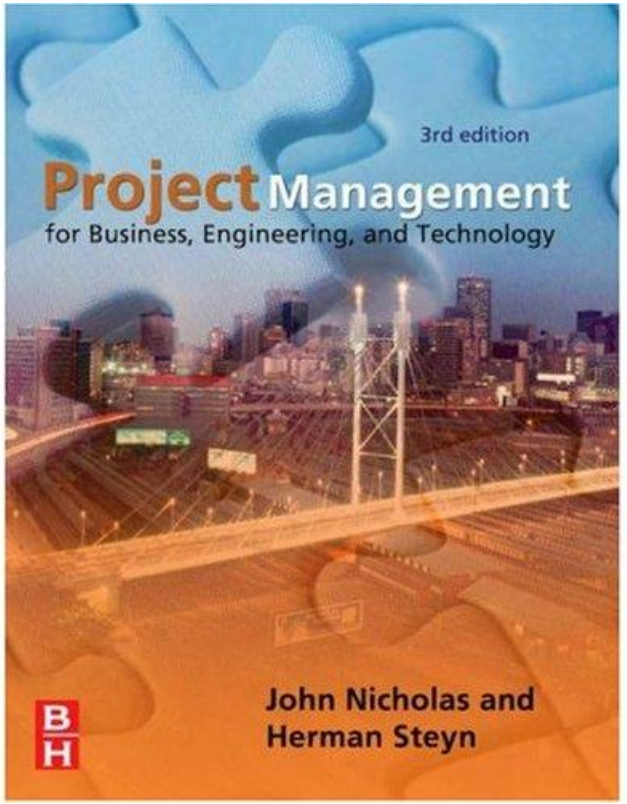
Chapter 10
Managing Risks in Projects

Project Management for Business, Engineering, and Technology



Prepared by
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Loyola University Chicago

Project Risk

- Possibility or probability that the project will not turn out as planned or desired

Project Risk

- Risk includes potential benefits (opportunities) as well as hazards
- Our focus: risk of serious problems or failure, i.e.,
  - Project not meeting performance requirements, schedule, or budget
- “Failure”
  - Not meeting time, cost, or performance targets by a predefined margin

Project Risk

Risk of involves two concepts:

- The *likelihood* that some event will occur.
- The *impact* of the event if it does occur.

It is a joint function of the two

Risk = f (likelihood, impact)

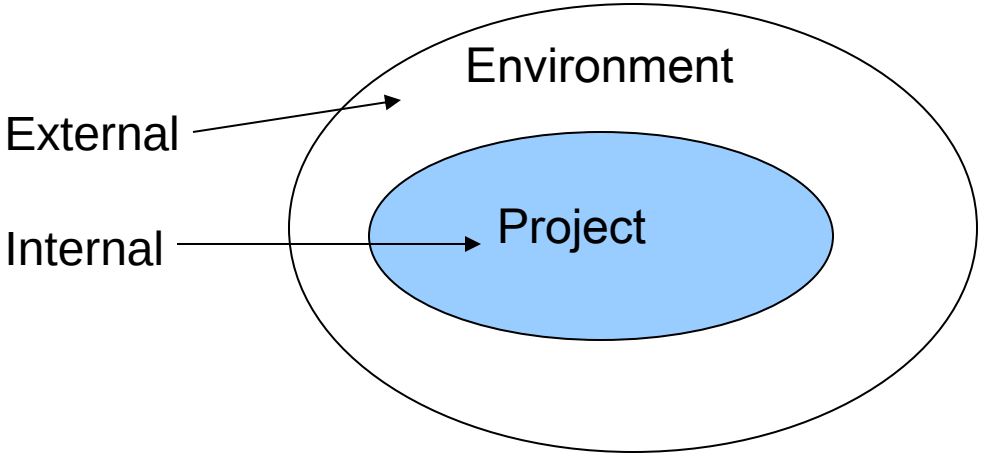
Project Risk Management Process

1. Identify risks
2. Assess the risks
3. Develop appropriate responses to risks
4. Track and control the risks

- The risk management process repeats throughout every phase of the project from Conception through Close-out

Risk Management Elements and Process

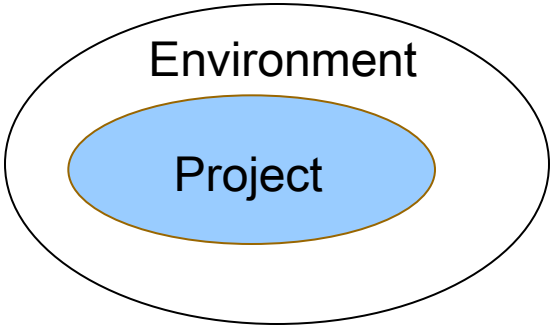
1. Identify Risks: Sources of Risk



Internal

- "Needs and Definition" Risk
  - Failure to correctly identify and define current or changing customer needs and requirements

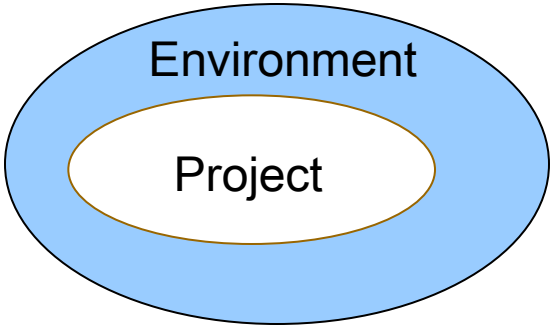
1. Identify Risks: Sources of Risk



Internal

- "Technical" Risk
  - Failure of the end item. Risk due to nature of the end item or the process to create it:
    - High complexity
    - Low maturity
    - Low reliability, produciblity, or testability
    - High concurrency (overlap of project work)

1. Identify Risks: Sources of Risk



External

- Risks in the project environment
  - Market conditions
  - Government mandate
  - Physical environment (weather, geography, etc.)
  - Labor and other resource availability
  - Project priorities
  - Customer/supplier relationships
  - Exchange rates

1. Identify Risks

- Analogy
  - Experience and documentation
- Checklists
  - Experience and post-mortem reviews

    Example, next slide
- WBS and work packages
- Process flow charts

Risk Checklist

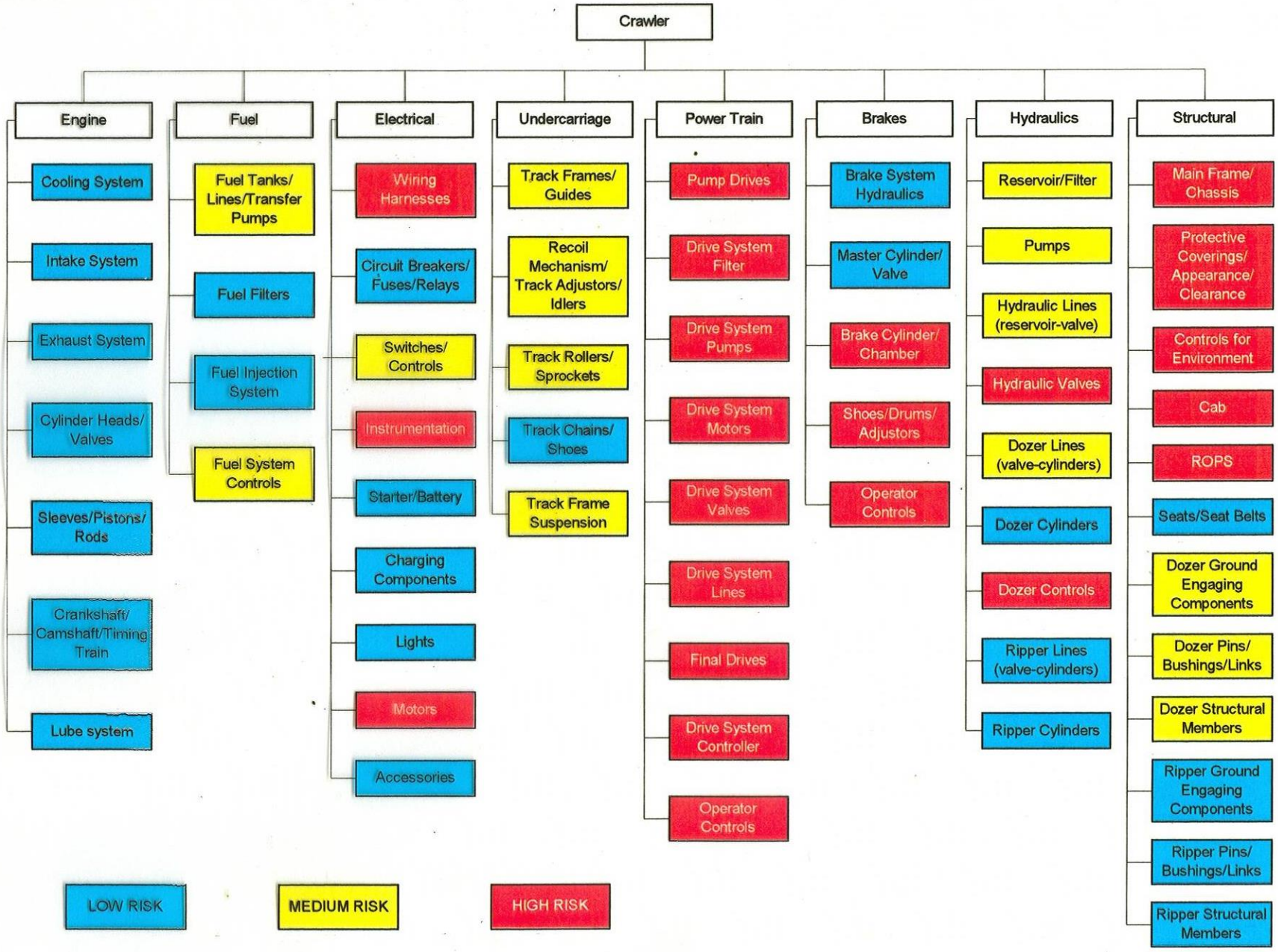
Element	Ref.	Risk	Likelihood (H, M or L)	Impact (H, M or L)
Project Management /authority	**1**	**Project Manager's lack of Project Management experience**		
	2	**Difficulty in securing full funding.** *(e.g. if the funding is coming from more than one source there may be a greater risk in securing it at the same time)*		
	3	**Lack of understanding of project management standards by everyone in the project team.**		
Project Nature	**6**	**Innovation or the introduction of new features.**		
	7	**The project is likely to need a large number of workdays.** *(e.g. low number of workdays = low risk, anything over six months =high risk)*		
	8	**Non-negotiable completion date.**		
Project Staff	**11**	**The project team is inexperienced or lacking appropriate skills for the project.**		
	12	**The project team will be expected to support end-users after project completion.** *(ongoing support = low risk, no support project beyond closure = high risk)*		
The Customer	**16**	**Customer support expected to be part of the project.**		
	17	**The project will affect current operations.**		
	18	**The customer requirements will not be well documented.** *(e.g. poor documentation increases risk of delivered product being unsatisfactory)*		
Third Parties /External bodies	**22**	**Third party suppliers are not well known to UEA.**		

1. Identify Risks

- Analogy
  - Experience and documentation
- Checklists
  - Experience and post-mortem reviews
- WBS and work packages

  Example, next slide
- Process flow charts

WBS and work packages with assessed level of risk



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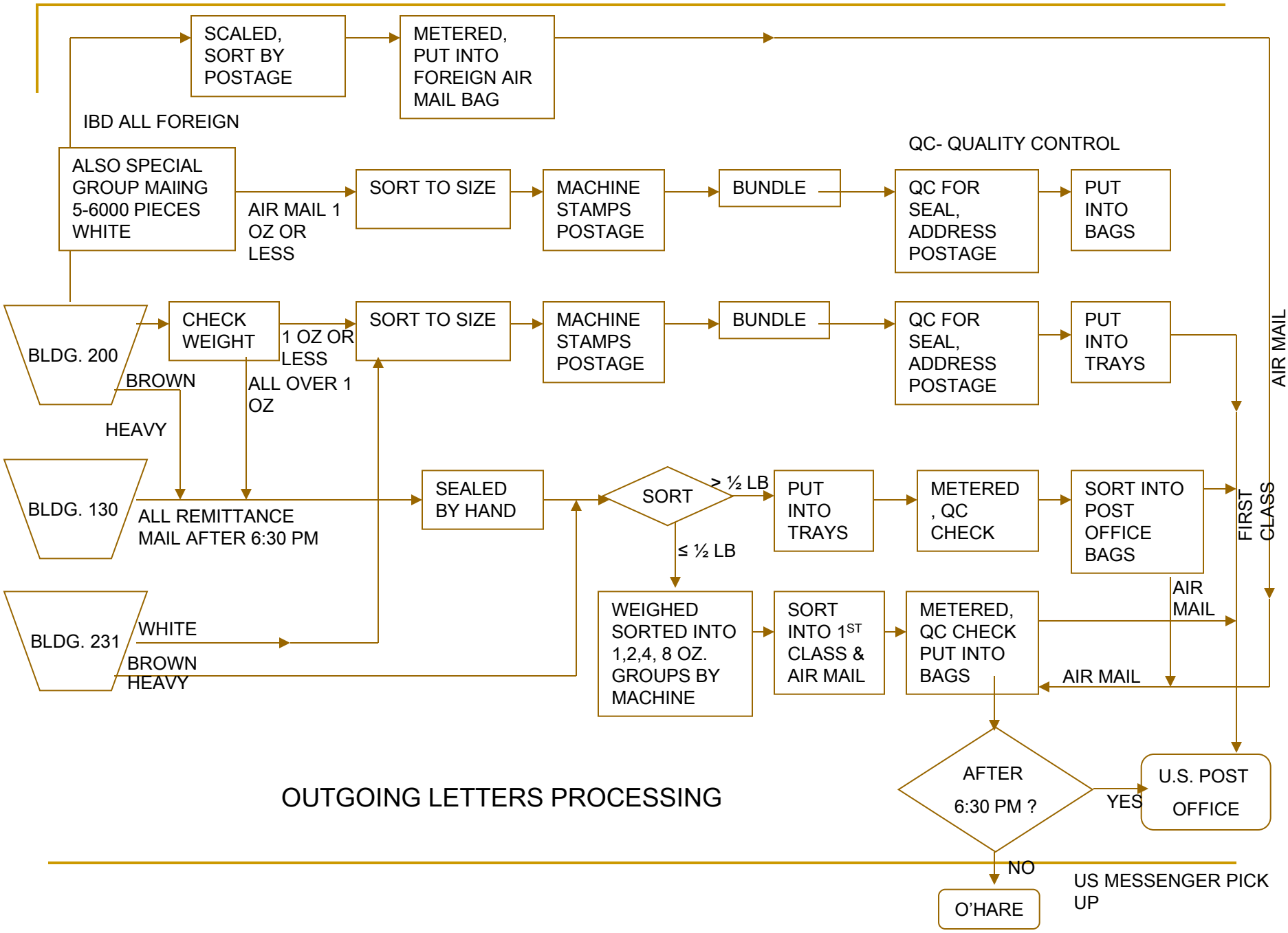

SCALED, SORT BY POSTAGE
METERED, PUT INTO FOREIGN AIR MAIL BAG
IBD ALL FOREIGN
QC- QUALITY CONTROL
ALSO SPECIAL GROUP MAIING 5-6000 PIECES WHITE
AIR MAIL 1 OZ OR LESS
SORT TO SIZE
MACHINE STAMPS POSTAGE
BUNDLE
QC FOR SEAL, ADDRESS POSTAGE
PUT INTO BAGS
BLDG. 200
CHECK WEIGHT
1 OZ OR LESS
SORT TO SIZE
MACHINE STAMPS POSTAGE
BUNDLE
QC FOR SEAL, ADDRESS POSTAGE
PUT INTO TRAYS
AIR MAIL
BROWN
ALL OVER 1 OZ
HEAVY
BLDG. 130
ALL REMITTANCE MAIL AFTER 6:30 PM
SEALED BY HAND
SORT
> ½ LB
PUT INTO TRAYS
METERED , QC CHECK
SORT INTO POST OFFICE BAGS
FIRST CLASS
≤ ½ LB
AIR MAIL
BLDG. 231
WHITE
BROWN HEAVY
WEIGHED SORTED INTO 1,2,4, 8 OZ. GROUPS BY MACHINE
SORT INTO 1ST CLASS & AIR MAIL
METERED, QC CHECK PUT INTO BAGS
AIR MAIL
AFTER 6:30 PM ?
YES
U.S. POST OFFICE
NO
O'HARE
US MESSENGER PICK UP
OUTGOING LETTERS PROCESSING

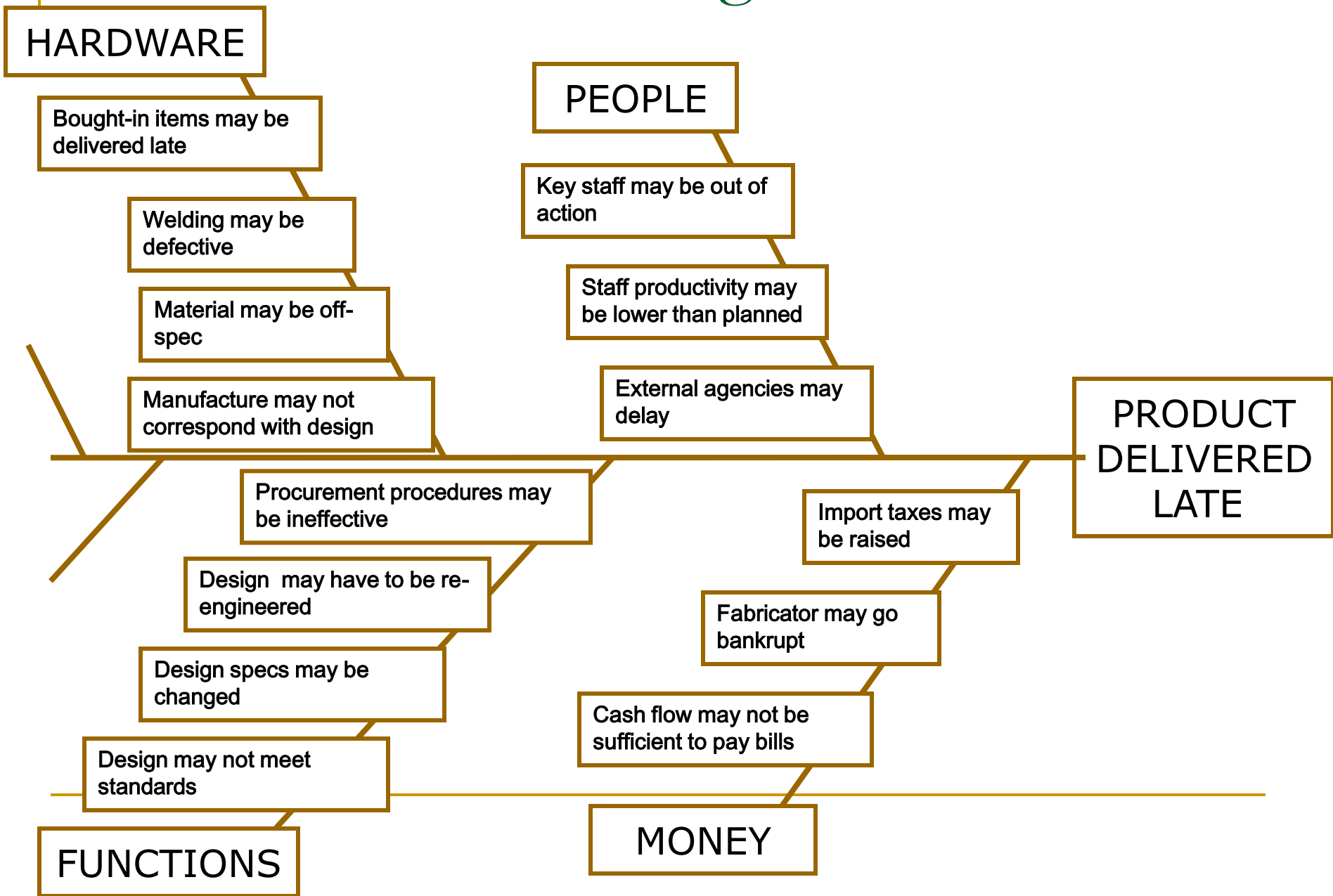
1. Identify risks

- Brainstorming
- Delphi Technique
- Cause-Effect analysis

Causes		Effect
Risk sources and hazards	→	Outcomes, Consequences

Example, next slide

Cause and Effect Diagram



2. Assess the Risk

- Assess RC (the risk “consequence” or “exposure”)

  RC = (Probability) x (Impact)

2. Assess the Risk

- Probability, expressed as
  - numerical estimate, 0-1.0
  - or nominal rating, e.g, VH, H, M, L,VL
  - or interval rating, e.g., 1-5

- Impact, expressed as
  - physical impact on time (weeks), cost ($) or, performance
  - or nominal or interval rating, e.g. VH, H, M, L, VL,
  - or interval rating, e.g., 1-5

2. Assess the Risk

Combing several independent risk sources

- ***Composite likelihood factor***,

$$CLF = (W1)\ M_H + (W2)\ C_H + (W3)\ M_S + (W4)\ C_S + (W5)D$$

where

- M_H , M_S , C_H , C_S , and D are failure likelihoods due to immaturity of hardware and software, complexity in hardware and software,and dependency on external factors, respectively; each has value 0 to 1.0
- W1, W2, W3, W4, and W5 each has value 0 through 1.0 and together total 1.0.

2. Assess the Risk

Combing several independent risk sources

- ***Composite impact factor***,

  CIF = (W1)TI + (W2)CI + (W3)SI

where

- T1, C1, and S1 are impacts due to failure in technical performance, cost, and schedule, respectively; each has value 0 to 1.0
- W1, W2, and W3 each has value 0 through 1.0 and together total 1.0.

2. Assess the Risk

Risk Consequence

RC = probability x impact

- Example

RC = 0.75 x 5 = 3.75

2. Assess the Risk

Risk Consequence

When probability and impact are expressed as nominal values (e.g., VH, H, M, L,VL; next three slides),

RC = f(probability,impact)

Element	Ref.	Risk	Likelihood (H, M or L)	Impact (H, M or L)
Project Management /authority	**1**	**Project Manager's lack of Project Management experience**		
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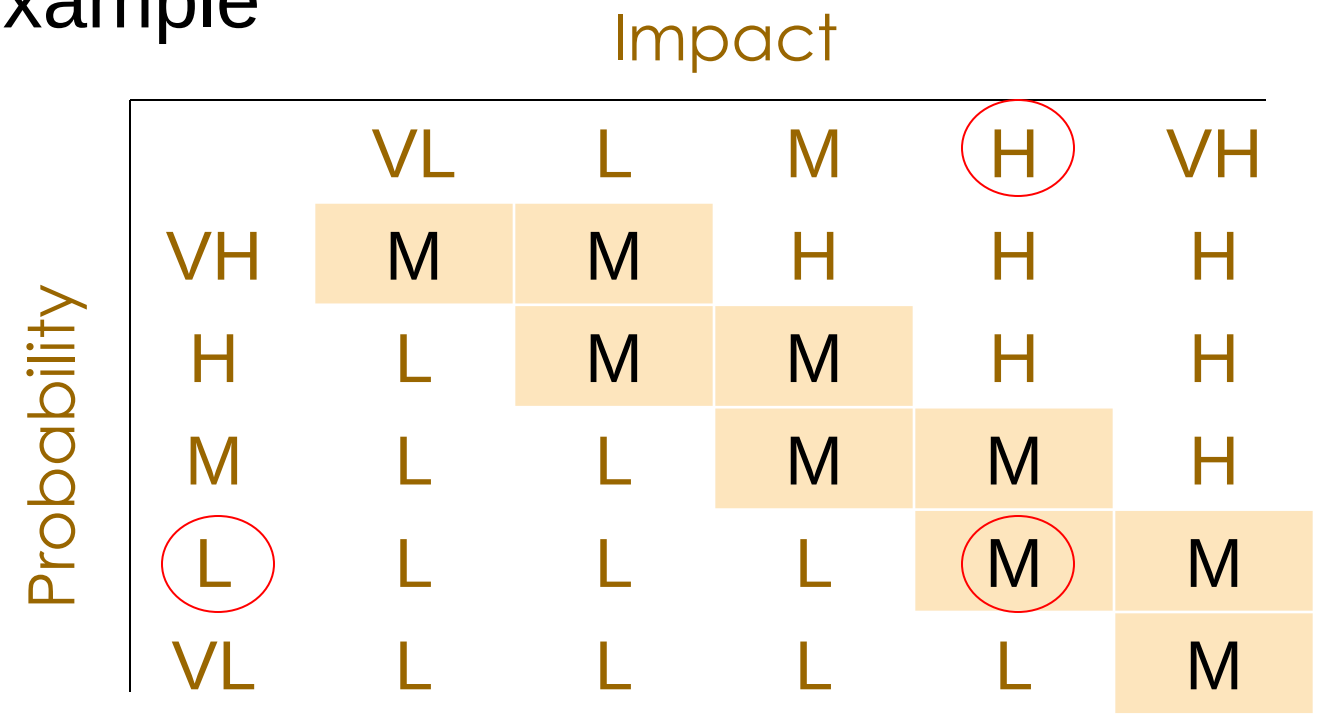
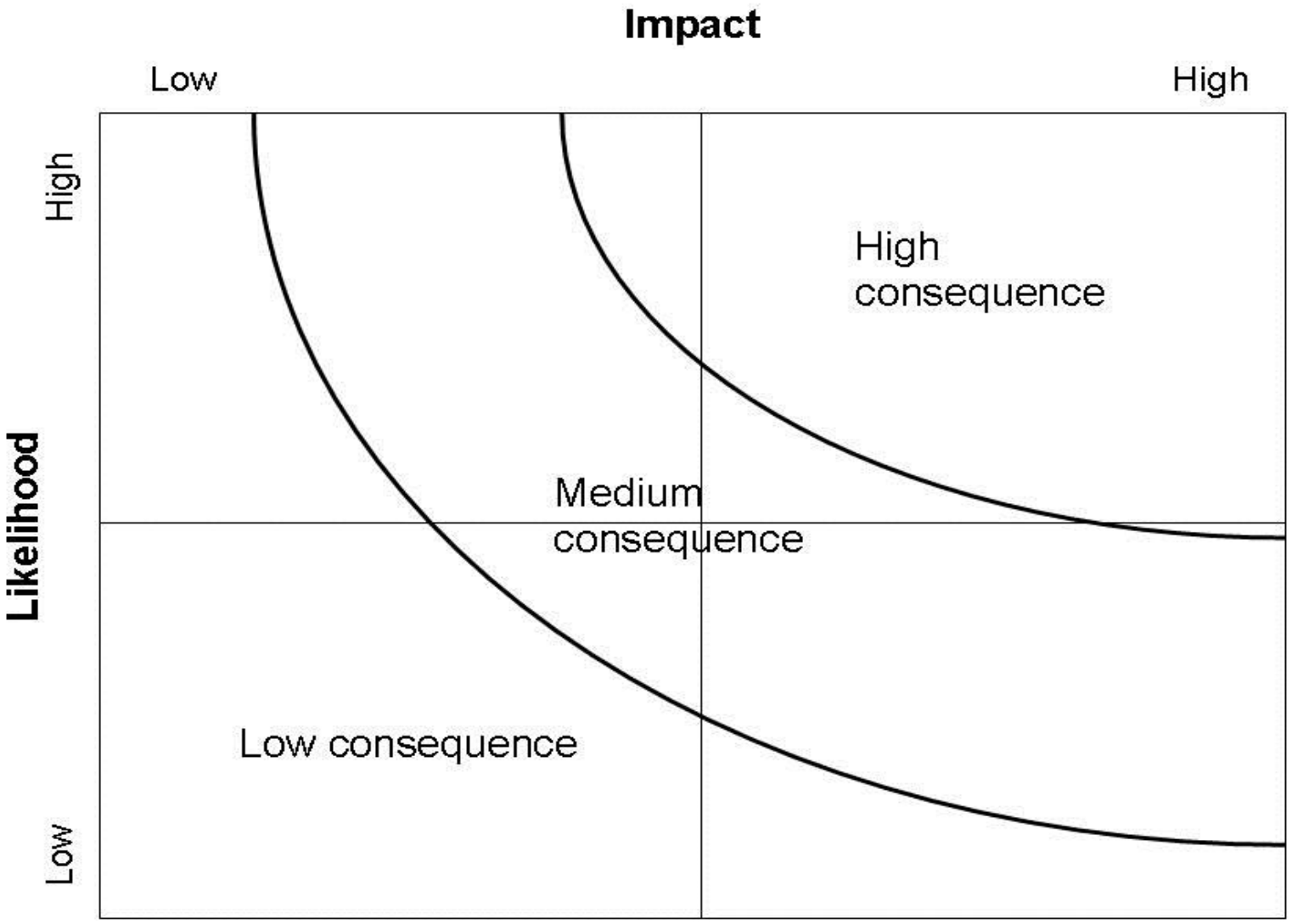
2. Assess the Risk

- Example



- RC = L x H = M (according to table)

2. Assess the Risk



3. Decide Risk Response Strategies (Ways of Handling Risks)

Transfer risk

- Insurance
  - Property damage or personal injury suffered as a consequence of the project
  - Damage to materials while in transit or in storage
  - Breakdown or damage of equipment
  - Theft of equipment and materials
  - Sickness or injury of workers, managers, and staff
  - Forward cover: insure against exchange rate fluctuations.

3. Decide Risk Response Strategies (Ways of Handling Risks)

Transfer risk (cont'd)

- Contracts
  - Fixed-price versus cost-plus

3. Decide Risk Response Strategies (Ways of Handling Risks)

Avoid risk

- Eliminate sources of risk
- Micromanage

3. Decide Risk Response Strategies (Ways of Handling Risks)

Reduce risk

- Employ best workers
- Use known and tested technology and tools
- Use parallel efforts
- Employ strong worker incentives
- Increase frequency and severity of reviews and tests
- Reduce system complexity
- Use design margins

3. Decide Risk Response Strategies (cont'd)

Contingency Plan

- Study possible what-if scenarios and develop a plan for each

- Accept risk (do nothing)

4. Risk Tracking and Response

- Create a ***risk log*** or ***risk register****; risks are* rank ordered, greatest risk consequence first.
  - Risk log and mitigation plan
  - Example, next slide

- ***Continuously monitor*** project for trigger symptoms of previously identified risks, and for symptoms of risks newly emerging and not previously identified.

Probability: 0-100%, Impact: 1-5: Exposure: (Probability) X (Impact), Scale 0-500

Item No.	Risk: Condition likely to occur; inherent in every project	Functional area impacted	Impact	Probability	Exposure	Effect: Consequences if risk occurs	Preventive action to reduce risk
11	Progeni solutions can't perform up to expectations.	Application Development	5	75%	375	Schedule delays. Cost of hiring a replacement vendor.	Analyze pilot results and create documents that will standardize the process.
8	Unknowns in migration project will occurs.	Technical Infrastructure	4	90%	360	Scheduling delays and possible re-engineering. Redundant system costs.	Build plan and tracking mechanism to manage schedule and resources
28	Client impact during migration phase.	Technical Infrastructure	5	70%	350	Dissatisfaction of client base with service levels.	Solid test process during System and Client Beta test. Focus from Business Development staff.
22	Programs/WFL run ineffectively in a muti-Usercode environment on a single system.	Application Development	4	75%	300	Increased S&P support and service level issues.	WFL training and testing. Technical support from S&P.
5	Lift & Merge process won't meet migration schedule, that calls for the moving of remaining clients, during the migration of the first V/Series site	Application Development	4	75%	300	Difficulty in establishing remaining first site clients. Would force a change in migration strategy.	Utilize knowledge learned from Purple system Lift & Merge even scheduled for May of 2000.
27	Excessive manual changes during post-syntran process.	Application Development	4	70%	280	Schedule delays.	After receipt of pilot determine extent of excess work and readjust resources.
10	Lift & Merge not kept up to date.	Application Development	4	70%	280	Difficulty in establishing remaining clients, on first site chosen, on the ClearPath.	Create Plan to keep L&M on track and current.
1	Conversion process of Jobflows to WFL and applicational re-design	Application Development	4	65%	260	If not handled properly, major impact on quality of product delivered to client base.	Training early in the project. Extensive quality assurance of process. Dedicate proper staffing.

Set Risk Management Practices and Policies

- Risk Management Plan
  - Specifies methods to identify, **profile**, assess, monitor, and handle risks
  - Names the **risk officer**
  - Contains a budget and schedule **reserve**
  - Example, next slide

- Risk Profile
  - The likelihood, impact, trigger symptoms, monitoring methods, and response strategy for **each identified risk**

Risk Management Form

Log Number	Date	Originator's Name	Risk Category
203	18 Oct. 97	E. Hall	Product. Test
Risk Title:	**Probability:**	**Consequence:**	**Time Frame:**
Test Growth	Likely	High	Medium
Project:	**Phase:**	**Function:**	**WBS Element:**
TEG-32	Code & Unit Test	System Test	01-05-03

Risk Assessment

Risk statement:
Growth in the number of object classes · will probably · increase the system test hours beyond plan.

Risk context: The number of object classes has grown over 20 percent beyond estimate used in test planning. Test is 10 months of 3 year program. Test is $10 million of $100 million total cost.

Risk analysis: 33 percent of system test is software integration test times 20 percent growth in software = 6.6 percent growth in overall system test schedule.

Risk exposure = probability between 61 to 80% times
consequence of 6.6% test growth
= 3.6 to 4.8%.

Cost impact = 660 K Schedule slip = 3 weeks.

Risk Planning

Strategy:
- ☐ Avoidance
- ☐ Protection
- ☑ Reduction
- ☐ Research
- ☑ Reserves
- ☐ Transfer

Risk action plan:
1. Use reserve to purchase COTS automated test tool and training.
2. Use tool to increase productivity of test engineers and decrease likelihood of schedule slip.

Risk Tracking

Quantitative target:	**Comments:**
2,000 object classes.	Per original estimate.
Indicator:	
Object class count.	
Threshold:	
2,400 object classes.	Anticipated software growth.
Trigger: At each unit test.	Update actual object class count.

Risk Resolution

Software Engineer:	System Engineer:	Quality Assurance:	Project Manager:
Date:	Date:	Date:	Date:

Risk Management Practices and Policies

- Risk Officer
  - Person to oversee the identification, assessment, monitoring, and handling of project risks
  - devil's advocate
  - usually not the project manager
- Risk Schedule and Budget Reserve
  - Time and dollar amount in schedule and budget to cover risks

Risk Management Practices and Policies

- Communicate Risks
  - Polices, procedures, and culture to ensure project manager is always quickly informed about problems and risks
- Standards and procedures for documenting the project
  - Good documentation (proposals, plans, work orders, change requests, reviews, and post-project summary reports) provides information necessary for identifying risks in future projects.
  - Helps to identify risks on current project and predict risks on future projects

Risk Management Planning, NASA website

- http://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PR_8000_0004_&page_name=main

Risk Assessment and Management, Example

- Risk Management for Tiles on the Space Shuttle
  - Source: Pate-Cornell and Fishbeck, “Risk management for the tiles on the space shuttle,” *Interfaces*, 24:1, Jan-Feb 1994, 64-86

Columbia Space Shuttle

Tiles on space shuttle

Criticality Index =
f{P(tiles lost from debris or weak bonding),
P(adjacent tiles lost),
P(burn-through given tiles lost),
P(failure of subsystems given burn-through),
P(LOV/C given failure of subsystem)}

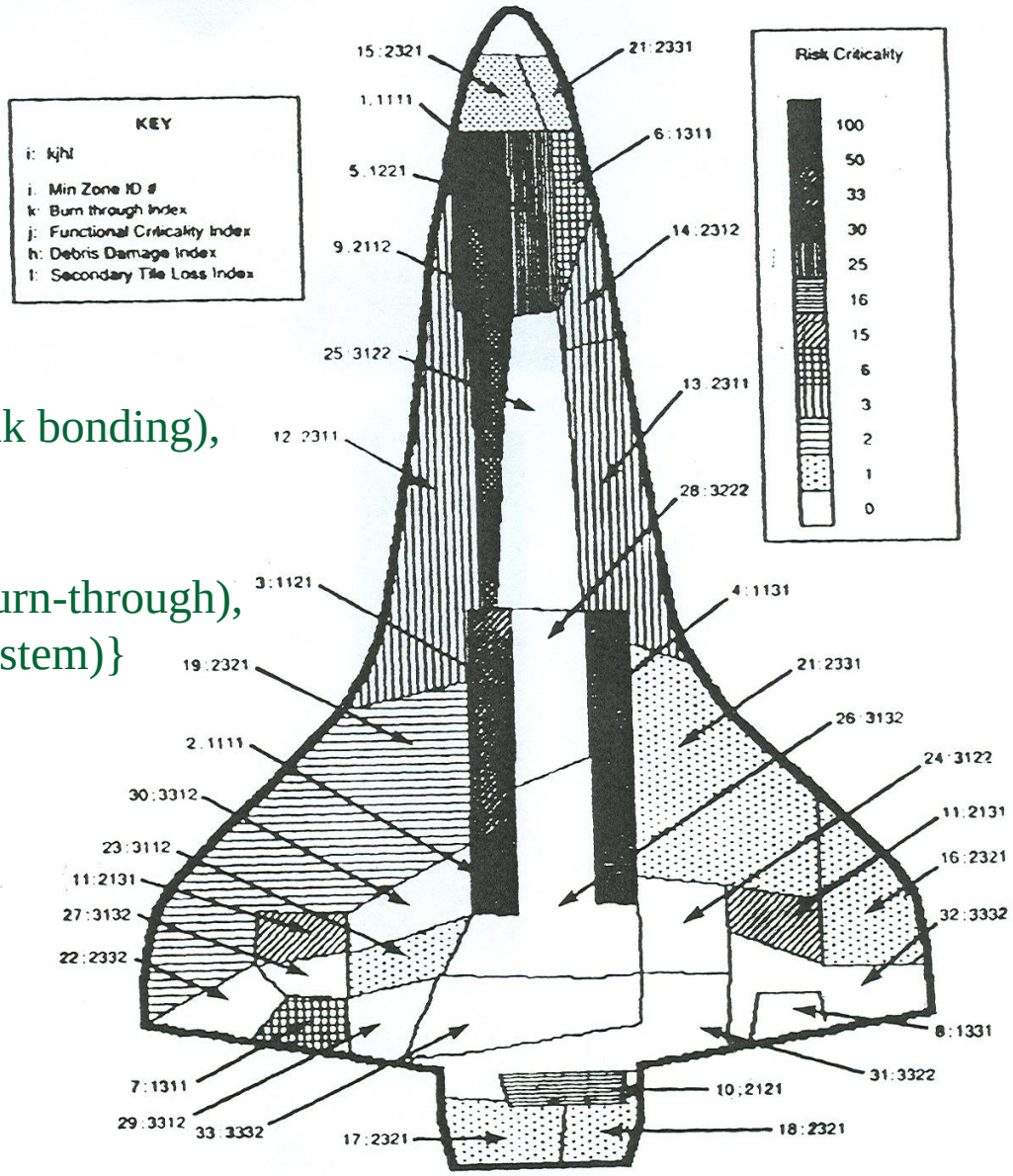
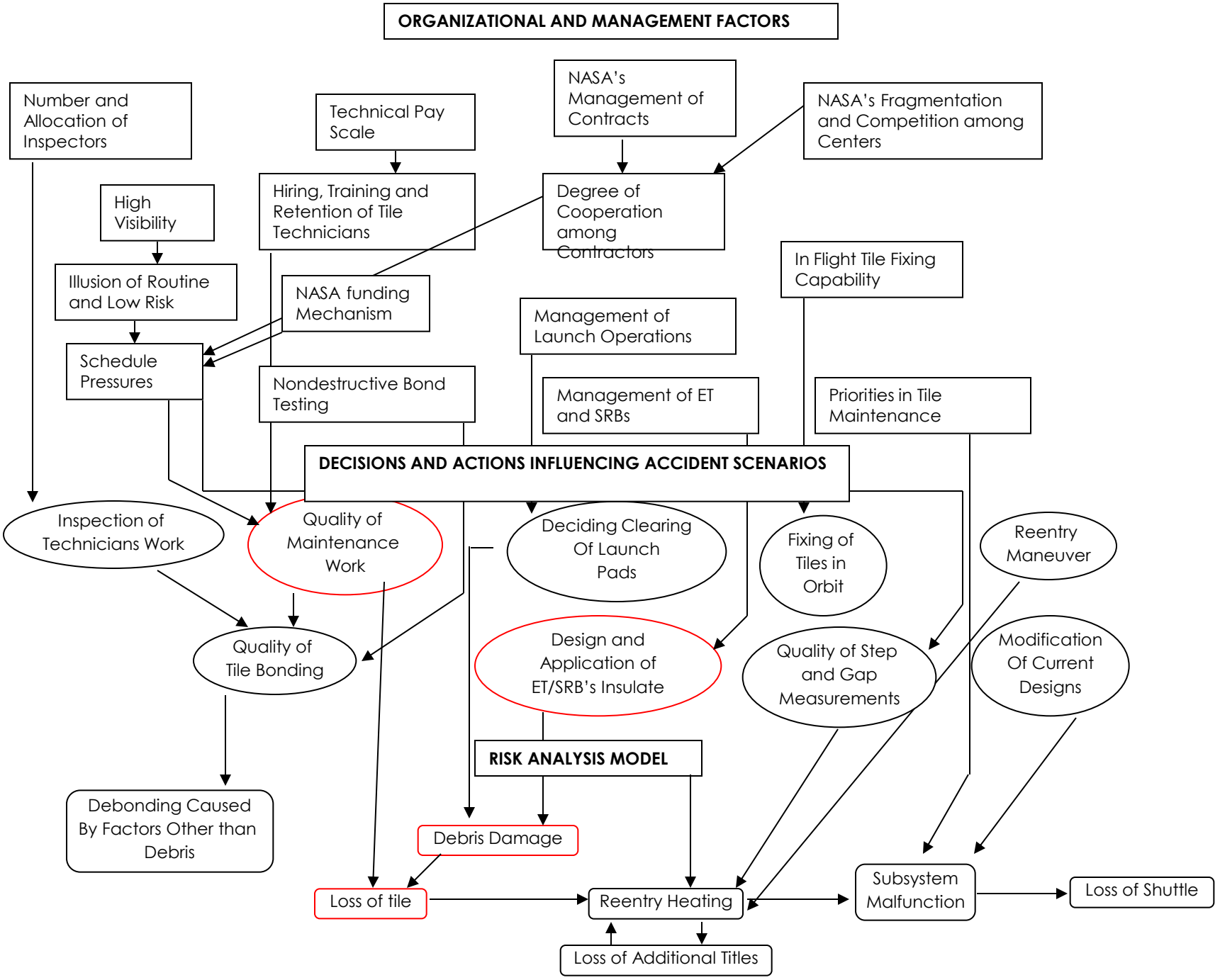


Figure 4: This map of the orbiter, showing the min-zones and the risk criticality of each tile, represents the main results of the analysis.


ORGANIZATIONAL AND MANAGEMENT FACTORS
Number and Allocation of Inspectors
Technical Pay Scale
NASA's Management of Contracts
NASA's Fragmentation and Competition among Centers
High Visibility
Hiring, Training and Retention of Tile Technicians
Degree of Cooperation among Contractors
In Flight Tile Fixing Capability
Illusion of Routine and Low Risk
NASA funding Mechanism
Management of Launch Operations
Schedule Pressures
Nondestructive Bond Testing
Management of ET and SRBs
Priorities in Tile Maintenance
DECISIONS AND ACTIONS INFLUENCING ACCIDENT SCENARIOS
Inspection of Technicians Work
Quality of Maintenance Work
Deciding Clearing Of Launch Pads
Fixing of Tiles in Orbit
Reentry Maneuver
Quality of Tile Bonding
Design and Application of ET/SRB's Insulate
Quality of Step and Gap Measurements
Modification Of Current Designs
RISK ANALYSIS MODEL
Debonding Caused By Factors Other than Debris
Debris Damage
Loss of tile
Reentry Heating
Subsystem Malfunction
Loss of Shuttle
Loss of Additional Titles