ID	25927	**Status**	**Date**
Risk Area	Risikovurdering: Helse, miljø og sikkerhet (HMS)	Created	21.12.2017
Created by	Håvard Nitter Vestad	Assessment started	21.12.2017
Responsible	Håvard Nitter Vestad	Actions decided	
		Closed	22.12.2017

Risk Assessment:

Master's Thesis, Spring 2018 - Biomimicry in PD

Valid from-to date:

1/1/2018 - 7/1/2018

Location:

TrollLabs, MTP, NTNU, Trondheim

Goal / purpose

This is a risk assessment to map out the potential incidents and dangers and their consequences associated with the work for my master's project. The project has a wide scope and will involve general prototyping tools and equipment.

Background

This risk assessment is being carried out as standard procedure in preparation of experimental work at NTNU.

Description and limitations

The risk assessment concerns the author and other potential users in immediate proximity to work being carried out by author. Work will only be carried out within the confines of Troll Labs (M66) and the Realization Lab(148) at Richard Birkelands vei 2B Work will take place between Jan. 1st and Jul. 1st.

Activities included are use of workshop tools, including hand tools and laser cutter, 3D printers and vacuum former. And use being carried out on these as intended.

Prerequesites, assumptions and simplifications

I assume that the machines used are regularly maintenance and function as they should. And that other users of the workshop follow the HSE guidelines from NTNU's HSE training course. I further assume that the HsE certification courses is sufficient to reduce the risks associated with operation of machines and tools, and that machine cards are used and up to date for all machines.

Attachments

[Ingen registreringer]

References

[Ingen registreringer]

Summary, result and final evaluation

The summary presents an overview of hazards and incidents, in addtition to risk result for each consequence area.

Hazard: **TrollLabs Workshop**

Incident: **Large cut damage**

Consequence area:			
	Helse	Risk before actions:	Risiko after actions:
	Omdømme	Risk before actions:	Risiko after actions:

Incident: **Small cut damage**

Consequence area:			
	Helse	Risk before actions:	Risiko after actions:

Incident: **Exposure to chemicals**

Consequence area:			
	Helse	Risk before actions:	Risiko after actions:

Incident: **Small burn injuries**

Consequence area:			
	Helse	Risk before actions:	Risiko after actions:

Hazard: **Laser cutter**

Incident: **Damage to machine**

Consequence area:			
	Materielle verdier	Risk before actions:	Risiko after actions:
	Omdømme	Risk before actions:	Risiko after actions:

Incident: **Fire**

Consequence area:			
	Helse	Risk before actions:	Risiko after actions:
	Materielle verdier	Risk before actions:	Risiko after actions:
	Omdømme	Risk before actions:	Risiko after actions:

Incident: **Eye damage**

Consequence area:			
	Helse	Risk before actions:	Risiko after actions:
	Omdømme	Risk before actions:	Risiko after actions:

Hazard: **Electric power tools**

Incident: **Large cut damage**

Consequence area:	Helse	Risk before actions:	Risiko after actions:
	Omdømme	Risk before actions:	Risiko after actions:

Incident: **Small cut damages**

Consequence area:	Helse	Risk before actions:	Risiko after actions:

Hazard: **3D printer**

Incident: **Small burn damages**

Consequence area:	Helse	Risk before actions:	Risiko after actions:

Incident: **Damage to machine**

Consequence area:	Materielle verdier	Risk before actions:	Risiko after actions:

Hazard: **Vacuum former**

Incident: **Burn injury**

Consequence area:	Helse	Risk before actions:	Risiko after actions:

Incident: **Fire**

Consequence area:	Helse	Risk before actions:	Risiko after actions:
	Materielle verdier	Risk before actions:	Risiko after actions:
	Omdømme	Risk before actions:	Risiko after actions:

Incident: **Damage to machine**

Consequence area:	Materielle verdier	Risk before actions:	Risiko after actions:

Hazard: **Water tunnel opperation**

Incident: **Electrocution from**

Consequence area: Helse Risk before actions: Risiko after actions:

Hazard: **CNC Mill**

Incident: **Damaging machine and tools**

Consequence area: Materielle verdier Risk before actions: Risiko after actions:

Incident: **Shrapnel and derbies during cutting**

Consequence area: Helse Risk before actions: Risiko after actions:

Final evaluation

When using lab and workshop equipment alertness and caution should be executed at all instances. The risk as assessed are low and acceptable due to the measures that are already put in place to ensure good practices and alertness by the users, and correct handling should an incident occur.

Organizational units and people involved

A risk assessment may apply to one or more organizational units, and involve several people. These are lsited below.

Organizational units which this risk assessment applies to

- Institutt for maskinteknikk og produksjon

Participants

[Ingen registreringer]

Readers

[Ingen registreringer]

Others involved/stakeholders

ProtoMore, Molde Kunskapspark

The following accept criteria have been decided for the risk area Risikovurdering: Helse, miljø og sikkerhet (HMS):

Helse

Materielle verdier

Omdømme

Ytre miljø

Overview of existing relevant measures which have been taken into account

The table below presents existing measures which have been take into account when assessing the likelihood and consequence of relevant incidents.

Hazard	Incident	Measures taken into account
TrollLabs Workshop	Large cut damage	Safety gear
	Large cut damage	Training
	Large cut damage	HSE Certification course
	Small cut damage	Training
	Small cut damage	HSE Certification course
	Exposure to chemicals	Safety gear
	Exposure to chemicals	Training
	Exposure to chemicals	HSE Certification course
	Small burn injuries	Training
	Small burn injuries	HSE Certification course
Laser cutter	Damage to machine	Training
	Fire	Training
	Fire	HSE Certification course
	Eye damage	Safety gear
	Eye damage	Training
	Eye damage	HSE Certification course
Electric power tools	Large cut damage	Safety gear
	Large cut damage	Training
	Large cut damage	HSE Certification course
	Small cut damages	Safety gear
	Small cut damages	Training
	Small cut damages	HSE Certification course
3D printer	Small burn damages	Training
	Small burn damages	HSE Certification course
	Damage to machine	Training
Vacuum former	Burn injury	Safety gear
	Burn injury	Training
	Burn injury	HSE Certification course
	Fire	Training
	Fire	HSE Certification course
	Damage to machine	Training
Water tunnel opperation	Electrocution from	Safety gear
	Electrocution from	Training

Water tunnel opperation	Electrocution from	HSE Certification course
CNC Mill	Damaging machine and tools	Training
	Damaging machine and tools	Machine Cards
	Shrapnel and derbies during cutting	Training
	Shrapnel and derbies during cutting	HSE Certification course
	Shrapnel and derbies during cutting	Machine Cards

Existing relevant measures with descriptions:

Safety gear
Appropriate safety gear and goggles are used

Training
Training and safety briefs need to be done before use of individual machines and tools.

HSE Certification course
Users of the labs have had HSE Certification course by NTNU

Machine Cards
[Ingen registreringer]

Risk analysis with evaluation of likelihood and consequence

This part of the report presents detailed documentation of hazards, incidents and causes which have been evaluated. A summary of hazards and associated incidents is listed at the beginning.

The following hazards and incidents has been evaluated in this risk assessment:

- **TrollLabs Workshop**
  - Large cut damage
  - Small cut damage
  - Exposure to chemicals
  - Small burn injuries
- **Laser cutter**
  - Damage to machine
  - Fire
  - Eye damage
- **Electric power tools**
  - Large cut damage
  - Small cut damages
- **3D printer**
  - Small burn damages
  - Damage to machine
- **Vacuum former**
  - Burn injury
  - Fire
  - Damage to machine
- **Water tunnel opperation**
  - Electrocution from
- **CNC Mill**
  - Damaging machine and tools
  - Shrapnel and derbies during cutting

Detailed view of hazards and incidents:

Hazard: TrollLabs Workshop

General use of trollLabs workshop including cutting with small hand tools, electronics tools and gluing/painting.

Incident: Large cut damage

Large cuts from hand tools, such as saws or knives.

Likelihood of the incident (common to all consequence areas): **Unlikely (1)**

Kommentar:

[Ingen registreringer]

Consequence area: Helse

Risk:

Assessed consequence: **Medium (2)**

Comment: [Ingen registreringer]

Consequence area: Omdømme

Risk:

Assessed consequence: **Medium (2)**

Comment: [Ingen registreringer]

Incident: Small cut damage

Small cut damages from hand tools such as saws and knives.

Likelihood of the incident (common to all consequence areas): **Likely (3)**

Kommentar:

[Ingen registreringer]

Consequence area: Helse

Risk:

Assessed consequence: **Small (1)**

Comment: [Ingen registreringer]

Incident: Exposure to chemicals

Exposure to paint, glues or solvents.

Likelihood of the incident (common to all consequence areas): **Less likely (2)**

Kommentar:

[Ingen registreringer]

Consequence area: Helse

Risk:

Assessed consequence: **Medium (2)**

Comment: [Ingen registreringer]

Incident: Small burn injuries

Working with soldering iron may cause small burn injuries.

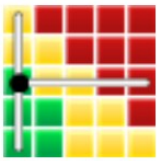
Likelihood of the incident (common to all consequence areas): **Likely (3)**

Kommentar:

High extent of usage of the tool, makes it a likely incident.

Consequence area: Helse

Risk:



Assessed consequence: **Small (1)**

Comment: [Ingen registreringer]

Hazard: Laser cutter

Hazards related to laser cutting work

Incident: Damage to machine

Wrong use of machine might lead to damages to the lens or machine assembly.

Likelihood of the incident (common to all consequence areas): **Less likely (2)**

Kommentar:
[Ingen registreringer]

Consequence area: Materielle verdier

Risk:

Assessed consequence: **Medium (2)**

Comment: [Ingen registreringer]

Consequence area: Omdømme

Risk:

Assessed consequence: **Medium (2)**

Comment: [Ingen registreringer]

Incident: Fire

Bad settings and use may lead to ignition of the materials being cut.

Likelihood of the incident (common to all consequence areas): **Unlikely (1)**

Kommentar:
[Ingen registreringer]

Consequence area: Helse

Risk:

Assessed consequence: **Medium (2)**

Comment: [Ingen registreringer]

Consequence area: Materielle verdier

Risk:

Assessed consequence: **Medium (2)**

Comment: [Ingen registreringer]

Consequence area: Omdømme

Risk:

Assessed consequence: **Medium (2)**

Comment: [Ingen registreringer]

Incident: Eye damage

Laser will shut of if door is opened, the weaker targeting laser can still be activated and potentially cause eye damage if used poorly.

Likelihood of the incident (common to all consequence areas): **Unlikely (1)**

Kommentar:

[Ingen registreringer]

Consequence area: Helse

Risk:

Assessed consequence: **Medium (2)**

Comment: [Ingen registreringer]

Consequence area: Omdømme

Risk:

Assessed consequence: **Medium (2)**

Comment: [Ingen registreringer]

Hazard: Electric power tools

Incident: Large cut damage

Likelihood of the incident (common to all consequence areas): **Unlikely (1)**

Kommentar:
[Ingen registreringer]

Consequence area: Helse

Risk:

Assessed consequence: **Medium (2)**

Comment: [Ingen registreringer]

Consequence area: Omdømme

Risk:

Assessed consequence: **Small (1)**

Comment: [Ingen registreringer]

Incident: Small cut damages

Likelihood of the incident (common to all consequence areas): **Less likely (2)**

Kommentar:
[Ingen registreringer]

Consequence area: Helse

Risk:

Assessed consequence: **Small (1)**

Comment: [Ingen registreringer]

Hazard: 3D printer

Incident: Small burn damages

Touching hot plate or heated nozzle might cause burns.

Likelihood of the incident (common to all consequence areas): **Less likely (2)**

Kommentar:

[Ingen registreringer]

Consequence area: Helse

Risk:

Assessed consequence: **Small (1)**

Comment: [Ingen registreringer]

Incident: Damage to machine

Bad settings and use of machine may cause damages such as scratching of build plate, clogging of nozzle or damage to electronics.

Likelihood of the incident (common to all consequence areas): **Likely (3)**

Kommentar:

[Ingen registreringer]

Consequence area: Materielle verdier

Risk:

Assessed consequence: **Small (1)**

Comment: [Ingen registreringer]

Hazard: Vacuum former

Incident: Burn injury

Touching heating elements or heated plastic may cause burn injuries.

Likelihood of the incident (common to all consequence areas): **Less likely (2)**

Kommentar:

[Ingen registreringer]

Consequence area: Helse

Risk:

Assessed consequence: **Medium (2)**

Comment: [Ingen registreringer]

Incident: Fire

Heating elements and plastic may cause local fire.

Likelihood of the incident (common to all consequence areas): **Unlikely (1)**

Kommentar:

[Ingen registreringer]

Consequence area: Helse

Risk:

Assessed consequence: **Medium (2)**

Comment: [Ingen registreringer]

Consequence area: Materielle verdier

Risk:

Assessed consequence: **Medium (2)**

Comment: [Ingen registreringer]

Consequence area: Omdømme

Risk:

Assessed consequence: **Medium (2)**

Comment: [Ingen registreringer]

Incident: Damage to machine

In proper use and settings can cause damages to the machine.

Likelihood of the incident (common to all consequence areas): **Less likely (2)**

Kommentar:

[Ingen registreringer]

Consequence area: Materielle verdier

Risk:

Assessed consequence: **Medium (2)**

Comment: [Ingen registreringer]

Hazard: Water tunnel opperation

Incident: Electrocution from

Live wires from electrolysis and water can potentially cause electrocution

Likelihood of the incident (common to all consequence areas): **Less likely (2)**

Kommentar:

[Ingen registreringer]

Consequence area: Helse

Risk:

Assessed consequence: **Small (1)**

Comment: [Ingen registreringer]

Hazard: CNC Mill

Risks associated with the Roland CNC milling machine at TrollLabs, the machine is secured with a door and sensor, which ensures that the machine can not be moved and run while being exposed to the surrounding environment and operator. Thuss mitigating risks such as entanglement with the machine as one might normally associated with these types of machines.

Incident: Damaging machine and tools

Risk associated with wrong use of machine leading to damage, of either machine or tools, as well as damage through normal use.

Likelihood of the incident (common to all consequence areas): **Likely (3)**

Kommentar:

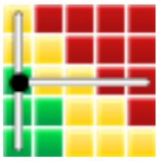
[Ingen registreringer]

Consequence area: Materielle verdier

Risk:

Assessed consequence: **Small (1)**

Comment: [Ingen registreringer]



Incident: Shrapnel and derbies during cutting

Risk associated with being hit by sharp chips, or shrapnel and derbies, during cutting

Likelihood of the incident (common to all consequence areas): **Unlikely (1)**

Kommentar:

The door of the mill is closed during opperation

Consequence area: Helse

Risk:

Assessed consequence: **Small (1)**

Comment: [Ingen registreringer]

Overview of risk mitiating actions which have been decided:

Below is an overview of risk mitigating actions, which are intended to contribute towards minimizing the likelihood and/or consequence of incidents:

Overview of risk mitigating actions which have been decided, with description:

Detailed view of assessed risk for each hazard/incident before and after mitigating actions