

Integrating MODLI's decision support tool for circular procurement in educational courses and assignments

1. MODLI's decision support tool for circular procurement

MODLI's decision support tool has been developed as part of MODLI (Modelling Dynamic Lifecycle Impacts of Circular Procurement in Healthcare), a two-year research project¹ part of the Collaborative Innovation & Entrepreneurship (CIE) research group at the Amsterdam University of Applied Sciences. The decision support tool is available as an open-source resource and is aimed at healthcare (procurement) professionals and others who want to gain insight into the economic, environmental, and social impact of different types of isolation gowns, to make better informed purchasing decisions. The tool is also useful for educators and students, helping them to better understand the trade-offs between economic, environmental, and social impacts in circular procurement decisions. The tool (including user instructions) is available at <https://www.circularprocurement.info/>

Background

The COVID-19 pandemic highlighted the vulnerability in supply networks in the healthcare sector and the tremendous waste problem and ecological impact of disposable healthcare products that are widely used (i.e. single-use products that are used once and then discarded).

Disposable isolation gowns are currently among the top single-use products used within Dutch healthcare organizations that have the [largest estimated CO₂ impact](#). An isolation gown is personal protective equipment (PPE) that healthcare professionals wear when caring for patients to protect themselves and others from blood, body fluids or infectious viruses and diseases. *Reusable* isolation gowns (i.e. gowns that can be reused after washing) potentially reduce ecological impacts; previous [lifecycle analyses](#) (LCAs) have shown that reusable gowns require less energy and produce less emissions and waste during their lifespan when compared to disposable gowns.

While disposable gowns follow a make-use-dispose linear model of production and consumption and are discarded as unrecyclable (medical) waste after being used only once, reusable gowns follow a more circular model which requires extra supply chain services, including transportation and washing (mainly at contracted industrial laundries), repairing, and quality-checking. Additionally, sorting and recycling services are needed when reusable gowns reach end-of-life (i.e. gowns are no longer fit for use).

2. Target groups and Learning objectives

The MODLI decision support tool is developed for healthcare professionals in procurement/supply chain/logistics and sustainability teams. In education, the tool is relevant to Bachelor or Master students enrolled in courses on supply chain management (e.g., purchasing, operations management, supply chain finance), and sustainability/circular strategy.


Integrating the MODLI tool in course content/assignments can contribute to the following learning objectives:


¹ MODLI was co-funded by the Taskforce for Applied Research SIA, part of the Dutch Research Council (NWO), RAAK.PUB11.024

- Understanding the trade-offs between economic, environmental and social impacts when making purchasing decisions.
 - The tool allows users to compare different types of disposable/reusable isolation gowns on the basis of their economic impact (e.g., purchasing cost, laundry cost, waste cost, residual value at end-of-life), environmental impact (e.g., CO₂-eq, energy, water), and social impact² (e.g., user comfort, hygiene & safety, and social certifications such as Fair Wear).
- Understanding the economic and environmental impact at different supply chain stages; from production, to use and end-of-life.
 - When comparing different types of isolation gowns, students can identify which stages contribute most to the economic and environmental impact. For example, reusable gowns incur large costs in the use phase, as laundry costs can be substantial depending on the market where the gowns are used. Another example is that in the production phase, organic cotton gowns have less CO₂-eq impact but have a much larger water impact compared to polyester gowns.
 - The tool allows students to execute an analysis on investment cost (e.g., buying a large number of reusable gowns all at once and spread the cost over a number of years) and operational cost (e.g., the purchasing cost of disposable gowns and the laundry cost for reusable gowns). *As this is more relevant to courses in finance and accounting, it is not included in this assignment.*
- Understanding the complexity in the transition from linearity (disposable gowns) to circularity (reusable gowns)
 - The tool allows students to understand the trade-offs between economic impact, environmental impact, and social impact in purchasing decisions, i.e. depending on which impact is prioritized (e.g. smallest water footprint or lowest CO₂ emissions or lowest purchasing price) different choices will be made.

3. Course assignment using the MODLI tool

This section demonstrates how the tool can be used in a course assignment. Lecturers are encouraged to adapt this example to fit the duration and content of their course.

 Assignment title: Circular Procurement at Healthcare Organisations

 Assignment type: Group assignment of 2-4 students.

3.1 Teaching plan

For a take-home assignment, provide students with the assignment document (section 3.2).

If the assignment is carried out in class, the following teaching plan is proposed.

- **Step 1 (~20 minutes):** Make student groups of 2-4 students. Provide students the assignment document (section 3.2). Have students read the introduction and the learning objectives. Allow students time for questions.
- **Step 2 (~15 minutes):** Have students perform the first task – searching for available gowns. *To save time, this step can also be assigned as homework. Additionally, lecturers could also perform this step and provide the gown details to students, which will make it easier to grade the assignment. However, searching for real products available on the market is a relevant task in procurement, and it will make this assignment more practice oriented. Please see section 4 for examples of*

² While the tool does provide space for users to add information on social impact, it is not included in the sample assignment (mostly quantitative) questions in section 3.2.

isolation gowns currently on the market, which can also be shared with students in case they experience difficulties in searching for gowns online.

- **Step 3 (~45 minutes).** Have students perform the second task – using the MODLI tool to analyse the environmental and supply chain service impact.
- **Step 4 (~20 minutes).** Have students finalize their reports for submission.

Example Answers

Please contact q.v.nguyen@hva.nl for a document with example answers to the assignment questions.

3.2 Assignment document (to be distributed to students)

Introduction

The COVID-19 pandemic highlighted the tremendous waste problem and ecological impact of disposable products in healthcare (i.e. single-use products that are used once and then discarded). During the pandemic, isolation gowns were heavily used by doctors and nurses. An isolation gown is personal protective equipment (PPE) that healthcare professionals wear when caring for patients to protect themselves and others from blood, body fluids or infectious viruses and diseases.

Disposable isolation gowns are currently among the top single-use products used within Dutch healthcare organizations that have the largest estimated CO₂ impact. *Reusable* isolation gowns, which can be reused after washing, potentially reduce waste and ecological impacts. Previous lifecycle analyses (LCAs) have shown that reusable gowns require less energy and produce less emissions and waste during their lifespan when compared to disposable gowns. Therefore, healthcare organizations have started to explore the transition from disposable to reusable gowns, for example by participating in small pilot projects where the use of reusable gowns is tested (think laundry and logistics flows, financial implications etc.).

- Figure 1 represents the simplified material flows of disposable and reusable gowns. Disposable gowns are single-use. Reusable gowns can be used multiple times. Reusable gowns have an average *maximum number of washes* after which they are no longer fit for use, i.e. they reach *End-of-Life* when they are sent to textile sorters/recyclers for recycling.
- Disposable gowns follow the linear *make-use-dispose* model of production and consumption and are discarded as unrecyclable medical waste after being used once. Reusable gowns follow the circular *make-use-reuse-recycle* model and therefore require extra supply chain services: transportation between hospitals and laundry companies, washing at laundry companies, repair services (gowns can get damaged during use phase) either at laundry companies or other textile-repair companies, quality control (checking the quality of washed gowns at laundry companies or at hospitals) and sorting/recycling end-of-life gowns.

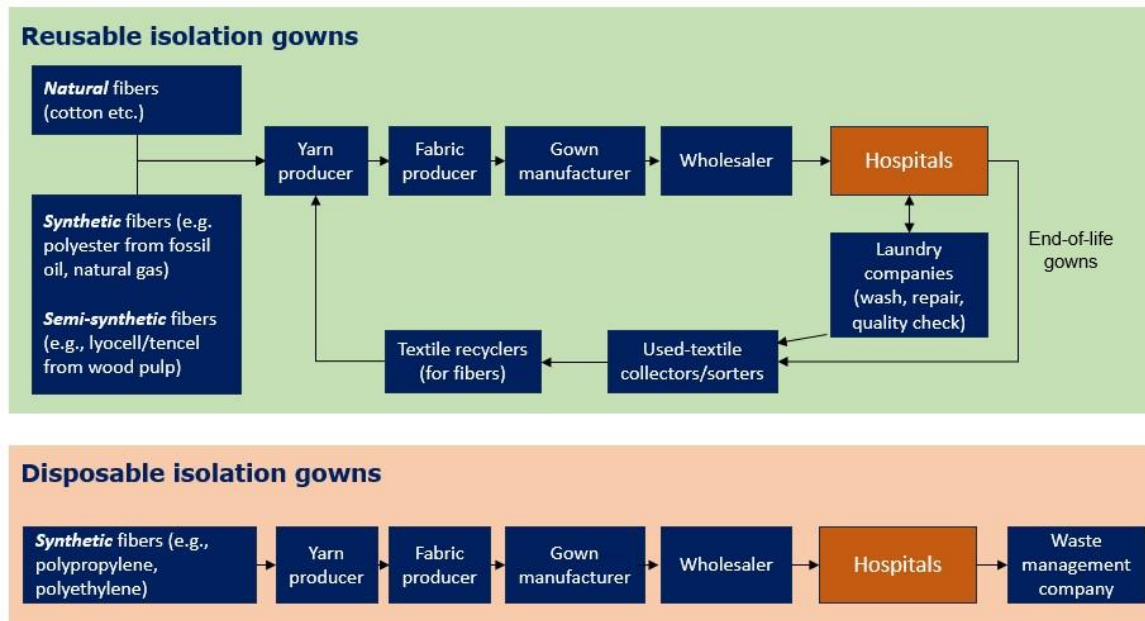


Figure 1. The simplified material flows of disposable and reusable isolation gowns

In this assignment, you/your group will simulate the role of *a procurement team* at a hospital where disposable isolation gowns are currently used in daily operations. The hospital management team has tasked your team with exploring the economic and environmental impact of transitioning from disposable to reusable gowns. Starting with collecting information about available reusable gowns on the market and then comparing their environmental and economic impact, you will experience the complexity in circular procurement (circular procurement prioritizes the purchase of products and services that adhere to circular economy principles, i.e. maximizing value of materials and minimizing resource use and waste and pollution).

Learning Objectives

- Understanding the trade-offs between economic, environmental and social impacts when making purchasing decisions.
- Understanding the economic and environmental impact at different supply chain stages; from production, to use and end-of-life.
- Understanding the complexity in the transition from linearity (disposable gowns) to circularity (reusable gowns)

Instructions

Step 1: Searching for available gowns

A. Conduct an online search for **two** types of reusable isolation gowns made from two different types of materials in this list: cotton, organic cotton, recycled cotton, polyester, recycled polyester, and lyocell. Cotton and polyester gowns are the most common. Suggestions for search keywords: *reusable/washable + medical/hospital + isolation gown + cotton/polyester* (in Dutch: *herbruikbaar/wasbaar + medisch/ziekenhuis + isolatiejas + katoen/polyester*). Many reusable gowns on the market are made from blended materials such as 65% polyester and 35% cotton. For the sake of simplicity, please select the material that constitutes more than 50% when assigning a material type to such blended gowns. For example, a blended gown of

65% polyester and 35% cotton will be considered as “100% polyester gown” in this assignment.

- B. Similarly, conduct an online search for **one** type of disposable (in Dutch: wegwerp) isolation gown made from polypropylene (PP). There are other disposable gowns on the market made from other types of synthetic fibers (e.g., polyethylene); in this assignment these are considered as comparable to polypropylene gowns in terms of environmental impact.
- C. **In your report, provide the following information (in a table)** about the **three** gowns you have selected: (i) the website link; (ii) materials; (iii) purchase price (in €) per gown; (iv) average maximum numbers of washes for reusable gowns - if this number is not available, search online for the expected numbers (of gowns made from similar materials) and provide reference sources; the expected maximum number of washes is typically within the range of 50-100.

Step 2: Analyse the environmental and economic impact


You will now use MODLI’s decision-support tool to compare the sustainability impact of your selected gowns. The decision support tool is available as an open-source resource and is aimed at healthcare (procurement) professionals and others who want to gain insight into the economic, environmental, and social impact of different types of isolation gowns, to make better informed purchasing decisions.

- A. Go to <https://www.circularprocurement.info/> and click “Compare Gowns”


 Compare Gowns →

- B. Read the instructions on how to select gowns for comparison
- C. Select “*Click here to view key variables, assumptions and data sources used in the comparison*” to read the brief descriptions and the default values of the economic variables (i.e. purchase cost, laundry cost, waste cost, residual value) and the choices/assumptions made in modelling the environmental impact.

Also read the “*Disclaimer*”. Note that the result of any LCA (life cycle analysis) is subjective to the modelling assumptions and choices made by the researchers. Therefore, you are recommended to always check how an LCA is performed (what sources are used, what assumptions are made etc.) when reading sustainability impact information about a product.


 **Click here to view key variables, assumptions and data sources used in the comparison**

- D. Under the “Reusable Gowns” list, locate the two gowns that are close to your selected two gowns in terms of material composition. For each gown: click “*Edit*” to enter the “purchase cost (€/gown)” and “maximum number of washes” (in case the data on maximum number of washes is not available online, keep the default value of 80). Make sure to click “*Save Changes*” before clicking “*Back*” to go back to the comparison page.

 **Reusable Gowns**

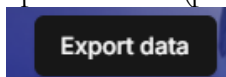
| | |
|--|-------------------------------------|
| <input type="checkbox"/> 100% Lyocell | <input type="button" value="Edit"/> |
| <input type="checkbox"/> 100% Organic Cotton | <input type="button" value="Edit"/> |
| <input type="checkbox"/> 100% Cotton | <input type="button" value="Edit"/> |
| <input type="checkbox"/> 100% Recycled Cotton | <input type="button" value="Edit"/> |
| <input type="checkbox"/> 100% Polyester | <input type="button" value="Edit"/> |
| <input type="checkbox"/> 100% Recycled Polyester | <input type="button" value="Edit"/> |

- E. Click “Edit” next to the single-use polypropylene gown to update the purchase cost and other parameters.

 **Single-use gowns**

| | |
|--|-------------------------------------|
| <input type="checkbox"/> 100% Polypropylene (disposable) | <input type="button" value="Edit"/> |
|--|-------------------------------------|

- F. Tick the checkboxes of the two reusable gowns that you want to compare as well as the single-use gown. The comparison results will appear automatically below the gown list.
- G. Download the comparison results (an Excel file) by clicking the button “*Export Data*”. In the downloaded Excel file, there are two tabs. The comparison results are under the “Gown Comparison” tab (please ignore the “Investment Analysis” tab).



H. In your report, add the relevant data/charts provided by the tool while you address the following questions:

- I. Compared to the disposable gown, to what extent do the two reusable gowns selected perform better/worse in terms of CO₂-eq / energy / water impact? Which gown is the best in terms of environmental impact? Please explain.
- II. Compared to the disposable gown, to what extent do the two reusable gowns perform better/worse in terms of costs? Which cost type(s) causes the difference? Which gown is the best in terms of economic impact? Please explain.
- III. Which gown is the best overall when considering both the environmental and economic impact? Please explain.
- IV. Laundry costs significantly contribute to the total (operational) cost of reusable gowns. The default value for laundry cost in the tool is €1.25 per gown per wash. Your hospital may be able to lower the laundry cost when you buy more reusable gowns (i.e. more reusable gowns mean higher washing volume in the contract, thus a lower price per wash can be negotiable; also the cost could be lower due to the economy of scale at laundry companies). What is the maximum laundry cost per wash that would make the reusable gowns cost-competitive to the disposable gown? Please explain your answer.
- V. (Large) European companies have to pay for their emitted CO₂. Search online for the current price per *metric tonne* of CO₂ under the [EU Emission Trading System](#) (EU

ETS) and convert the CO₂-eq amount (note that the unit used in the tool is *kg* CO₂-eq) to economic (monetary) cost.

- Briefly discuss the current trend of CO₂ prices.
- In the downloaded Excel file (step G), make a new row for this (new) CO₂-eq cost. Add this new cost to the Total Cost. When considering the new total cost, which of the three gowns is the best? What should the required EU ETS price of CO₂ be to make reusable gowns cost-competitive to the disposable gown? Please explain.

- VI. In your report, discuss other alternatives that your hospital can consider to bridge the cost gap between reusable and disposable gowns. For this question, place this sustainable procurement task in the broader context of supply chain management, regulation, economy and politics. Remember to cite reference sources to support your arguments in the discussion.

Deliverables

- A written report of 500-1000 words according to the instructions and questions under the **Instructions** section.

Evaluation criteria

The assignment will be evaluated based on:

- Demonstrated understanding of the trade-offs in circular procurement
- Demonstrated understanding of the impact of supply chain services in the transition to circular products
- Professional report and layout of the report.

4. Examples of isolation gowns

Disposable (medical) isolation gowns



Figure 2. Example of disposable medical isolation gowns from <https://medisheartikelen.nl/product/9002540-wegwerp-isolatiejas-115cm-x-137cm-geel-smms-10/>



Figure 3. Example of disposable medical isolation gowns from <https://www.merkala.nl/verbruiksmateriaal/persoonlijke-bescherming/beschermjassen.html>



Figure 4. Example of disposable medical isolation gowns from <https://cleandirect.nl/a-63259707/isolatiejassen/medische-isolatiejas-100-stuks-1/#description>

Reusable medical isolation gowns



Figure 5. Example of reusable medical isolation gowns from <https://www.zorgvrijkleding.nl/product/infectiepreventie--wasbare-isolatie-jassen-schorten-100-keer-wasbaar/>



Figure 6. Example of reusable medical isolation gowns from <https://www.lusini.com/nl-nl/pdp/157242/>



Figure 7. Example of reusable medical isolation gowns from https://www.intrakoop.nl/docs/default-source/default-document-library/rentex-reusable-isolatiejassen.pdf?sfvrsn=8ad7dd7c_0

5. Further reading

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- Xu, L., Jia, F., Yan, F., & Chen, L. (2022) Circular procurement: A systematic literature review. *Journal of Cleaner Production*, 365, 132845.