

08

CONCLUSIONS & DISCUSSION

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8.1 | RESEARCH CONCLUSION

Lidl NL has been putting efforts on implementing Circular Economy principles in their sustainable operations, but the lack of social aspects and integration to the local context was still needed for obtaining a total sustainable and balanced system. The Southern part of Spangen was the study case due to poor urban metabolism and social aspects, being very far from the Sustainable Development Goals established by the United Nations.

So the main research question of this thesis was:

To what extent the sustainable redesign of Lidl supermarket can improve the social context, urban metabolism related to essential flows and help to achieve Sustainable Development Goals (SDGs) in Spangen?

- Direct conclusion:

Lidl redesign, through the help of three interventions (square, Lidl and greenhouse), allowed to improve in general the current situation regarding social context and urban metabolism of Spangen and Lidl, but at different levels of success. In the end, apart from several achievements of SDGs indicators, there has been obtained new SDGs in both Lidl and Spangen.

On one hand, the proposal enabled to enormously improve the existing social context by providing new comfort spaces for having healthy, enjoyable, interesting, well-being, cohesive, integrational, climate awareness workshops and new social activities. Moreover, not only indoor spaces were improved regarding sociability among citizens (Lidl and GH), but also outdoor public space (square) was converted into a safer, nicer, social, interesting, enjoyable space to stay and interact with each other. The three interventions were socially connected to each other, being an integrated design and achieving the following SDGs related to social dimension: 5, 8, 10, 13, 17.

On the other hand, the main accomplishment of urban metabolism regarding essential flows was achieved with food flows, especially in food waste reduction (hierarchy re-circularity). On-site processing of surplus and avoidable solid food waste (FW) allowed a reduction of 70%. Other FW measures allowed reducing 7.5% of fried oil, 100% of coffee ground and in general reduce waste and resources from outside, at the same time as allowed providing new saleable products (soap, candles, fertilizer), boosting local business, identity and synergy between the neighbourhood's facilities. The downside was that the new local food production only covered 1.5% of the demand due to the focus on social aspects rather than intensive farming. The introduction of new rainwater and greywater collection tanks and on-site local treatments (biofilters), enabled the proposal to work almost self-efficiently. Around 65% of rainwater (without considering bathrooms and kitchen demands) was used within the interventions,

leaving 35% of remain rainwater for other purposes such as toilets. However, only 2.4% of greywater was able to cover the total water demand of Lidl.

Air flows were in general terms slightly improved, providing nicer indoor and outdoor air quality through biodiverse and local greenery species, but O2 supply was very far from covering O2 demands. The consolidation and achievement of SDGs related to environmental dimension were: 2, 3, 6, 7, 11, 12, 13, 14, 15, 17.

- Conclusion by sub-questions:

To answer the research question, the following sub-questions were put forward:

- 1- What are the essential flows of interest for Spangen neighbourhood and Lidl supermarket regarding SDGs?
- 2- What is the current urban metabolism, related to essential flows, between Lidl supermarket and the local neighbourhood?
- 3- What are the existing social initiatives for the local community and which ones could be improved or introduced through Lidl redesign?
- 4- What are the main circular opportunities that can be achieved through Lidl redesign for the improvement of the urban metabolism and according to the socio-economic context of Spangen?
- 5- Which Sustainable Development Goals result from the synergy between Lidl redesign and the neighbourhood?

The first sub-question is answered from the analysis in chapter 5.2 *Definition of flows*. In general, existing challenges regarding SDGs were detected to find possible improvements within the Lidl redesign. Afterwards, the selection of the final flows (Water, Food, Air) were evaluated according to greater improvement possibilities, SDGs, social impact and further factors. But, although these 3 essential flows were considered in the future design, air flows had less synergistic potentials and consisted on a complex range of factors (PMx, CO2, O2, etc), so it was discarded from the further analytical research.

The current urban metabolism (sub-question 2) can be answered from chapter 5.5 *Data flows in Spangen area*, in which the diagram of flows represents clearly the existing linear urban metabolism occurring in Spangen.

Great amount of avoidable food waste (FW) was thrown away and without any recovery measure, accounting for around 142,500 Kg FW/y and a loss of 80 Euros/y/person, so considering that Spangen was an area in need, people should not afford the right to waste food and money. The only FW recovery measure, accounting only for 4.4%, was the Lidl donations to national charities but without relation to Spangen citizens, being the rest sent to anaerobic digestion. Likewise, there were not water recycling measures or rainwater collection, being sent and mixed with the sewage urban system and reducing possibilities for urban synergy. Lastly, there was bad management of

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greenery spaces, being very scarce and predominating hard pavements, thus decreasing the opportunities from greenery in favour of airflows benefits.

The existing social initiatives (sub-question 3) are explained in chapter 5.1.3 *Existing initiatives*, being reduced in recent years and only remaining two social clubs with social activities and basic services to people in need. Stichting Openhaard was the only social club established within the study area (South) but based on chapter 6.1.3 *Definition of system boundaries*, its interior distribution and spaces were not attractive due to lack of lighting, comfort, healthy, motivational or working environment, so these issues led to new possibilities and social improvements within the Lidl redesign.

The previous sub-questions (1, 2, 3) proved that at least three types of interventions were needed for achieving further SDGs, improving social context and urban metabolism in Spangen: Square, cafeteria and greenhouse (GH). The latest allowed to relocated activities from the social club and introduce new activities for increasing social offer and boosting well-being among citizens.

-Existing activities/uses in Stichting Openhaard:

- Languages lessons
- Instrument lessons
- Photography
- Kick-boxing
- Cooking activities
- Sewing courses
- Turkish coffee
- Dancing lessons
- Conferences
- Art lessons
- Indoor football
- Reading
- Informatics
- Excursion

-Moved activities/uses to the new GH:

- Language lessons
- Guitar lessons
- Photography
- Kitchen workshops
- Sewing courses
- Coffee time
- Dancing lessons
- Conferences
- Art lessons

-New additional activities/uses in the GH:

- Nutrition & FW workshops
- Climate awareness, sustainability conference, upcycling & CE workshops
- Low technology and innovation
- conferences
- Table games
- Agriculture lessons & harvesting
- Animal feeding & care
- Dinner events
- Private plant ownership (com-
- mitment, care, good feeling, propriety feeling..)
- Social rooms, study area
- Organization of indoor fairs, cinema sessions or small events

Circular solution routes (sub-question 4) were searched and described in chapter 6..2.1 *Sustainable and low tech measures*, considering the socio-economic situation (low tech measures) and intervention type. In the end, only a few were selected, discarding others due to ethical, feasible, complex and expensive reasons. These are the selected circular opportunities, organized through the 3 R concept (reduce, reuse and produce):

-1 Food flows:

·Reduce: By local and direct donations to school, social clubs or other people in need, and changing the behav-

iour and buying practices through FW workshops.

·Reuse: Reprocess FW on-site (upcycling) into edible products (juices, cakes, ice cream from ripe fruits and vegetables, etc) and by-products (soap and candles from kitchen waste oil, mushrooms from coffee grounds...).

Collecting FW for animal feeding and vermicomposting in the GH (through new trash bins) and reusing animal waste as fertilizer or fish feeding.

-Produce: Local food production (aquaponics NFT, outdoor farm, livestock) allow reducing packaging, waste, transportation or costs, and providing new jobs, fresher, tastier and organic products to Spangen.

-2 Water flows:

·Reduce: NFT hydroponic system enable to reduce water, energy consumption and the need of soil.

·Reuse: Greywater reuse and bio-filtration.

·Produce: Rainwater collection and bio-filtration.

-3 Air flows:

·Reduce: By the introduction of local food production, waste reuse and introduction of greenery.

·Reuse: CO2-O2 exchange between livestock and crops.

·Produce: New outdoor and indoor greenery for O2 production and improvement of air quality.

Lastly, by considering the previous steps, several SDGs (sub-question 5) were achieved within Spangen and Lidl redesign, shown in chapter 7.5.2. *Achievement of SDGs*.

Overall, not only further indicators of each SDG were achieved in Spangen (S) and Lidl (L), but also new SDGs such as SDG6 and SDG8 (highlighted in green colour):

- SDG 2: Zero hunger (S, L)
- SDG 3: Good health & well-being (S, L)
- SDG 5: Gender equality (S, L)
- SDG 6: Clean water & sanitation (S, L)
- SDG 7: Affordable & clean energy (L)
- SDG 8: Decent work & economic growth (L)
- SDG 10: Reduced inequalities (S, L)
- SDG 11: Sustainable cities & communities (S, L)
- SDG 12: Responsible consumption & production (S, L)
- SDG 13: Climate action (S, L)
- SDG 14: Life below water (S, L)
- SDG 15: Life on land (S, L)
- SDG 17: Partnership for the goals (S, L)

Therefore, as mention at the beginning, by answering the previous 5 sub-questions, it was possible to develop an optimum result (with the limited available data and socio-economic constraints), being social context, food flows and SDGs much more improved.

8.2 | DISCUSSION

8.2.1 GENERAL DISCUSSION & FURTHER RESEARCH

General discussion:

This research concluded with the necessity to act in three different interventions, providing specific services and spaces for the improvement of the local social context, urban metabolism and achievement of SDGs in Spangen and Lidl. Nevertheless, the final result did not represent the only solution as there was room for discussion.

1- Food production and social activity in 1 location or 2:

Due to limited food production compared to supply, another location would need to be considered. From the two possible rooftops, only the first building was chosen due to views, food waste distribution or direct connection to Lidl cafeteria. However, although the second building had lower benefits regarding orientation, it could serve as an additional space for social purposes, thus leaving the first building for only food production. But this would result in higher consumption of resources, building construction labour and economic costs, being far from the objective of keeping the lowest construction and costs.

2- Profitable food production:

Food production objectives were focused on animal welfare and treatment, providing fresh, ecological and organic food. This resulted in wider spaces and fewer production of crops or livestock, so if economy and profitability were desired, better-exploited spaces would be needed, thus allowing to fulfil food demands in Spangen.

3- Wider indoor refurbishment of Lidl supermarket:

The ground floor where divided in Lidl and Toros supermarket, occupying 3/4 of front facade by Lidl and 1/4 by Toros. The indoor refurbishment design was aimed to be at the entrance of Lidl, modifying the least interior distribution and using the least commercial surface as possible, resulting in an elongated shape. However, if the space occupied by Toros supermarket was available for Lidl, greater benefits for the square and restaurant design could have been achieved, but resulting in higher distribution modifications, costs and possible conflicts with Toros.

4- Increase of water collection surface:

Water collection surfaces were not enough for the efficient management of the final proposal (when considering bathrooms and kitchen consumption, so, more water capturing surfaces would be needed, for example by considering other rooftops and streets nearby. This could lead to legal and property issues with neighbours or city council for letting get benefits for only Lidl, but could be a valuable and feasible option if an agreement was reached.

Recommendations for further research:

Introducing urban farming practices, social interaction among users, and implementation of circular routes have been independently achieved enough level of success in several projects. However, the combination of all these aspects in one location, through social circular economy principles and for the final achievement of SDGs, could

be something new or barely studied, needing for this inclusive design further research in the following domains:

1- Financial feasibility:

Investments and financial costs have been considered in the design but they were not further developed in detail. Due to Lidl supermarket's thesis, it was thought that Lidl would be the main investor for the cafeteria and greenhouse, being the city council the main interested party for the improvement of the square (public identity). The greenhouse could be funded by Lidl but owned by the community association, paying gradually back until reducing the Lidl loan. However, other financial possibilities would need to be searched, involving potential stakeholders, city council, Lidl and private companies, etc.

2- Relation to the rest of the flows:

Only the main essential flows have been studied in detail, but the relationship and impact to the rest of the flows (energy, emissions, packaging...) would need to be considered too in order to see the real feasibility of the project.

3- Food production variety and competitiveness:

Although food consumption habits was performed, a further study would be needed for finding the most effective food production and definition of type of species. The quality, fresher and organic products from the greenhouse was considered to have great acceptance to local consumers, but research (economical and environmental) and comparison of the new impact on the Lidl food supply chain would be needed.

4- Social activity variety:

New social activities were based on current social challenges from national statistics data and the desire to maximise social relationship among users. However, due to Covid-19 limitations, a further analysis of specific social activities adapted to local neighbours would be necessary for increasing their well-being and satisfaction.

5- Other circularity routes:

Mostly low tech and inexpensive measures according to the socio-economic circumstances of Spangen were introduced, being necessary to search for other innovative and more efficient possibilities (if costs are not considered).

6- On-site biodigester possibility:

A great part of surplus and food waste from the Southern part of Spangen was able to be re-processed and reduced on-site. With the introduction of a biodigester, food waste from the Northern part and production of energy could be achieved, but carrying ethical issues and regulations.

7- Decentralization and transferability:

Decentralization solutions were indirectly aimed for giving independence and higher benefits to small areas of a city. By solving efficiently local issues (neighbourhoods), the big scale (city) could be easier improved by applying repetitive patterns in the rest of the conflict areas. This research found at some extent, a general methodology that could be applied to any degraded urban context.

8.3 | REFLECTION

1- Methodology, approach and research methods:

The methodology of this thesis was elaborated based on predictive research (design by research). By critically identifying the causes and effects of the current issues and predict possible solutions in align with the SDGs (design exploration), this research project seeks to improve the spatial and societal issues occurring in Spangen and Lidl.

Furthermore, this graduation project is based on applied research, which begins from a particular situation: the socio-economical situation of Spangen and how this affects the urban metabolism and social community. Seeking social reintegration, cohesion and improvement of flows with minimal economic aids and difficult social context result in a challenging task. Therefore, this research aims to find a solution through a Lidl store redesign in order to improve the social context and urban metabolism, and in line with social sustainability and SDGs.

The conceptual approach follows an order that starts with the analysis of the baseline (formed by SDGs, Lidl position, flows and the social context), followed by the improvement phase (with circular solution routes, interrelations and design process) and ending with the evaluation of the design proposal. The design process is the most challenging part due to the need to consider efficiently the previous baseline analysis into optimal spatial translations. Degraded socio-economic environments are delicate areas that require careful attention mostly on social aspects, thus it is necessary to find a method that covers environmental but also social dimensions. ELSI framework seems to be the best option due to the inclusion of the 3 aspects of sustainability and ease to address and achieve the SDGs in a systematic and efficient way. After some adjustments, the final design framework was developed, including some smart strategies through circular solutions and spatial improvements. Moreover, prior to the design process, further analysis of local context was performed for recognising specific interventions, social spaces, species required, circular routes and detailed strategies.

2- Relationship between research and design:

In this graduation project, the design follows the research, which is divided in theoretical and analytical framework. All the theoretical research plays an important role for the understanding of the general case study situation and interpretation of the theoretical concepts (such as circular economy principles, social sustainability, urban metabolism, synergy, etc), in which important data is collected for finding at the end, ways to translate the theory into spatial designs. Afterwards, there has been found and identified several design objectives and general strategies (through design framework) in order to address the current challenges. Analytical research is also important

for understanding in more detail the causes and effects of social challenges and urban metabolism, and finding possible improvements adapted to the local situation.

Afterwards, those objectives and strategies were able to be integrated into the final design proposal through performing "research by design". Research by design consisted of finding first the potential zones of interventions, identifying the species and spaces needed, circular solution routes by a thorough and further analysis of the local context and needs. Therefore, at the end of the design process, optimal spatial designs were presented. Design in this project is a tool for inclusive architectural design and urban development within the framework of addressing and improving the essential flows and local social issues. Design strategies were aligned with the SDGs, sources, species and ecosystems, culture and economy, health and happiness, at the same time as considering urban symbiosis and social sustainability approach.

3- Relation between the graduation project topic, the studio topic, the master track and the master programme:

-Graduation topic, studio topic and master track (building technology):

Building technology is carried out within the only studio "Sustainable Graduation Studio", in which students can choose to focus their graduation topic in two fields, from façade, climate, structural design or design informatics. This research fell within the field of climate design and building physics and services, covering topics related to the indoor and outdoor environment and the dividing skin in-between, essential flows that enable living, working and travelling (energy, water and materials), and other important themes with societal and scientific value.

The purpose of this research topic is to study the local urban metabolism and improve societal issues through the investigation of the circular economy and circular routes, social sustainability, upcycling process, sustainable technology innovations, and resource flow, among others. Therefore, this graduation project is aligned with the workflow of the tutors and the scope of the sustainable graduation studio.

-Graduation topic and master program:

The Dutch government has established a goal for achieving a circular economy by 2050, thus TU Delft has already started to study this principle since years. The graduation project is in very closed relation with the master program of MSc Architecture, Urbanism and Building Sciences, in which experience in architecture design, spatial planning and the built environment is developed. Specifically, skills in design practice, from the physical and social sciences, technology and urban planning, to name a few, were ex-

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plored in order to find ways of creating sustainable development and integrated solutions for the built environment, thus in line with the scope of the thesis too.

4a- Societal relevance:

Rotterdam is a wealth region but nevertheless, it is formed by different districts that still undergoing social, economical and degradation issues, representing a great problem that leads to a lower rate of satisfaction and well-being for the local citizens. In particular, Spangen is constituted by a complex social structure, in which different ethnicities, ages and gender try to live together. However, far from profiting this variety of factors for enhancing social life, prosperity and interactions among neighbours, little social efforts and urban improvements have been made for fighting against the current degraded image of Spangen.

By solving and improving the existing social issues within this area, it could contribute to a better equity, quality of life, satisfaction, individual empowerment, inclusion, diversity, integration and in general, better well-being, co-existence, happiness and social relation among citizens. Moreover, the benefits would not only be focused on the social dimension but also economical aspects would be also improved as a result, increasing economic prosperity, partnership with local companies, commitment, inspirational ideas or productivity...

In general, several social initiatives have been organized by different associations in order to solve these current social issues in the area, but only a few seemed to be really effective and with enough engagement among local citizens. Opposite to other initiatives, this research project were not focused only on the provision of a wide range of social activities. This graduation project seeks to offer alternative multifunctional spaces for performing selected social activities that are aligned with the enhancement of integration, cohesion and participation of local citizens. Moreover, an increase of personal satisfaction, identity, community feeling, sense of belonging, stimulation of sense through new experiences, etc, at the same time as the introduction of climate awareness, teaching innovate technology and circular principles were searched through the different interventions of the proposal.

The positive fact is that the final social measures could serve as an inspiration and be transferred to other areas that experience similar processes of degradation or struggle with similar issues, getting benefit not only from a sustainable and economical point of view but also in order to increase their social quality of life. Therefore this thesis has societal relevance at different scales: from the local neighbourhood to an entire city, because by applying certain measures and according to local demands inside a specific neighbourhood (decentralization systems), big-

ger scales could be improved through repetitive patterns along with the territory.

The thesis does not respond to a unique answer at a specific location, but it could affect the future architecture and built environment design through social sustainability and synergetic approach with the surroundings.

Moreover, this research could also contribute to the achievement of Lidl sustainability goals and develop further the social inclusion and role of the supermarket within the community, in order to enhance customer satisfaction, exchange experiences and integration.

4b- Scientific relevance:

On one hand, the United Nations has established several Sustainability Development Goals focusing on social aspects and sustainability targets. The social circular economy is a concept that has a direct relation to the sustainability concept, but it has been barely applied efficiently through urban and architecture disciplines. From a scientific perspective, the goal of the thesis was to create a link that could interpret and translate the social circularity thinking towards spatial urban designs in order to find answers for a feasible and balanced sustainability system. In the end, the results allowed understanding the spatial relationships and social impacts of the social circular economy principles, so it enabled to set a good base for future researchers and other groups that might be interested in this type of research.

On the other hand, urban metabolism is in continuous expansion and transformation, differing from regions and countries, trying to integrate social, cultural, economic and political perspectives in order to shape sustainable environments. The form in which different flows could be combined in synergy with the urban environment would be inspiring not only for municipalities but also other researches or companies, in which further benefits than economical and sustainable measures were achieved, such as social well-being.

Moreover, the way this thesis tried to apply decentralization systems for addressing the issues at big scale through repetitive interventions at smaller scale could contribute to different scientific discussions about urban planning.

4c- Link to other professions:

Briefly, the thesis tried to establish a link between the circular economy and sustainable measures with urban design practices. However, waste collection, treatment systems and food production, among others, are actions that require help from different disciplines, such as architecture, administration, interior design, urban design, agriculture, etc to make them work. For example, reducing and recycling flows would need an approach from different disciplines because the urban design would not be

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able to solve all the issues alone.

5- Ethical perspective:

The cultural variety of Spangen can be an advantage for boosting integration, diversity and cohesion between different backgrounds, but also a challenging task due to privacy culture, closed-minded or particular behaviour. However, realistic social benefits remain unknown due to the impossibility to perform the expected questionnaires about the final proposal due to Covid-19, so perhaps some citizens would refuse to participate in social activities. But, this issue could be reduced by providing them some motivation (discounts, prizes,...).

Lidl has not been involved during the thesis, so its level of cooperation and objectives in the neighbourhood are unknown, although they agreed on establishing more connection with the community. This led to more open possibilities, but its willingness to invest in the new proposals and have an economical agreement with the food production in the greenhouse is still unsolved. Another issue is related to the stakeholders or Lidl food suppliers, which would be reduced due to new local food production.

By putting efforts on closing food, air and water loops through cradle to cradle principles, visible and enjoyable examples, people would be part and involved in these sustainable measures and would be able to learn and be more conscious about it, thus increasing sensibility, responsibility, awareness, cooperation, commitment and community feeling for improving common benefits for Spangen. An almost zero net waste facility could be able to achieve if fully cooperation between citizens is engaged, thus developing a proud feeling and sense of belonging to a healthy and sustainable community.

6- Personal reflection, results of research, expected results, results applicable in practice:

-Personal reflection:

This project helped me to develop a critical and analytical thinking, as well as extending my knowledge through research, analysis and strategy development. It was helpful to understand the importance of social sustainability for the improvement of degraded urban areas in social terms but also for the development of the other two dimensions of sustainability (economy and environment), and in which the link between these three dimensions allows to obtain much greater benefits than only focusing on a few. Addressing these three dimensions was a challenging task due to the socio-economic context of Spangen, but the new design framework helped to achieve further SDGs and in general, a better sustainable balanced system in the neighbourhood. Finally, this research enabled to change my way of thinking and perception on several notions, such as public space, degraded areas, urban

planning, socio-economic context, and the role of the architect within the society and environment.

-Research approach:

From my perspective, the methodology was adequate to answer the research question and sub-questions. However, several factors that were out of my scope such as lack of cooperation of private identities (Lidl and neighbourhood's facilities) and Covid-19 situation, led to uncertain results, thus adding some weaknesses points to the research. However, the lack of flows data and citizens feelings or requirements were efficiently solved by national statistic reports, newspapers, fieldwork and international reports, which provided general data in standard facilities.

The final result was slightly different from what I expected, being more detailed, completed and well-argued through the extent research framework. The analytical research conducted in Spangen and Lidl allowed me to understand the magnitude of their waste problem and urban metabolism, lacking local sustainable measures. The identification and improvement attempt of the urban metabolism regarding essential flows and the achievement of further SDGs and social aspects made my design proposal coherent, allowed perhaps to increase their relevance (social and also scientific) and created a great impact on social and environmental aspects (and a bit in economical one). In the end, I believe that the final design could strongly influence Spangen in a positive way, improving the quality of life of citizens, safety and health, boosting the local economy, people's satisfaction and participation, and integrating all variety of citizens under one area, among others, at the same time as implementing sustainable measures in the new social environment. Moreover, Lidl could obtain benefits from this research as synergy between the local neighbourhood could be much more beneficial for its commercial operations, as well as their increase in profits and customer satisfaction. Lidl could be the first supermarket that could play a prominent role within a community by in improving social cohesion through sustainable and circular principles.

-Applicability:

In terms of transferability, even though that each territory has inherent characteristics and properties, the broad idea could form a valuable base for initiating another different and future project. Moreover, the idea of this thesis could help to the improvement of other regions with similar degradation issues and contribute to their sustainable development. However, using the decentralization concept cannot assure the effectiveness and success of the new study territory, but by changing and adapting different parameters, I believe it could also work and help to achieve their sustainable goals.