Implementing Critical Systems Heuristics and Soft Systems Methodology on Ogden Downtown Alliance's Recycling Program

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The overarching objective of the Ogden Downtown Alliance (ODA) is to bolster the city center through community engagement. The organization supports the growth of downtown Ogden by "increasing economic vitality and community vibrancy throughout Ogden's Central Business District" (Ogden Downtown Alliance, 2018). Their most popular event is the farmers market in Downtown Ogden. Due to its size and popularity, it has become a testbed for some of the ODA's other initiatives, such as its recycling improvement program (Bowsher, 2019). The recycling initiative is where the team focused their efforts.

Currently, Ogden City does not have a viable recycling program due to the continual contamination of recycling bins with nonrecyclable materials. This contamination greatly affects the labor and equipment needed to process the materials, driving up cost and exceeding the city's budget. The ODA is acutely experiencing these consequences through the public events that they host, resulting in recycling bins being removed altogether until the issue is resolved (Bowsher, 2019). Ultimately, the ODA's objective is to reinstate recycling bins at all public events through increased community education and awareness about Ogden's recycling program as well as create a streamlined recycling process during these events. The ODA created a Recycling Task Force, but their meetings have been limited and have seen little progress.

After the team's application of the Viable System Model (VSM), the team redirected its focus specifically to the educational outreach opportunities that would allow for a more viable recycling program. Within this paper, the team addresses how the communication and engagement systems were further defined and what recommendations can be implemented to be effective while accommodating budgetary and resource limitations within the ODA.

Methods

Step 1: Description of the Situation Considered Problematical

The team began by asking the sponsor questions that would fully define the problematic situation. The questions asked and sponsor's responses are summarized in Table 1.

Step 2: Expression of the Situation as a Rich Picture

The team created a rich picture (Figure 1) to depict the current situation.

Step 3a: Identification of the Relevant Systems

The idea for a communication system emerged, which was solidified by identifying symbols synonymous with communication in the rich picture. The specific items contributing to the communication system are circled in red in Figure 2.

After the team identified the communication system, the team evaluated the remaining items in the rich picture and decided that they would focus primarily on human interaction. The public's interactions with the recycling program and the ODA and its stakeholder's interactions with the public establishes the engagement system, circled in blue in Figure 2.

Step 3b: Answering Ulrich's Boundary Questions

The team worked with the ODA's director, Kim, to answer the set of 24 questions defined by Critical Systems Heuristics (CSH). This exercise was completed to help the team further understand the current situation (reference system), identify any existing conscious/unconscious judgments, and design an improved scenario based on how the team envisions the system to work (Ulrich & Reynolds, 2010). The questions are listed along with the answers for the two relevant systems in Table 2.

Step 3c: Root Definitions of the Relevant Systems

When defining the root definitions, the team applied the Customer, Actor, Transformation, Weltanschauung, Owner and Environment (CATWOE) approach developed by the INCOSE UK (Emes, et al., 2012). The goal was not only describe what the system does, but also how and why it is important for the customers who benefit from the change in state, the actors that enable the transformation, the aspects that make the change meaningful and how it affects and can be affected by the environment (Williams & Hummelbrunner, 2010).

For the communication system, an effective *distribution of knowledge* was identified as the key transformation. This root definition for the Communication System, made up of Customers, Actors, Owner and Environment, is depicted in Figure 3.

For the Engagement System, the team identified the promotion of *enthusiasm for recycling* as the key transformation due to the lack of interest that Ogden residents, businesses and officials have shown to get actively involved with proper recycling efforts. The root definition for the Engagement System is depicted in Figure 4.

Step 4: Conceptual Models of the Relevant Systems (Holons) Named in the Root Definitions

The conceptual model for the Communication System is shown in Figure 5. The conceptual model for the Engagement System is shown in Figure 6.

Step 5: Comparison of Models and the Real World

The Burge tables for the communication and engagement systems are summarized in Table 3 and Table 4, respectively.

Step 6: Identification of Changes

The changes identified in the Burge tables, as well as the scores for the Ease-Benefit matrix, are summarized in Table 5 for the Communication System and Table 6 for the Engagement System. The Ease-Benefit bubble charts for the Communication and Engagement Systems are depicted in Figure 7 and Figure 8, respectively.

Team Recommendations

The team recommends that the ODA should pursue the following changes for the Communication System

To create meaningful changes that are both impactful and are relatively easy to implement, the group recommends four suggestions based on the Ease-Benefit Matrix outlining the potential benefits of the Communication System. The first recommendation is to translate the recycling requirements into laymen's terms that can be easily distributed to the public. Research has shown that there is already a generally high awareness by the general public on the benefits of recycling, and efforts should thus be focused on effectively educating the public on proper recycling habits that will enhance recycling performance (Timlett & Williams, 2008). The first step in achieving this is to illustrate the capabilities of the private recycling company effectively. When outlining this information, the ODA should focus on what specifically can be recycled and the different recycling collection locations that exist within ODA-sponsored events (Kaplowitz, Yeboah, Thorp, & Wilson, 2009). The team recommends this action because it has a high level of benefit despite its mediocre level of ease. It would require some research to fully develop the requirements of the recycling program into an easy-to-digest platform for the end-user, but the payoffs would be worth the effort. The most important point to this translation is that the result should cater to the specific needs of the Ogden citizens. Research suggests that the effectiveness

of persuading the population to adopt an effective recycling program can be "enhanced by the inclusion of information from reference groups relevant to the individual" (Burn & Oskamp, 1986). Ultimately, the ODA should stray from focusing on overwhelming the citizens with vast knowledge about the larger system and should instead focus on the environmental content and how the effective recycling program specifically benefits the citizens of Ogden (Kaplowitz, Yeboah, Thorp, & Wilson, 2009).

The second recommendation to the ODA by the team is to define a succinct mission, goals, roles and responsibilities of the members of the Recycling Task Force. By defining a mission statement, goals and roles for the members of the task force, the team will be able to maintain momentum and see tangible steps forward toward the implementation of a successful recycling program within the community. The definitions can be completed with relative ease and would have a high benefit for the recycling program moving forward.

The third recommendation to the ODA by the group is to identify effective ways to interact with patrons during events. The interactions with patrons will be most effective if the personal contacts that are identified by the ODA "possess adequate knowledge regarding the operations" or the ODA's recycling program in addition to the "benefits of recycling as a whole" (Kaplowitz, Yeboah, Thorp, & Wilson, 2009). Having subject matter experts near recycling bins at ODA events can assist patrons in making correct recycling choices and can provide that personal interaction that research has shown to be successful. Also, the impact of communication efforts depends upon the credibility of the person performing the communication (Burn & Oskamp, 1986). Thus, having subject matter experts would improve the impact that the communication would have on the attendee.

The fourth and final recommendation to the ODA is to use a broader spectrum of easily accessible and obtainable mediums to communicate the recycling program to the attendees of ODA events. These additional mediums could include pictures on bins, billboards and "word-of-mouth" by event vendors as well as other forms of media. The use of a large variety of mediums allows for recycling information to be effectively communicated across different groups and be catered to whatever method is most effective for the target audience (Kaplowitz, Yeboah, Thorp, & Wilson, 2009). While the largest hindrance to a large-scale education or advertising campaign is usually related to monetary limitations, implementing small-scale improvements to the Communication System can also be effective.

Changes that the Team Recommends the ODA Should Pursue for the Engagement System

The first recommendation by the team to the ODA to improve community engagement is to define an engagement liaison on the Recycling Task Force. This individual would enforce accountability and would emphasize to the task force the importance of continually engaging all demographics of the Ogden community. This individual would not only assist in implementing new engagement opportunities and activities but would also act as the point of contact for the community to ask questions regarding the recycling program. To effectively engage the community, it is imperative to fully understand the perceptions and attitudes of the community members (Lavery, et al., 2010). For this reason, the engagement liaison would be tasked with listening to community members "express their perspectives in their own terms" (Lavery, et al., 2010) and cater to any questions or concerns that the community may have.

The second recommendation to the ODA is to provide more opportunities that encourage patron engagement at events. One of the ways in which the ODA could engage the community could be to distribute pledge cards and stickers to those that receive the recycling education

media described in the communication suggestions. These pledge cards could mirror the efforts of Burn and Oskamp, where the card stated, “I, (name), pledge support for [Ogden]’s Recycling Program. I will help win the war on waste!” (Burn & Oskamp, 1986). These cards can emphasize to the citizens of Ogden the importance of having a universal public commitment.

In addition to the pledge cards, citizens could be given recycling stickers for their cars, recycling cans, bikes or anywhere else that citizens of Ogden would like to demonstrate their commitment to recycling (Burn & Oskamp, 1986). Having public engagement and commitment to successfully implementing a meaningful recycling program can increase the attendee’s motivation to process and internalize the communication techniques that were previously outlined (Burn & Oskamp, 1986). While the benefit of this suggestion is high, the ease of implementation is not incredibly easy. The largest hindrance to the success of this recommendation would be the resources available to the ODA, as the success on a large scale (i.e., ODA sponsored events) is dependent on the successful personal contact with attendees (Burn & Oskamp, 1986). However, the ODA has a large volunteer network that could assist in ensuring the success of this recommendation.

The final recommendation of the group to the ODA is to use Recycling Task Force meetings to address monitoring criteria and assign roles and responsibilities to act on any corrections needed. Like the recommendation in the communications system, maintaining an organizational structure that outlines goals and actions to achieve these goals will be imperative for the success of the engagement system within the ODA recycling program. This structure would ideally be run by the engagement liaison, and tasks that are tracked would be specifically linked to the success of the Engagement System. Maintaining an organized and driven Task Force will drive the recycling program to the finish line and will allow for tangible

improvements within the community to be measured and communicated back to key stakeholders.

Changes that the Team Does Not Recommend

For the Communication and Engagement System, the team decided that the sponsor should refrain from three different changes. The first is to not currently define part of their mission to be to learn and grow from other healthy, established recycling programs of a similarly sized city. While it would be a relatively easy task to accomplish, the benefit received from researching, learning about, and growing from other cities would not surpass the benefit received from other activities. Research can be time-consuming and Ogden has unique recycling problems.

The team also recommends not holding meetings to address the topic of recycling specifically. These meetings would require a sizable number of the ODA's resources in the form of time and money. The team unanimously decided that meetings are not always productive, and the time spent discussing the recycling issue in an ODA dedicated meeting could be better used for other tasks. Also, there are many other ways for people to discuss the recycling issue that do not involve holding a dedicated meeting.

Finally, the team recommends not creating large-scale formalized content that implements several mediums and could potentially require an outside marketing firm. This change is the least strong change generated from the application of the CSH and SSM methods due to its low scores in both ease and benefit on the ease-benefit matrix. Creating and distributing various mediums of formalized and consistent content is expensive and provides questionable benefits for the cost associated.

Specific to the Engagement System, the team does not recommend limiting the scope of the audience to exclusively ODA event patrons. A limited audience would not offer much gain to the ODA in terms of successfully promoting its community recycling engagement efforts. If anything, it would hinder the ODA in the long term because proper recycling information would not reach as many citizens. Limiting the scope of the audience to only ODA event attendees is an action that aids in reducing both the difficulty of dissemination of information and the volume of resources required to educate the public, but the benefit suffers as a result.

The team also recommends not allocating funds specific to the recycling engagement program. Doing so would require siphoning funds from the ODA's existing "beautification" budget (meant to help with keeping a clean and operable streetscape in Ogden) directly to the recycling engagement program. Siphoning funds is not an ideal suggestion due to the importance of keeping the city clean, presentable and, most importantly, operable. Funding the recycling engagement program at the expense of the budget of another important upkeep function is not practical nor preferable. Also, the benefit gained from reallocating funds was lower than a majority of the other suggested changes in the ease-benefit matrix.

Conclusions

Assessment of the Applicability of the Adapted SSM Approach

The ODA is a small organization, and the recycling program is a very small part of its greater mission. Because the ODA is a third-party organization facilitating Ogden's improvements, its projects' successes rely heavily on the participation of external stakeholders such as Ogden's residents or businesses. Creating a rich picture made this observation even more apparent and aided the team in identifying the two systems which ultimately increase the involvement of external stakeholders. Additionally, answering the boundary questions allowed

the team to think deeply about the problem and its potential effects not only on the ODA but also on Ogden's businesses and residents. Finding a solution for the ODA's recycling project could have easily focused solely on the ODA, but using the SSM approach forced the team to look at the problem through different perspectives, which ultimately lead to a more well-rounded evaluation of the issue at hand.

Lessons Learned That Were Not Known Before Applying SSM and CSH

The development of the rich picture helped to reveal all of the players in the recycling program for the Ogden Downtown Alliance. Initially, the problem was understood to be contamination in the recycling bins due to lack of knowledge by event patrons. The rich picture revealed a problem that included many more tentacles. The problem proved to be much larger than just the ODA and the City of Ogden. Global recycling is undergoing a shift because China is no longer purchasing recycled material (Joyce, 2019). This market change has drastically increased the cost and the need for better separation of recyclable materials. The rich picture also revealed that the recycling issue consisted of two distinct systems: a communication system and an engagement system. Before the CSH and SSM approaches, people viewed the problem as simply a problem in the communication system between the recycling company, the ODA and the event patrons.

Ulrich's boundary questions revealed that no one established success criteria for the new recycling program other than to reduce contamination in the recycling stream. Ulrich's questions, and defining the root definitions of the relevant systems, allowed our team to define more global objectives such as increased personal investment and reduced environmental impact that were not previously understood. Further, the conceptual models allowed the group to create ways to monitor the progress of the program and to take action based on the criteria.

Finally, the Burge table and ease-benefit matrices educated the team on which problems to address and how to attack them. Before applying the CSH and SSM methodology, the team would have attempted to implement solutions for the sponsor's problems, but they would have been misguided and most likely inefficient. The ease-benefit matrix elucidated the most efficient solutions to the sponsor's problems by utilizing the fewest resources. Because the ODA is a small organization with limited funding, limiting the resources to solve the recycling problem is of the utmost importance.

Benefits and Weaknesses of Applying the Adapted SSM Approach

The strong points of applying the adapted SSM approach in our project are, first and foremost, the "road map" and the big picture that were outlined to help us understand the situation. These come in the form of the rich picture, Ulrich Boundary Questions and Conceptual models. These aspects of the SSM approach aided us in the breaking down of systems in place, parties involved, environment, relevant actors and helped us reveal the missing links or areas that need to be improved. Furthermore, it has helped organize the information, so we have a clearer understanding of the situation to provide our arguments in a rational and defendable basis (Burge, 2015). The SSM methods also promote and generate good conversations regarding our project, submersing us deeper into the situation. This approach allowed us to gain a solid understanding of the situation, which is essential for developing good, viable solutions. Ultimately, the SSM has set up the framework of the situation, which has aided us in defining the problematic areas, how to approach them, and the considerations and resources needed. Therefore, using the Soft System Methodologies helped us in organizing messy aspects of a system and organizing them in such a way that it's easier to understand to lead to solutions more effectively and efficiently.

The main weak point of the Soft System Methodology is that it is not problem-solving in the sense of analyzing the real world to find the root cause of issues (Burge, 2015). While it helped us in framing the problem and system, it does not provide solutions. We gained an understanding of the situation and areas that needed to be addressed from just a short meeting with Kim from the ODA. Perhaps the whole of the SSM approach is of more benefit to more complex systems that benefit from cycles of discussion, debate and learning or systems without defined boundaries, elements and resources as opposed to established organizations.

Potential Modifications

The SSM-CSH approach provides a framework to analyze problem situations that are undefined by identifying and focusing on the relevant systems. However, these approaches don't provide system-specific guidance about how to select the relevant system and choose what to model. A potential modification is incorporating a way to show the process flow so that the model can be simulated and validated. The final conceptual models have multiple inputs and outputs to the proposed processes without defining if any outputs exist that are dependent on certain inputs. This lack of specifics can make it difficult to validate the model.

This approach also requires significant time to conduct the analysis required to produce a detailed model. The use of a computerized tool would be beneficial in shortening the time needed to complete the process and might help with the maintenance of the models generated.

Another weakness the team identified was that this approach helped us in framing the problem and developing the system, but it did not help us decide which specific solutions would be the most effective. Incorporating tools like concept generation and selection would facilitate the team to come up with more specific solutions in a methodical way, in the scope of the relevant system already identified.

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Tables

Table 1

Questions for the Project Sponsor

Question	Summary of Responses
Who are some of the stakeholders in these categories? Direct beneficiaries Bosses Colleagues Employees General public	The stakeholders who are direct beneficiaries of the recycling program include the general population for their ability to improve upon the world in which they live and the city of Ogden for paying less additional fees to the private recycling company. The 'Bosses' category of stakeholders would include the Ogden City government and Kim, the Director of the Ogden Downtown Alliance. Some of the stakeholders who are 'Colleagues' to the recycling program include the city staff who, in a minimal capacity, might be the ones retrieving the recycling at the end of the day, and the vendors who attend the downtown events sponsored by the ODA. The 'Employees' of Ogden City and of the ODA would be stakeholders for the recycling project. Finally, the attendees of the ODA-sponsored downtown events and the general population of Ogden City would fall under the 'General Public' category for the relevant stakeholders of the ODA recycling program.
Are there other stakeholders who do not fit in these categories?	None
How do the stakeholders get along? Do they have conflicting values or desires?	The stakeholders tend to remain cordial and professional. The collective user group would be fairly similar in goals.
What are some issues or roadblocks that you are facing?	The largest roadblock that the ODA is facing is funding for additional projects and staff capacity. While there is a volunteer network that the ODA can draw upon, as a whole, the staff is fairly limited. This makes it difficult to pull staff members from existing projects into new ones.
Is there some past history that indicates certain approaches are doomed to failure?	One of the approaches that has not been successful previously is the current governance of the Recycling Task Force. The meetings of the Task Force have been limited, and not a lot has yet to be accomplished. In addition, a hurdle that is present is the withdrawal and re-entry from the recycling program by the City of Ogden. These motions are due to rising costs from the contracted recycling company. Due to this situation, it becomes more difficult to engage the community as they feel downtrodden with the uncertainty of the recycling program.

Table 2

Individual Questions in Preferred Order

Number	Question	Answer - Communication System	Answer - Engagement System
2 (is)	What is the purpose of the system?	The purpose of the system is to assume a level of general knowledge regarding the recycling program in the general population so that a passive recycling approach can be taken.	The purpose of the system is to bring together external and internal players of the Recycling Task Force to encourage the general population to recycle accurately.
2 (ought)	What ought to be the purpose of the system?	To purpose of the system ought to be to actively educate the population so that citizens of Ogden can perform informed actions when they make the decision to recycle.	The purpose of the system ought to be to get the community excited about recycling and educate them on making accurate decisions when recycling.
1 (is)	Who is the intended beneficiary of the system?	Because the recycling cans are currently only available at public downtown events, the current intended beneficiaries of the system are the attendees of these downtown Ogden events.	The intended beneficiary of the system is the City of Ogden as they are the ones who will be saving funds due to a successful educational outreach program.
1 (ought)	Who ought to be the intended beneficiary of the system?	The intended beneficiaries of the system should be the entire Ogden City.	The intended beneficiary of the system ought to be both the City of Ogden and the general population of Ogden City.
3 (is)	What is System's measure of success?	The System's measure of success is to track the level of contamination in the recycling trucks to determine if the cost of the recycling program is viable to maintain.	The system's measure of success is to have an engagement plan in place.
3 (ought)	What ought to be System's measure of success?	The System's measure of success should be to track the level of contamination in the recycling trucks to determine if the cost of the recycling program is viable to maintain.	The System's measure of success should be to track the number of people who interact with the recycling-themed events or booths at the ODA-sponsored events.
5 (is)	What conditions of success are under the control of the system?	The conditions of success that are under the control of the system are the physical recycling bins and the ability of the employees and volunteers to volunteer by word-of-mouth at the various events.	The conditions of success that are under the control of the system currently include an organized communication team as well as additional internal manpower and volunteers.
5 (ought)	What conditions of success ought to be under the control of the system?	The conditions of success that ought to be under the control of the system should be to create a more informed public.	The conditions of success that ought to be under the control of the system should include feedback and monitoring from the external sources such as the general population.
4 (is)	Who is in control of the conditions of success of the system?	The public is in control of the conditions of success of the system.	The communications team within the Ogden Downtown Alliance is in control of the conditions of success of the system.
4 (ought)	Who ought to be in control of the conditions of success of the system?	The public in addition to the ODA should be in control of the conditions of success of the program.	The citizens of Ogden in addition to the ODA communications team ought to be in control of the conditions of success of the system.

Number	Question	Answer - Communication System	Answer - Engagement System
6 (is)	What conditions of success are outside the control of the decision maker?	The free will of the population and the costs of the recycling capabilities are outside of the control of the decision maker.	The free will of the population and the costs of the recycling capabilities are outside of the control of the decision maker.
6 (ought)	What conditions of success ought to be outside the control of the decision maker?	The free will and habits of the population ought to be outside the control of the decision maker.	The free will and habits of the population ought to be outside the control of the decision maker.
8 (is)	What are relevant new knowledge and skills for the system?	The ability to successfully use social media is currently a relevant new skill for the system.	The relevant knowledge and skills for the system include having the ability to bring in large groups to ODA-sponsored events.
8 (ought)	What ought to be relevant new knowledge and skills for the system?	The ability to effectively teach others should be a relevant new skill for the system.	The ability to effectively teach and persuade community members to take a more informed decision when it comes to recycling ought to be relevant new knowledge and skills for the system.
7 (is)	Who is providing relevant knowledge and skills for the system?	The ODA Executive Director is providing the relevant knowledge and skills for the system.	The entire ODA is providing relevant knowledge and skills for the system.
7 (ought)	Who ought to be providing relevant knowledge and skills for the system?	The ODA Communications Team and the Recycling Task Force should be providing the relevant knowledge and skills for the system.	The ODA and external stakeholders ought to be providing relevant knowledge and skills for the system.
9 (is)	What are regarded as assurances of successful implementation?	Before removal of the recycling bins, passive visual verification was regarded as assurance of successful implementation.	The progressions of ideas and methods are regarded as assurances of successful implementation.
9 (ought)	What ought to be regarded as assurances of successful implementation?	Consistency and repeatability of successful recycling program implementation at multiple events should be regarded as assurance of successful implementation.	A progressive increase in community engagement confirmed by an auditor-role within ODA or a volunteer ought to be regarded as assurances of successful implementation.
11 (is)	What are the opportunities for the interests of those negatively affected to have expression and freedom from the worldview of the system?	While there are opportunities available for those negatively affected to have expression and freedom from the worldview of the system, the general public is not aware of these opportunities due to a lack of communication of the efforts taking place to improve the recycling program in Ogden.	An opportunity for the interests of those negatively affected to have expression and freedom from the worldview of the system is at the ODA booth that is set up during their sponsored events as well as Town Hall Meetings and social media outreach.
11 (ought)	What ought to be the opportunities for the interests of those negatively affected to have expression and freedom from the worldview of the system?	The opportunities that ought to be present are the ability for citizens to take full advantage of the occurring Town Hall Meetings, and to know who to approach on the Recycling Task Force if they have any concerns about the system.	The opportunities that ought to be present are the ability for citizens to take full advantage of the occurring Town Hall Meetings, and to know who to approach on the Recycling Task Force if they have any concerns about the system. In addition, ODA should continue to have the booths at events to provide real-time reactions to community feedback.

Number	Question	Answer - Communication System	Answer - Engagement System
10 (is)	Who is representing the interests of those negatively affected by but not involved with the system?	Nobody is currently representing the interests of those negatively affected by but not involved with the system.	Nobody is currently representing the interests of those negatively affected by but not involved with the system.
10 (ought)	Who ought to be representing the interests of those negatively affected by but not involved with the system?	The entire population, both those who have previously communicated with the ODA and those who have not, ought to be representing the interest of those negatively affected by but not involved with the system.	The entire population, both those who have previously communicated with the ODA and those who have not, ought to be representing the interest of those negatively affected by but not involved with the system.
12 (is)	What space is available for reconciling differing worldviews regarding the system among those involved and affected?	Town Hall Meetings and social media are available for reconciling differing worldviews regarding the system among those involved and affected.	Town Hall Meetings, social media, and the ODA booth at events are available for reconciling differing worldviews regarding the system among those involved and affected.
12 (ought)	What space ought to be available for reconciling differing worldviews regarding the system among those involved and affected?	In addition to Town Hall Meetings and social media, Recycling Task Force panels or an anonymous comment box should be implemented to speak about specific recycling issues and reconciliation.	In addition to Town Hall Meetings, the ODA booth and social media, Recycling Task Force panels or an anonymous comment box should be implemented to speak about specific recycling issues and reconciliation.

Table 3

Communication Comparison

Communication		
Conceptual Model Activities	**Real World**	**What could we do**
Define recycling requirements	Defined strictly by the recycling companies. ODA has no impact to the actual requirements.	1. Translate the given requirements into layman's terms. 2. Ensure the requirements are legible to the non-English speaking population
Appoint a taskforce	Lack of direction and motivation. Ill-defined actions/goals and roles/responsibilities. Relies heavily on Kim.	3. Define a mission for the end-goal and establish roles/responsibilities to become self-sufficient
Create education material	No formal education material currently exists besides inconsistent pamphlets, social media posts, or directly on the recycling website.	4. Create formalized consistent content that implements several mediums
Reach out to event patrons	Event patrons are not actively involved	5. Identify effective ways to interact with patrons during events
Define communication program budget	There is no communication budget specific to recycling.	6. Allocate money to the recycling program from the communication budget
Identify communication mediums	Communication mediums specific to recycling are constrained to the recycling website, intermittent pamphlets, and occasional social media posts	7. Use a broader spectrum of mediums, including pictures on bins, billboards, radio, reinforced "word-of-mouth" to recycle by event organizers etc.
Researching implemented/working strategies	Passive research has been conducted on a few options pitched by specific companies	8. Define as part of the mission to learn and grow from other healthy, established recycling programs of a similar sized city
Define Criteria (E1, E2, E3)	Success criteria is not formally defined	Define Criteria using the criteria defined by Team 9 as a guideline
Monitor Criteria (E1, E2, E3)	There is no monitoring of the success criteria	9. Use meetings to address this specifically 10. Make this a defined role/responsibility of a taskforce member to reinforce accountability
Take Control Action	No take control actions are identified	11. Use meetings to address monitoring criteria, and assign roles/responsibilities to take action against any corrections needed

Table 4

Engagement Comparison

Engagement		
Conceptual Model Activities	**Real World**	**What could we do**
Define audience	Everyone in the town of Ogden	1. Limit the scope of the audience to ODA event patrons
Appoint a taskforce	Lack of direction and motivation. Ill-defined actions/goals and roles/responsibilities. Relies heavily on Kim.	2. Define a mission for the end-goal and establish roles/responsibilities to become self-sufficient
Create engagement opportunities	Minimal engagement opportunities exist. Social media is available, but rarely used as a form of engagement	3. Provide more opportunities that encourage patron engagement
Reach out to event patrons	Event patrons are not actively engaged besides the use of an informational booth which is not being utilized to its fullest extent	4. Reach out to event patrons in a way that encourages their participation, as opposed to one-way communication
Define engagement program budget	There is no engagement budget specific to recycling.	5. Allocate funds specific to the recycling program from the beautification budget
Identify engagement methods	No formalized engagement program exists	6. Use methods of interaction that incentivize/motivate the patrons to actively learn about recycling
Researching implemented/working strategies	Passive research has been conducted on a few options pitched by specific companies	7. Define as part of the mission to learn and grow from other healthy, established recycling programs of a similar sized city
Define Criteria (E1, E2, E3)	Success criteria is not formally defined	Define Criteria using the criteria defined by Team 9 as a guideline
Monitor Criteria (E1, E2, E3)	There is no monitoring of the success criteria	8. Use meetings to address this specifically 9. Make this a defined role/responsibility of a taskforce member to reinforce accountability
Take Control Action	No take control actions are identified	10. Use meetings to address monitoring criteria, and assign roles/responsibilities to take action against any corrections needed

Table 5

Communication System Ease-Benefit Matrix

Change	Description	Benefit	Ease	Resources
1	Translate the given requirements into layman's terms.	9	5	3
2	Ensure the requirements are legible to the non-English speaking population	7	3	3
3	Define a mission for the end-goal and establish roles/responsibilities to become self-sufficient	9	7	8
4	Create formalized consistent content that implements several mediums	5	3	7
5	Identify effective ways to interact with patrons during events	7	6	2
6	Allocate money to the recycling program from the communication budget	2	4	1
7	Use a broader spectrum of mediums, including pictures on bins, billboards, radio, reinforced "word-of-mouth" to recycle by event organizers etc.	9	2	7
8	Define as part of the mission to learn and grow from other healthy, established recycling programs of a similar sized city	5	9	2
9	Use meetings to address this specifically	4	8	8
10	Make this a defined role/responsibility of a taskforce member to reinforce accountability	6	7	1
11	Use meetings to address monitoring criteria, and assign roles/responsibilities to take action against any corrections needed	8	4	8

Table 6

Engagement System Ease-Benefit Matrix

Change	Description	Benefit	Ease	Resources
1	Limit the scope of the audience to ODA event patrons	2	8	1
2	Define a mission for the end-goal and establish roles/responsibilities to become self-sufficient	7	3	3
3	Provide more opportunities that encourage patron engagement	7	5	8
4	Reach out to event patrons in a way that encourages their participation, as opposed to one-way communication	9	2	9
5	Allocate funds specific to the recycling program from the beautification budget	3	4	1
6	Use methods of interaction that incentivize/motivate the patrons to actively learn about recycling	8	3	6
7	Define as part of the mission to learn and grow from other healthy, established recycling programs of a similar sized city	5	9	2
8	Use meetings to address this specifically	4	8	8
9	Make this a defined role/responsibility of a taskforce member to reinforce accountability	6	7	1
10	Use meetings to address monitoring criteria, and assign roles/responsibilities to take action against any corrections needed	8	4	8

Figures

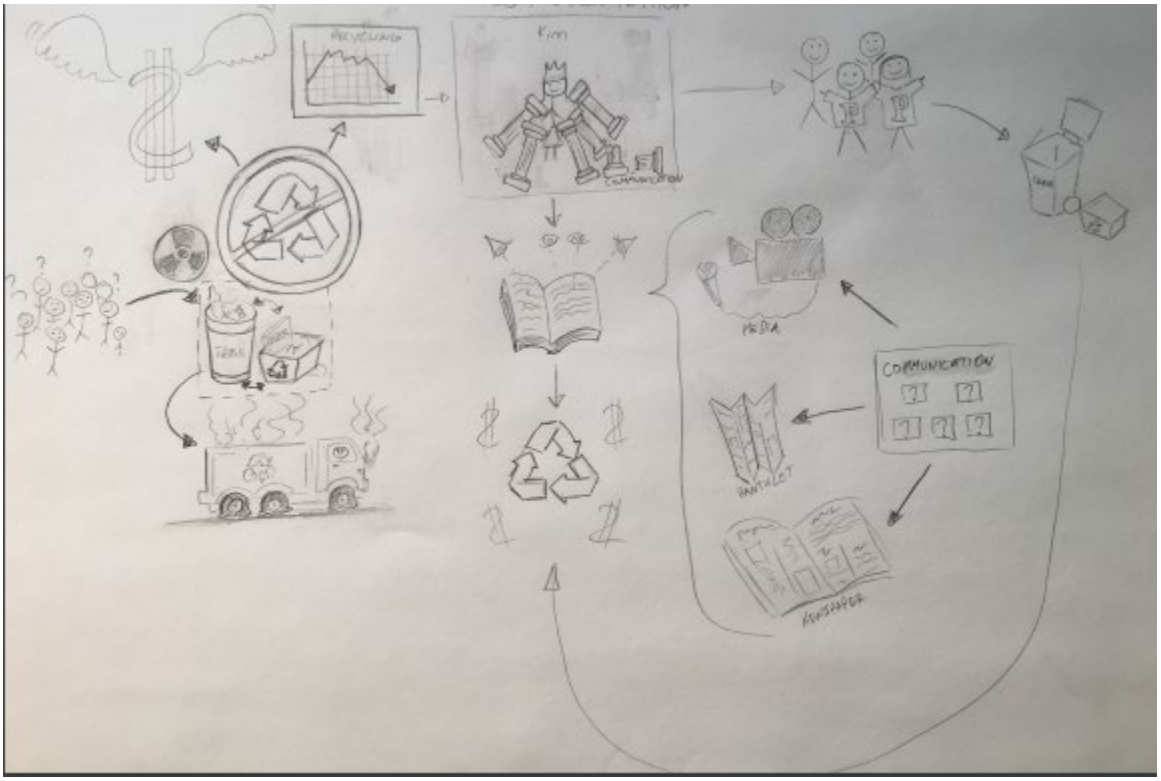

Figure 1. Rich Picture

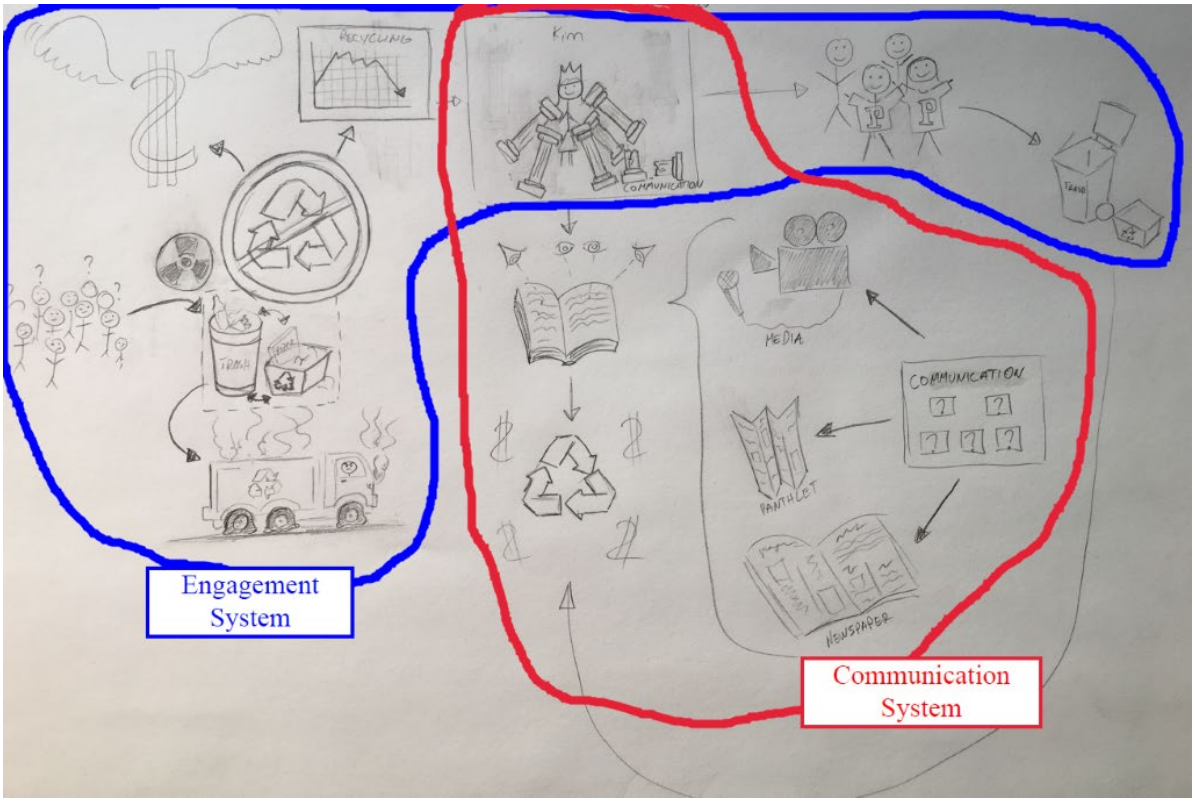

Figure 2. Relevant Systems

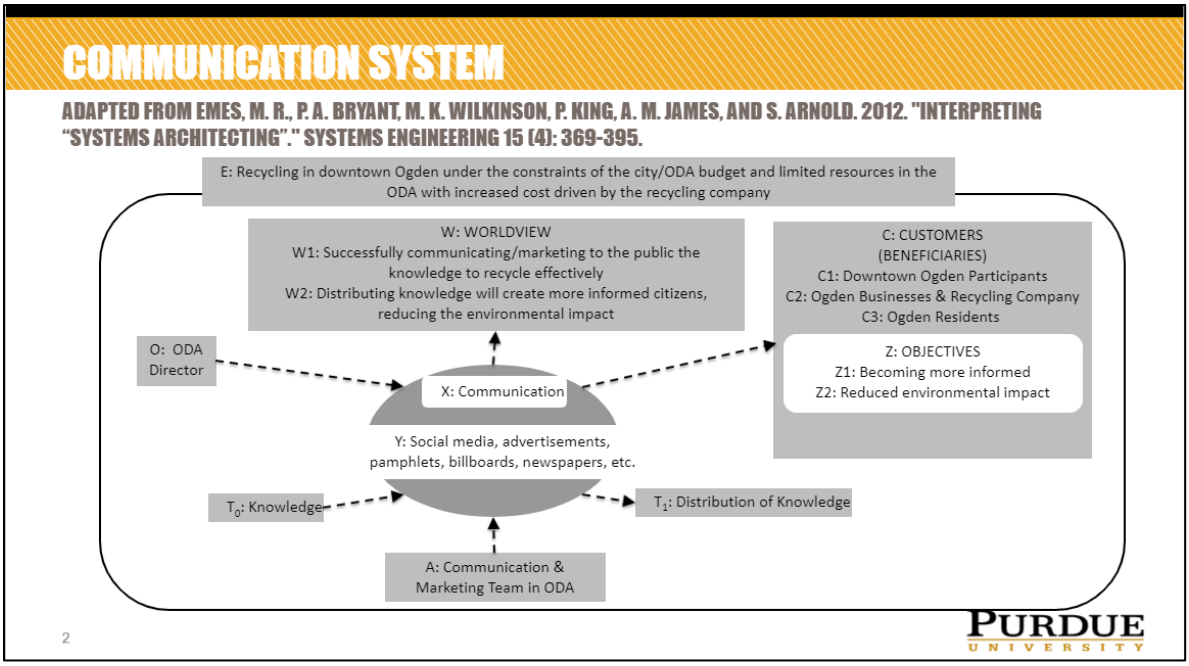

Figure 3. Root Definition — Communication

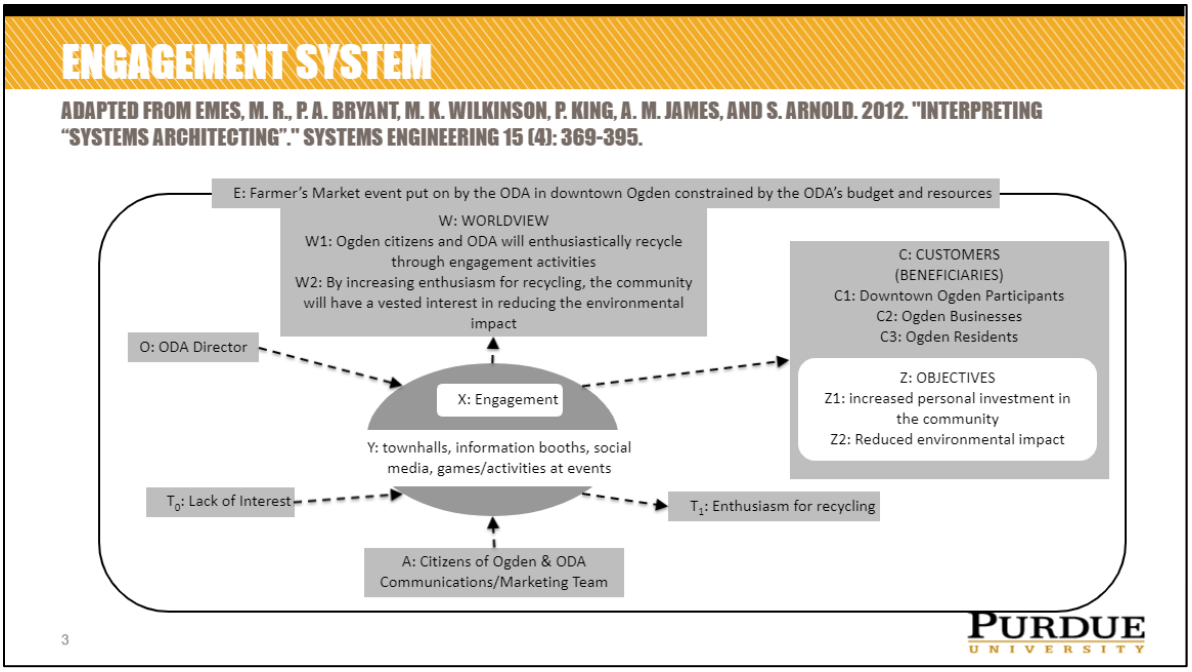

Figure 4. Root Definition — Engagement

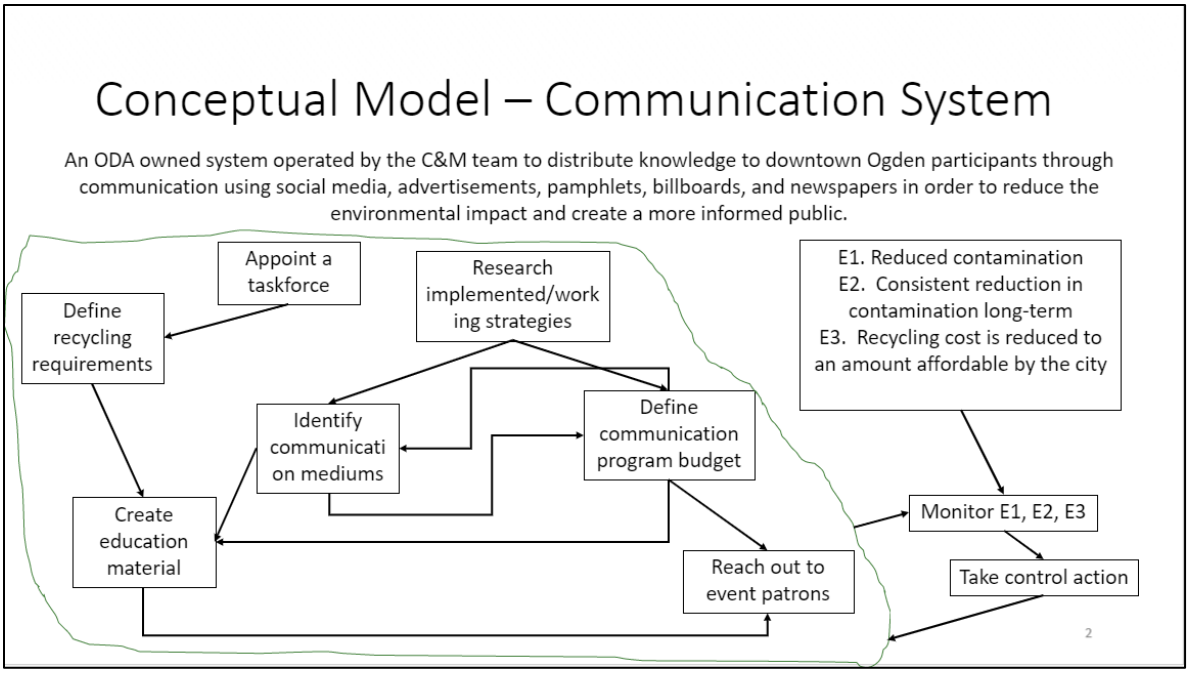

Figure 5. Conceptual Model — Communication

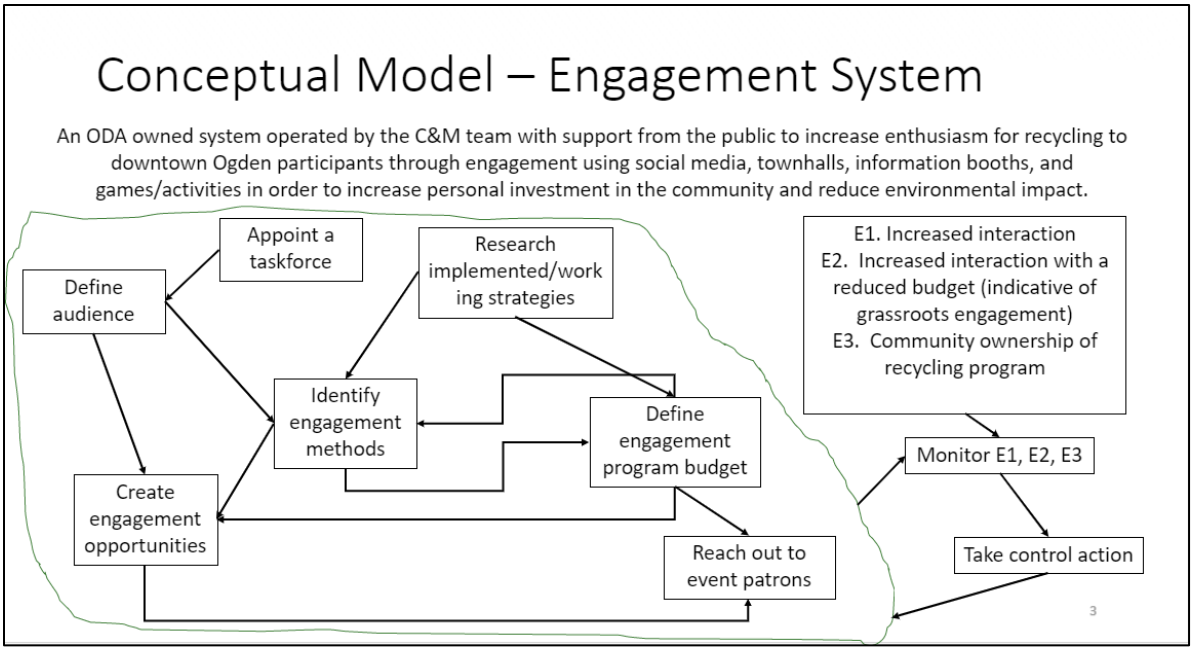

Figure 6. Conceptual Model — Engagement

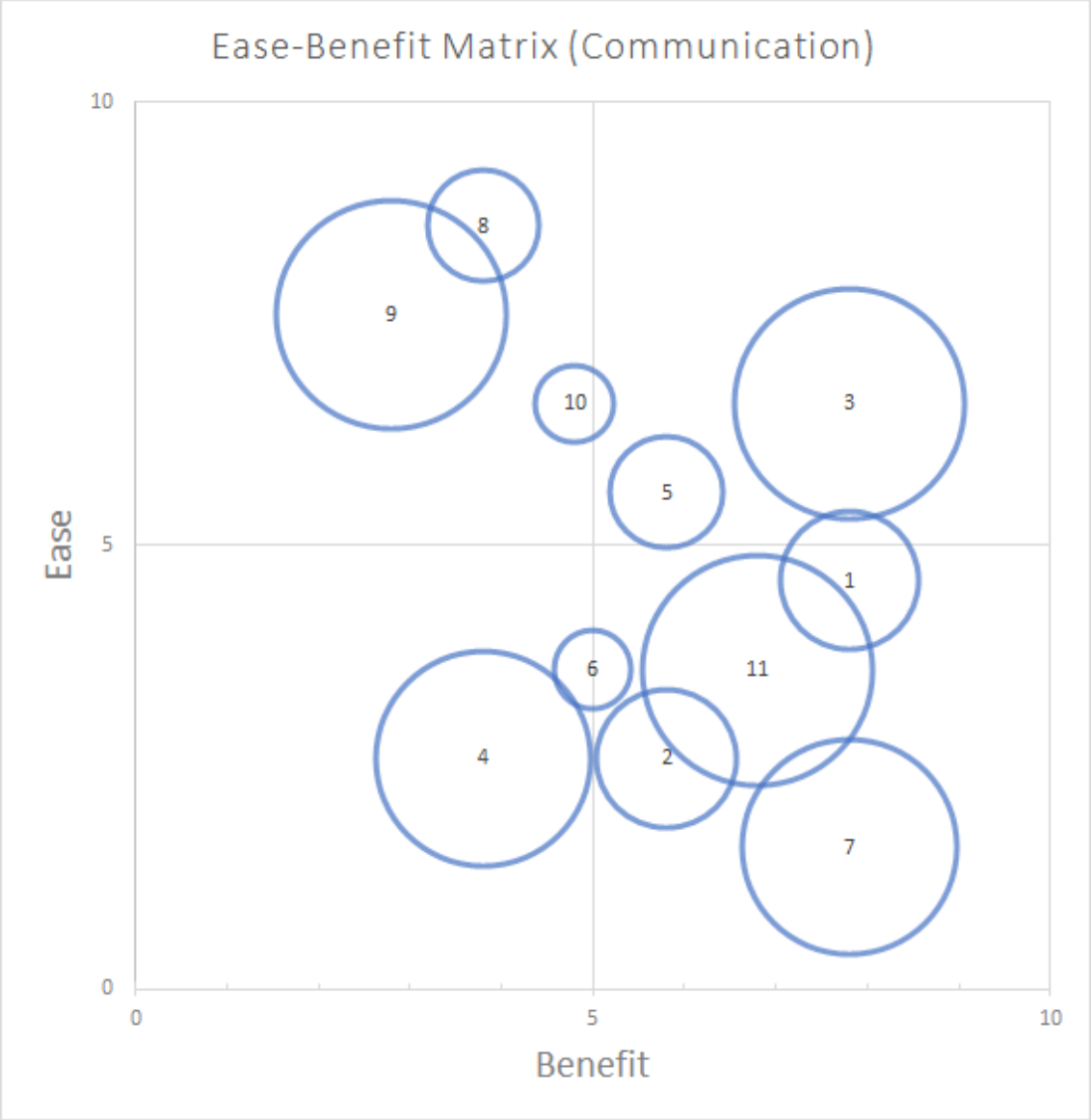

Figure 7. Bubble Chart — Communication System

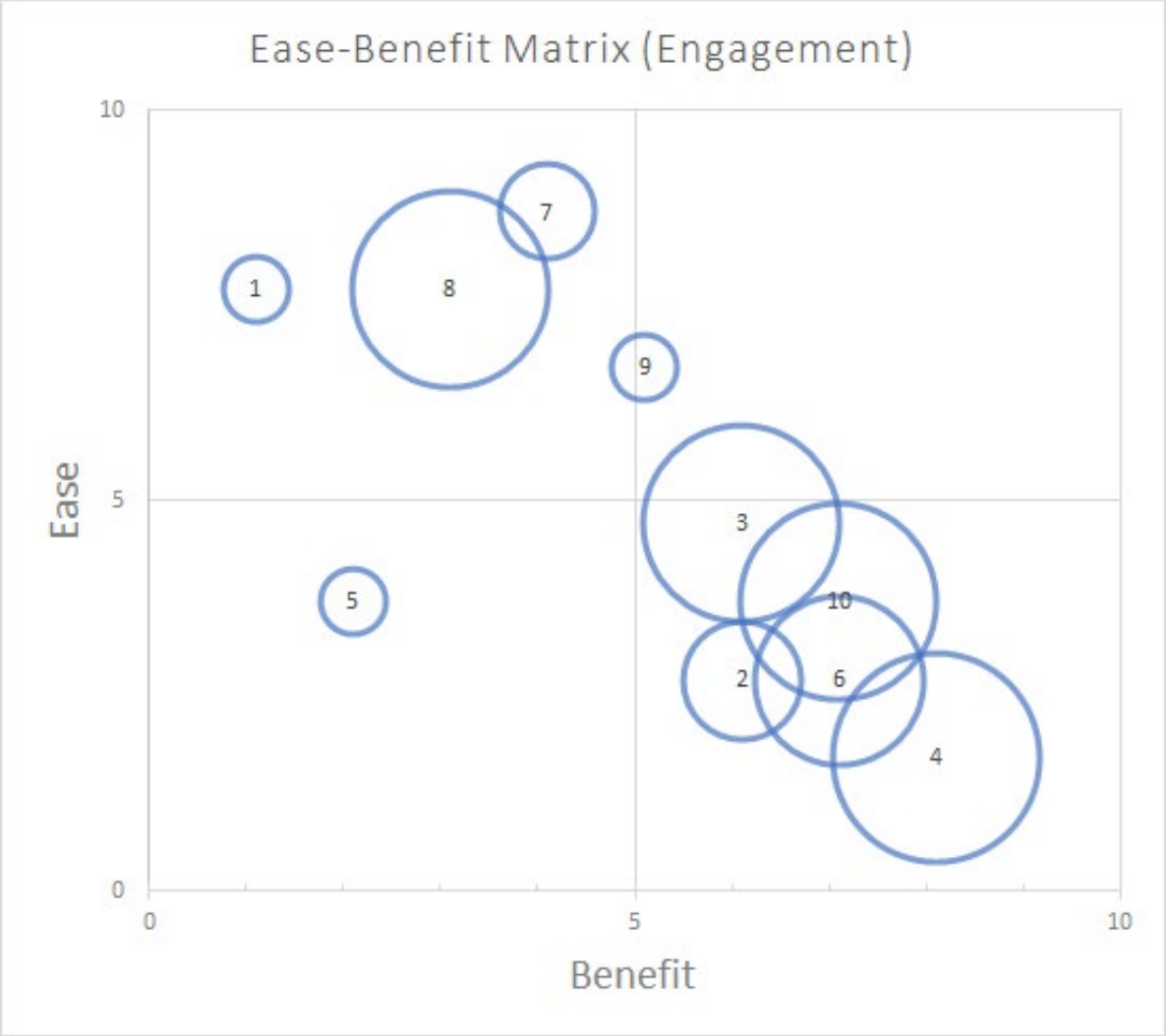

Figure 8. Bubble Chart — Engagement

Claudia Arenas

Claudia Arenas works as a Six Sigma Master Black Belt for Cummins Inc. She has over 10 years of experience in the manufacturing industry spanning from controls, process engineering and new product introduction to quality assurance and project management. She has led a wide range of process improvement projects in manufacturing, sales and service areas. She graduated with a master's in electrical engineering from the University of Kentucky in 2010 and a master's in interdisciplinary engineering with a concentration in business management from Purdue University and the Kelley School of Business in 2019.

Caite Beck

Caite Beck has worked for Northrop Grumman as a structural design engineer for the metals, seals and joints group for one year in Promontory, Utah. Her previous role was as a supply chain quality engineer for Northrop Grumman for 2.5 years. During these two roles, Caite has worked on NASA, commercial and government aerospace programs. Originally from Houston, Texas, Caite moved to Utah by way of Illinois after receiving her B.S. in aerospace engineering from the University of Illinois at Urbana-Champaign in 2016. She completed her M.S.E. with a concentration in aerospace engineering from Purdue University in 2019 and is currently pursuing her MBA from the Kelley School of Business at Indiana University.

Vlad Bleoca

Vlad Bleoca has been a designer at General Motors for the past five years. During this time, he has obtained a DFSS Green and Black Belt certifications and also began his master's in systems engineering at Purdue University. Prior education includes a bachelor's in engineering technology from the University of Windsor and an associate degree in mechanical engineering automotive product design from St. Clair College. Vlad resides in Windsor and commutes to the General Motors Corp. Warren Tech Center in Warren, Michigan. In his free time, he enjoys backcountry camping, traveling, wrenching on cars, playing sports and staying active.

Jacob Dahlberg

At the time of writing this paper, Jacob was a senior pursuing a B.S. in aerospace engineering from Purdue University. He has participated in the American Institute of Aeronautics and Astronautics (AIAA), Purdue Automotive Performance Association (PAPA), Purdue Club Tennis, and a five-session co-op with Gulfstream Aerospace Corporation in Savannah, Georgia. He started full time as a service engineer with Gulfstream in January 2020.

Elle Stephen

For the last three years, Elle has been working at Los Alamos National Lab in New Mexico as an R&D engineer developing machining processes for nuclear material. Before that, she lived in Indiana (born and raised) and spent 4.5 years working for Honeywell Aerospace as a product design engineer qualifying aircraft fuel controls. She obtained her B.S. in aerospace engineering from Purdue and is currently pursuing an M.S.E. focused on systems engineering.

Dave Templeton

Dave has been a lead ground test engineer at Sikorsky Aircraft (part of Lockheed Martin) in Stratford, Connecticut, for six years. He was previously a rotors and blades structural analysis engineer, also at Sikorsky, for five years. He received his B.S. in mechanical engineering from Cornell University. He has also obtained his MBA from the University of Connecticut and an M.S. in aerospace engineering from Purdue University.