

**PROJECT TITLE:** SPO227: Smart Waste Bin System for McConnell

Please answer the following questions and return the completed form to the [SPF Staff](#) via e-mail.

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Actual Project Start Date 2011-10-19 Actual Project End Date 2021-05-21

**Questions**

1. Please summarize the project and its key accomplishments to date. In your answer, consider the impact your project has had so far on McGill's campus(es).

*Unlimited characters, suggested minimum ½ page or ~250 words.*

Many smart-waste bin devices already exist on the market, and are either meant as 1) single unit public awareness campaigns for waste generation and waste contamination and 2), as large scale municipal systems. The first category of these systems are often expensive units that cannot be scaled across campus and cannot be integrated with existing infrastructure. These devices are much more diverse in their tactics, ranging from well-integrated screens with bins that are public facing, to computer vision approaches that tell users where to throw trash away, to robotics that hide the waste sorting process from users. The second category of systems do not stress waste education and are often limited to fill-level sensors for ease of deployment, and do not provide the valuable weight data that facilities management at institutions often needs.

In collaboration with the Building and Grounds department, the Recycling Pioneers have developed a smart sensor system that retrofits into existing waste bins. This system seeks to achieve the two aforementioned goals of smart bin systems. Screens above the waste bins serve to inform and educate the individual and the general McGill community about real-time changes in waste levels in addition to encouraging better recycling habits. Sensors integrated into each separate bin collect data about waste habits. Distance sensors monitor how full a bin is. Weight scales monitor the mass of incoming waste in the various streams.

We have installed our flagship, public facing smart waste bin system in the Trottier building\*. These bins actively receive real-time data from sensors, and push them to our new website, [Recyclingpioneers.ca](#). From this website, you can view the data, explore the project, and (with the right login credentials) view the public facing carousel display.

\*As the project title denotes, the system was intended to be installed in McConnell. The pandemic forced us to relocate, as between the 1st and 2nd wave, Trottier was to be opened for limited activities while McConnell was shut down. Further shutdowns during the 2nd wave prevented a more in depth installation and public usage of our system.

2. Please describe the key successes and challenges of your project. Include a minimum of two examples for each.

*Unlimited characters, suggested minimum ½ page or ~250 words.*

The key successes of this project can be broken down into collaboration successes, product successes, and public feature successes. For our collaborations, we coordinated and sponsored a mechanical engineering capstone team in 2019, hired a summer intern in 2020, hired a graphic designer in 2020, and hired a web developer in 2021. Establishing and maintaining these collaborations has been a highlight of this project for us. For our products, we were able to launch a website and we iterated through numerous sensor designs to produce a currently installed prototype. In terms of public features, our project was featured in an article by McGill Giving for Alumni.

There were many challenges in this project. For collaboration, it became quite difficult to manage and coordinate many people to work on multiple objectives in parallel. We adopted new methods of communication and digital team

management tools to overcome this. In addition, the process of hiring talent and running the interview process was something most of us were unfamiliar with. Learning how to determine our criteria for selection, filter applicants efficiently, and respond to applicants tactfully and smoothly was a huge challenge.

Hardware issues were certainly the most challenging issues. As building entry and access to the bins was limited due to the pandemic, it was very difficult to develop the most compatible system that was easy to mount and install. To be more specific, it was difficult to reduce the profile of the weight scales to be thin enough to fit in the narrow gap between the bin and the waste base. It took four prototype iterations and multiple collaborations to settle onto the final weight sensors. In addition, calibration of the weight scales continues to be an issue, and it is not providing as reliable of readings as we would like. For this reason, the current system as of today only provides distance sensor fill readings, but not weight readings.

3. What key points of advice or lessons learned would you give to other SPF teams either regarding your experience managing your project or the project itself?

*Unlimited characters, suggested minimum ½ page or ~250 words.*

If building a product, make sure you establish connections and start speaking to your target audience or collaborator as soon as possible. Frequent communication over the ideas, goals, and constraints of the problem will ensure you design and build something that is useful and effective for all parties involved!

In terms of team management, make sure you have a good core team that is motivated and driven, with well-defined roles. This will see you through to the end of your project! If you foresee a longer term project, make sure you know when all team members are graduating, and be on the constant hunt for opportunities to recruit new members who may have similar interests with your project. Frequent communication is key to keeping things moving, so make sure to schedule regular meetings. There are many online tools for team management these days, allowing for easy collaboration over gantt charts, scrum boards, etc. It is okay to experiment and switch between tools if it is not working for the team, just make sure you pick some task organizer that is not a simple calendar.

If you have to develop a product from home, make sure all parties involved have the tools they need to be effective, even if it means purchasing multiple versions of the same tool. Last minute issues always arise with hardware. Always build simple tests into your system so you can quickly diagnose what might be wrong with your hardware in the field. For example, for a microcontroller system, you could include a LED that changes its blink pattern depending on the functional state.

4. How has your project helped to grow a culture of sustainability at McGill? You may consider social, economic, and/or environmental sustainability in your answer.

*Unlimited characters, suggested minimum ½ page or ~250 words.*

Over the course of this project, we established and maintained many different collaborations across campus. This meant regularly discussing issues surrounding waste management and contamination with various departments, and students from a large range of academic disciplines. This helped further awareness about the issues involved, and connect different parts of the community towards a goal of improving our knowledge about waste on campus and reducing waste contamination.

Our first flagship bin installation has a public facing screen that is meant to grow a culture of sustainability at McGill. By informing users about their waste habits, as well as providing messaging on waste contamination, the system directly encourages better behavior and waste consciousness. If negative trends in waste habits are noticed, we and the building and grounds department can deploy new messaging to help encourage the sustainable behaviors we want to see in a more targeted manner.

The Building and Grounds department has already been greatly devoted to improving sustainability on campus. The

smart waste system simply provides them with the extra data and tools they need to better optimize waste diversion on campus. This way, they can make sure we as an institution are reacting correctly in targeted ways to reach our ideal waste targets. In addition, the data collected will eventually be made public on our website for downloading. The hope is, that with this data made publicly available, students and external parties concerned about waste generation rates can scrutinize behaviours across McGill and keep us accountable for maintaining a culture of sustainability.

5. What recommendations do you have for the future of this project and are there any opportunities for complementary projects? Who will take responsibility for the project's future and how can interested persons be in touch? The SPF team may be in touch for updates on the project's progress in coming years, if ongoing.  
*Unlimited characters, suggested minimum 1 paragraph.*

There are still improvements to the system we want to make, most pressingly we would like to fix weight calibration issues in the current system. From February 2021-Nov 2021, we have received a separate tech-accel grant to continue iterating our hardware for larger scale production. This means making improvements to make the hardware more reliable, easier to install, and easier to maintain. This means making a more modular system where components can be swapped when breakdowns occur. We will continue to upgrade the Trottier smart waste system into November as we make improvements. From 2021-2022 we intend to expand the smart bin systems to 5 more buildings across the downtown campus.

Here are the categories of systems to maintain (What, Who's Responsible + Duration, Costs):

- Website -> Arneet Kalra until Summer 2022, \$20 yearly fee
- Database -> Arneet Kalra until Summer 2022, Currently free
- Public Display -> Building and Grounds in perpetuity (it's their screen)
- Computer -> Kirk Lau until Summer 2023
- Hardware -> Simina Alungulesa and Kirk Lau until Summer 2023
- Firmware -> Kirk Lau until Summer 2023

If you have any inquiries, you can contact us at: [recyclingpioneers3@gmail.com](mailto:recyclingpioneers3@gmail.com)

6. Would you or your project team member(s) be willing to serve as a mentor to SPF project teams? Please choose one. If yes, SPF Staff will contact you with more information.  Yes  No
7. In your application, you listed the following additional sources of funding:

**Mechanical Engineering Department - \$1,000**

Please confirm if you received this funding in the space below and list the actual amount (in dollars) that you received.

The MechEng funding sources was intended to cover machining costs for the two semester long capstone project. The beginning of the pandemic prevented any of this hardware prototyping / metal work from happening. As such, this funding source was never used.

8. How did you document your project, and did you include the SPF logo on any project materials (e.g. posters, promotional materials, social media posts, webpages, decals, etc.)? Please briefly describe in the field below.

The project is documented on our website, [RecyclingPioneers.ca](http://RecyclingPioneers.ca). The office of sustainability is currently credited on our public displays, as well as the Building and Grounds department. We are currently re-formatting our website again and will include the SPF logo.

9. Did you purchase equipment or make an installation on campus?  Yes  No  
If yes, please briefly describe how these items will be maintained and used in the future.

Yes, we purchased equipment and made an installation on campus, for our flagship smart bin with waste display in the Trottier building.

For maintenance of the hardware, firmware, computer, and website-- if we can grow the team to include new students, this will give us time to transfer knowledge and ownership to them. Due to the nature of hardware upgrades and maintenance, there is no stable plan yet as to who will be overseeing this 5-10 years from now. Ideally, with an improved system, this knowledge could be transferred to buildings and grounds such that building and expanding the system would be as easy as contacting a manufacturing contractor who already has the plans, and then having an employee follow a simple standard operating procedure for booting the firmware, installing the system, and connecting to the network.

If maintenance to the website / database features long term will be transferred to buildings and grounds, we may need to collaborate with third party companies that create waste management dashboard platforms for support.

10. The following Key Success Indicators were indicated in your project application and selected for tracking. Please indicate the actual results that you have achieved in the "Actual" column.

Selected Key Success Indicators	Target	Actual
Waste at a specific waste station (kg/day)	XX	0
# of successful detections of a full bin in a month	XX	0
Amount of recycling contamination from audits % weight/day	XX	0

If there is a significant difference in the target numbers and the actual numbers achieved, please explain. If you have any additional information to share about these success indicators, please also include it below.

Due to building shutdowns from the pandemic, and a lengthy installation process, we do not yet have real data collected. We look forward to getting our first real public usage data and producing our first monthly reports soon!

11. Please report on your progress with the Standard SPF Key Success Indicators in the "Actual" column.

Standard SPF Key Success Indicators	Actual
# of people hired using SPF funding for the project	
# of volunteers directly or indirectly engaged in the project	
# of people (student, staff, or other) trained in the context of the project	7
\$ raised for project activities subsequent to SPF funding	1800
# of tons of GHG emissions reduced by your project	0
# of partnerships or collaborations developed between the project team and other McGill administrative units, student groups, community groups, other universities, and/or other groups/organizations	4

Please list the groups and/or organizations that you counted in the last Key Success Indicator. *Point form acceptable.*

Building and Grounds Dept, Mechanical Engineering Dept, Electrical Engineering Dept, McGill Engine

If you have any additional information to share about the Standard SPF Key Success Indicators, please include it below.

2 people were hired, 4 volunteers were directly engaged in the project. Were unable to fill these into the fields above due to a Microsoft Word issue. The \$1800 came from a TechAccel grant through the Engine.

12. Please indicate the McGill stakeholder groups that were involved with your project as a team member or collaborator/partner. Select all that apply.

Undergraduate  Postgraduate  Administrative Staff  Academic Staff  Alumni

13. Please rate your project team's overall satisfaction with the support provided by the **SPF Staff**.

Very Dissatisfied  Dissatisfied  Neither Satisfied Nor Dissatisfied  Satisfied  Very Satisfied

Please provide any feedback or recommendations regarding your team's experience with the SPF Staff.

You are all helpful, kind, flexible, and incredibly supportive. Without your generous efforts and time, none of this would be possible, and we are truly thankful for that support. Our primary liaison through the course of this project, Stéphanie, was always very responsive and helped clarify any difficulties we might have.

14. Please rate your project team's overall satisfaction of your experience with the **SPF**.

Very Dissatisfied  Dissatisfied  Neither Satisfied Nor Dissatisfied  Satisfied  Very Satisfied

Please provide any feedback or recommendations regarding your team's experience with the SPF.

15. If there is additional information you would like to share about your project, please use the field below.  
*Unlimited characters.*

Recruiting of students interested in the intersection of technology and waste sustainability has been extremely difficult given the lack of on-campus activities. We are looking for more students to volunteer to join the team, and any help SPF may be able to provide in terms of advertising both the project, and that we're actively looking for new members, would be greatly appreciated!

16. Has your involvement in this SPF project positively impacted your team in the area of **professional growth**?

Yes  No  Prefer Not to Share

If you would like to elaborate, please use the field below.

This is the first time many of us have been involved in hiring talent for a project. We all learned and honed many professional skills such as interviewing, screening candidates, and becoming aware of common hiring biases that effect the process. In addition, we became much more adept at explaining and presenting a project pitch to quickly convey the goals and deliverables of a project.

17. Has your involvement in this SPF project positively impacted your team in the area of **personal growth**?

Yes  No  Prefer Not to Share

If you would like to elaborate, please use the field below.

We've all grown and learned so much about collaboration throughout this project. We've made great strides at improving the skills listed below.

18. Which of the following skills or attributes has your team improved through involvement in your SPF project?  
Select all that apply.

- |  |  |   |
|--|--|---|
| <input checked="" type="checkbox"/> Budgeting      | <input checked="" type="checkbox"/> Networking                 | <input type="checkbox"/> Systems Thinking                                   |
| <input checked="" type="checkbox"/> Communications | <input checked="" type="checkbox"/> Planning                   | <input checked="" type="checkbox"/> Teamwork                                |
| <input type="checkbox"/> Conflict Resolution       | <input checked="" type="checkbox"/> Problem Solving            | <input checked="" type="checkbox"/> Technology                              |
| <input type="checkbox"/> Leadership                | <input checked="" type="checkbox"/> Project Management         | <input checked="" type="checkbox"/> Time Management                         |
| <input checked="" type="checkbox"/> Listening      | <input checked="" type="checkbox"/> Public Speaking            | <input checked="" type="checkbox"/> Writing                                 |
| <input checked="" type="checkbox"/> Mentoring      | <input type="checkbox"/> Stakeholder Engagement                | <input type="checkbox"/> Other ( <i>Please specify in the field below</i> ) |
| <input checked="" type="checkbox"/> Negotiating    | <input checked="" type="checkbox"/> Stakeholder Identification |   |

Other:

19. Since starting your SPF project, has your team improved its **knowledge of sustainability**?

- Yes  No  Prefer Not to Share

If you would like to elaborate, please use the field below.

Thanks to this project, we are now well versed about recycling contamination, waste management at large institutions at Quebec, and public behavior.

20. (Optional) If applicable, please list the total number of team members voluntarily self-identifying as members of marginalized communities. Total number: \_\_\_\_\_

(Optional) Please identify the represented communities below.

### THANK YOU FOR COMPLETING YOUR FINAL REPORT!

Please e-mail your report to the [SPF Staff](#) attaching any additional information that you would like to share (e.g. other reports, research, documents, photos, etc.). Please note that this Final Report will be shared publicly on your SPF Project Webpage.