

# LS-NeoCare bioreactor

The bioreactor will stimulate the 3D-printed cartilage so it can function in the adult body.

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Created on: October 12, 2023 4:53 PM  
Changed on: October 19, 2023 10:03 AM

Context of use: Education  
Level of education: Bachelor

# Technology Impact Cycle Tool

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## Impact on society

What impact is expected from your technology?

### What is exactly the problem? Is it really a problem? Are you sure?

Osteoarthritis affects a vast population, causing progressive cartilage degeneration and substantial pain, significantly limiting daily activities and work performance. The costs associated with OA are expected to escalate, with an aging population and obesity contributing to its rapid increase. The absence of efficient treatment options exacerbates the impact of OA on patients' lives and underscores the critical need for groundbreaking interventions.

### Are you sure that this technology is solving the RIGHT problem?

Yes, because Osteoarthritis affects cartilage and the Bioreactor will stimulate 3D printed cartilage until fully functional for human adult body. So it can replace the damaged cartilage.

### How is this technology going to solve the problem?

The Bioreactor will make the new solution sufficient by stimulating the 3D printed cartilage so it can handle the forces of the human body. So this can be implemented as a replacement of the damaged cartilage.

### What negative effects do you expect from this technology?

It is too early in the process to come up with negative effects from this technology.

### In what way is this technology contributing to a world you want to live in?

This technology will contribute to eliminating pain and reversing the OA condition in a way that enables people to live a normal life again. It will also reduce health care expenses related to OA so the resources can be relocated to other concerns/diseases.

### Now that you have thought hard about the impact of this technology on society (by filling out the questions above), what improvements would you like to make to the technology? List them below.

- Improve the scalability of the Bioreactor
- Make it easy to be produced
- Easy to handle for user
- Reduce the cost

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## Hateful and criminal actors

What can bad actors do with your technology?

*This category is not applicable for this technology.*

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## Privacy

Are you considering the privacy & personal data of the users of your technology?

*This category is not applicable for this technology.*

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## Human values

How does the technology affect your human values?

### **How is the identity of the (intended) users affected by the technology?**

If successful, the technology and the research it is part of, will allow for a healthier population worldwide by providing a durable solution to help Osteoarthritis patients.

### **How does the technology influence the users' autonomy?**

The technology can lead to increased autonomy of its end-users, as it allows patients with previously damaged knees to move around freely again.

### **What is the effect of the technology on the health and/or well-being of users?**

The technology can improve the health of its end-users. However, as the technology is in research, no data on possible risks is available yet.

### **Now that you have thought hard about the impact of your technology on human values, what improvements would you like to make to the technology? List them below.**

As the technology can drastically improve the life of many people, it doesn't need big changes in regards to human values in it's current state. A better conclusion can be made once more data on the risks of the technology are available.

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## Stakeholders

Have you considered all stakeholders?

*This category is only partial filled.*

**Who are the main users/targetgroups/stakeholders for this technology? Think about the intended context by answering these questions.**

### **Name of the stakeholder**

Eindhoven University of Technology

### **How is this stakeholder affected?**

They are conducting the research on the printing and stimulation of the cartilage.

### **Did you consult the stakeholder?**

Yes

### **Are you going to take this stakeholder into account?**

Yes

### **Name of the stakeholder**

Fontys University of Applied Sciences (Michiel van Osch, Omar Idoum and Paul Goede)

### **How is this stakeholder affected?**

They are the project owners of the bioreactor assignment at Fontys.

### **Did you consult the stakeholder?**

Yes

### **Are you going to take this stakeholder into account?**

Yes

### **Name of the stakeholder**

University Medical Center Utrecht

### **How is this stakeholder affected?**

Knowledge source in the field of articular cartilage.

### **Did you consult the stakeholder?**

No

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Are you going to take this stakeholder into account?

No

**Name of the stakeholder**

Leiden University Medical Centre

**How is this stakeholder affected?**

Knowledge source in the field of immunology and rheumatology

**Did you consult the stakeholder?**

No

**Are you going to take this stakeholder into account?**

No

**Name of the stakeholder**

Regenerative Medicine Crossing Borders

**How is this stakeholder affected?**

Knowledge source in the field of regenerative medicine

**Did you consult the stakeholder?**

No

**Are you going to take this stakeholder into account?**

No

**Name of the stakeholder**

Corbion (legal entity: Purac Biochem BV)

**How is this stakeholder affected?**

Knowledge source in the field of biomaterials

**Did you consult the stakeholder?**

No

**Are you going to take this stakeholder into account?**

No

**Name of the stakeholder**

Demcon

**How is this stakeholder affected?**

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Knowledge source in the field of mechatronics

**Did you consult the stakeholder?**

No

**Are you going to take this stakeholder into account?**

No

**Name of the stakeholder**

Scinus Cell Expansion BV

**How is this stakeholder affected?**

Knowledge source in the field of cell expansion

**Did you consult the stakeholder?**

No

**Are you going to take this stakeholder into account?**

No

**Name of the stakeholder**

ASR Zorgverzekering

**How is this stakeholder affected?**

Knowledge source in the field of insurance

**Did you consult the stakeholder?**

No

**Are you going to take this stakeholder into account?**

No

**Name of the stakeholder**

NC Biomatrix BV

**How is this stakeholder affected?**

Knowledge source in the field of decellularized tissue products

**Did you consult the stakeholder?**

No

**Are you going to take this stakeholder into account?**

No



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Name of the stakeholder

Azar Innovations

**How is this stakeholder affected?**

Knowledge source in the field of organ on chip

**Did you consult the stakeholder?**

No

**Are you going to take this stakeholder into account?**

No

Name of the stakeholder

Poletis

**How is this stakeholder affected?**

Knowledge source in the field of bioprinting/biofabrication

**Did you consult the stakeholder?**

No

**Are you going to take this stakeholder into account?**

No

**Did you consider all stakeholders, even the ones that might not be a user or target group, but still might be of interest?**

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**Now that you have thought hard about all stakeholders, what improvements would you like to make? List them below.**

*This question has not been answered yet.*

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## Data

Is data in your technology properly used?

*This category is not applicable for this technology.*

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## Inclusivity

Is your technology fair for everyone?

### **Will everyone have access to the technology?**

no and its not interesting for everyone to have access to this technology because its is a technology specific for futhering a specific field of research. we could make the technology available for everyone but if someone is not involved in the research they will have very little use for this technology.

### **Does this technology have a built-in bias?**

yes this technology has a bias to improve human knowledge in the field of cartilage research. we can think of very little reasons to be against this improvements without using reasoning based upon things like religion or conspiracys. and because of this we think that it might be incorrect to call it a bias.

### **Does this technology make automatic decisions and how do you account for them?**

no this technology will not be able to make decisions on its own. everything this technology can do is based upon settings which are set up by the profesionals using this technology.

### **Is everyone benefitting from the technology or only a a small group?**

#### **Do you see this as a problem? Why/why not?**

the only people benefiting from our technology are the profesionals which use the system to futher the research. This research will benefit a lot of people mainly the people which have need for cartilage implatations, which is pretty much everyone beyond a certain age whos cartilage has deteriorated.

### **Does the team that creates the technology represent the diversity of our society?**

no and this is not important because it is a electo-mechanical system all people working on the creation on this system are engineers, who themselves are roughly the same age but from different parts of society.

### **Now that you have thought hard about the inclusivity of the technology, what improvements would you like to make? List them below.**

there are little improvements we can make based upon inclusivity due to the nature of our technology.

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## Transparency

Are you transparent about how your technology works?

### **Is it explained to the users/stakeholders how the technology works and how the business model works?**

there is not really a business model to speak of. our project is part of a larger research project. the researchers in this larger project are our stakeholders and users. we not only need to be very transparent on how the system works but our stakeholders will also be involved with the designing of the system and by extent choosing how its works.

### **If the technology makes an (algorithmic) decision, is it explained to the users/stakeholders how the decision was reached?**

there will be very little algorithmic decisions to be made, because the system has a lot of settings that can be set up according to the needs of the research.

### **Is it possible to file a complaint or ask questions/get answers about this technology?**

this is not really applicable to our situation because our stakeholders, end users, and designers are the same group of professionals, so if there were to be complaints or questions these professionals will be able to ask each other.

### **Is the technology (company) clear about possible negative consequences or shortcomings of the technology?**

again this is not really a scenario that can occur for our project. because the results of our project is going to be used to further research which is a very specific system that can only really be used for a single purpose.

### **Now that you have thought hard about the transparency of this technology, what improvements would you like to make? List them below.**

we think its important to be open about the working of this system in order to allow other professionals to use the system to its fullest and improve upon the system if need be.

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## Sustainability

Is your technology environmentally sustainable?

### In what way is the direct and indirect energy use of this technology taken into account?

The system contains controllers that limit the power to the minimum necessary for the use of the electronic components to realise the specific tasks of the system. In the future could be improvements in which type of controllers to use or a redesign that will improve the energy efficiency of the system.

### Do you think alternative materials could have been considered in the technology?

Taking into account the final use of the prototype (health care) the use of materials are limited

1. Stainless Steel
2. Copper
3. Titanium
4. Cobalt Chrome
5. Aluminum
6. Magnesium
7. Gold
8. Platinum
9. Silver
10. Iridium
11. Tantalum.

Plastics:

polycarbonate, polypropylene, polyethylene

Undo recycle or alternative materials have not been considered yet for the prototype can be applied in the future phases of the project.

### Do you think the lifespan of the technology is realistic?

The end of the research phase we are at is to create a small proof of concept that its purpose lifespan will be not more than the testing phase.

### What is the hidden impact of the technology in the whole chain?

The manufacture of the pieces or components used in the system. A positive influence would be to find reuse or recycle components from old projects or pieces made in a most sustainable manufacturing process.

**Now that you have thought hard about the sustainability of this**

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**technology, what improvements would you like to make? List them below.**

I would start doing a prove of concept with the materials and component that we already have without "spend" in new expensive materials that may be not use and prove the basic functions of the system. Therefore if the functions of the system have been prove. We can think in how the future design should be, components and materials (more sustainable options) that will be need it. An ways to improve the efficiency through the design.

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## Future

Did you consider future impact?

### What could possibly happen with this technology in the future?

This technology will be used to further research into the field of cartilage implantations and into cartilage itself.

### Sketch a or some future scenario (s) (20-50 years up front) regarding the technology with the help of storytelling. Start with at least one utopian scenario.

a person whose knee cartilage has degraded due to age or excessive use can have a new cartilage made for his knee, this cartilage can be stimulated in order for it to have the correct properties. after the operation this person can use his knee in everyday activities without pain or complications again.

### Sketch a or some future scenario (s) (20-50 years up front) regarding the technology with the help of storytelling. Start with at least one dystopian scenario.

because this is a medical application and the cartilage is in use all day everyday the long term consequences can only be discovered through testing and implanting. the worst thing that could happen is that the implanted cartilage will turn bad over time and will affect the cartilage and bone tissue around it in a negative way.

### Would you like to live in one of this scenario's? Why? Why not?

ofcourse we would like to live in the utopian scenario. its always very fulfilling to hear your machines have changed lives for the better. this project and this machine will be used to try and predict the long term consequences in order to prevent the dystopian scenario.

### What happens if the technology (which you have thought of as ethically well-considered) is bought or taken over by another party?

we think its a good idea to have this technology open to the world. because there are a lot of smart people who would be able to improve such technology better than we can. which we think outweighs the risk of this technology being used for ethically bad use cases.

### Impact Improvement: Now that you have thought hard about the future impact of the technology, what improvements would you like to make? List them below.

we would like to see this technology be expanded and improved upon by

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engineers and professionals from all different fields of research in order to provide the best system possible