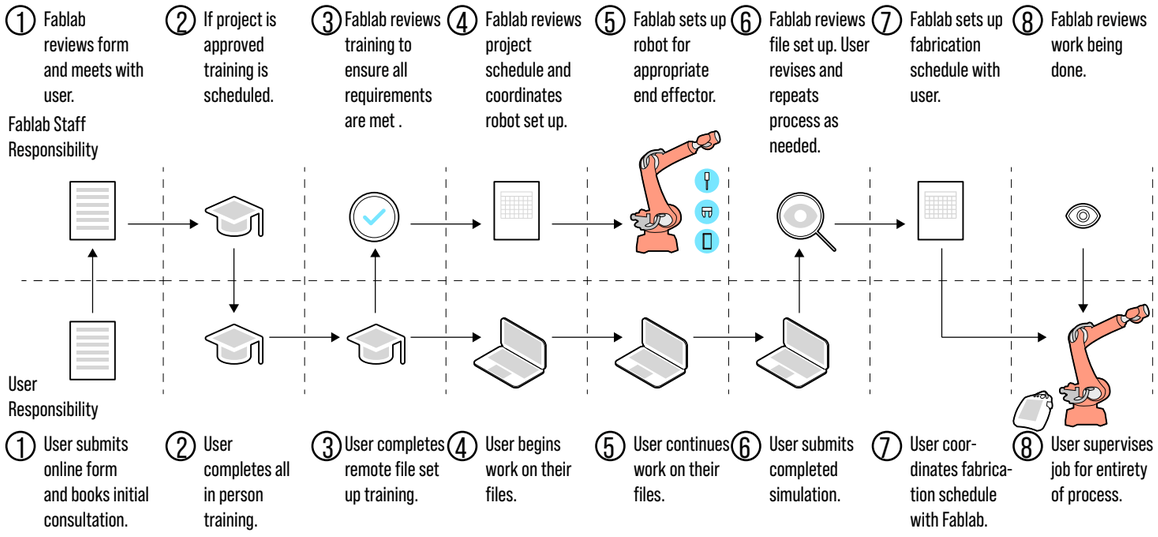
Robotic Arm

The robotic arm will create opportunities for students and faculty interested in fabrication, robotics, automation, coding and manufacturing. The robotic arm offers a tremendous amount of versatility in fabrication processes such as cutting, moving, milling, machining, and printing. The specific robotic arm at the U_SoA can lift up to 500 lbs of material within an 8’ working diameter and is capable of manufacturing parts made out of a variety of mediums. TThe robotic arm will primarily be taught in courses developed specifically around the use robotic fabrication techniques.

GENERAL USAGE

Due to the complexity and safety hazards of the robotic arm, its use will be limited to trained faculty and students only. The fabrication lab will provide only the primary robotic training as included with our intial set-up and any end effector that is created specifically through University of Miami School of Architecture Model Shop designated funds (e.g. The Model Shop purchases a new end effector and program to run the robotic arm, training will be made available for its use to all). Please see the following diagram to demonstrate the general process for use of the robotic arm (note - other processes will be described on subsequent pages).

General robotic arm usage diagram:



While the fabrication lab aims for all equipment to be open use for all faculty, staff, and students the robotic arm has certain complex requirements that will limit its usage. Due to the expected high demand of usage, high barriers to entry, long preparation and production times, and potential issues with authorship the following policies will apply to the use of the robotic arm:

Prioritized Classroom Use:
With the complexity of knowledge required for a university to build a collective knowledge base for continually operating a robotic arm, all courses taught will have priority over individual or small research project use. This policy aims to bolster the amount of taught content related to the robotic arm so that knowledge will inherently pass through students across multiple years at the University of Miami.

GENERAL USAGE (cont.)

Training Program:
Faculty members and students approved to move forward with training on the robotic arm must commit to two training workshops for basic training, each consisting of a continous four hour session. The sessions will cover the following:

Session A(4 hours):
- -Initial Introduction to Robotics
- -Manual Movement
- -Basic Operation
- -Setting a Base
- -Safety Training
- -Troubleshooting
- -Introduction to Powermill

Session B(4 hours):
- -Powermill Training Session

As new workflows are developed, additional and alternative training sessions will become available for Session B (or Sessions C and onward if needed for multiple end effectors), such as KUKA PRC training session. Due to the length of the sessions and limited initial staff available for training, training sessions may not meet all project deadlines. The fabrication lab recommends moving forward with project inquiries and training, months in advance of project deadlines.

Additional Training Requirements:
The operation of the robot can cause potential serious damages to the equipment and surroundings, which are critical in the project and file set-up. All users must demonstrate their understanding of these dangers in their file set-up including safe transitions and safe movement (e.g. no collisions or singularities). Training is dependent on user background and skill set and could take between a couple weeks and multiple months. The fabrication lab will provide training as listed above, but users must submit a completed file set-up as an additional remote training requirement to demonstrate their full comprehension and understanding of key robotic procedures and safety factors in project set-up. The user is responsible for the production of all of their files including running the simulation to ensure safety of movement.

Intellectual Property:
Robotic fabrication is at the forefront of emerging technology and unique research may create issues of authoriship. To avoid authorship and copyright issues within the school and larger academic community, all files must be generated by the user and not the fabrication lab staff. Just as architects have ownership over their drawings, fabricators have ownership over all production files, code, and product therefore it is the sole responsibility of the user to complete the files and code they will run on the robotic arm. Any intellectual property created in the preparation of files or products built by the fabrication staff is owned per the University of Miami Intellectual Property Guidelines and appropriate credit must be granted in all communications, exhibitions, and images.

Time Frames:
The use of the robotic arm contains extended time frames required for set-up and operation. The fabrication lab staff cannot maintain all equipment and safe usage across all lab spaces while simultaneously creating files and operating the robotic arm for users. While staff will be responsible for training and assistance, users must create their own files and be present for the length of the entire job. File set-up can take from multiple hours to multiple semesters depending on setup and process. Additionally, many processes could result in multi-day jobs which must be separated and run only during times of operation of the fabrication lab. All files must be ran with one trained user operating and one trained staff member in the same room.

Alternate Modes of Fabrication:
Any processes that can be completed by other simpler processes should be completed on other equipment, with the exception of building knowledge for future portions of the process (e.g. student test cuts with the hot wire cutter on small strips that could be hand cut, but will eventually cut larger pieces that can only be cut by the robotic arm is allowed, if the student is only aiming to cut at that scale they will be required to use the hand hot wire cutter).

User Roles and Responsibility:
All users are responsible for completing all training requirements and submitting all required forms prior to using the robotic arm. The users files must all be approved by the Fabrication Lab Manager prior to being run on the equipment. During the operation of the robotic arm, the user must wear all proper PPE and be present and focused on the equipment the entire duration of the project run time.

Fabrication Lab Staff Roles and Responsibility:
Similar to other equipent in the Fabrication Lab the staff's primary responsibility is to help train students on how to use equipent, provide maintenance on equipment, and ensure safe processes are being performed on all equipment. Processes on the robotic arm are too complex and time consuming for student workers to produce the files and run the equipment for users. Additionally, unfair usage concerns may arise out of one particular user being provided file service and while others are not. (Please note, not all fabrication lab employees are trained on the robotic arm so there may be limited access to assistance).

Trained Staff in the Lab will provide the following service related to the Robotic Arm:

-Training Workshops for Faculty and Students (scheduled in advance of use, after robotic arm use form has been submitted and approved).
-Ensure proper PPE is worn.
-Monitor the use of the equipment for any issues.

Safety:
The robotic arm is an extremely dangerous piece of equipment and must be treated as such. To ensure student, staff, and faculty safety, all safety guidelines must be met:

-All proper PPE must be worn.
-Two trained people must be in the room at all times during use of the robotic arm (one primary user and a second trained staff member of the fabrication lab).
-All files must be reviewed prior to sending.
-All files must have run a complete environment and collision simulation.
-Entrance to the robotic arm cage during files or manual movement is restricted.
-All files must be started in T2 mode, with a maximum of 30% speed and must remain for the first 5 minutes to ensure proper set-up.
-User must monitor job during the fabrication, no phones or computers are allowed during the use of the robotic arm forfabrication.

Installation Schedule
During the initial set up, testing, and early usage of the robotic arm will be restricted to projects specifically researching the use of the robotic arm and it's workflow (e.g. faculty member researching how to use the robotic arm to wrap carbon fiber structures would be allowed, faculty member requesting to mill something that only requires 3 axis machining would not be allowed). The robotic arm was installed in Spring of 2020 and due to its complexity will require a longer amount of time to reach critical use compared to other equipment. Training and workflows are currently still being developed for the arm. The lab aims to operate under the following schedule:

-Spring 2020 - Initial Set-Up, Restricted Availability

-Fall 2020 - Initial Testing, Restricted Availability

-Spring 2021 - Continued Testing, Limited Training, Restricted Availability

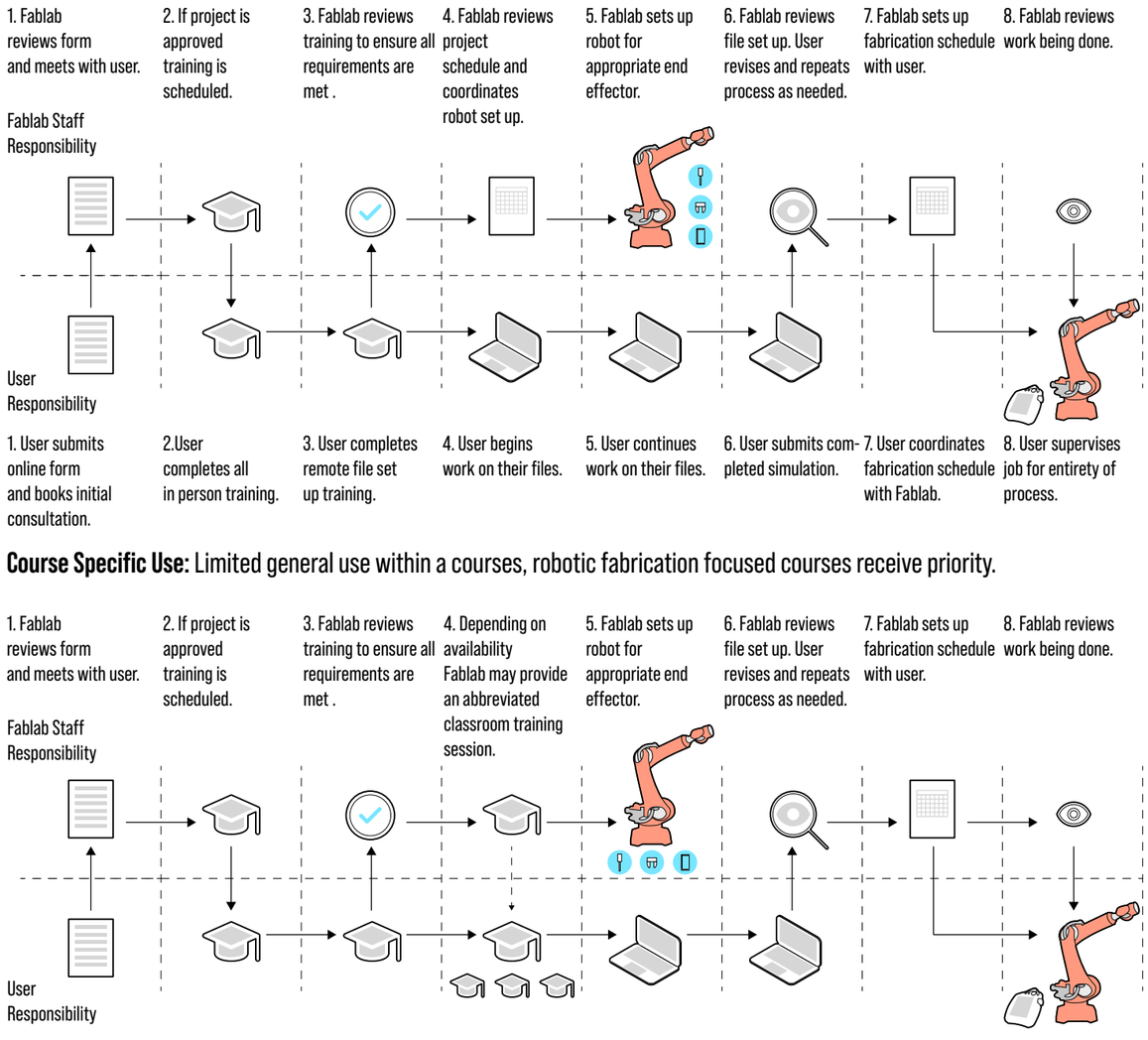
-Fall 2021 - Expanded Training and Increased Availability

This extended installation is required due to the limited amount of existing trained staff and faculty members and aims to give time to produce a larger community of users at which point training and use of the robotic arm will become increasingly available to the broader community. Any school closures or continuity issues may delay this process further.

USAGE TYPES

The Digital Fabrication Committee has created four systems for use of the robotic arm that provide offer different levels of committment and lab support based on funding and research interests. Those four systems are:

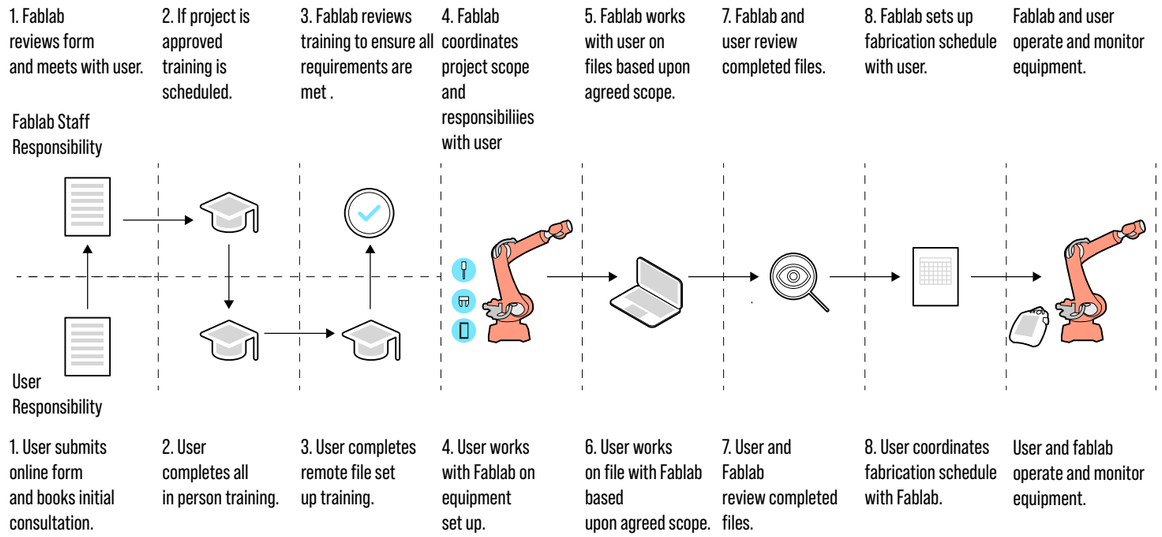
General Use: Student research related to coursework or Faculty Creative Practice Work



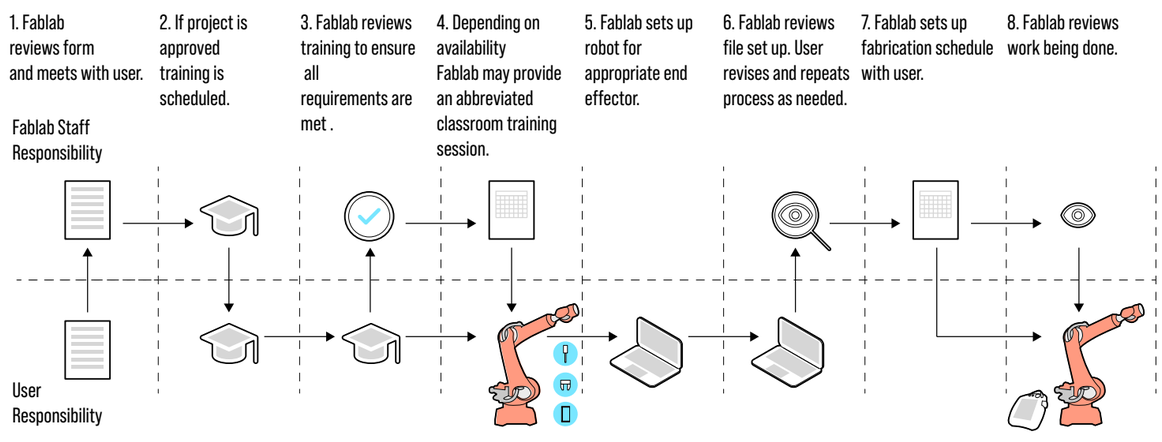
Course Specific Use: Limited general use within a courses, robotic fabrication focused courses receive priority.

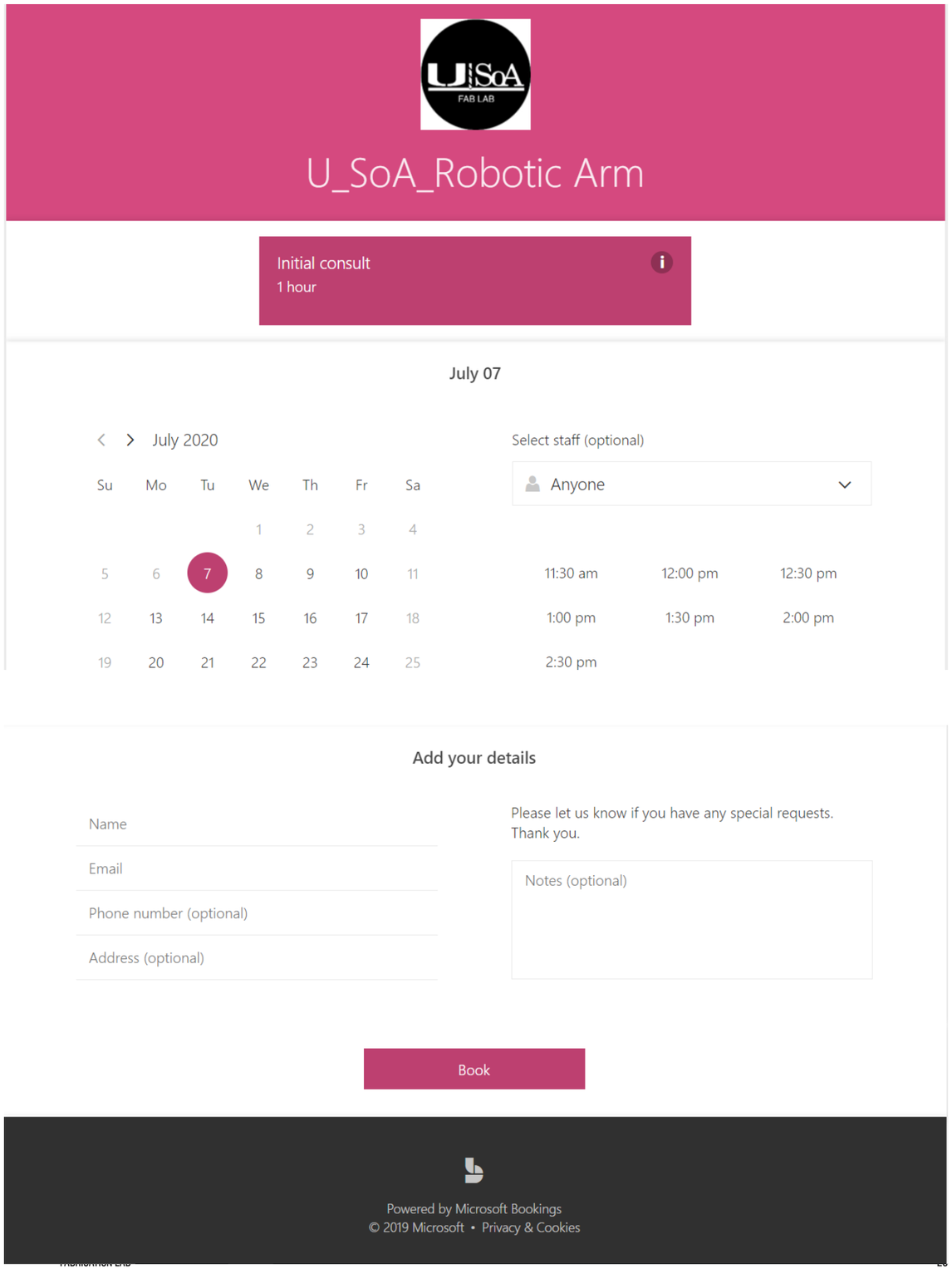
USAGE TYPES (cont.)

Funded Research: Research covering costs for extended Fabrication Lab Involvement (dependent on lab capacity, availability and agreement on scope sharing).



Research Requiring Special End Effector: End effectors developed or owned by faculty/students outside the Fabrication Lab.





Initial Consultation and Use Approval:

Faculty members and students can reserve an initial project appointment via the School of Architecture's website to consult on their intended project. The purpose of this meeting is to gauge viability, project responsibility, timeline, and fabrication process. If the project is approved to move forward, the faculty member or student will schedule a training workshop with a trained user approved by the Fabrication Lab Manager. To complete the booking appointment, follow the steps below:

Open the booking page through the School of Architecture website.

Click Initial Consult.

Select a staff member who is able to provide the consultation from the drop down menu under "Select Staff"

Click a date and time that is available via through their schedule.

FIll in all additionall details at the bottom of the page.

Click "Book", the user should receive an immediate confirmation. If no confirmation was received the appointment was not created.

This initial appointment is only to discuss project details and viability. At this point the Fabrication Lab Manager will approve or rejects the project and schedules training sessions directly with user. The user must complete all training and file preparation before they will be allowed to operate the robotic arm. All operation will be scheduled once the Fabrication Lab has approved that the training requirements have been met and reviewed all project files that will be run on the equipment. Only approved files shall be run and any changes require Fabrication Lab approval before being resent to the Robotic Arm.

Robotic Arm Project Request Form

In addition to booking an initial project consultation, users must submit a Robotic Arm Project Request form (shown on next page). The form requires users to fill out their name, project modality (as descrived on previous page), existing training level, specific end effectors required, project description, project timeline, funding information and scope of Fabrication Lab's role. Additionally the project incorporates items from the Faculty Project Acknowledgment Form to reduce the submittal process to a single page. The Fabrication Lab will provide justification for any accepted or rejected processes. Any errors or emissions of project scope will result in a project rejection. Project request forms must be filled out and brought to the initial consultation.

Robotic Arm Project Request Form

Name:

Modality:

☐ General Use ☐ Course Specific Use ☐ Funded Research ☐ Research Requiring Special End Effector

Existing training/skill level on digital fabrication equipment(specific):

Robotic arm end effectors to be used:

Project description (specific robotic processes):

Desired project schedule and time frame:

If funded research, describe funding sources, allocation, and project scope (e.g. user+fabrication lab specific roles and responsibilities):

Project type (Check One):

☐ Academic ☐ Creative professional development (related to academic position) ☐ University of Miami affiliated personal project* ☐ Non-University of Miami affiliated personal project*

Accepted: ☐ Declined: ☐

Justificaton:

User signature: _____ Date: _____

Manager signature: _____ Date: _____

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