FMEA Teamwork- Bicycle

Phase I - Groups

Student Group: Body [excluding accessories (mudguard, bell, reflectors etc.)]+ Power transmission (gears, pedals, chain, etc.) excluding tyres+ Brakes (cable, levers, pads etc.)

Coach Group: Tyres and wheels
- For each group team name and leader should be defined

Phase II - Review of the product and brainstorm potential failure modes

List all items related to the subject of the group and for each item, select a commonly used solution. If possible, obtain a blueprint (engineering drawing) of it.
- Think over possible failure modes of the items

- Each item the effect of

    1. People

    2. Methods

    3. Equipment

    4. Materials

    5. Environment

- Group (rearrange) or combine failure modes

    - E.g. mechanical, environmental, user generated etc.

- Write down details into the FMEA worksheet (see Appendix I)

Phase III - Assign severity, occurrence and detection ratings

- Firstly, list potential effects of each failure mode

    - Use the concept: *If the failure occurs, then what are the consequences*

    - Several effects per each failure mode are possible

- Assign a severity rating for each effect (based on the table below)

Rating	Description	Definition
10	Dangerously high	Failure could injure the customer or an employee.
9	Extremely high	Failure would create noncompliance with federal regulations.
8	Very high	Failure renders the unit inoperable or unfit for use.
7	High	Failure causes a high degree of customer dissatisfaction.
6	Moderate	Failure results in a subsystem or partial malfunction of the product.
5	Low	Failure creates enough of a performance loss to cause the customer to complain.
4	Very Low	Failure can be overcome with modifications to the customer's process or product, but there is minor performance loss.
3	Minor	Failure would create a minor nuisance to the customer, but the customer can overcome it in the process or product without performance loss.
2	Very Minor	Failure may not be readily apparent to the customer, but would have minor effects on the customer's process or product.
1	None	Failure would not be noticeable to the customer and would not affect the customer's process or product.

- Secondly, for each failure mode list potential cause(s) and assign an occurrence rating based on the table below

Rating	Description	Potential Failure Rate
10	Very High: Failure is almost inevitable	More than one occurrence per day or a probability of more than three occurrences in 10 events ($C_{pk} < 0.33$).
9		One occurrence every three to four days or a probability of three occurrences in 10 events ($C_{pk} \approx 0.33$).
8	High: Repeated failures	One occurrence per week or a probability of 5 occurrences in 100 events ($C_{pk} \approx 0.67$).
7		One occurrence every month or one occurrence in 100 events ($C_{pk} \approx 0.83$)
6	Moderate: Occasional failures	One occurrence every three months or three occurrences in 1,000 events ($C_{pk} \approx 1.00$)
5		One occurrence every six months to one year or one occurrence in 10,000 events ($C_{pk} \approx 1.17$)
4		One occurrence per year or six occurrences in 100,000 events ($C_{pk} \approx 1.33$).
3	Low: Relatively few failures	One occurrence every one to three years or six occurrences in ten million events ($C_{pk} \approx 1.67$).
2		One occurrence every three to five years or 2 occurrences in one billion events ($C_{pk} \approx 2.00$).
1	Remote: Failure is unlikely.	One occurrence in greater than five years or less than two occurrences in one billion events ($C_{pk} > 2.00$).

- Assign a detection rating for each failure mode and/or effect

    − Think over (or guess) how easy it would be for the manufacturer to detect
    the possible problem?

Rating	Description	Definition
10	Absolute Uncertainty	The product is not inspected or the defect caused by failure is not detectable.
9	Very Remote	Product is sampled, inspected, and released based on Acceptable Quality Level (AQL) sampling plans.
8	Remote	Product is accepted based on no defectives in a sample.
7	Very Low	Product is 100% manually inspected in the process.
6	Low	Product is 100% manually inspected using go/no-go or other mistake-proofing gauges.
5	Moderate	Some Statistical Process Control (SPC) is used in process and product is final inspected off-line.
4	Moderately High	SPC is used and there is immediate reaction to out-of-control conditions.
3	High	An effective SPC program is in place with process capabilities (C_{pk}) greater than 1.33.
2	Very High	All product is 100% automatically inspected.
1	Almost Certain	The defect is obvious or there is 100% automatic inspection with regular calibration and preventive maintenance of the inspection equipment.

Phase IV - Calculate risk priority number for each failure mode

- RPN = Severity x Occurrence x Detection

- Also total RPN (sum of all RPNs) should be calculated

    − Absolute value is meaningless, but can be used for evaluating the effect of
    revisions/improvements

- Prioritise the failure modes for action

    − Create a "Pareto diagram"

    1st Highest severity ratings
    − 2nd Define "a critical RPN"

Phase V – Think over (and list down) the actions to eliminate or reduce the high-risk failure modes

- Increasing detectability can be easy, but it is not recommended

- Calculate the resulting RPN as the failure modes are reduced

  - Total RPN should be $< 50\%$ of the original RPN

Phase VI – Prepare presentation of the team work

- Presentation (about 30-45 min) will be given 10.12.2008

- Presentation should contain at least:

  - General description of the team's FMEA process (incl. how the responsibilities were divided)

  - Explanation of the FMEA worksheet

  - Pareto diagram

  - Few examples of the corrective actions/solutions

  - General comments of the task

N.B. William Martin gives online language support as well as hints for the presentation.

Appendix I

Product: Bicycle
FMEA Team name:
Team Leader:

FMEA Number:
FMEA DATE (Original):
FMEA DATE (Revised):

FMEA Process

Action Results

Item and function	Potential failure mode	Potential effect(s) of the failure	Severity	Potential cause(s) of the failure	Occurrence	Current controls	Detection	RPN	Recommended action	Responsibility and target completion date	Action taken	Severity	Occurrence	Detection	RPN