

EXAM

Product Planning – Needs and Opportunities

Course code: PPU085

Wednesday 2022-01-12 at 14.00-18.00

Examiner: Professor Johan Malmqvist.

Questions: Professor Johan Malmqvist, 031 – 772 1382, johan.malmqvist@chalmers.se. Prof Malmqvist will visit the exam rooms at approximately 14.30 and 15.45.

Department: Industrial and Materials Science.

Solutions: Will be posted on the course’s Canvas page on Thursday 2022-01-13.

Results: Will be announced no later than Wednesday 2022-02-02.

Exam review: In Inspera, you will be able to access your own answers also after the exam. Requests for correction of the marking should be sent by e-mail to Lena Bendrioua (lana.bendrioua@chalmers.se) using the “Request for correction_review of grade.pdf” form that is available in Canvas under Templates.

Grades: The maximum score on the exam is 20 points. 8 points are required for passing the exam and a “3” grade. For grades “4” and “5”, 12 and 16 points are required, respectively.

Tools

The exam is run in the Inspera digital exam system. In addition, pen, paper and dictionaries and “Chalmers approved calculators” are permitted.

NB! Solutions should be documented with text and drawings. Equations should be motivated. Also partially solved problems will be assessed. If some details are missing in the problem statement, introduce suitable parameters and assume, if necessary (reasonable) numbers.

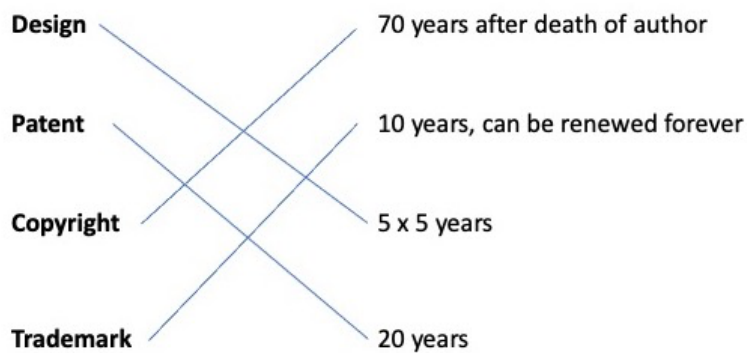
It is recommended that graphics are drawn using the functionality available in Inspera. However, you may also draw them on paper and hand them into to the exam staff. Ask the exam staff for assistance in the matter.

1 Patents (1 p)

The picture below shows four types of intellectual property rights (IPR) and four different protection periods. Draw lines to connect each IPR with the correct protection period.

Design	70 years after death of author
Patent	10 years, can be renewed forever
Copyright	5 x 5 years
Trademark	20 years

Solution



2 Patents (1 p)

As defined in the Ulrich et al. textbook, a *trademark* is:

- a) information used in a trade or business that offers its owner a competitive advantage and that can be kept secret
- b) an exclusive right granted by the government to a trademark owner to exclude others from using an invention
- c) a temporary monopoly granted by the government to a trademark owner to use a specific name or symbol in association with a class of products or services
- d) an exclusive right granted by a government to copy and distribute an original work.
- e) an exclusive right granted by the government to a trademark owner to use a specific name or symbol in association with a class of products or services

Source: Mousumi Roy (University of Connecticut) (slightly modified)

Solution

(e)

3 Business development (2 p)

What is minimal viable product? What are the main purposes of a minimal viable product?

Solution

A minimal viable product (MVP) embodies the minimal set of features that customers are willing to pay for.

The main purposes of a MVP are to:

1. Reduce wasted engineering hours, by making sure that development only works on features that customers actually need
2. Maximize learning by getting something into the hands of early adopters (“earlyvangelists”), and obtaining their feedback as early as possible.

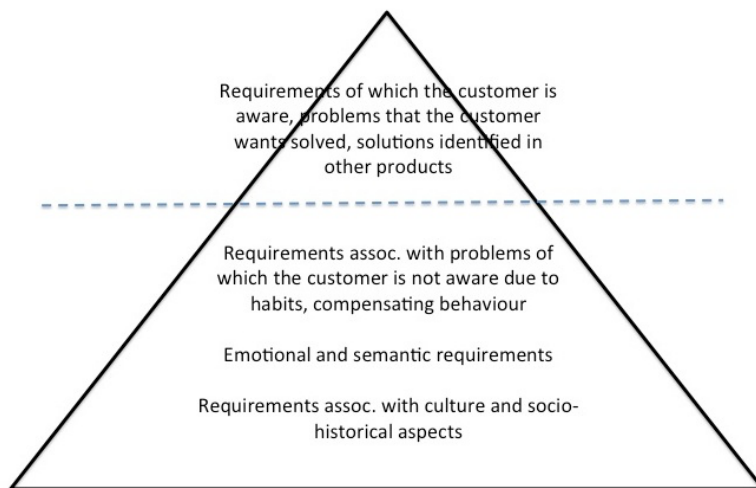
4 Iceberg phenomenom (2 p)

Describe the “Iceberg phenomenom” in the customer requirements context. What kinds of requirements are above/below the surface? What kinds of requirements are typically furthest away from the surface?

Solution

As indicated in the figure below, the requirements that are easiest to elicit involve problems that customers want solved or solutions available in other products. These constitute the tip of the iceberg.

It becomes increasingly difficult to elicit requirements shown in compensating behaviours, emotional needs or related to socio-historical aspects. These requirements are said to be below the surface and thus more difficult to access.



5 Technology readiness level (TRL) assessment (3 p)

Describe in principle the Technology Readiness Level (TRL) model. What are the main motives underlying the introduction and use of this model?

On (approximately) what level do you consider your own project to be and why?

Solution

The Technology Readiness Level describes the level of maturity of a technology ranging from the basic properties have been observed (level 1) to that an actual system has been “flight proven” in real missions (level 9). Along this development stairway 9 levels are identified. Each level is associated with relevant activities and success criteria, see graphic below.

Technology Readiness Level	Description
1. Basic principles observed and reported	This is the lowest "level" of technology maturation. At this level, scientific research begins to be translated into applied research and development.
2. Technology concept and/or application formulated	Once basic physical principles are observed, then at the next level of maturation, practical applications of those characteristics can be 'invented' or identified. At this level, the application is still speculative: there is not experimental proof or detailed analysis to support the conjecture.
3. Analytical and experimental critical function and/or characteristic proof of concept	At this step in the maturation process, active research and development (R&D) is initiated. This must include both analytical studies to set the technology into an appropriate context and laboratory-based studies to physically validate that the analytical predictions are correct. These studies and experiments should constitute "proof-of-concept" validation of the applications/concepts formulated at TRL 2.
4. Component and/or breadboard validation in laboratory environment	Following successful "proof-of-concept" work, basic technological elements must be integrated to establish that the "pieces" will work together to achieve concept-enabling levels of performance for a component and/or breadboard. This validation must be devised to support the concept that was formulated earlier, and should also be consistent with the requirements of potential system applications. The validation is "low-fidelity" compared to the eventual system: it could be composed of ad hoc discrete components in a laboratory.
5. Component and/or breadboard validation in relevant environment	At this level, the fidelity of the component and/or breadboard being tested has to increase significantly. The basic technological elements must be integrated with reasonably realistic supporting elements so that the total applications (component-level, sub-system level, or system-level) can be tested in a 'simulated' or somewhat realistic environment.
6. System/subsystem model or prototype demonstration in a relevant environment (ground or space)	A major step in the level of fidelity of the technology demonstration follows the completion of TRL 5. At TRL 6, a representative model or prototype system or system - which would go well beyond ad hoc, 'patch-cord' or discrete component level breadboarding - would be tested in a relevant environment. At this level, if the only 'relevant environment' is the environment of space, then the model/prototype must be demonstrated in space.
7. System prototype demonstration in a space environment	TRL 7 is a significant step beyond TRL 6, requiring an actual system prototype demonstration in a space environment. The prototype should be near or at the scale of the planned operational system and the demonstration must take place in space.
8. Actual system completed and 'flight qualified' through test and demonstration (ground or space)	In almost all cases, this level is the end of true 'system development' for most technology elements. This might include integration of new technology into an existing system.
9. Actual system 'flight proven' through successful mission operations	In almost all cases, the end of last 'bug fixing' aspects of true 'system development'. This might include integration of new technology into an existing system. This TRL does not include planned product improvement of ongoing or reusable systems.

Motives for using TRL assessment include:

- Risk management (a technology is not cleared for next level development or deployment before all tests on the previous level have been carried out successfully).
- Project planning (for each level, a number of standard activities are suggested)
- Portfolio planning (a company should have a balanced project portfolio, for example not dominated by research projects (level 1-3) but also not dominated by near-commercialization projects (levels 7-9)).

The approximation of the TRL for each project should provide a motivation for your assessment with reference to the TRL scale, for example by setting upper and lower bounds for how you consider your project.

6 Questionnaire (3 p)

Create a small questionnaire that can be used to elicit customer needs for an face masks intened to protection against Covid-19, exemplified below. Your survey should include at least six questions/statements with appropriate answer categories, and include all basic question types (demographic, behavioural, rating).



<https://smartairfilters.com/en/blog/comparison-mask-standards-rating-effectiveness/>

Solution

Demographics, for example:

- What is your sex < female, male, prefer to state >
- What is your age < < 13, 13-19, 20-30, 31-50, 51-65, > 65 >
- What is your highest level of education? < secondary school, high school, university degree, doctoral degree >
- How would you classify your political views? < left , left-centre, centre, centre-right, right, prefer not to say >
- ...

Behaviour, for example:

- How often do you use a face mask? < several times per day, once per day, once of more per week, once or more per week, once or more per month, never >
- If you use face masks:
 - Why are you using face masks (or not)? < for my own protection, for protecting others, because the government requires it, because it is a social norm, other >
 - Where do you use a face masks (multiple selections possible) < on public transport, in crowded indoor environment, in my workplace, outdoors, other, please specify ...>
 - How many times do you use a face mask before throwing it away or washing < once, 2-3 times, 4-6 times, > 6 times >
 - What type of face mask do you use < N95, FFP2, cloth mask, surgical mask, other, please specify. I don't know)
- If you are not using face masks:

- Why do you not use face mask? < I don't think that they are effective, Masks are too expensive, I don't want the government to tell me what to do, I prefer not to say >

Ratings, for example:

- The price of a face mask is < not at all important, somewhat important, important, very important > to me.
- The protective performance of a face mask is < not at all important, somewhat important, important, very important > to me.
- The aesthetic appearance of a face mask is < not at all important, somewhat important, important, very important > to me.
- The comfort of a face mask is < not at all important, somewhat important, important, very important > to me.
- The environmental friendliness of a face maske is < not at all important, somewhat important, important, very important > to me.

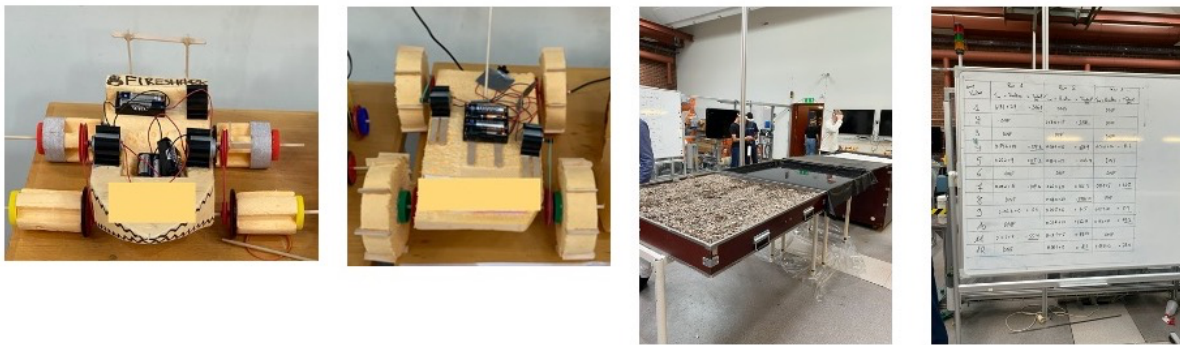
7 Benchmarking (4 p)

The pictures above show PD Classic track and some of the vehicles from this year.

Outline how you could carry out a benchmarking of the team's processes and vehicles in order to state recommendations for designing, building, testing and operating a successful vehicle for the competition.

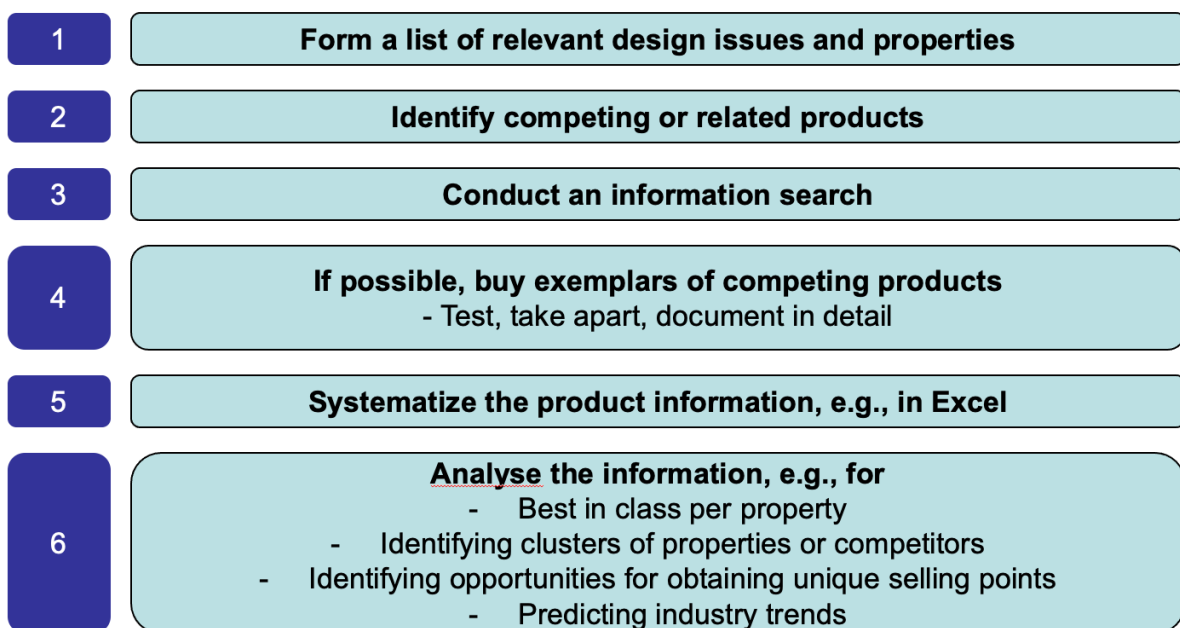
You can assume that you have access to the lab premises prior to and during the competition, and thus can make observations.

For full points, a solution should cover the relevant steps of this process, but does not have to be exhaustive. For example, not all possible design parameters need to be listed nor quantified.



Solution

The benchmarking process is summarised in the figure below:



1. Form a list of relevant design issues and properties

For the PD Classic and its' vehicle, we might consider vehicle dimensions and features, process characteristics, and, performance parameters, such as:

Vehicle dimensions and features

- Wheel base
- Front wheel track
- Rear wheel track
- Ground clearance
- Tire pattern
- Shovel blade
- Two-wheel drive / Four-wheel drive
- Special features
- ...

Process characteristics

- Created design models (eg sketches) prior to building
- Analysis of course characteristics
- Testing activity
- ...

Performance

- Time to complete race /TCR)
- Finished / Did not finish

2. Identify competing and related products

For the 2021 PD Classic, the 12 vehicles that competed that year.

3. Conduct an information search

- Study the vehicles. Take photographs, measure dimensions, note features
- Note the TCR and Finish / DNF
- Observe the teams in order to characterise their working processes

4. If possible, buy exemplars of competing products

- Not possible in this case

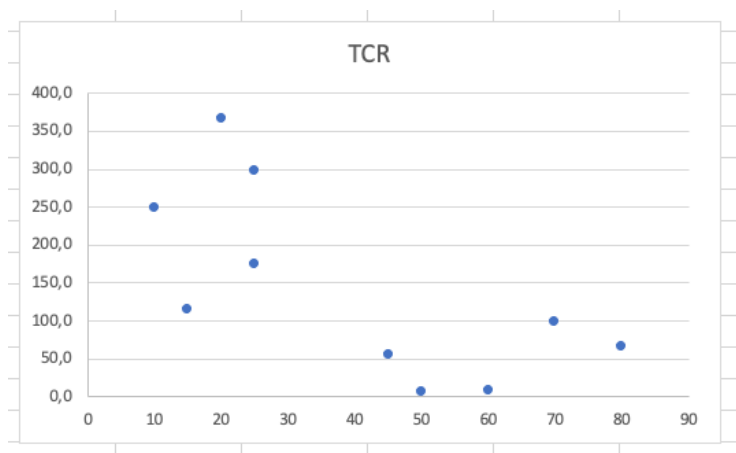
5. Systematize the product information, e.g. in Excel

- A partially complete benchmarking table is shown below.
- Numbers are fictitious and in some case deliberately distorted from actual designs

Vehicle	Design parameters							Special features	Process characteristics			Performance	
	Wheel base (mm)	Front wheel track (mm)	Rear wheel track (mm)	Ground clearance (mm)	Tire pattern (slick, medium, coarse)	Shovel blade (mm)	2WD/4WD		Design models	Course analysis	Testing (times)	F / DNF	TCR
1				20						0	F	366,1	
2				10						1	F	248,0	
3				25						1	DNF		
4				25						2	F	174,6	
5				15						2	F	115,2	
6				25						1	DNF		
7				80						3	F	66,5	
8				25						2	F	298,0	
9				50						4	F	5,9	
10				70						3	F	99,2	
11				45						3	F	55,4	
12				60						4	F	8,1	

6. Analyse the information

For example, the relations between ground clearance and TCR could be plotted in a charts.



An associated recommendations could be:

- Ground clearance should be at least 45 mm

8 Course learning outcomes (4 p)

Account for in text and graphics for what you know about the following course learning outcome:

“Generate, screen, and select product opportunities that derive from new technologies, environment, markets, and customer needs“

Solution

As this question can be answered in many ways, no single solution is presented. However, the underlying contents is mainly found in lectures notes 2.