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DESIGN FUTURES LAB
Collaborative Robotics Lab

Risk Assessment Form

Do I need to perform a risk assessment?

A risk assessment must be completed at the commencement of every new project which uses equipment housed the DFL 'Collab' including Kuka iiwa Collaborative Robots, our end effectors, any additions you may make to our end effectors or your own end effector designs.

A 'New Project' is defined as any combination of the following events taking place:

- A new application will be loaded and run on equipment that has not been subject to a Risk Assessment.
- A new end effector, accessory or hardware is being used with an existing application.
- Any equipment in the Collab is going to be physically moved, or furniture re-arranged around it.

For these reasons, please consider the scope of your project and anticipate the above factors to ensure your initial risk assessment will cover the full extent of your project. You may wish to perform the risk assessment in multiple locations and configurations to broaden the effective scope of your risk assessment.

Live Document

During projects it is understood that things might change. You might take a different path that changes your risk assessment. As such this form is considered a live document. Make sure you update your risk assessment if things change and you will need to get any adjustments approved by the DFL staff. These changes might include:

- An incremental or small update is being issued to an application
- An adjustment is being made to to an end effector which changes the robot's overall reach, or load.
- A new group of participants not subject to a previous risk assessment is enacting a previously assessed project

Risk Assessment Requirements

A risk assessment will consist of the following:

- Project Details
- Project Hardware
- End Effector Details
- Spatial Layout
- Protected Objects in the Robot Cell
- DFL Collab Floor Plan
- Hazard Identification
- DFL Staff Declaration
- Participant Declaration

Project Details

A risk assessment must include the title of the project, the date the project started, a short description of the project, all participants, approval from relevant DFL staff, an identified academic lead, and can require additional technical and support participants when deemed necessary by other participants..

Project Name: _____

Project Start Date: _____

Project Description: _____

_____

_____

_____

_____

Project Participants	zNUMBER	Signature
Academic Lead	zNUMBER	Signature
DFL Staff	zNUMBER	Signature

Project Hardware

Identify all the hardware that you will be using in your project. It is important for us to have access to the manuals and documentation. Checking each box below indicates that you have attached or have located all the manuals. Particularly including any additional piece of hardware not list.

Hardware	**Serial Number**	**Documentation URL**
☐ Kuka LBR iiwa R820 Robot (A)	983434	See UNSW Making Website to download
☐ Kuka LBR iiwa R820 Robot (B)	983435	
☐ Kuka Industrial Robot	501826	
☐ Robotiq Gripper 2F 85	C-41724	
☐ Robotiq E-Pick	U-01052	

End Effector Details:

We need to know the precise length and weight and the intended load

Tool Name:	
Weight in Grams (g):	
Length from Media Arm flange (mm):	
Expected Load (g):	

Spatial Design

The DFL Collab is split into two spaces, the 'Safe Area', where users are permitted to stand, and the 'Robot Cell' where projects take place. To minimize risk, we need to document the design of the contents of the cell for a given project. Please confirm and implement the following requirements in addition to providing a floor plan for your design indicating the location of the robot and any other objects in the cell.

☐The robot, manipulator and its tooling cannot touch or project into the safe area.

☐The robot, manipulator and its tooling cannot touch any walls or windows.

Protected Objects in the Robot Cell

☐The cartesian origin and bounding box (relative to the robot root) of any fixed objects inside the safe area has been specified below:

To ensure no collision is made, we need to input the cartesian location of any fixed objects in the cell

Object Description	**Origin Point and Rotation (x,y,z,a,b,c)**	**Width, Length, Height (x,y,z)**

☐Cartesian Workspace monitoring (Optional)

If the the above requirements cannot be met, the robot must by limited to a specific workspace, please specify below

Origin Point and Rotation (x,y,z,a,b,c)	**Width, Length, Height (x,y,z)**

Please attach DFL Collab floor plan on next page. A DXF file can be downloaded from the making website.
https://www.making.unsw.edu.au/dfl/facilities/robotics-lab/rmf/

Human Robotic Integration, Risk Estimation & Evaluation Criteria

To evaluate the risk of the robot to humans , we use an evaluation methodology that is based on Pilz criteria and experience, an evaluation of the factors, Degree of Possible Harm (DPH), Probability of Occurrence of a Hazardous Event (PO), Possibility of Avoidance (PA) and Frequency and/or duration of Exposure (FE), must be performed on the risk related with each hazard. A Pilz Hazard Rating is then calculated from the following formula:

$$PHR = DPH \times PO \times PA \times FE$$

Where the above parameters can take the following values:

Degree of Possible Harm (DPH)

0.25	Scratch / Bruise
0.5	Laceration / cut / mild ill health effect/ minor burns
3	Fracture minor bone – fingers, toes
5	Fracture major bone – hand, arm, leg
8	Loss of 1 or 2 fingers/ toes or major burns
11	Leg / hand amputation, partial loss of hearing or eye
15	Amputation of 2 legs/hands, total loss of hearing/sight in both ears/eyes
25	Critical injuries or permanent illness/condition/injury
40	Single Fatality
65	Catastrophe

Possibility of Occurrence of Hazard Event (PO)

0.05	Almost impossible
1.25	Unlikely
2.5	Possible
4	Probable
6	Certain

Possibility of Avoidance (PA)

0.75	Possible
2.5	Possible under certain circumstances
5	Not Possible

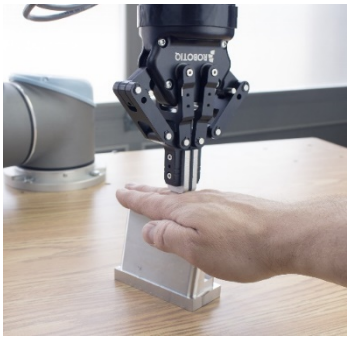
Frequency of Exposure (FE)

0.5	Annually
1	Monthly
2	Weekly
3	Daily
4	Hourly
5	Constantly

The maximum and minimum numerical values that could be assigned to each factor for every hazard are shown in the following table.

PHR Numeric Range		
PHR	**Risk**	**Comment**
1-10	Negligible Risk	Presents practically no risk to health and safety, no further risk reduction measures are required.
11-20	Very Low Risk	Presents very little risk to health and safety, no significant risk reduction measures are required, may necessitate the use of personal protective equipment and/or training.
21-45	Low Risk	Risk to health and safety is present, but low. Risk reduction measures must be considered.
46-160	Significant Risk	The risk associated with the hazard is substantial enough to require risk reduction measures. These measures should be implemented at the next suitable opportunity.
161-500	High Risk	Potentially dangerous hazard, which requires risk reduction measures to be implemented urgently.
501+	Very high Risk	Risk reduction measures should be implemented immediately, corporate management should be notified.

Here is an example hazard identification. Copy the following blank page and complete one form for each hazard you identify.

Hazard Identification			Hazard No. 1
Title	Pick up object		
Target	Hand		
Activity	Normal operation		
Task	Robot is attempting to pick up object		
Hazard Type	Crushing and impact (Quasi-static)		
Description	The robot reaches to pick up the object with fingers closed. There is a possibility that a worker could place his/her hand between the gripper and the part. The robot is running at a reduced speed of 20 mm/s and has a 10 N threshold. Since the fingers are closed together, they have an area of (13.5 x 23 mm) 310.5 mm2 or 3,105 cm2. In case of an impact at 10 N, the pressure spread over this surface and applied by the gripper fingers is (10 N/3.105 cm2) 3,22 N/cm2. This is equivalent to energy of 0.0001 J. With a maximum allowable pressure of 197 N/cm2 and 0.49 J of energy, this force and energy are slightly lower than levels permissible by ISO/TS 15066.		
References:	ISO/TS 15066, ISO 10218		

Risk Estimation and Evaluation			
Degree of Possible Harm:	0.5	Possibility of Avoidance:	0.75
Probability of Occurrence of a Hazardous Event:	1.25	Frequency And/or Duration of Exposure:	4
Pilz Hazard Rating (PHR):	1.875	Summary Level:	Negligible Risk

Risk Reduction
Not necessary

Risk Estimation and Evaluation			
Degree of Possible Harm:	n/a	Possibility of Avoidance:	n/a
Probability of Occurrence of a Hazardous Event:	n/a	Frequency And/or Duration of Exposure:	n/a
Pilz Hazard Rating (PHR):	#VALUE!	Summary Level:	Negligible Risk

Hazard Identification			Hazard No.
Title			
Target			
Activity			
Task			
Hazard Type			
Description			
References:	ISO/TS 15066, ISO 10218		
Risk Estimation and Evaluation			
Degree of Possible Harm:		Possibility of Avoidance:	0
Probability of Occurrence of a Hazardous Event:		Frequency And/or Duration of Exposure:	
Pilz Hazard Rating (PHR):		Summary Level:	
Risk Reduction			
Risk Estimation and Evaluation			
Degree of Possible Harm:		Possibility of Avoidance:	
Probability of Occurrence of a Hazardous Event:		Frequency And/or Duration of Exposure:	
Pilz Hazard Rating (PHR):		Summary Level:	

DFL Staff Declaration

This project has been subject to appropriate risk assessment and has the approval of DFL staff to be run in:

☐ T1 Mode only
☐ T2 Mode
☐ Auto Mode

Name: _____ zNumber: _____

Signature: _____ Date: _____

I acknowledge reviewing the information referenced in the above form and approved execution of this project in the DFL Collab

Submission Requirements and Declaration

Please sign an acknowledge having read and completed the segments of the form below and include

☐ Project Details
☐ Project Hardware
☐ End Effector Details
☐ Spatial Details
☐ Protected Objects on the Robot Cell
☐ DFL Collab Floor Plan
☐ Hazard Identification
☐ DFL Staff Declaration
☐ Participant Declaration

Select a project lead from the participants listed to sign the declaration

Name: _____ zNumber: _____

Signature: _____ Date: _____
I acknowledge reviewing the information referenced in the above forms