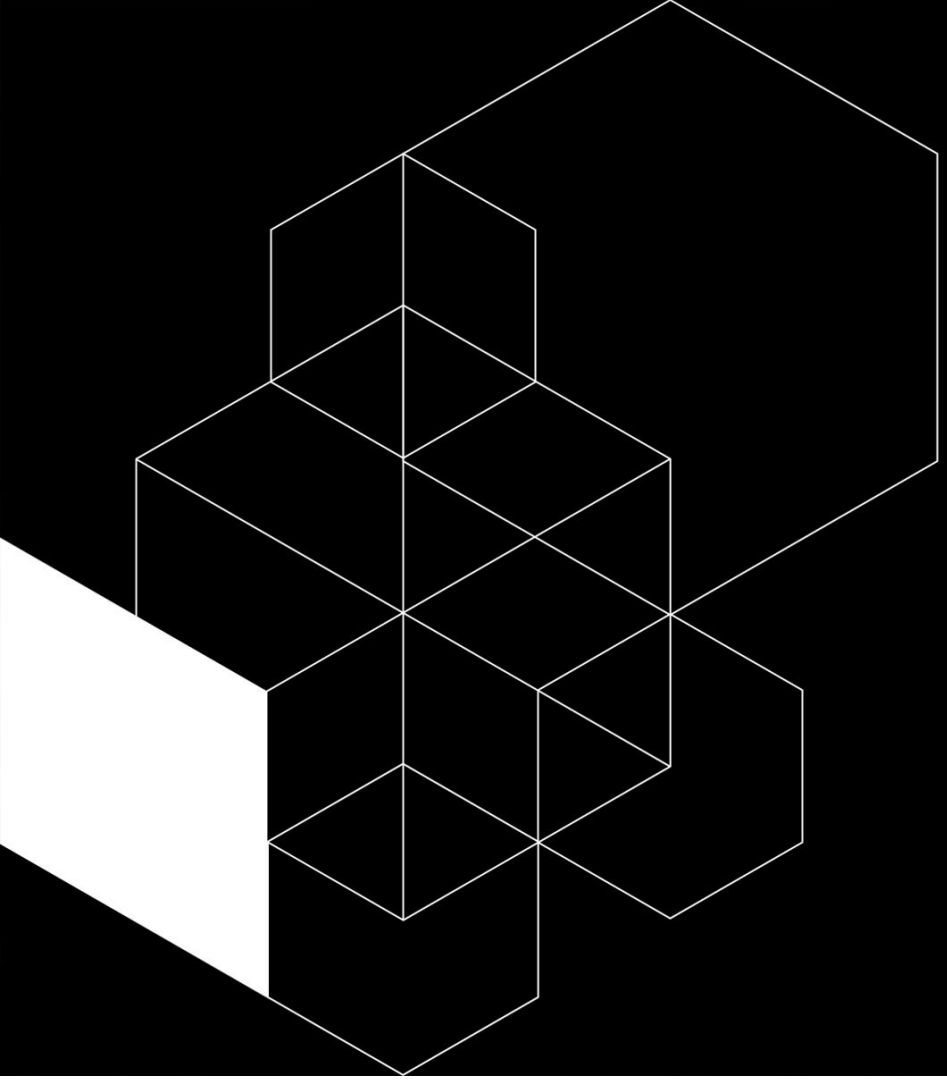

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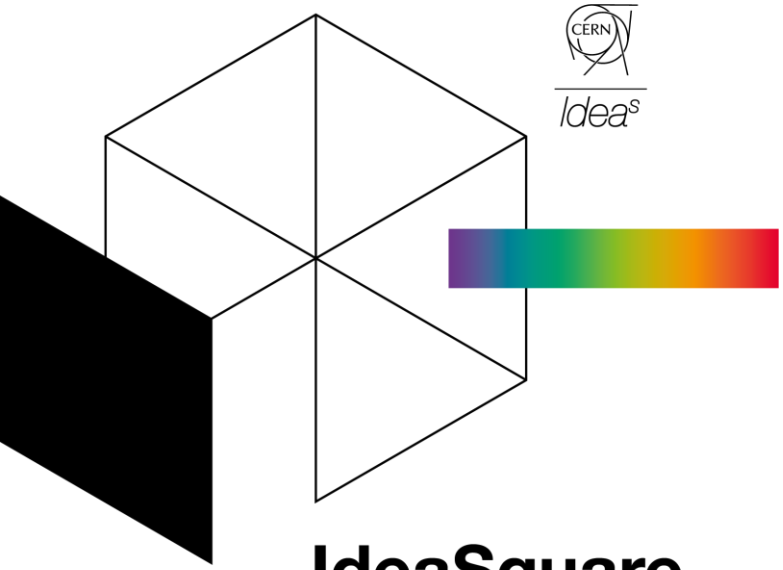
15 and 16 February

CERN

Ideas



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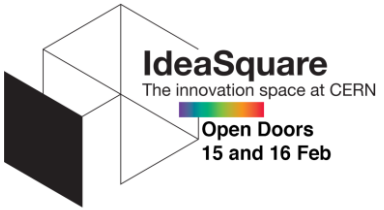
Piching Prototype Challenges from the CERN Community

F. Pedrosa and R. Morton

15/Feb/2023

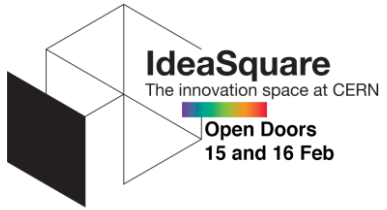
The trigger and the idea



- The trigger:
  - Scarcity of masks availability in the market and the COVID crisis

- The idea:
  - Develop a 3D printed washable mask with replaceable filters that could offer a better protection than a surgical type mask
  - Find filters that could be easily available in a period of scarcity like the Covid-19
  - Make all the Information publicly available once we have the test results and the OK from the CERN management

The team



Markus Nordberg	IPT-DI
Katy Foraz	EN-ACE
Jerome Bendotti	EP-DT
Corrado Gargiulo	EP-DT
Richard Francis Morton	HSE-OHS
Olivier Bernard Prouteau	HSE-OHS
Laura Stewart	TE-CRG
Federico Ravotti	EP-DT
Joao Batista Lopes	EP-DT
Ombretta Pinazza	EP-UAI
Alex Iribarren	IT-CM
Sebastien Clement	TE-MSC
Fernando Baltasar Dos Santos Pedrosa	EN-ACE
Mario Di Castro	EN-SMM
Jaroslava Schovancova	IT-CM
Alessandro Mapelli	EP-DT
Walid Fadel	HSE-OHS

Luis Granado Cardoso	EP-LBC
Chris Thomas	EP-UAT
William Vigano'	BE-BI
Remy Gauthier	TE-MSC
Marzia Bernardini	EN-ACE
Andre Henriques	HSE-OHS
Jose Antonio Ferreira Somoza	TE-VSC
Giuseppe Pezzullo	EP-DT
Francois Boyer	EP-DT
Josef Sestak	TE-VSC
Roberto Cardella	EP-UAT
Romain Gerard	EN-MME
Jonathan Pascal Meignan	EN-ACE
Hans Boe	IPT-DI
Pascal Secouet	EP-AIO
Romain Gavaggio	TE-MSC

The mask design

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Design for “Human Interface”

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Design Steps

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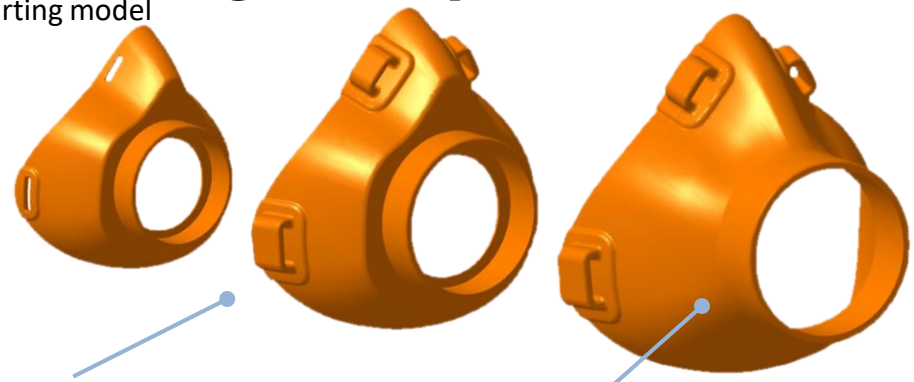
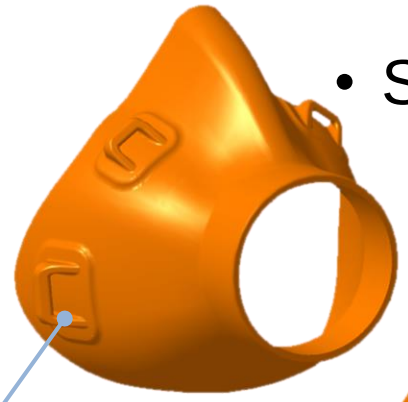
Starting model



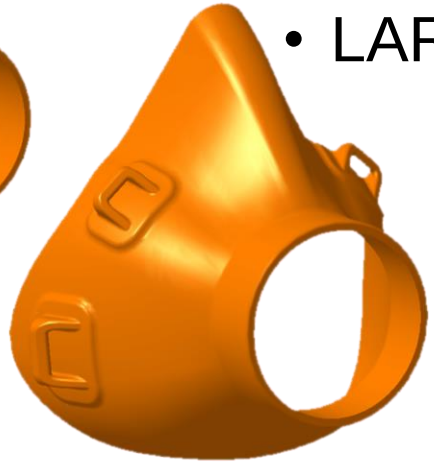
CHANGE ANCHOR POINT

AVOID FLAT PLANE FOR EASIER PRINTING

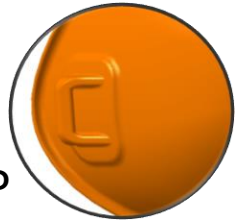
SHAPE ANCHOR POINTS FOR EASIER PRINTING



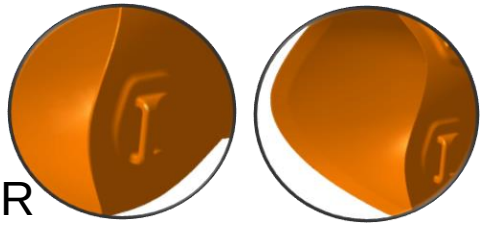
- SMALL
- LARGE



FLAP



CHAMFER



Design for filters

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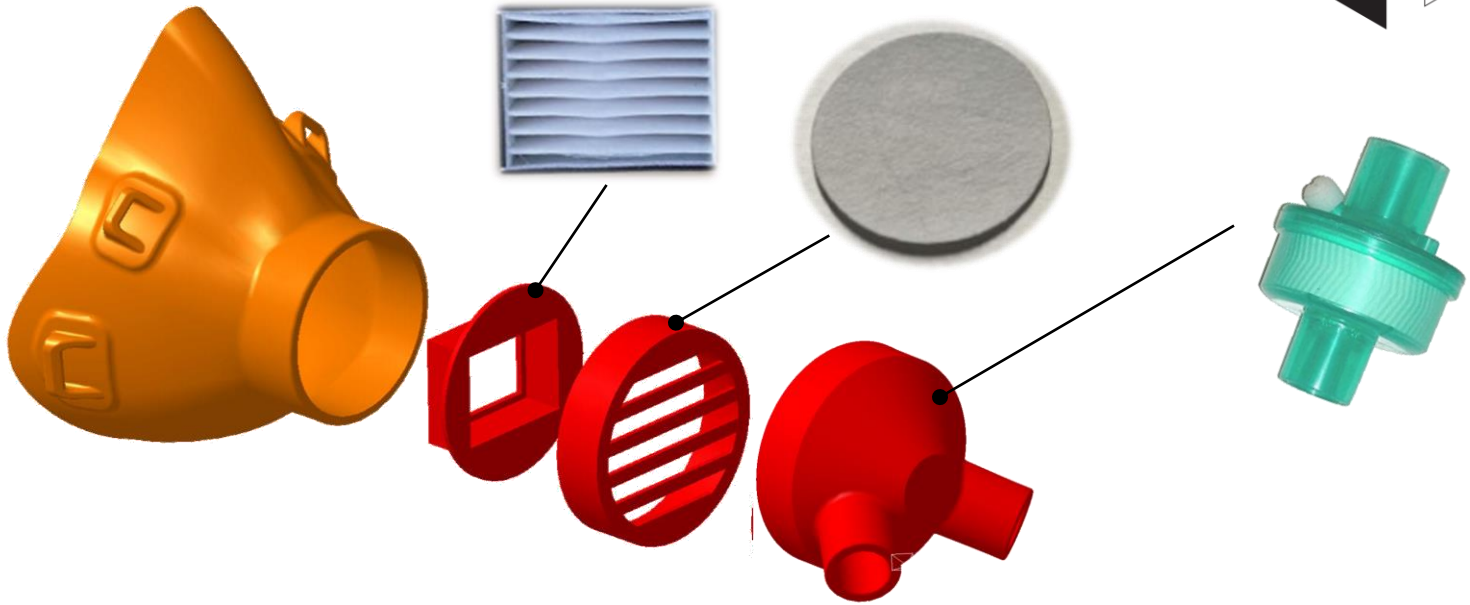

WE DESIGNED SEVERAL INTERCHANGEABLE SUPPORTS SO AS TO HAVE THE FLEXIBILITY TO USE DIFFERENT FILTERS

Design a mould

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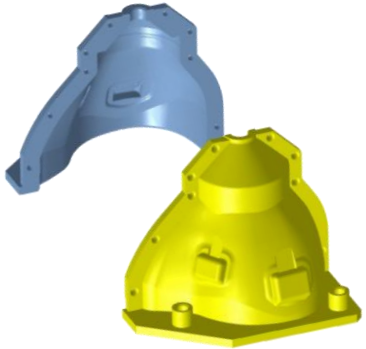

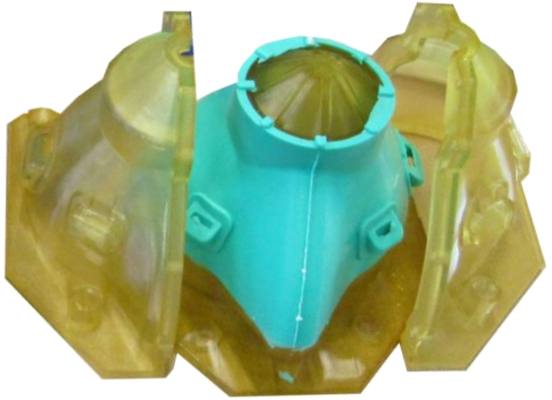

WE DECIDED TO DESIGN A MOULD IN ORDER TO PRINT THE MOULD INSTEAD OF THE MASK, AND PRODUCE SEVERAL MASKS BY MANUAL INJECTING SILICON

Light shield integrated in the mask

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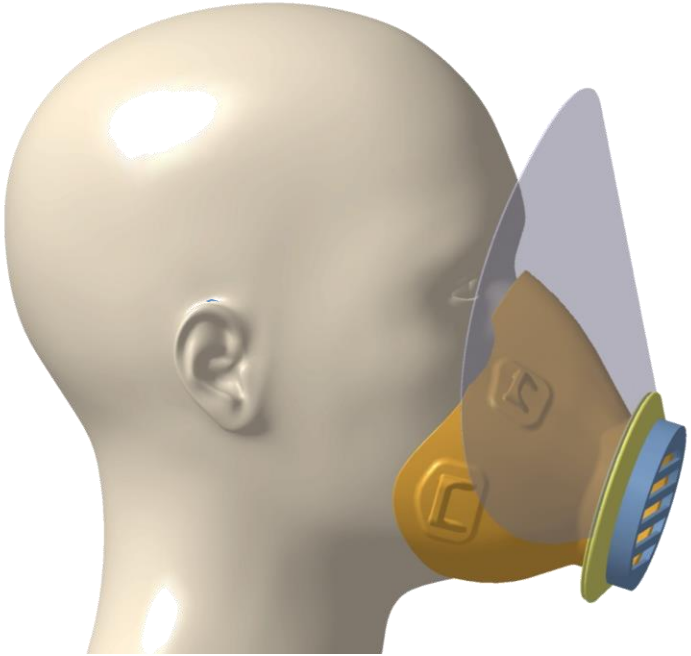

FINALLY WE DESIGNED A LIGHT SHIELD DIRECTLY SUPPORTED BY THE MASK

3D printing

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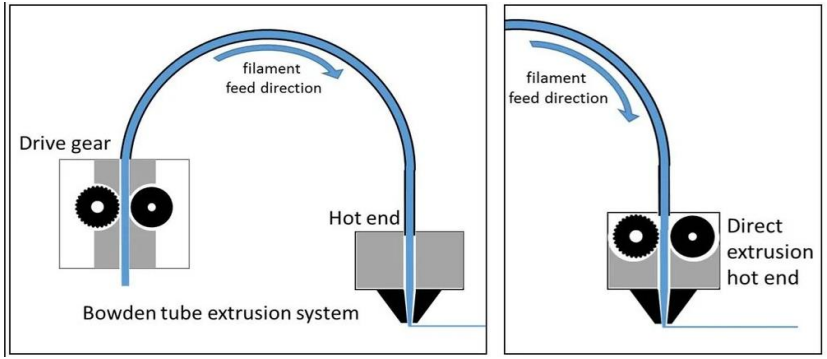
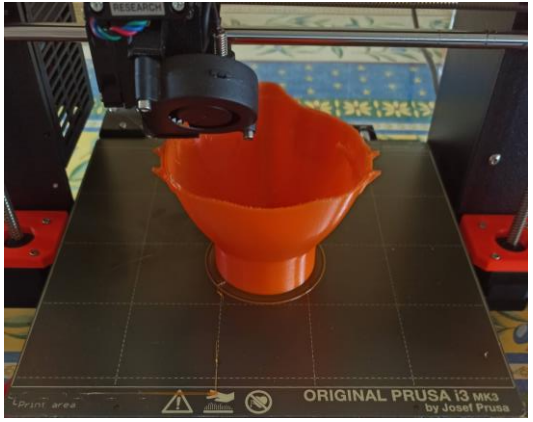
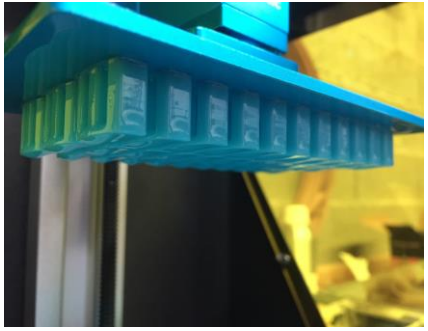


Image: forefrontfilament.co.uk



STEREOLIThOGRAPHY (SLA): ANYCUBIC PHOTON ZERO
FUSED DEPOSITION MODELIING (FDM) PRUSA i3 MK3,
ERYONE THINKER S, LABISTS X1, ULTIMAKER



Injection using 3D printed moulds

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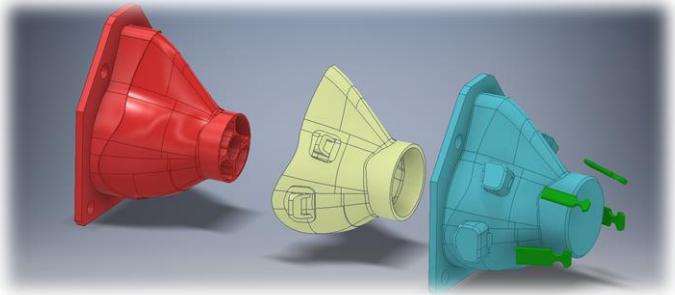
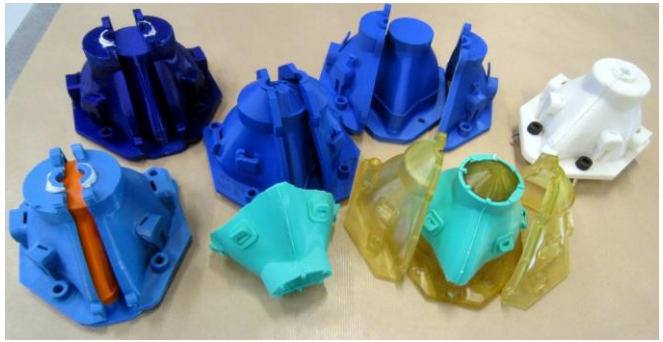


WE TESTED THE MOULD WITH DIFFERENT SILICONES TYPES AVAILABLE IN THE POLIMER LAB, BUT WE ALSO RECEIVED SOME SILICONE DONATIONS FROM COMPANIES THAT WE CONTACTED



Filters and traceability

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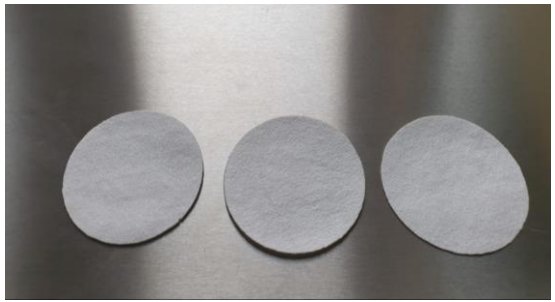
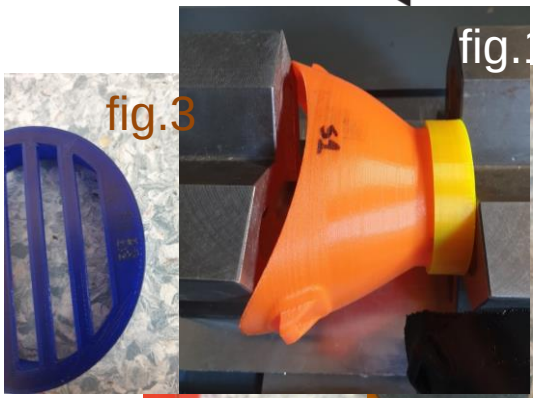
WE RECEIVED A DONATION FROM AN ITALIAN COMPANY THAT WAS IN THE PROCESS OF VALIDATION THEIR MATERIAL FOR AN FFP3 TYPE



WE CREATED A QR CODE THAT WOULD ALLOW TO HAVE ALL THE INFORMATION NEEDED IN A CENTRAL PLACE

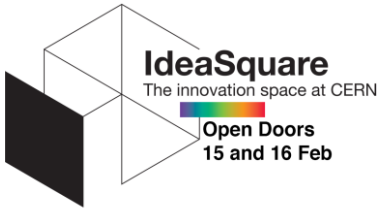


Safety tests

Tests	Methodology
1. Visual Inspection	Simplified
2. Temperature conditioned	Point 8.3.2 (a) EN149
3. Simulated Wearing	Point 8.3.1 EN 149
4. Performance teste	Point 8.4.1 and 8.2 EN 149
5. Breathing Resistance (valveless devices)	Point 8.9.2 and 8.9.3 EN 149
6. Flammability	Point 8.6 EN 149
7. Filtration efficiency (FE)%	Adaptation for Annex B EN 14683:2019 Methodology
8. Differential pressure	Point 5.2.3 EN 14683:2019

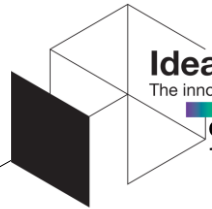
- Difficult to find a certified lab available during the COVID19 period to perform the tests
- List of tests suggested by the certified LAB and approved by HSE
- One additional test requested by HSE
  - CO2 concentration
- These tests don’t certify the mask, but before making the mask information public we wanted to be sure the product was safe

Few conclusions



- 3D design for comfort and easy 3D printing was a complex process
- 3D printing flexible materials adds quite some challenges to the 3D printing process where some of us had no experience or limited experience
- Finding easily available filters that offer a good filtration level and that let you breathe proved to be more difficult than initially expected
- Manual injection moulding was a great experience and added some additional challenges for the team (mould development, silicone selection, …)
- Material usually easily available (3D printing filament) can become complicated to obtain with confinement, and the same reference for different manufacturers doesn't mean the same product
- We were all out of our comfortable zone, but together and with a mixture of competencies we managed a great end result
- Essential support from the CERN Against COVID19 task force, CERN Fire Brigade, CERN Legal service and CERN knowledge transfer group
- If you believe never give up (CERN OHL Page - https://ohwr.org/project/3dmask/wikis/home)

[redacted]



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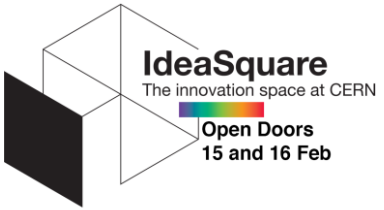
The trigger and the ideas



- The trigger:
  - Old electrical switchboard handles breaking and unavailability of spare parts
- The idea:
  - 3D print a handle that could do the job
- The team:
  - Richard Morton (HSE-OHS)
  - Oscar Lilleloekken (IPT-DI)
  - Patrick Gallay (EN-EL)
  - Christophe Mutin (SY-EPC)

The existing handles

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WE WENT ON-SITE TO SEE THE HANDLES BUT WE FOUND ALSO OTHER PIECES

The schematics from the on-site visit

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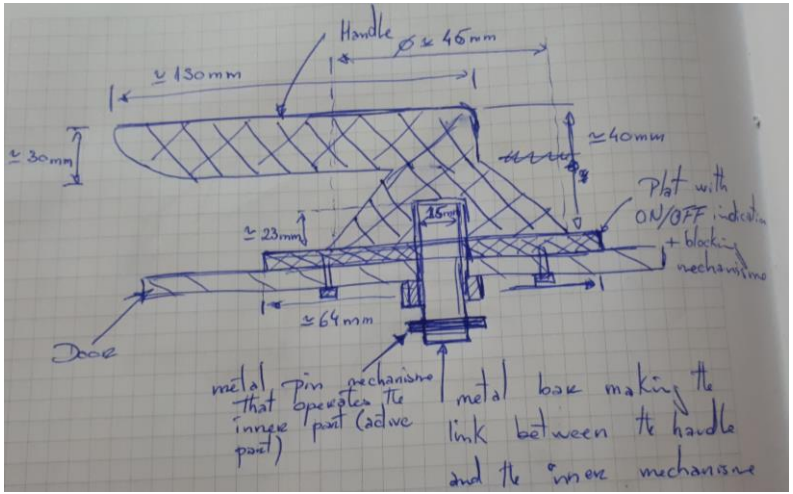

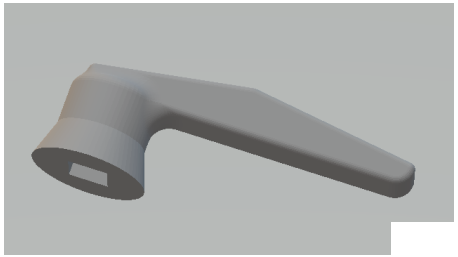

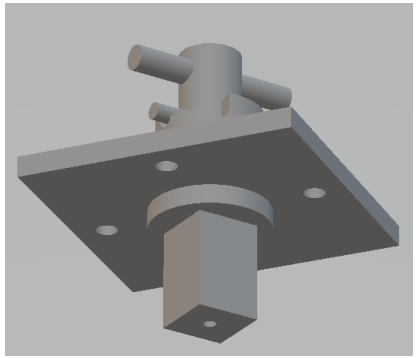

WHILE DOING IT AND DISCUSSING WITH THE PEOPLE WE ALSO UNDERSTOOD BETTER THE PROBLEM

The result of different iteractions

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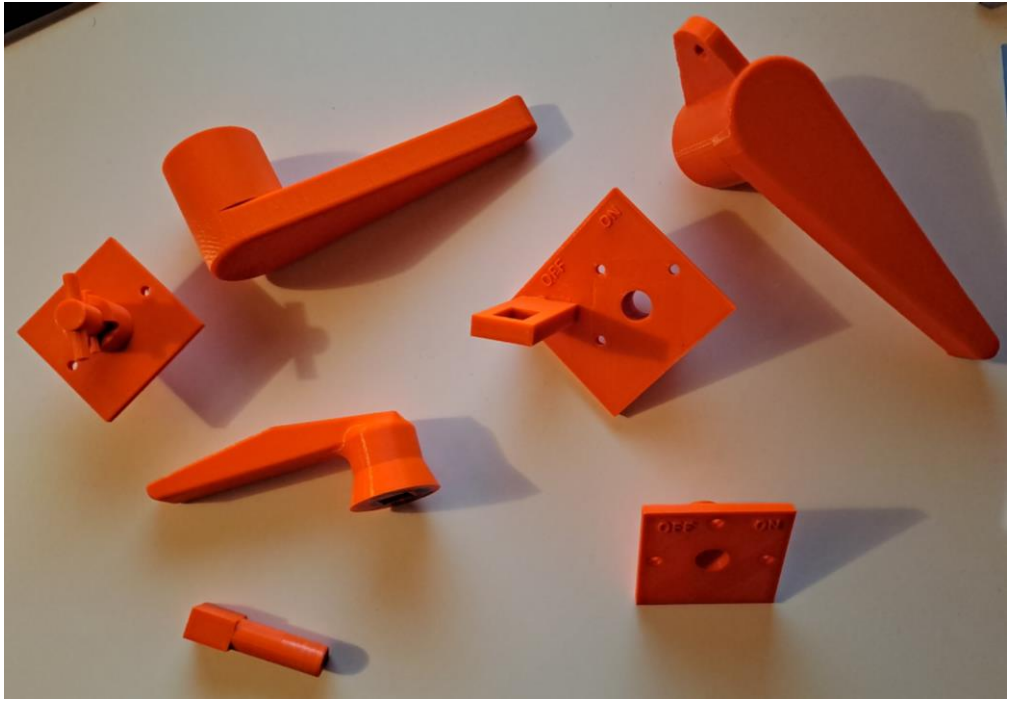

WE HAD SOME DIFICULTIES OF TIME AVAILABILITY AMONG THE DIFFERENT MEMBERS, AND SOME CONSTRAINTS TO TEST THE SOLUTIONS ON AN OPERATIONAL INSTALLATION

Few conclusions

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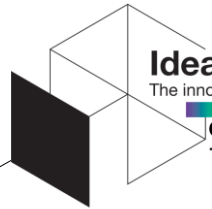
- Good example how easy solutions could help
- Good example of collaboration between those that needed something and those that were willing to help with the tools they had available
- Time availability of team members and the installation to test is a key
- The decision to replace the full switchboard was taken before all prototypes could be tested, so none of the handles was used

[redacted]



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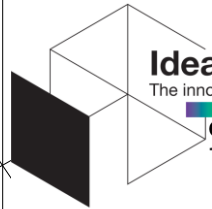
If you

- like to collaborate and you are willing to collaborate in an informal way
- are willing to come out of your comfort zone
- need help prototyping something
- want to take part in a discussion forum to find practical solutions
- have equipment that could be useful for the CERN community
- …

Then don’t hesitate to subscribe to the following e-group:

Engineers-at-IdeaSquare@cern.ch

[redacted]



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