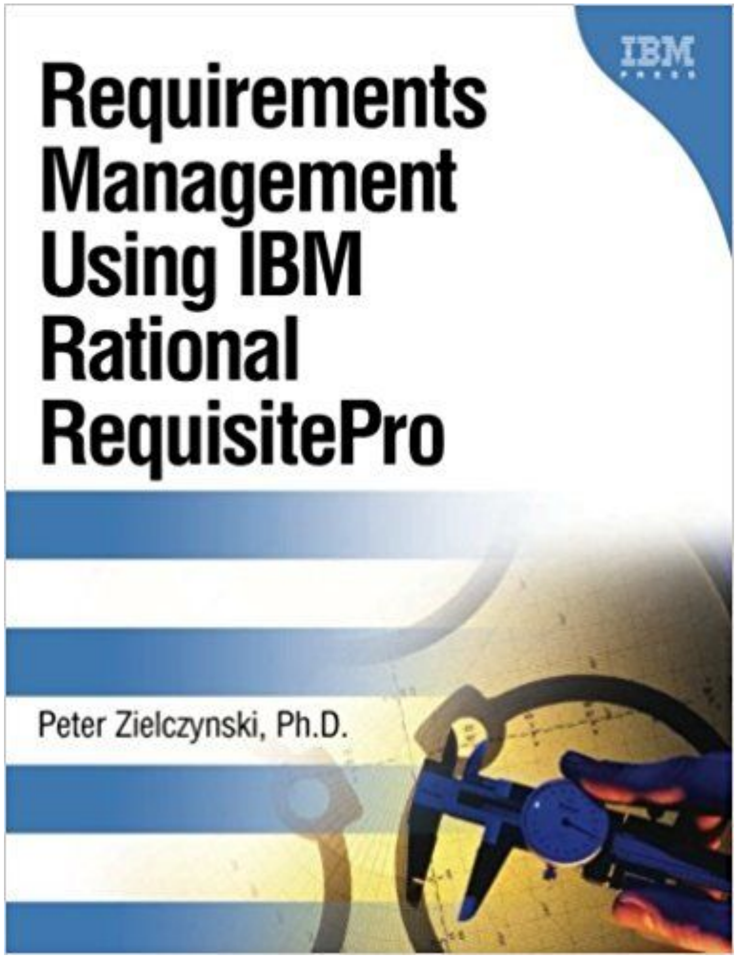
Systems Engineering Vee Model

https://en.wikipedia.org/wiki/V-Model_(software_development)



Requirements Management

[IBM Press](#) | [Relational and Software Development](#)

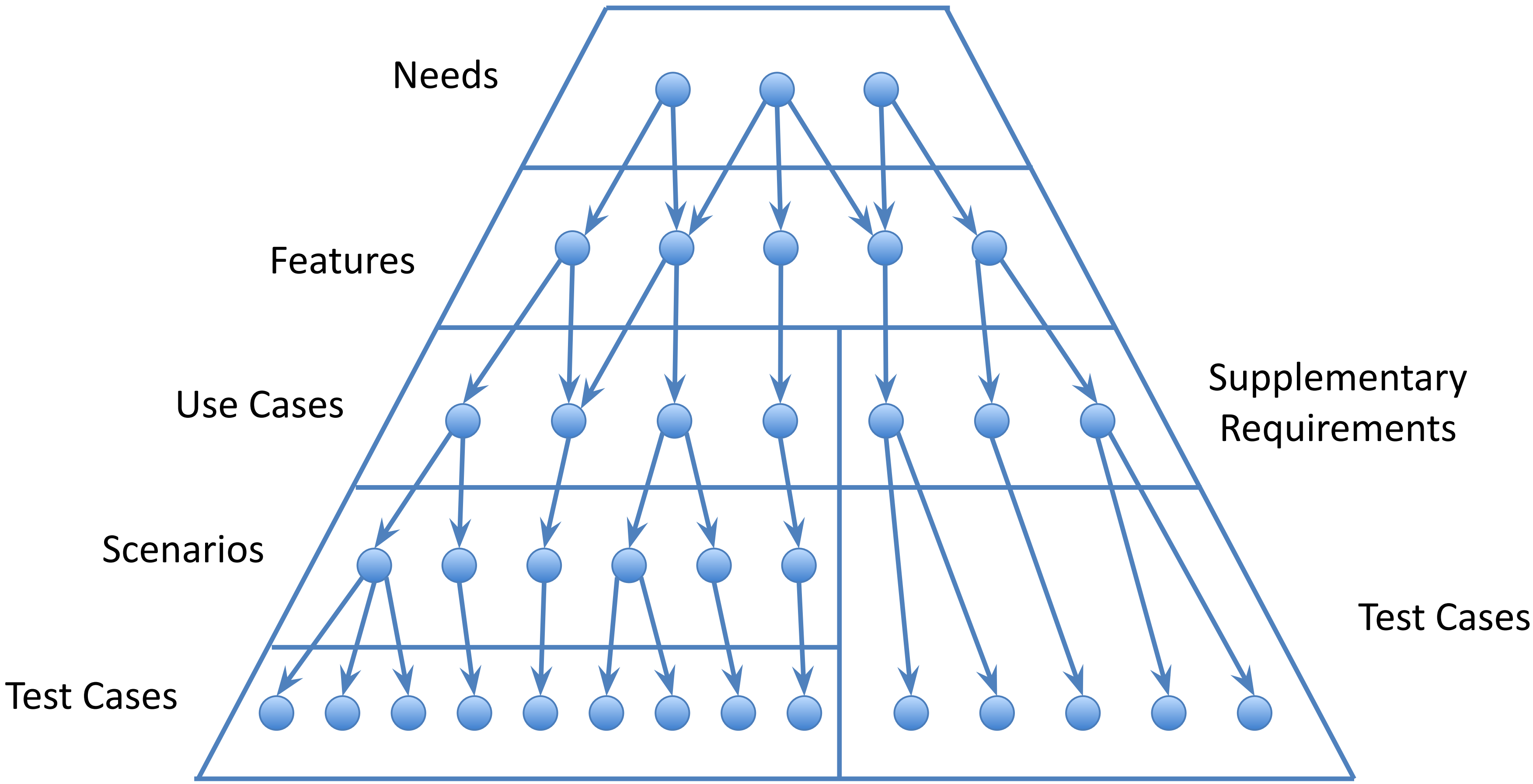


1. Requirements management
2. Overview of RequisitePro
3. Establishing a requirements management plan
4. Setting up the project
5. Requirements elicitation
6. Developing a vision document
7. Creating use cases
8. Supplementary specification
9. Creating test cases from use cases
10. Creating test cases from supplementary requirements
11. Object-oriented design
12. Documentation
13. Managing projects
14. Requirements management in the rational unified process
15. Summary

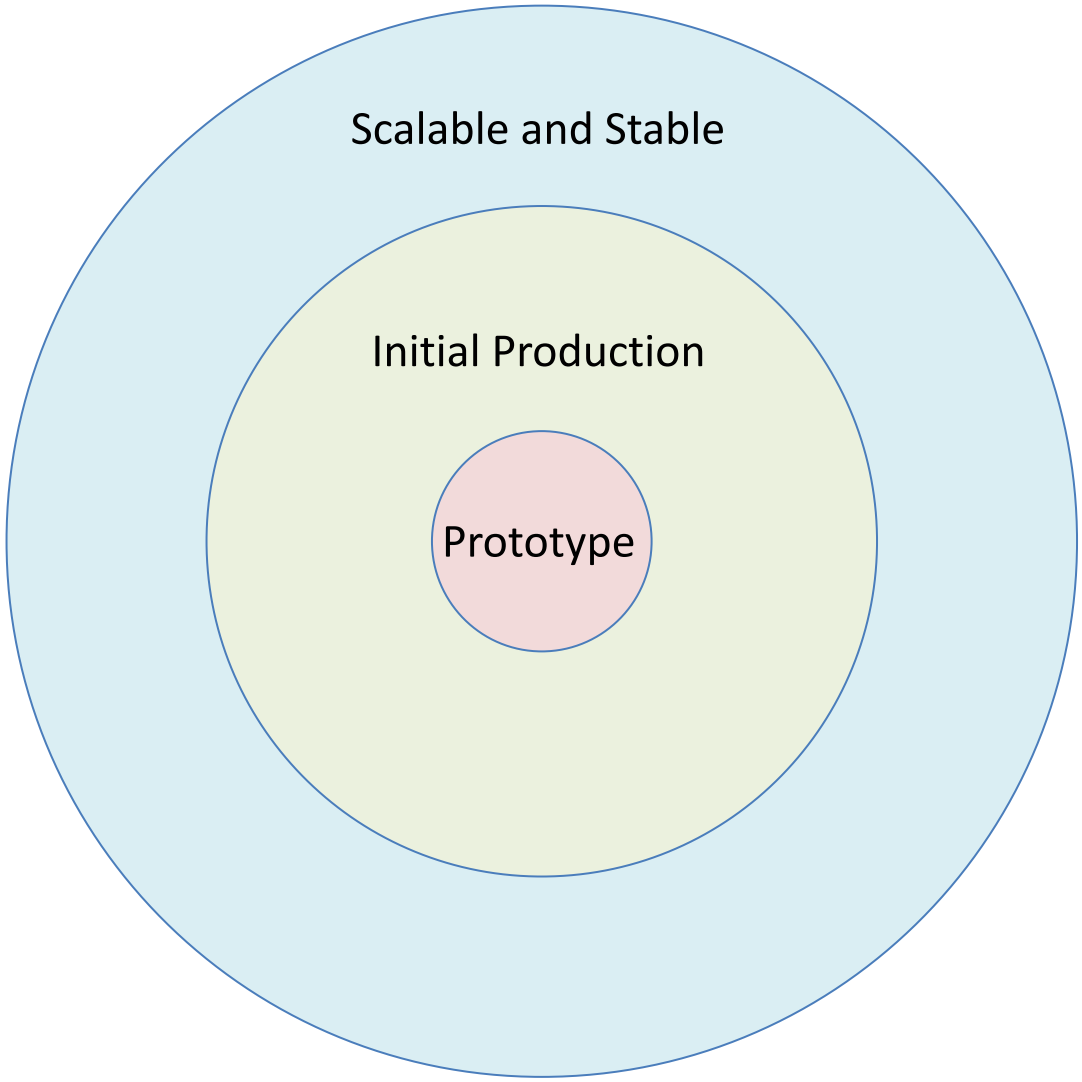
Sample requirements management plan

Requirements Pyramid

Peter Zielczynski, *Requirements Management Using IBM Rational RequisitePro*, 2007



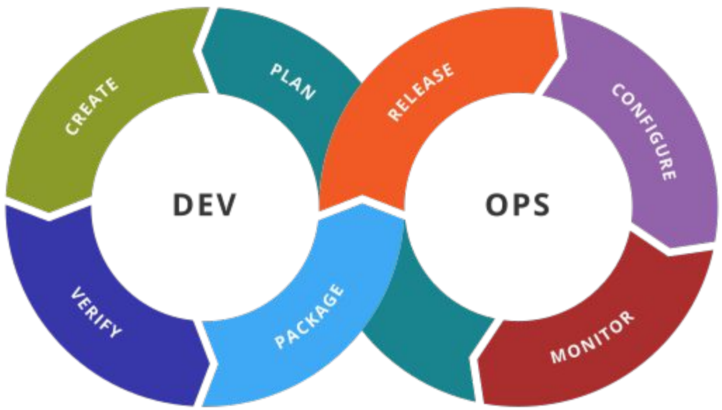
From Prototype to Production



DevOps

Sanjeev Sharma, The DevOps Adoption Playbook

1. DevOps – designing processes for coordinating software development with IT operations
2. Continuous integration / delivery
3. Dev vs. Ops – agile vs. water-scrum-fall
4. Continuous testing / monitoring
5. Infrastructure as code
6. Continuous deployment
7. Continuous improvement



IEEE 2675 Standards for DevOps: Building Reliable and Secure Systems Including Application Build, Package and Deployment

Matthew Setter, "What is SecDevOps and why should you care?" Sqreen blog

The Scrum Framework

https://www.scrumalliance.org

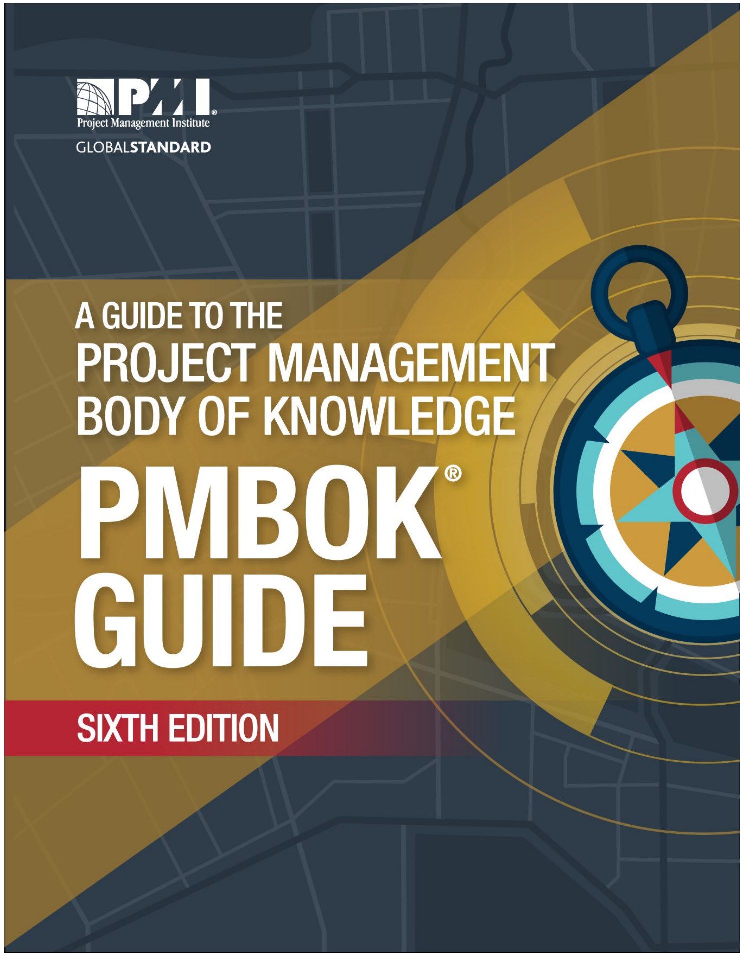
- A product owner creates a prioritized wish list called a product backlog
- During sprint planning, the team pulls a small chunk from the top of that wish list, a sprint backlog, and decides how to implement those pieces
- The team has a certain amount of time — a sprint (usually two to four weeks) — to complete its work, but it meets each day to assess its progress (daily Scrum)
- Along the way, the ScrumMaster keeps the team focused on its goal
- At the end of the sprint, the work should be potentially shippable: ready to hand to a customer, put on a store shelf, or show to a stakeholder
- The sprint ends with a sprint review and retrospective
- As the next sprint begins, the team chooses another chunk of the product backlog and begins working again

Why Is It Called Scrum?

When Jeff Sutherland created the scrum process in 1993, he borrowed the term "scrum" from an analogy in a 1986 study by Hirotaka Takeuchi and Ikujiro Nonaka published in the Harvard Business Review that compares high-performing, cross-functional teams to the scrum formation used by Rugby teams

Project Management

PMBOK Guide and Standards 6th Ed. vs. 5th Ed.

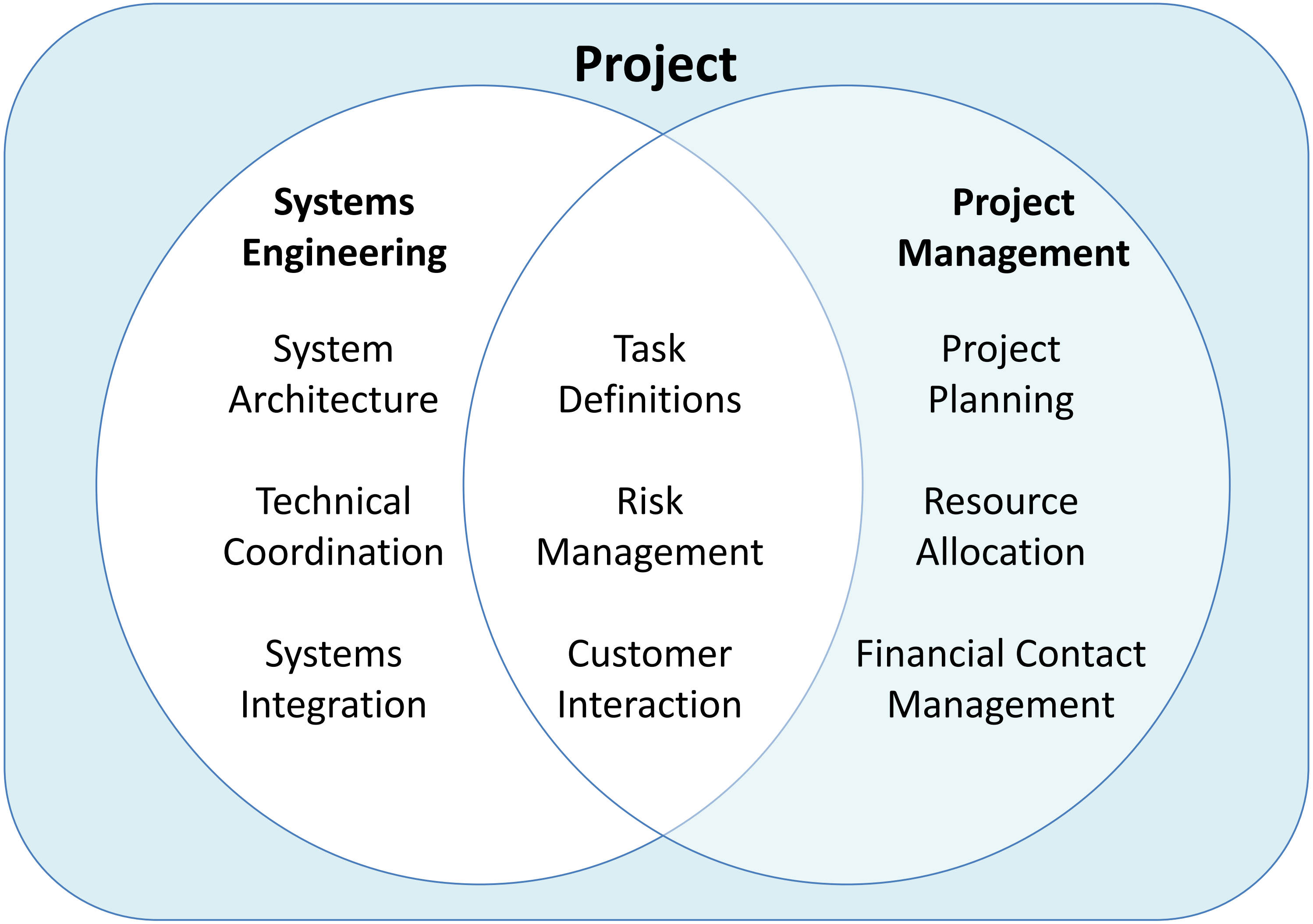


1. Introduction
2. The environment in which projects operate
3. The role of the project manager
4. Project integration management
5. Project scope management
6. Project schedule management
7. Project cost management
8. Project quality management
9. Project resource management
10. Project communications management
11. Project risk management
12. Project procurement management
13. Project stakeholder management

Project Management Process Group and Knowledge Area Mapping

Knowledge Areas	Process Groups				
	Initiating	Planning	Executing	Monitoring Controlling	Closing
Integration	✔	✔	✔	✔	✔
Scope		✔		✔	
Time		✔		✔	
Cost		✔		✔	
Quality		✔	✔	✔	
Human Resource		✔	✔		
Communications		✔	✔	✔	
Risk		✔		✔	
Procurement		✔	✔	✔	✔
Stakeholder	✔	✔	✔	✔	

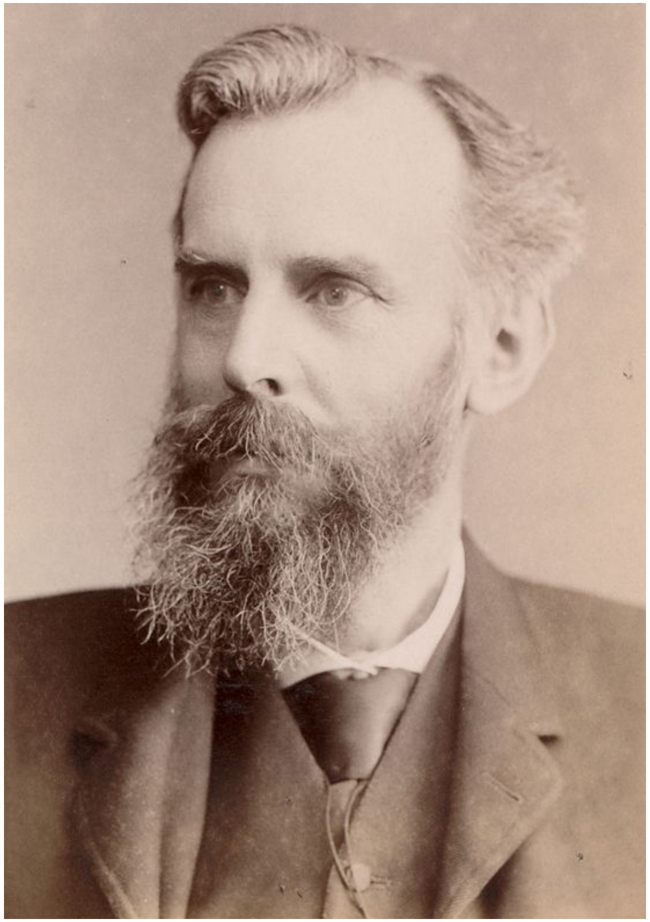
Project Venn Diagram



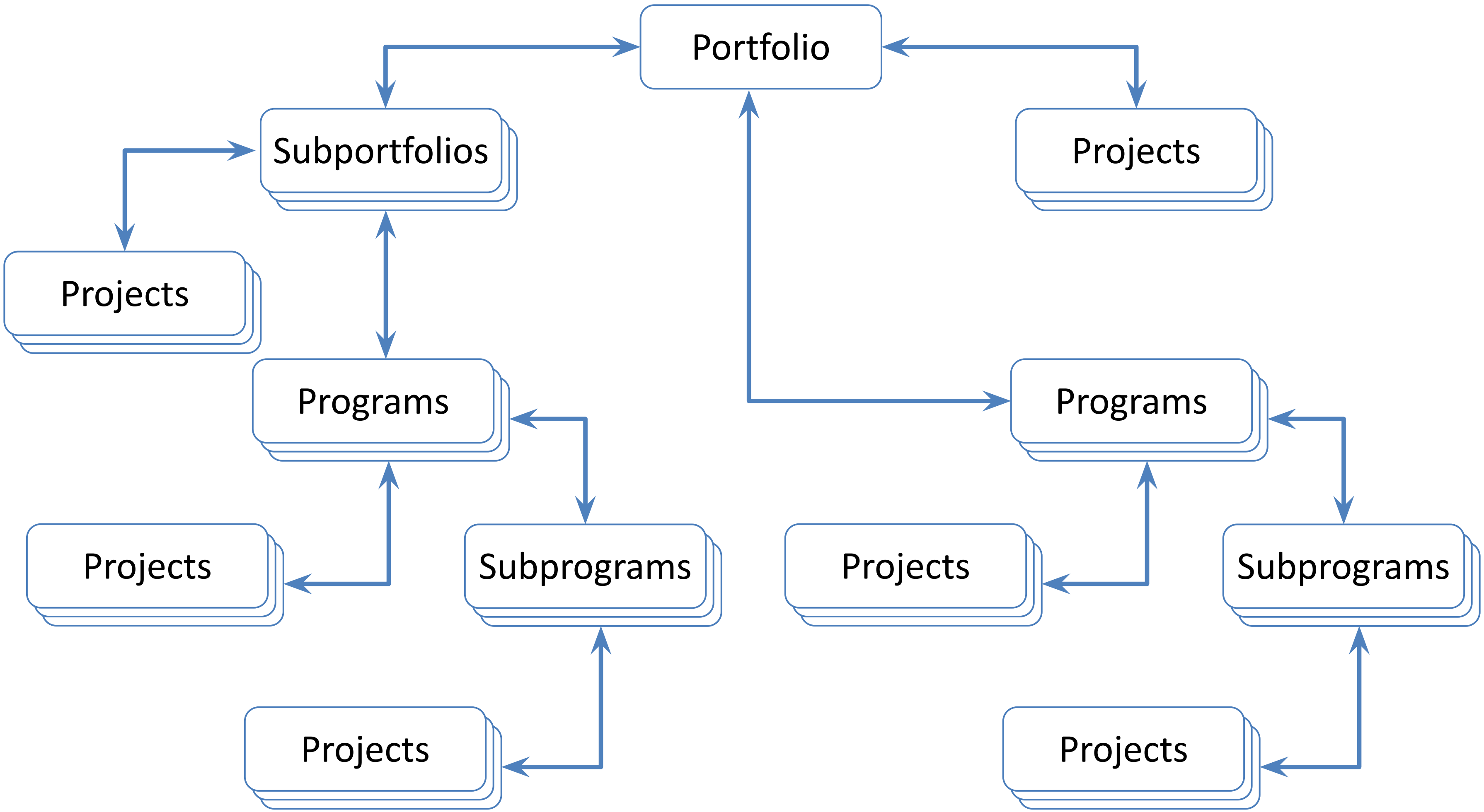
John Venn 1834—1923

https://en.wikipedia.org/wiki/John_Venn

- English logician and philosopher
- Introduced the "Eulerian circles" to show all possible logical relations between a finite collection of different sets in "On the Diagrammatic and Mechanical Representation of Propositions and Reasonings," *Philosophical Magazine and Journal of Science*, Series 5, Vol. 9, No. 59, pp. 1-18, July 1880
- Clarence Irving Lewis 1883—1964 was the first to use the term "Venn diagram" in his 1918 book *A Survey of Symbolic Logic*

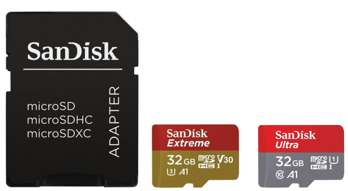


Portfolio, Program, and Project



Raspberry Pi 3B+

➔ Raspberry Pi 3 Model B+

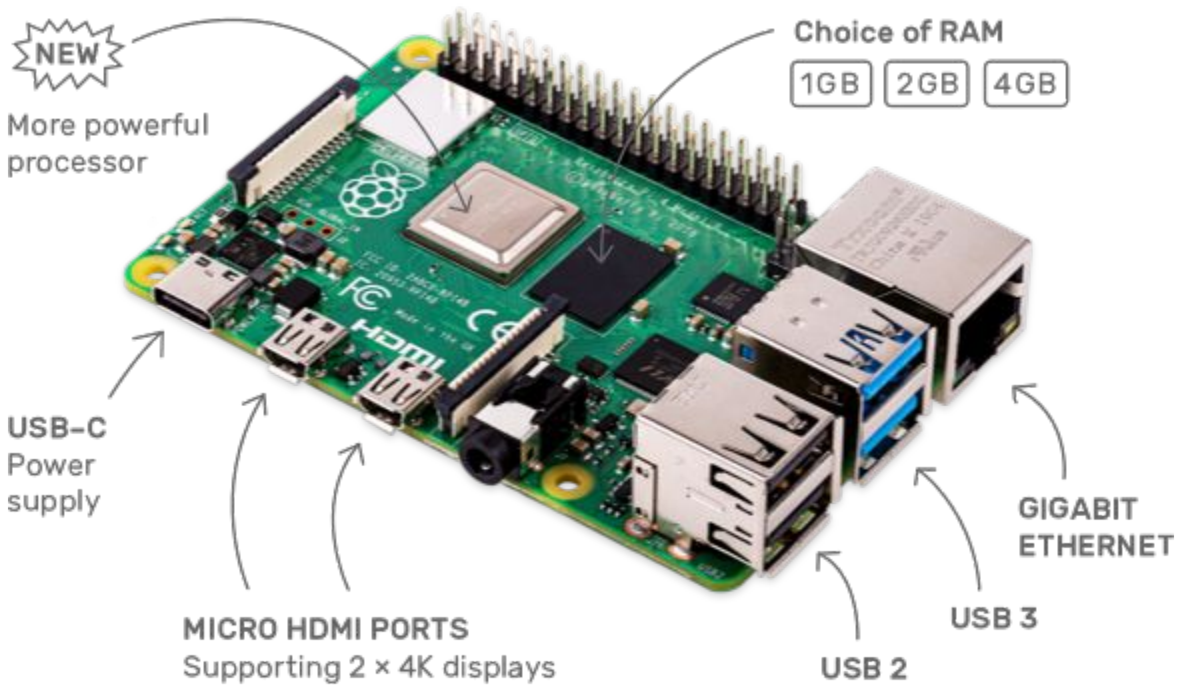


➔ 32GB MicroSDHC (Secure Digital High Capacity) Memory Card with Adapter

➔ 5V 2.5A or 5.25V 2.4A Power Supply with Micro-USB connector

Raspberry Pi 4B

https://www.raspberrypi.org/products/raspberry-pi-4-model-b/



Optional Clear Case

- Transparent case with screws and rubber feet
- Open GPIO header area — heat sinks are not necessary

Weekly Reports

At the Google site, insert a text box with weekly results of objectives in reverse chronology similar to the work experience in a resume, e.g.,
[YYYY-MM-DD] Completed Exercise 3 on problem formulation; modified and uploaded Lab 3 Python code to the GitHub repository as contributions

[YYYY-MM-DD] Completed Exercise 2 on establishing the need to develop a technical solution to a problem; completed Lab 2 such as minicom

[YYYY-MM-DD] Completed Exercise 1 on installing the latest Raspberry OS; completed Lab 1 on Raspberry Pi configuration, SSH, and VNC

[YYYY-MM-DD] Completed Exercise 0 on creating a Google site and GitHub repository; studied the *IEEE Editorial Style Manual*