

Supplementary Materials

S1. PROTOCOL OF THE STRUCTURED INTERVIEWS

S2. SURVEY QUESTIONNAIRE

S3. CLASSIFICATION OF DISCUSSION FORUM INSIGHTS

S1. PROTOCOL OF THE STRUCTURED INTERVIEWS

INTRODUCTION

OBJECTIVES

- To identify the phases of the Life Cycle (LC) of Opera Sets (OS)
- To identify the main environmental impacts generated in the phases of the LC of OS. Impacts related with the use of materials, the use of energy and the generation of waste.
- To identify the challenges and potential improvements that Opera houses have with regards to the sustainability of OS.

INTRODUCTORY QUESTIONS

- Indicate professional position.
- Identify the main responsibilities of the interviewee related with the LC of OS.
- Identify the agents that the interviewee interacts with that are related with the LC of OS (describe roles).

PART 1. THE LIFE CYCLE OF OPERA SETS

- 1.1. Give a detailed description of the different phases that the opera sets undergo.
- 1.2. Validate a proposal of diagram of the LC of OS
- 1.3. Identify the agents that take decisions affecting the environmental impacts of OS at each phase.

PART 2. ANALYSIS OF THE DIFFERENT PHASES OF OPERA SETS LC

Objectives: evaluating the different phases of the LC of OS.

Aim: characterizing the phase and its sub-processes, identify the main sustainability issues, and to analyse the specific use of materials, energy, and generation of waste that can be related to that LC phase.

Information to be collected from main phases:

DESIGN OF THE OS

General questions

- Characterize the OS design phase. What happens during this phase? Are there distinctive types of processes?
- Main impacts in terms of sustainability
- Main activities to mitigate sustainability issues
- Main challenges to mitigate sustainability issues

Materials

- What materials are mainly used in the design of OS? In what proportions?
- Where do the different materials come from?
- Who determines the purchasing of materials and products for OS design and building?
- What factors are considered in the purchasing of materials and products for OS design and building?
 - o Is the origin of materials and products considered in the materials decision making? Are local products or materials prioritized?
 - o Are renewable materials prioritized?
 - o Are materials that last preferred to easily replaceable materials?
 - o Are any suppliers asked to include a Carbon footprint label on the materials provided?
 - o Are there any products/materials bought for OS design that have an eco-label?

Energy

- Is business travel usual when designing the opera set?

Waste

- Is waste generated during the design of opera sets? What/how materials are trashed?

SETS BUILDING

General questions

- Characterize the OS building phase. What happens during this phase? Are there distinctive types of processes?
- Main impacts in terms of sustainability
- Main activities to mitigate sustainability issues
- Main challenges to mitigate sustainability issues

Materials

- In which parts/subsystems would you divide an opera set?
- Which are the most used materials in each of those parts?
- Could the amounts of materials be reduced?
- Is or could the structure be standardized among different sets? And among different operas?
- What about other parts of the OS, could they be standardized?

Energy

- Is business travel usual when setting agreements with material and product suppliers?
- Is business travel usual when building the opera set?

Waste

- Is waste generated during the building of opera sets? What/how materials are trashed?

SETS USAGE

General questions

- Characterize the OS usage phase. What happens during this phase? Are there distinctive types of processes?
- Main impacts in terms of sustainability
- Main activities to mitigate sustainability issues
- Main challenges to mitigate sustainability issues

Energy

- Is there any use of energy during OS usage? Specify.

Waste

- Is there any waste generated during OS usage? Specify.

SETS DISMANTLING

General questions

- Characterize the OS dismantling phase. What happens during this phase? Are there distinctive types of processes?
- Main impacts in terms of sustainability
- Main activities to mitigate sustainability issues
- Main challenges to mitigate sustainability issues

Materials

- Is there specific material that is bought/used for sets dismantling? Specify.

Energy

- Is there any use of energy during OS dismantling? Specify.

Waste

- Is there any waste generated during OS dismantling? Specify.

SETS STORAGE

General questions

- Are all OS stored after dismantled?
- Characterize the OS storing phase. What happens during this phase? Are there distinctive types of processes?
- Main impacts in terms of sustainability
- Main activities to mitigate sustainability issues
- Main challenges to mitigate sustainability issues

Materials

- How are OS packed for storage?

Energy

- Where are the OS usually stored? How are they transported?
- Is there any energy use during storage? (heating/humidity control...)

ALTERNATIVE USES AFTER DISMANTLING

- Which is the mean life span of an opera set? How many times can it be used during its lifespan?
- Which materials/systems of the OS are: reused/donated/leased-rented/trashed?
- From the materials reused, which are reused for the same purpose, and which are simply kept for alternative uses?
- How many cycles of building/using/disassembling/storing and building can happen (and usually occur) during an opera set lifespan?

REUSE (TOTAL OR PARTIAL)

- Characterize the possibility of reusing the whole or parts of the OS. Is it frequent?
- What parts can be reused?
- Main impacts in terms of sustainability
- Main activities to mitigate sustainability issues
- Main challenges to mitigate sustainability issues

DONATION (TOTAL OR PARTIAL)

- Characterize the possibility of donating the whole or parts of the OS. Is it frequent?
- What parts can be donated?
- How are the donations transported? Are they frequently far from origin?
- Main impacts in terms of sustainability
- Main activities to mitigate sustainability issues
- Main challenges to mitigate sustainability issues

RENTING (TOTAL OR PARTIAL)

- Characterize the possibility of renting the whole or parts of the OS. Is it frequent?
- What parts can be donated?
- How are the leased/rented OS transported? Are they frequently far from origin?
- Main impacts in terms of sustainability
- Main activities to mitigate sustainability issues
- Main challenges to mitigate sustainability issues

END OF LIFE

- How are OS usually trashed at their end of life?
- Which percentage of materials are sent to be waste managed?
- Which are the waste management procedures usually used?
- How are materials transported to be waste managed?
- Main impacts in terms of sustainability
- Main activities to mitigate sustainability issues
- Main challenges to mitigate sustainability issues

PART 3. GLOBAL EVALUATION

This last section asks for a global analysis of the sustainability of the whole LC of OS.

- What is the phase of the LC of OS where the sustainability impacts are more/less relevant/challenging to reduce?
- What are the biggest latest achievements regarding sustainability of OS?
- What are the most important challenges regarding the overall sustainability of OS?

S2. SURVEY QUESTIONNAIRE

INTRODUCTION

The survey is centred on the Life Cycle of Opera Sets. Most questions refer to your organisation's current practices regarding sets eco-design and sustainability and to your own point of view on some specific topics.

The estimated time to answer the survey is 10 to 20 minutes.

Thank you for your time and consideration.

ABOUT YOU AND YOUR ORGANIZATION

Q1. What organisation do you work for? Write the full name of the organization you work for.

Q2. Where is your organization located? Indicate the country where your organization is located.

Q3. What is your current position in the organisation?

- a) Technical director, deputy director or manager
- b) Production director / manager
- c) Head of set workshops
- d) Head of design office
- e) Technical Manager
- f) Logistics Manager
- g) Other: _____

Q4. For how long have you been working in the performing arts sector? Indicate how many YEARS you have been working in the performing arts sector in the current or other positions (if necessary, use decimals).

Q5. What is the average number of sets that are built every year at your organization? Indicate the AVERAGE NUMBER OF SETS built yearly by your own workshop, subcontractors, and co-producers for your organization.

- a) Number of sets built by your own workshop for your organization
- b) Number of sets built by sub-contractors for your organization
- c) Number of sets built by the workshops of co-producers for your organization

ABOUT YOUR ORGANISATION'S GENERAL PRACTICES

Q6. Is your organization currently collecting data on the following issues? Only tick on the box if your organization is regularly collecting data on the specific items described.

- a) Information on the quantities of materials bought every year (volume or weight):
 - ☐ Total quantity of materials bought every year
 - ☐ Quantity of wood
 - ☐ Quantity of steel
 - ☐ Quantity of aluminium
 - ☐ Quantity of dense polymers
 - ☐ Quantity of expanded polymers
 - ☐ Quantity of cardboard and paper
 - ☐ Quantity of glass
 - ☐ Other: _____
- b) Information on the annual energy consumption:
 - ☐ Total annual energy consumption

- ☐ Total electricity consumption
- ☐ Total fossil fuel consumption
- ☐ Others _____
- c) Information on the annual waste produced (volume or weight):
 - ☐ Total annual waste produced
 - ☐ Steel waste
 - ☐ Aluminium waste
 - ☐ Wood and wood derivatives waste
 - ☐ Dense polymers waste
 - ☐ Expanded polymers waste
 - ☐ Cardboard and paper waste
 - ☐ Glass waste
 - ☐ Other: _____

Q7. Is your organisation certified under the following environmental standards or any other environmental certification? Indicate which certifications your organization holds.

- ☐ None
- ☐ ISO 14000 family
- ☐ ISO 50000
- ☐ EMAS
- ☐ Other: _____

ABOUT THE ENVIRONMENTAL IMPACT OF A SET

Q8. What is the average lifespan of a set in your organization since it is built until it is disposed? Indicate how long does a set last in average in YEARS (if necessary, use decimals).

Q9. On average, how many cycles of [assembling → using → disassembling → storing → re-assembling] can happen during a set lifespan in your opera house/theatre?

Q10. To which extent is your organization applying the following practices when building a set? Quantify from 1 (we do NOT apply this practice) to 7 (we ALWAYS apply this practice).

1. Reuse materials or parts of old sets
2. Use permanent assemblies: Gluing, welding, or other methods
3. Use reversible assemblies / dismantables
4. Use water-based paints
5. Use modular parts that can then be reused
6. Use single-material parts to facilitate their waste management
7. Adapt the dimensions of an OS to fit standards of materials
8. Rent structure to avoid construction
9. Ask wood suppliers for documents on the origin of their products
10. Look for substitutes to polystyrene
11. Look for substitutes to other non-recyclable materials
12. Other: _____

Q11. In your organization, what is, in your opinion, the contribution of the following 5 life cycle stages to the environmental impact of a set (in %)? NOTE: the addition of percentages of the 5 stages should total 100%.

- a) Construction: materials, basic products manufacture. Indicate the % contribution of construction to the environmental impact of a set in your organization.
- b) Use during performances and rehearsals. Indicate the % contribution of use to the environmental impact of a set in your organization.

- c) Assembling, disassembling and storage. Indicate the % contribution of assembling, disassembling and storage to the environmental impact of a set in your organization.
- d) Transport of sets to store, reuse, or waste them. Indicate the % contribution of transport to the environmental impact of a set in your organization.
- e) Waste management. Indicate the % contribution of waste management to the environmental impact of a set in your organization.

Q12. In your opinion, to which extent can your organization reduce the environmental impacts of the following stages of the Life Cycle of sets? Rate from 1 (there is no room for improvement) to 7 (there is a large room for improvement).

- 1. Construction: materials, basic products manufacture
- 2. Assembling, disassembling, and storage
- 3. Use during performances and rehearsals
- 4. Transport of Sets to store, reuse, or waste them
- 5. Waste management

Q13. Evaluate what is the importance that your organization gives to the following criteria when purchasing raw materials for building sets?

- 1. Price
- 2. Availability (easy and fast to obtain)
- 3. Geographical proximity
- 4. Durability
- 5. Aesthetics
- 6. Materials issued from renewable sources (i.e.: bamboo, cork, recycled wood, paper natural fibres, recycled plastic)
- 7. Eco-Labelled (i.e.: FSC, Blue Angel, EU ecolabel, Nordic Swan)
- 8. Partnerships with regular suppliers / reliability of the supplier

Q14. To which extent are the structures of your sets (including floor, ceilings, walls) standardized (i.e.: same elements are always used to build different structures)? Quantify from 1 (NOT standardized at all) to 7 (ALL structures are standardized).

- 1. For Horizontal Structure
- 2. For Vertical Structure
- 3. For Access structures (stairs, railings, walkways)
- 4. For Mechanical Systems (revolves, elevators, rakes)

Q15. To which extent are your structures for sets compatible with the ones used by other operas or festivals? Quantify from 1 (NOT compatible at all) to 7 (COMPLETELY compatible).

Q16. What is the final destination of the materials of opera sets that are not reused for your own productions, sold or donated? More than one destination can be selected.

- ☐ Recycling
- ☐ Landfill (trashed)
- ☐ Incineration
- ☐ I do not know
- ☐ Other: _____

CHALLENGES AND COLLABORATIONS

Q17. What factors are preventing you from making the sets more sustainable keeping the same functionality and aesthetics?

- ☐ None
- ☐ Money

- ☐ Time
- ☐ Lack of manpower
- ☐ Knowledge about alternatives
- ☐ Work habits
- ☐ Other: _____
- ☐ Q18. Are you partnering with other organizations to find new sustainable solutions?
- ☐ Yes
- ☐ No

Q19. If you are partnering with other organizations to find sustainable solutions, please indicate with whom and how.

Q20. What are, in your opinion, the most important challenges regarding the overall sustainability of sets? Any other kind of comments are also welcome here.

THANK YOU VERY MUCH FOR YOUR TIME AND COLLABORATION

S.3. CLASSIFICATION OF DISCUSSION FORUM INSIGHTS

Note: Those insights that researchers sorted in two different categories are include in both categories.

RESOURCES: Need/existence of additional resources (e.g., work time, storing space and money) to put initiatives into practice.

- The biggest barrier to sustainability is production time. To choose between different suppliers or different materials available on the market-there is often not enough time in the planning period.
- We need more space and labour to break items into component material parts. Both cost money.
- Planning time is insufficient to account for sustainability.
- How to get the financial engagement is not trivial. So far it has not been available.
- We need to engage top level decision makers in organisations to release the required funding.
- The lack of consideration of sustainability in design is often due to time considerations and training (*also classified as Knowledge).
- We need to engage top level decision makers in organisations to release the required funding (*also classified as Management).

KNOWLEDGE: Need/existence of capacitation, awareness, and substantiating data to put initiatives into practice.

- The lack of consideration of sustainability in design is often due to time considerations and training (*also classified as Management).
- Everybody needs to be aware of this topic, first!
- I have the impression that the awareness of the need is very high in technical departments and the workshops. Not so much elsewhere.
- It would be essential for us to find something which creates a very quick and a perceivable impact - otherwise we will not have any acceptance within our own institution.
- It is important to identify the potential impact of a set circularity for the sector
- These ideas will need deep thought and implementation
- Sourcing of materials is always a big difficulty in this sector for all to get a clear view of the supply chain.
- You need detail about the sourcing of material to have the power to decide.
- You need maturing and gathering environmental knowledge also for efficiency.
- Reliability in terms of pursuit of excellence can be an issue - convincing ourselves & others than an equally excellent aesthetic effect can be achieved with a new process or material (*also classified as Criteria).
- There are a lot of issues to be faced. For example, if you consider the materials used for costumes, that come from India or China you have no record of the impact these have. If you buy furniture from Indonesia, although there are certificates, you may have doubts whether you should trust them. As soon as you source materials for the opera sets you need to be aware of their impacts. This needs to be disclosed to everyone in the field (*also classified as Criteria).

CRITERIA: Existence/alignment of (competing) criteria, priorities and stakeholders' interests/values facilitating/hindering putting initiatives into practice.

- There are a lot of issues to be faced. For example, if you consider the materials used for costumes, that come from India or China you have no record of the impact these have.

If you buy furniture from Indonesia, although there are certificates, you may have doubts whether you should trust them. As soon as you source materials for the opera sets you need to be aware of their impacts. This needs to be disclosed to everyone in the field (*also classified as Criteria).

- Design considerations for disassembly are not undertaken by technical designers. Thus, different criteria apply.
- Artists still seem to perceive sustainability as a restriction of artistic freedom.
- We should try to buy materials that we can produce close to home
- Transporting a set might be more sustainable than remaking in it in NY
- The issue of the artists can be solved including environmental clauses in the collaboration contracts. Aesthetics and sustainability shouldn't be opposed in the creation.
- The constraints should be incorporated beforehand in the creative process. Accountability cannot be left to the end. Conditions must be set and digested from the start.
- There are many activities that can impact within the opera sector. For example, we have reduced waste of food in the canteen. Artistic designers would be keen to move into a more environmental image (*also classified as Management).
- Despite artists perceive sustainability as a restriction of artistic freedom, it is the management who needs to go into this discussion (*also classified as Management).
- It is the artists that must be engaged. But those who are talking to the artists are the top managers. Artistic quality often primes on other values (*also classified as Management).
- A combination of things needs to be accounted for: the commitment and decisions from our boards regarding sustainability are vital but also the everyday decisions we all are taking is vital (*also classified as Management).

MANAGEMENT: Need/existence of managerial/organizational commitment to set goals and put initiatives into practice.

- There are many activities that can impact within the opera sector. For example, we have reduced waste of food in the canteen. Artistic designers would be keen to move into a more environmental image (*also classified as Criteria).
- Despite artists perceive sustainability as a restriction of artistic freedom, it is the management who needs to go into this discussion (*also classified as Criteria).
- It is the artists that must be engaged. But those who are talking to the artists are the top managers. Artistic quality often primes on other values (*also classified as Criteria).
- A combination of things needs to be accounted for: the commitment and decisions from our boards regarding sustainability are vital but also the everyday decisions we all are taking is vital (*also classified as Criteria).
- We need to engage top level decision makers in organisations to release the required funding (*also classified as Resources).
- Artistic director is the key person; however, you need to engage top level management to release required funding.
- Where do you start of the many things we do? You need to engage your management and company.

SECTORAL: Need/existence of changes and leadership at a sectoral level that enhance/hinder initiatives.

- It is hard to think for a whole sector when we haven't really found the core topics for our own organization.

- Whether the sector is mature and ready matters for the needs that it will experience to achieve the new goals and conditions.
- The very first step for a sector Route map is to agree on a target and a scope.
- When you work on circularity, if the industry focusses on carbon, the assessment rules exist. The sector does need to decide on what to prioritize and focus. Otherwise, it will not work.
- Who should lead? Should it be from the organizations or should it come up from above them. I suspect both. Opera Europa could have a role.
- It would seem desirable that exemplary champions should be encouraged to design and lead action plans which would help the rest to move forward and encourage and engage more reluctant organizations.
- International co-productions at a sector level need to be rethought. The idea of creative people sharing ideas is necessary, but we should try to find a more sustainable way of doing this in the future.
- It is necessary to organize a sectorial meeting to discuss the actions that can be taken.

EXTERNAL: Need/existence of external political, economic, social, technological, and legal forces to put initiatives into practice.

- Maybe the sector is not mature enough but our young audiences and, also, politics will heavily demand us to respect aspects of sustainability soon regardless of whether we are prepared or not.
 - We need to keep up with the young audience.
 - I agree that we need to keep up with the expectations of the younger public.
 - Besides the sets, we will need to think about the audience - our biggest CO2 driver.
 - There is the legal responsibility that is a good argument.
-