

HN/BSc Computing Portfolio

Module: Changemakers: Creativity and Value Creation ACCA5033

Assignment Title: Innovation & Research

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TASK 1: Ideation & Mind Map

Ideation & Mind Map Topic: SmartCampus Waste Management System (IoT-based)
Includes Mind Map at the end
Innovation and creativity are two of the most powerful forces shaping the modern world, especially within technology and computing. When we consider how societies have developed over time, it becomes clear that new ideas, tools and technologies often emerge because individuals or groups apply creative thinking to existing problems.

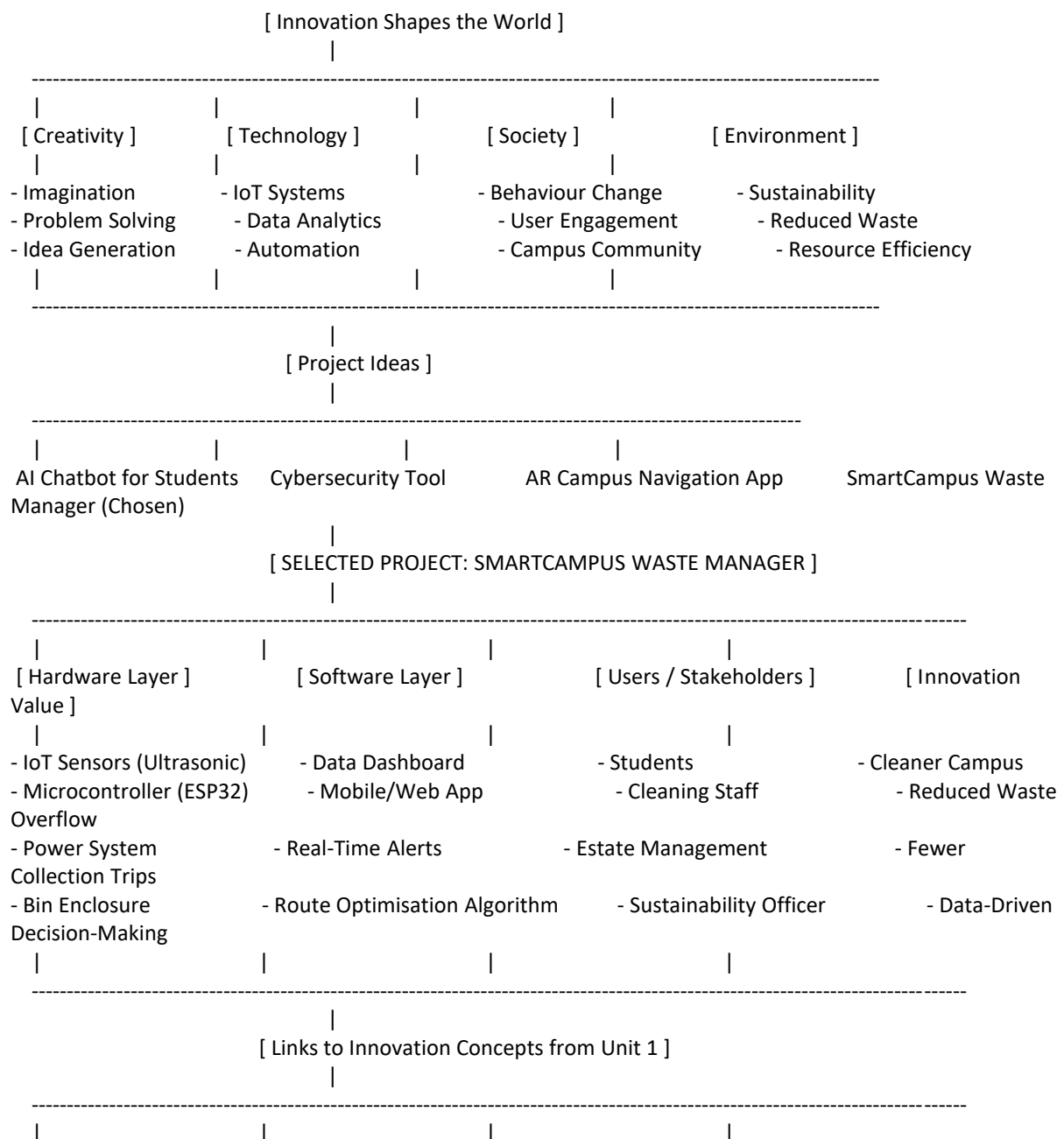
For example, innovations like the internet, smartphones and artificial intelligence did not appear out of nowhere—they were developed by people who recognised unmet needs, experimented with new ideas and used creative reasoning to build solutions. In this way, creativity pushes innovation forward, and innovation in turn drives social change, economic growth and improvements in quality of life. At the same time, many of today's global challenges—such as sustainability, environmental waste, climate change and resource management—require innovative solutions that combine technology with thoughtful design. This is particularly relevant for computing students, because the discipline naturally intersects with problem-solving and digital solution development. Technologies like the Internet of Things (IoT), cloud computing, data analytics and machine learning can be applied to real-world contexts in ways that improve efficiency, reduce waste and support environmental goals. These technologies form the foundation of many emerging smart-city projects, which aim to create more sustainable and intelligent urban environments. When brainstorming project ideas using principles from Unit 1 Topic 1 ("How Innovation Shapes the World"), I considered several possible directions: an AI-driven student support chatbot, a gamified cybersecurity awareness tool, a campus-navigation mobile app and a smart waste-management system.

All of these ideas relate to creativity and innovation in different ways. However, the SmartCampus Waste Manager stood out as the strongest option because it links directly to sustainability and value creation, two important themes in the Changemakers module.

Waste management is a visible issue on most university campuses. Overflowing bins, inefficient collection routines, lack of recycling awareness and unnecessary carbon emissions sometimes contribute to general wastefulness. By combining creativity with technology, it is possible to design a system that monitors waste levels automatically, notifies maintenance teams when bins need servicing and provides useful insights about waste patterns. This aligns perfectly with the module's focus on innovation, value creation and real-world impact. It also reflects the idea that creativity is not only about producing something artistic—it can also involve designing practical, technology-based solutions to everyday issues. In my mind map, I explored several high-level concepts: the role of innovation in economic and social development, the importance of sustainability, creative problem-solving skills and examples of how technology contributes to societal improvement. These concepts lead naturally to project ideas relevant to computing. After comparing different options, I selected the SmartCampus Waste Manager because it offers a meaningful opportunity to apply IoT hardware, data analysis and software design in a way

that genuinely benefits the campus community. Not only does it address an environmental challenge, but it can also produce measurable improvements, such as reducing waste-collection frequency, lowering costs and encouraging better recycling habits among students. This project fits comfortably within the broader narrative of innovation shaping the world. Just as smart-city technologies are transforming urban living, this smaller-scale project aims to bring similar value to a university environment. By integrating real-time data, automation and user-centred design, the system demonstrates how computing students can act as changemakers who apply creativity to generate tangible societal value. The chosen idea also provides strong foundations for future development, including extending the system with predictive analytics or linking it to sustainability dashboards for the university.

MIND MAP



- Creativity → Producing new ideas - Innovation → Applying new tech - Value Creation →
Improving - Changemakers Mindset →
such as smart bin prototypes like IoT sensors to solve problems campus environment
Taking initiative to solve real issues

TASK 2 - Aim, Objectives & Research Area

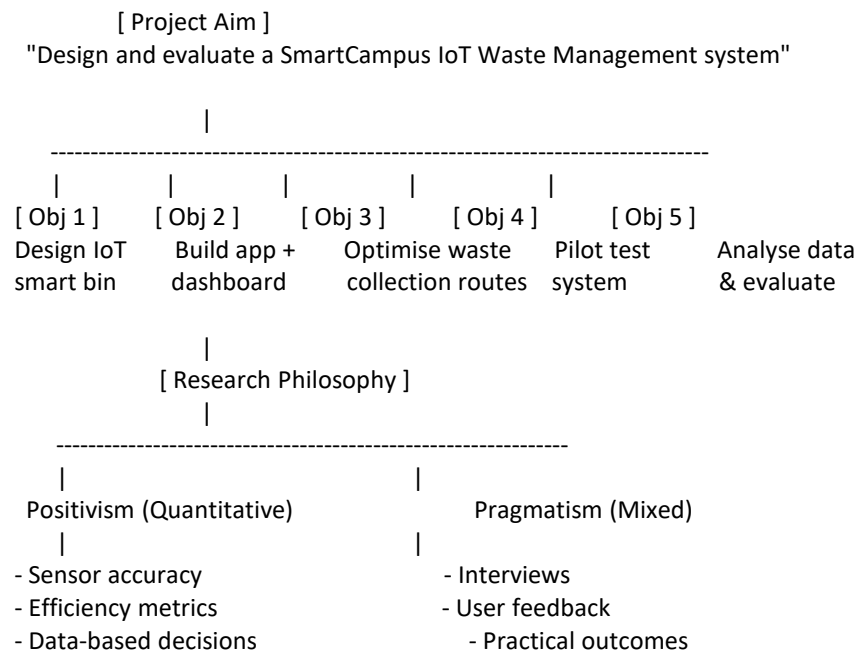
The aim of my project is to design, develop, and evaluate a SmartCampus IoT Waste Management System capable of monitoring bin usage in real time and supporting improved waste collection and recycling practices on a university campus. This system will integrate hardware technologies such as sensors with a software dashboard that allows staff to view data, track trends, and make informed operational decisions. To achieve this aim, I have set a series of objectives that break the project into manageable steps and ensure that the research is focused and structured.

My first objective is to design the prototype smart bin, including selecting appropriate IoT sensors that can measure fill levels, detect motion, and record timing data. The second objective is to create a web or mobile dashboard that collects the sensor data and allows users to see information easily. The third objective is to develop an algorithm for route optimisation so that staff can prioritise which bins need attention, reducing unnecessary collection trips. The fourth objective is to carry out a small pilot test of the system on campus to gather initial feedback and identify technical challenges.

The final objective is to analyse the pilot data and evaluate the overall effectiveness, reliability, and usability of the system. To guide the research process, I selected pragmatism as the most suitable research philosophy. Pragmatism allows for the use of multiple methods—both quantitative and qualitative—depending on what is most appropriate for answering the research question. Since this project involves collecting numerical sensor data and evaluating user perceptions through surveys or interviews, a pragmatic approach offers flexibility and a balanced perspective. Although the project includes elements of positivism, such as measuring bin fill levels and system performance, it also requires understanding user experiences, which aligns with interpretivist thinking. Pragmatism therefore provides the freedom to combine both traditions without being restricted to one philosophical viewpoint. For the literature review and background research, I identified specific search tools and databases relevant to computing and engineering. IEEE Xplore is one of the primary databases for IoT and smart city research, while ACM Digital Library and ScienceDirect provide high-quality articles on software engineering, human–computer interaction, and environmental technologies. Google Scholar is also useful for broad searches and finding citations. To create a systematic search strategy, I plan to use Boolean operators, synonyms, and keyword variations—for example, “smart waste management,” “IoT bin sensors,” “campus sustainability,” and “waste collection optimisation.”

Using filters such as publication date and subject area will help refine the results to recent and credible studies. In addition to research databases, I will use tools such as Zotero or Mendeley to organise sources and keep track of references. During the pilot phase, I may use spreadsheet software or basic statistical tools to analyse numerical data, while simple thematic coding techniques will help synthesise qualitative feedback. These tools support

both the technical and reflective aspects of the project, ensuring that the findings are robust and meaningful. Overall, Task 2 clarifies the project direction by defining what I want to achieve, how I will approach the research, and which tools I will use to support my decisions. Establishing a clear aim, grounded objectives, a practical philosophy, and appropriate research tools ensures that the project remains well-structured and academically rigorous.



TASK 3: Research Strategies, Validity, Reliability, Ethics, Analysis

Designing a research strategy for this project requires careful consideration of validity, reliability, research methods, and ethical principles. Since the system involves both technology testing and user feedback, I need a combination of quantitative and qualitative approaches. Establishing validity and reliability is essential to ensure that my findings are trustworthy and that any conclusions drawn from the pilot are meaningful and accurate. To enhance validity, I must ensure that the tools and instruments used in the study measure what they are intended to measure.

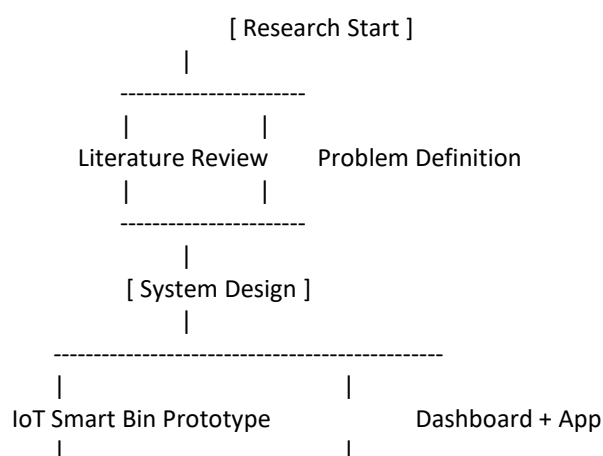
For example, if I want to evaluate bin fill levels, the sensor readings must accurately reflect real-world conditions. This means calibrating the sensors before deployment and testing them under different scenarios to confirm that they are consistently reliable. For the qualitative side, asking clear and relevant questions in interviews or surveys helps ensure that the responses genuinely reflect users' views about the system's usability or usefulness. I will also check that the questions directly relate to the project's aims and do not introduce unnecessary bias. Reliability refers to the consistency of the results. If I repeat the same measurement several times under the same conditions, I should obtain similar results each time. In this project, reliability can be improved by using stable, well-tested sensors and

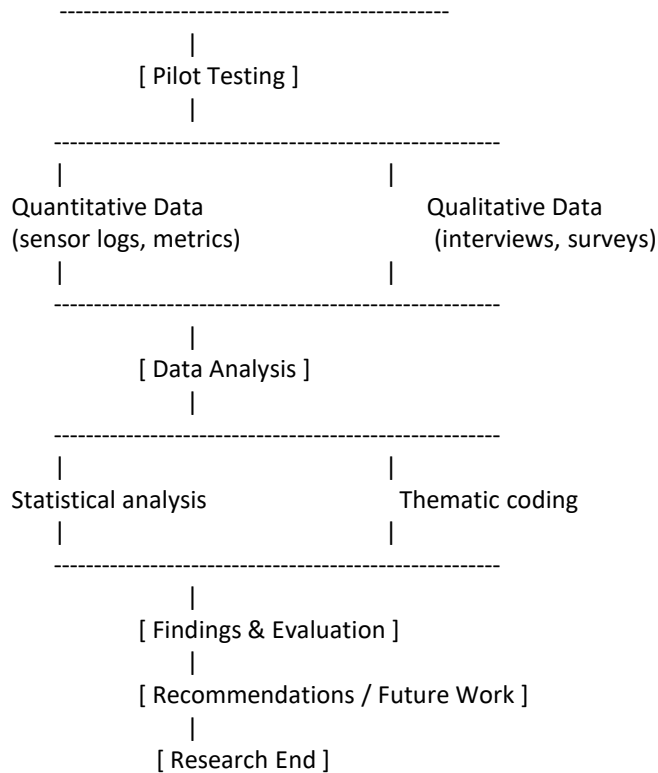
running repeated measurements during the pilot. For surveys, ensuring that questions are unambiguous and piloting them with a small group of users will help identify any issues with wording or interpretation.

Documenting procedures clearly, such as how bins are installed or how data is collected, also contributes to reliability because it enables repetition of the study in the future. Ethical considerations are essential because the project involves collecting data from users, even if the data is not personally sensitive. Ethical research requires voluntary participation, informed consent, and assurance of privacy. Before conducting surveys or interviews, I will provide participants with a short information sheet explaining the purpose of the study, how their responses will be used, and their right to withdraw.

No identifiable data will be collected, and all responses will remain anonymous. Sensor data relates to bin usage rather than people, but I will still ensure that no personal tracking occurs and that the system only gathers operational information. In terms of research strategy, I will adopt a mixed-methods approach. Quantitative methods include capturing real-time bin data using IoT sensors, recording timestamps, and analysing usage patterns. This information provides objective evidence of how effective the system is. Qualitative methods complement the numerical data by capturing users' thoughts through interviews or open-ended survey questions. Staff members, for example, may provide insight into whether the dashboard is easy to use or whether the system genuinely helps them work more efficiently. To collect data, I will design a pilot deployment of around three smart bins in selected locations on campus.

The pilot will run for a short period to capture enough information to assess performance. The survey questions included in the appendix will help gather student and staff opinions on waste disposal behaviours and their experience with the system. Feedback from the pilot will be used to refine the design before any wider rollout. When analysing the data, I will use descriptive statistics such as averages, percentages, and basic charts to summarise quantitative findings. This may include patterns in bin usage or reductions in collection frequency. Qualitative data will be analysed thematically, identifying repeated ideas or concerns across responses. Combining both sets of findings strengthens the project's conclusions because numbers provide measurable evidence while user comments offer context and meaning. In summary, Task 3 outlines a structured and ethically responsible research strategy that supports the technical and human-centred aspects of the SmartCampus Waste Management project. Ensuring validity, reliability, and careful analysis will help produce credible findings that contribute to both academic understanding and practical improvements on campus.





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Appendix: Pilot Survey as an example

SmartCampus Waste Manager – Pilot Questionnaire

1. **Consent:** I have read the study information and agree to participate voluntarily. (Yes/No)
2. How often do you dispose of waste (trash) on campus? (Daily / Several times a week / Once a week / Less)
3. Do you use recycling bins on campus? (Always / Sometimes / Rarely / Never)
4. How easy was it to find recycling bins on campus? (Very Easy / Easy / Difficult / Very Difficult)
5. The new Smart Waste Management app would send alerts when bins are nearly full. Would you find this useful? (Yes / Maybe / No)
6. In your opinion, what is the biggest problem with campus waste management? (Your answer)
7. Any suggestions for improving recycling on campus? (Your answer)

THANK YOU.