RS9 Project management Institute (PMI) definition
Project: a t*emporary endeavour* undertaken to *achieve a particular aim* and to which project management can be applied, regardless of the project's size, budget or timeline

RS10 Project management: a tool to help manage the complexity of a project, the application of knowledge, skills, tools and technique to a broad range of activities in order to meet the requirements of a particular object

Processes:	*Initiating* *Planning* *Executing - most time spent, for limited HR instead of peak lengthy wider period of time spent* *Controlling* *Closing*
Knowledge Areas:	Project Integration Scope Time Cost Quality Human Resources Communication Risk Management Procurement

Project Initiation: what is needed	-show -Identify problem: purpose of project -Stakeholders: People who are interested in project -Resources / project constraints -Align with company values: worth tackling, are we the people who should tackle this After deciding to take on project -identify requirements -project management plan: decision makers (OVERALL plan) -decision points in project -how to break problem up in order to tackle it -what types of people/skills needed to take on project
Project Planning	-how to communicate -refine goals vs requirements (wants vs need reasonable: time/money budget) -baseline scheduling -baseline budgets: human resources/ money/ time/ raw materials etc -types of skills -Identify risks components of risk: Probability & consequence Likelihood of it happening Consequences if it does -estimation

Project Execution

-Monitor, update : schedule, budget risks
-Communicate: to team, customers, stakeholders
-Manage change
“Protect from above and promote from below”

Project Delivery

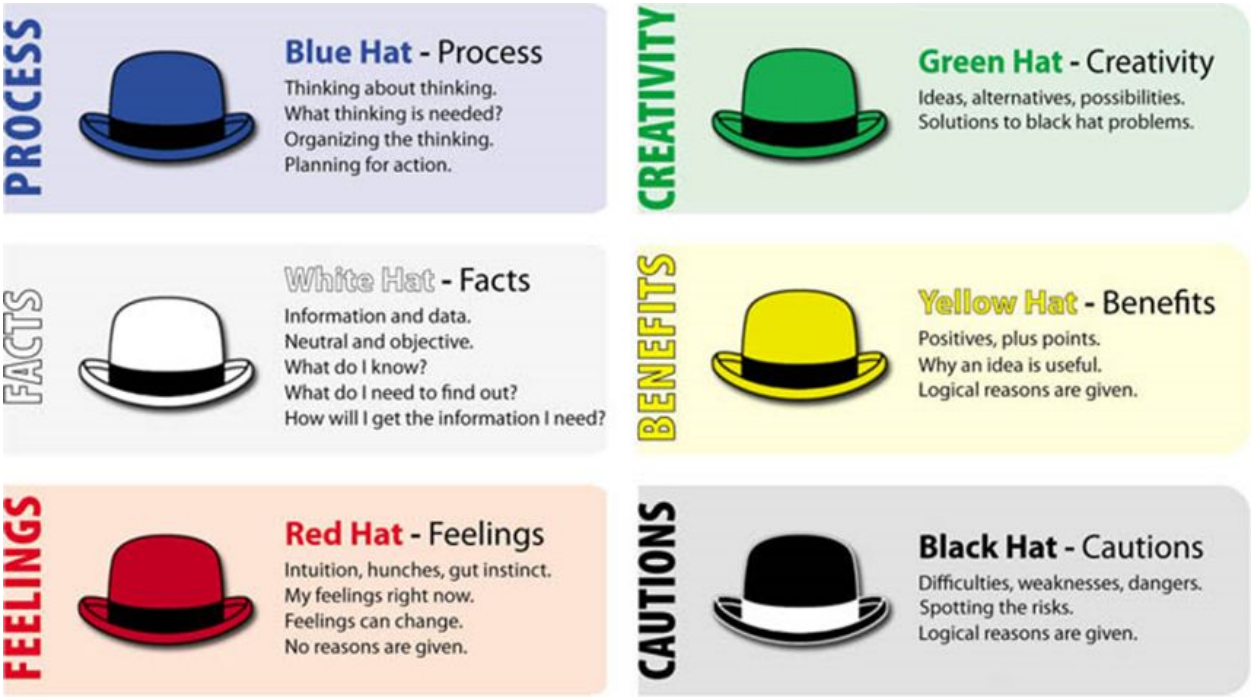
that meeting requirement meets needs of customer
-Did we do what we intended to? Can we prove it?
-Lessons learn: what went well, what didn’t go well

Pressures on projects

-Requirements creep, based on customer expectations and delivery
-Phase overlap
-Risk realization
-Communication challenges

RRS30 Critical Path - *“If they slip your schedule slips”*
sequence of project network activities which add up to the longest overall duration, regardless if that longest duration had float or not
Determines the shortest time possible to complete the project

RS21 Scope management: defining what work is required, who is responsible for each stage, what tool will track change
RS22 **Communication plan**
RS31-32 Free float : amount of time that an activity can be delayed from its early start date without delaying the early start of another ACTIVITY
Total Float : amount of time that an activity can be delayed from its early start date without delaying the project FINISH DATE



Responsibility Assignment Matrix - RACI Chart

	Jeff	Michael	Reto	YOU	Alex	Anna	Bill	Cindy	Felix	Fred	Hans	John	Livio	Luc	Marco	Paul	Peter	Sue	Ted	Tim
Planning / Schedule	R	A	I	C					C											Q
Risk Management		I	I	Q						A								R		
Quality Management			R	C						R										A
Procurement				R		Q				R								R		A
1. Specifications Listing								A		R								R		R
2. Site Requirements		C	A	R	Q						R									
3. Call for Tenders				Q	A	R	C				R							R		
4. Budget Approval				A	Q					R							R			R
5. Contract Negotiations			A		Q	R	R											R		

* R – Responsible (works on), A – Accountable, C – Consulted, I – Informed, Q – Quality Reviewer

RS23

Work Package: breakdown into small manageable sizes, a size able to track progress

WP ID: 1440	WP Name: Create projects for us to collaborate on heading to a common purpose
Expected effort in hours: 1500	WP manager: F. Newland, 250h Support: Various, 1250h
Expected start date: 1 Jan 2019	Expected end date: 1 Jun 2022
Inputs needed: (all documents, materials etc. required to perform the work package) Your visions of a better world, other campus and off-campus stakeholders who share a common purpose, a guiding statement of work	
Tasks to be performed: Identify common language for purpose, identify common goals, requirements, recognize voices not present in project stakeholder team, propose actionable projects to work towards the goal, monitor project success, learn lessons and iterate	
Outputs generated: (all systems/subsystems/documents or other outputs from this work package) Lessons learned from early iterations of projects collaborating to make the world a better place	

RS53-56 Waterfall project management: (formal gated flow) fixed initiation phase, design phase with various gated reviews

RS57-60 Agile Project management: ready access to the user, upload something and go straight to the user and ask, reiterate. Constantly going through cycle

Lean Project Management: how to focus on the most important thing, remove all the “junk”

-minimal paperwork/tools etc efficient and simple

Stages of **Waterfall** project management : Do it once, do it right : management regular reviews

Oldest of the three

-expensive, physical things

-projects with clear scope or requirements

-fixed sop projects may be optimal, predictable
-project risk can be understood, with gated decision points
-- inflexible, hard to change direction once started
-- assumes scope/ requirements able to be pinned down at the start (change adds cost, must modify design)
+safety purpose systems (software) MUST achieve certain requirements
+Large and complex, not expected to change during development
+no access to users other than at start and end
+determine feasibility before sinking money into development

1. *Concept review*
2. *Requirements review*
3. *Preliminary design review*

-Functional breakdown, operations concept, budget, trade studies
-work breakdown, work package description, GANTT/ PERT Chart
-Risk matrix, RACI chart

4. *Critical design review*

-Simulation, prototyping, detailed design verification
-updated PM doc

5. *Test readiness review*

-what will be tested, how, under what conditions, how demonstrates compliance

6. *Test review*
7. *Pre-delivery review*
8. *Decommissioning review*

Project manager acts as top down, drives project froward

Agile :small scale project. do it small and fast, and iterate : facilitate as opposed to manage
-Know starting, know goal, as you go through process identify most important and always focus on goal
-Accept uncertainty , Unpredictable
-Do not plan to launch with perfection, launch to develop
-"Take top 2 things, make those and get feedback. Then take top 2 of those designs, make them and get feedback. Repeat. "
-requires close interaction with key stakeholders

+ Uncertain, likely to change significantly during its development
+ Ready access to the key stakeholders and they are happy to work with you (may deviate from needs, add in wants, negative if fixed price contract)
+ When process of finding a solution may itself valuable

Example: in civil engineering projects: preliminary design proposal for a bridge, only during various phases
Research into different materials, other research activities
Tools:

1. Sprints

-backlogs
-scrum master: facilitate the team's progress
-Product owner: acts as user of the product in the absence of the user in this phase

2. Agile roadmap

-product vision: what things do you need, why are you doing this
-feature roadmap: what are features you know you NEED to do, categorize
-release planning

3. Sprint process

-sprint plan

-scrum

-print review

-sprint retrospective: did we achieve everything we needed to, what do we need to change next week

RS61-63 PRINCE2 : Project in a Controlled Environment version 2 **: manage when required, otherwise facilitate**

Largely complex : most widely used worldwide

Focus on process: what you're doing and why you're doing it NOT how you have to do it (use waterfall & agile too help)

Work product output -> outcome -> business benefit

Used in UK, australia and Europe

Heavy emphasis on planning & business justification, planning, cost analysis and risk mitigation

-methodology which separates Management and Specialist Products

-management products are rigid, waterfall-like elements

-specialist products can be product specific, like a software project could use an agile specialist product

+large high risk complex project

-complex to get certified to use PRINCE2

-may require experts in multiple methodologies

-process is exhaustive

5 main aspects considered:

1. Method to be used (how to approach the job
2. How will the work be organized
3. Main factors that need to be taken into account
4. Who will be responsible for what
5. How will the progress be monitored and communicated

Project Variables:	**Project Characteristics:**
Cost	Monitor *Change*
Scope	*Uncertainties* to reduce to address risks
Risk	May be *temporary* aspects to the project
Quality	How manage project in different ways:breakdown time, function etc (cross functional)
Benefits	What makes project *unique* and requires different management

7x7x7

7 Principles : best practice framework, define a PRINCE2 Project

-focus on benefits (business justification

-learn from experience during & before the project (lessons learned throughout instead of after)

-defined roles & responsibilities

-stages

-managed by exception (appropriate delegation of authority)

-focus on products

-tailor to suit project environment

7Themes: guidance on aspects of project work, should be addressed at various points during the undertaking. Relate to each other and are integrated into the Process	-business case (why are you doing the work, how it evolves throughout project) -organization -quality -plan -risk -change -progress: how to monitor work progress and how project evolves
7 Processes : "journey" through project, critical aspects of project work are not forgotten	-start (brainstorming phase) -direct -initiate (execution of actual project work -controlling -managing product delivery -managing stage boundary -closing a project

PMBOK: Project Management Body of Knowledge
Set of standards terminology and guidelines for project management
input -> tools & technique -> project management output

Gated Reviews RS73

Blue team review : **RS75**	-outline review -going through necessary requirements to see if criteria is met -gaps in information -who are the subject matter experts (SME) *Purely internal to the team who will prepare, present review*
Pink team review **RS76**	How consistent is the story? -content -narrative Is there anything contradictory -is it compliant to requirements *Internal team plus SME & management*
Red Team review : Most important! **RS77**	-"first full draft -bring in external reviewers Fresh perspective before documentation goes out
Green team review : MUST if budget **RS78**	only relevant if gating review includes financial proposal for next phase ALWAYS required when financial proposal being prepared -pricing review -risks understood -info compliant to policies, laws, customer requirements

Gold team review **RS79**	Senior management quality control of the final product before it goes out the door -does the documentation, proposal represent the company well? -is the risk acceptable but competitive
White team review **RS80**	Administrative review -enough copies -delivered on time -no pages missing -spelling grammatical errors

RS67-63 Phases

Phase 0: Need identification	Objectives Compliance matrix Simulation / analyses
Phase A: Feasibility	REQUIREMENTS DEFINED
Phase B: Preliminary definition	PRELIMINARY DESIGN REVIEW budgets
Phase C: Detailed definition	CRITICAL DESIGN REVIEW Requirements management
Phase D: Qualification and production	Pre-shipment review, readiness review System test
Phase E: Operations / utilization	Commissioning review ROUTINE USE
Phase F: Disposal	Lessons learnt Replenishment / obsolescence plan

Risk: potential events that have negative impacts on safety or project technical performance, cost or schedule
(inevitable, can be reduced but never eliminated)
Lessons from past projects are captured via "trigger questions", or questions that challenge a development strategy / design strategy

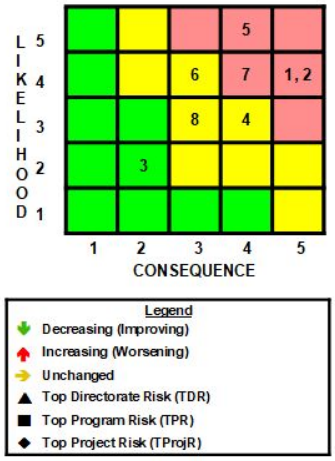
Risk realization : When the risk have already occured, no longer a hypothetical situation that we aim to avoid but something must presently work to deal with

Risk Management: looks at the sources, magnitude and mitigation of risk, and the actions directed towards its balanced reduction
Continuous and iterative decision making technique, designed to improve the probability of success

Identify > *Analyse* > Plan > *Track* > Control

Technical complexity: many design constraints must occur in right sequence or right time
Organizational complexity: many independent organizations having to perform with limited coordination

RS33Risk Matrix :
-title of risk
-possible categorizations
- system/ sub system
- cause category (tech, cost)
-owner
-likelihood / consequence
-mitigation
-significant milestones
-opening / closing windows
- decision points

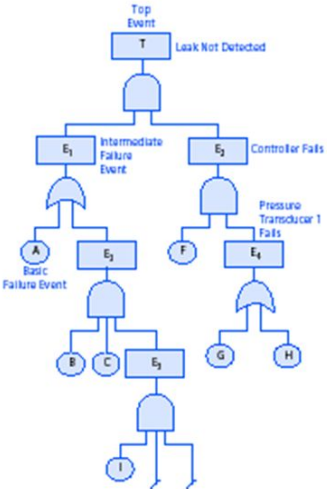


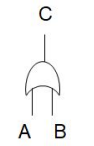
Rank	Trend	Title	Owning Team	LIKE	Consequence			
					SAFE	PERF	SCHED	COST
1	N	◆ 1677 - Ares I/Orion Ascent Aeroacoustic Environments	FP_SIG	4	4	5	5	5
2	N	◆ 1676 - Structural loads on CEV and LSAM during TLI	FP_SIG	4	5	5	4	4
3	↓	■ 1122 - Requirements Maturation	SE&I-PRIMO	2	0	2	2	2
4	→	■ 1135 - Program Visibility for Closing the Architecture	SE&I-AT&A	3	0	4	0	4
5	N	◆ 1603 - (SRR) Abort Site Sea State Limits Launch Availability	SE&I_SOA	5	3	4	4	4
6	→	■ 1125 - Software Development and Assurance	CSI_SIG	4	3	3	3	3
7	→	■ 1195 - CxP Lifecycle cost	SE&I_SOA	4	0	0	0	4
8	↓	▲ 1046 - Tailoring of Human-Rating requirements	SE&I_PTI_HR	3	0	0	3	3

RS43 *Example* Risk categories:
-Technical (physical)
-Programmatic (personnel, regulatory changes)
-Supportability (reliability/ maintainability, training, system safety)
-Cost (estimating error, labour rates, schedule risks)
-Schedule (cost, currency, # of critical path items)

RS44 Each *hazard* that requires mitigation : **Hazard Analysis** uses risk matrix (likelihood vs consequence)
1 *Control* - activity that prevents the hazard from occurring
2 *Verification* - activity which shows that the control is in place

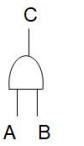
Risk Mitigation:
RS48-50 ***Fault Tree Analysis:*** *g*iven a consequence, what are the possible sources and how those sources lead to that consequence. Determine how likely is the path to get to the source of failure.
Flag WHERE in the system need to change the design in order to minimize the impact of the risk



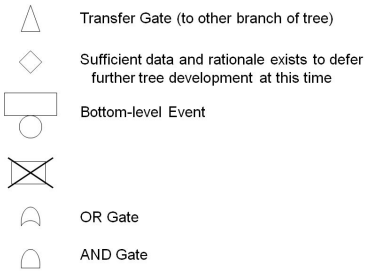


A / B	No Fault	Fault
No Fault	Output C= No Fault	Output C = Fault
Fault	Output C= Fault	Output C= Fault

AND gate



A / B	No Fault	Fault
No Fault	Output C= No Fault	Output C = No Fault
Fault	Output C= No Fault	Output C= Fault



RS51 Failure Mode Effects Analysis

Ensures all failure modes have been identified and evaluated
Steps:
Select a method to rank project failure modes
Analyze failure modes & effects
Determine failure modes that may benefit from mitigation
Determine which corrective actions to take

Economics

RS120 Reliability: probability that a system will successfully complete its function
Reliability = Number of successful operations / number of total operations
(to get statistical significance, observe system for long enough for many failures to occur (30))
Better approach : compute reliability from mean time between failure for each components, combine to form a system reliability

Probability of failure RS124

In series:

Reliability = (RelA) * (RelB)

System reliability ***decreases*** with more components in series

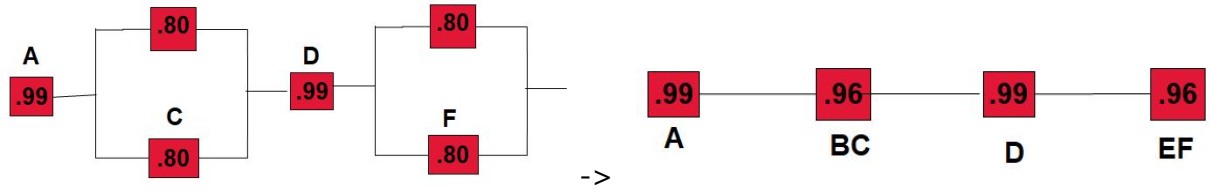
In parallel:

Reliability = 1- ((1-RelA) * (1-RelB))

= 1 - (FailA) * (FailB)

System reliability ***increases*** with components in parallel

For *combination* of series & parallel reliability systems
1. Combine systems in parallel using formula, total reliability for the two sections
2. Combine remaining in series (including the combined amounts added in parallel)



Redundancy systems : "the inclusion of extra components that are not strictly necessary to functioning, in case of failure in other components."

Component redundancy: add copies of the same component to increase redundancy.

+ Lowest cost, weight
+ Lowest system impact (change interface of one, not multiple)
+ Best when one component has slightly HIGHER failure rate than other components
- Doesn't provide full coverage

System Redundancy: create a duplicate system that runs in parallel with current system

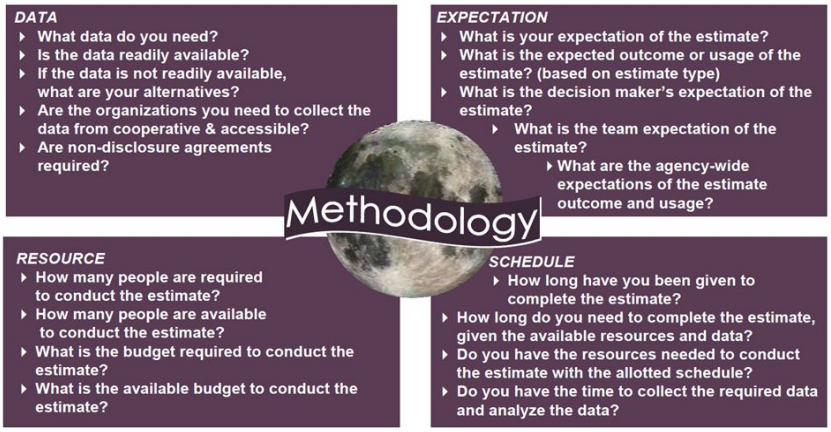
+ Best possible coverage
- Highest cost, weight
- Highest system impact
- May not achieve full effect, if common mode failures in *supporting systems* or subject to a common *failure location*

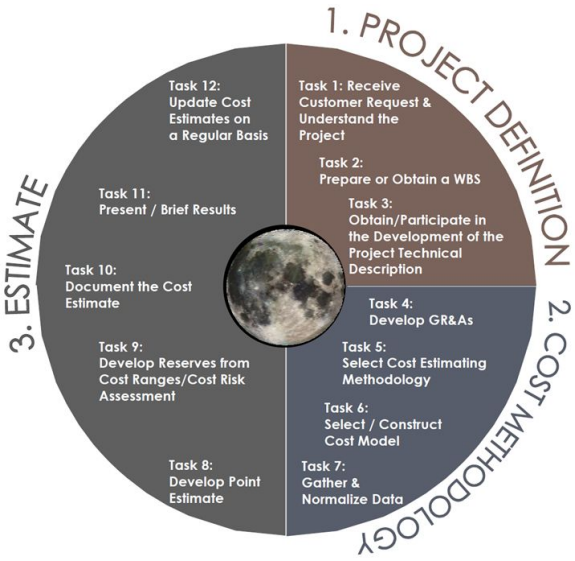
"The Bathtub Curve": Failure rate ^ near beginning & End.
System failure most likely to occur in beginning, in the first few times used & also become weaker after a significant amount of time/use.

Failure Mode Effects Analysis: a design tool for *identifying* risk in system design, with the INTENT of *mitigating* those risks with *design changes*

Cost Estimation

RS108 Life Cycle Cost Estimate (LLCE) : estimate that includes the cost of ownership, all project feasibility, project definition, system definition, preliminary & final design, fabrication and integration, deployment, operations and disposal efforts
Identifies all costs of a project
Used for:
- budgetary decisions
-system trades & studies
-to support milestone reviews
-determine a projects viability, appropriate scope and size





GRA: Ground Rules and Assumptions

Top down, parametric model
Given a certain amount of budget, this is how i would divide it up based on historical examples
Exemplar (a specific example)

Bottom up: work out budget of each piece then add it together
Regression Analysis Methodology requires:

- Review literature, develop theoretical model
- Specify model
- Select individual variables and functional form
- Hypothesize expected signs of coefficients
- Collect the data
- Estimate and test hypotheses regarding the models parameters
- Document the results

Example: using various university websites to estimate cost of tuition/ fees of another school

+	Based on actual historical data	-	Relies on single data point
+	Quick	-	Can be difficult to identify appropriate analog
+	Readily understood	-	Requires “normalization” to ensure accuracy
+	Accurate for MINOR deviations	-	Relies on extrapolation or expert judgement for “adjustment factors

Vendor- distributor or a product or service, “one time” not established trust relationship
Supplier- long term agreements, reliable source, goes to often / always
Partner- shares in risk and benefit

OEM: original equipment manufacturer, often outsourcing marketing and distribution
Vertical: raw materials to finished product. Does everything, small (nuts n bolts) to finishing pieces
Horizontal: expert in one thing. Do the same function for many different products/ industry

Supply chain: system of organizations, people, tech, activities etc involved in moving a product or service from supplier to customer
Value chain: chain of activities. Products pass through all activities of the chain in order and at each activity the product gains some value. The chain of activities gives the products more added value than the sum of added values of all activities. (NOT costs occurring throughout the activities)

Globalization: the process by which the people of the world are unified into a single society

“The world is flat” : how globalization has changed and leveled the competitive playing fields between industrial and emerging countries.

flatteners : something that “evens out the playing field” ex. The internet, the soviet union: the rivalry that accelerated technological advancement, market was open to both sides

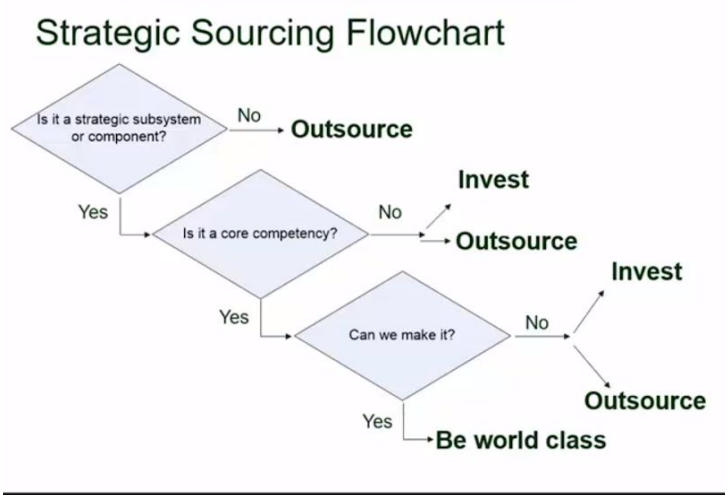
Triple convergence: the idea that all flatteners are interconnected. The power of flattening is enhanced.

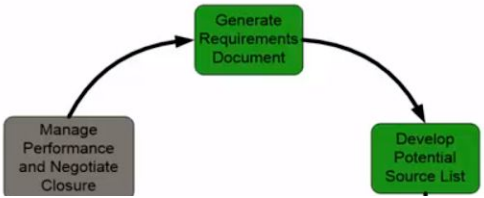
Materiel: adds logistics, transportation and inventory to function. “Buy things from you and have you bring them to us”

Supplier management: moves up the value chain to buy bigger pieces - buy as element of the total strategy

Supply chain management : includes the full product life cycle- SCM is a key element of the strategy

Strategic - long term goal, wcho we are : management
Tactical - what we need to do to survive this week : operational
RS136 Alignment of all 3 things ->





Financial factors: is it cheaper to buy? Or make?
Non-financial factors: are we the right group to make it? Is another group fine since they're not in competition with us

RS138 Leverage: the action of a gain a mechanical advantage, to use for gain, the use of credit to enhance one's speculative capacity.
Early: the buyer(developer). Potential sales for the supplier
Later: the seller (supplier). They have the knowledge/ equipment to provide the component service. + more competition

RS141 Boeing wants to spend most time in green boxes
90% of time spent in grey box but green boxes yield greatest results

Account profit: how much earned on something - how much paid to make something
Economic profit: "opportunity cost" / tradeoff. Doing one thing means not doing another thing
EP= Accounting profit + sunk costs (money already spent) - opportunity costs

SP : **RS129-132 Break even formula**
Selling price per unit
-VC Variable cost
CM Contribution margin (each unit benefits how much) money/unit
-FC Fixed costs (doesn't vary with added units)
NI Net income

Variable costs: costs that are proportional to units sold ex. Material costs
Fixed costs: unchanging costs regardless of amount of sales ex. Property tax, president / board of director salary
Selling point: value gained overall

RS100 Rate of return
>>Stream = [-investment, 1st period income, 2nd period income, …. , nth period income];
>>ROR= **irr(**Stream**)**
Internal Rate of Return: % gain over period without inflation & taxes

RS95 Effective rate: ((takes compounding into account)
Increase in number of periods increases the rate of borrowing
>>EffRate = **effrr(** nominal rate, Number of periods**)**
EffRate = effrr(2.8/100, 365)

RS95 Nominal Rate: ((acts as though only one period of borrowing)
>> *NomRate* = **nomrr(** effective rate, number of periods)

RS101 Present Value: FIX payment, FIXED interval
>> PresVal = **pvfix(Rate**,NumPeriods,Payment,ExtraPayment,Due**)**

Ex. Borrow money now but a year from now, have to pay 3% on that $100. Compounded monthly. To find how much that $100 would be worth today, use Present Value
>> presentval = pvfix (0.03/12 , 12, 100/12)
presentval =
98.3938
Therefore, you would technically be borrowing $98.39 NOT $100

For variable regular payments,
-know cash flow
-interest rate
-variable dates of the cash flow
>>PresVal = **pvvar(CashFlow**,Rate,CFDates**)**
Value in comparison to REGULAR payments

>> PresVal = pvvar (stream, 0.0236, CashFlowDates)
PresVal =
-172.7027
***not -172.70 of investment overall, but that much less when compared to regular annual periods

Lending: ((Investment as negative *amount))*
Best of take money out earlier, money works for less amount of time
Borrowing: ((investment as positive *amount))*
Best to give money back as late as possible, takes advantage of loan for longest amount of time. Money able to work harder for longer.

Future Value:
>> FV= **fvfix(Rate**,NumPeriods,Payment,PresentVal,Due**)**

RS103 Depreciation:
Linear (goes down same amount each year)
>>deprL = **depstln(Cost**,Salvage,Life**)**
Cost- initial amount paid
Salvage - final amount worth
Life- time span to get to salvage amount
20% linearly

General Depreciation : Declining balance method (variable depreciation, accelerated initially & less after time)
>> DeprA = depgendb(**Cost**,Salvage,Life,Factor)
Factor - Double the normal amount

Excel Spreadsheet
To find **effective rate** given nominal rate:
((1+nominal rate%)/(nominal period/compound period))^ (Nominal period/ comund period) - 1
Change to percentage
Nts period must be in same time rate
=(1+B1/(D1/D2))^(D1/D2)-1

B1=Nominal rate
D1= Nominal Period
D2= Compound period

In Excel

=EFFECT(Nominal Rate, Compound Period)

To find **nominal rate** given effective rate:

(((1+effective rate)^(compound period/ nominal period)) -1)* (nominal period/ compound period)

(((1+B2)^(D2/D1))-1)*(D1/D2)

B2= Effective rate
D1=Nominal Period
D2=Compound period

In excel

=NOMINAL(Effective rate, Nom Periods)

=MOD(Number day, Period)