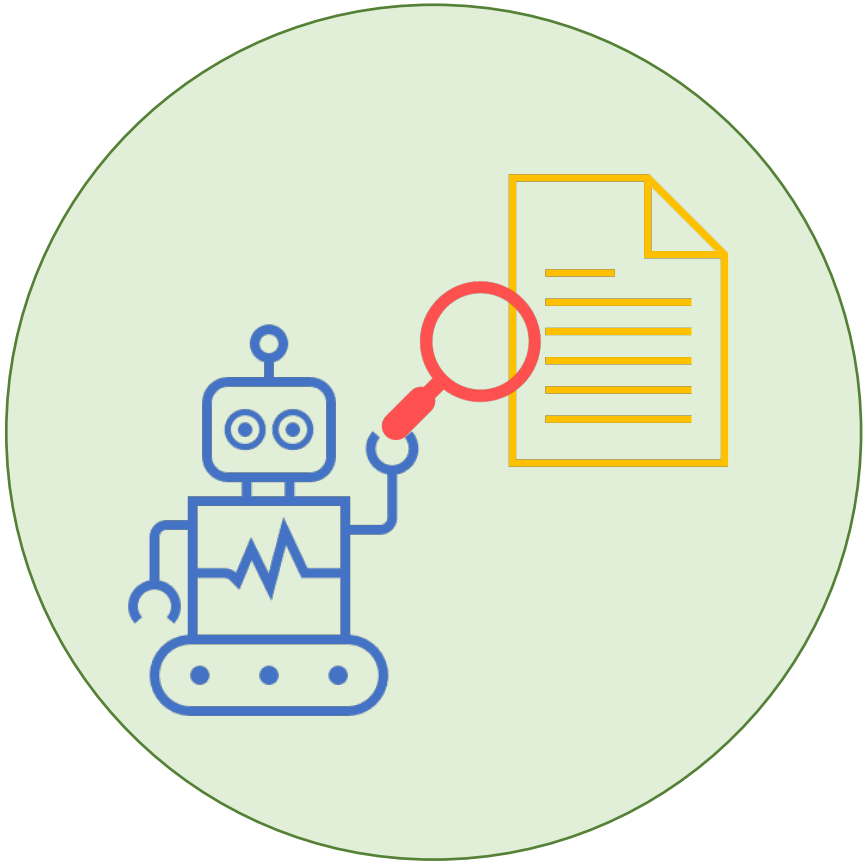
Digital Ethics and Data Privacy

Topic 3: Automation and Autonomous Systems

Case Scenario: Olympic Games

- Suppose that Singapore National Stadium is to house the next Olympic Games. In view of this, the stadium organizers have decided to deploy crowd management IoT technologies such as sensors and robots to act as intermediaries that will direct crowds to areas that are less crowded. These robots can freely move within the stadium. The organization also looks to implement video analytics by running cameras throughout the stadium. However, the organization is unaware of the potential risks that the autonomous systems could pose and is considering many options to oversee the robots, and act as secondary crowd directors.



Group Discussion

In your coming Group discussion, analyze the case study, and propose on how you have identified the autonomous system as (based on the matrix you were taught), and develop 15-20 questions to assess the potential ethical risks and considerations that can arise from the organizers desire to implement such autonomous systems.

Role Sheet

Stakeholder	Questions to Consider:
Olympic Games Organizing Committee Role: The organizing committee is responsible for all aspects of the games, including security, logistics, marketing, and overall operations. This includes the implementation of the IoT and autonomous systems at the Singapore Stadium.	• How will the deployment of IoT and autonomous systems impact the overall operations and logistics of the games? • What contingency plans should be in place if the systems encounter issues? • How can we ensure clear communication with all stakeholders about how these systems function and their purpose? • What training or education needs to be provided to staff, athletes, and visitors about the systems?
Athletes and Coaches Role: As participants in the games, the athletes and coaches will interact with the systems, especially for navigation and accessing the facilities. They need to understand how the systems work and how they will be affected.	• How can we familiarize ourselves with the IoT and autonomous systems to ensure smooth operations during the games? • What are our responsibilities in relation to these systems? • How will these systems affect our movements and interactions within the stadium? • What should we do if we encounter issues with the systems?

Role Sheet

Stakeholder	Questions to Consider:
Spectators and Visitors Role: These are the people who will attend the games and directly interact with the systems, especially for movement and navigation around the stadium. Their experiences and feedback are important for evaluating the success and effectiveness of the system.	• How can we understand and navigate the IoT and autonomous systems effectively? • What are our rights and responsibilities in relation to these systems? • How can we provide feedback or raise concerns about the systems during the games? • How will these systems enhance or impact our experience at the games?
Technology Providers Role: The technology providers are the companies or entities that have developed and supplied the IoT sensors and autonomous robots. They are responsible for providing technical support and ensuring that the technology functions as intended.	• How can we ensure that our IoT sensors and autonomous systems are reliable and perform accurately during the games? • What technical support will be needed on-site during the games and how can we provide it? • How can we address any technical concerns or issues raised by other stakeholders? • How can we ensure our systems adhere to all relevant safety and privacy regulations?

Role Sheet

Stakeholder	Questions to Consider:
National Stadium Management Role: The organizing committee is responsible for all aspects of the games, including security, logistics, marketing, and overall operations. This includes the implementation of the IoT and autonomous systems at the Singapore Stadium.Role: The stadium management is responsible for maintaining the physical infrastructure, including facilitating the installation of IoT devices and autonomous systems.	• How can the stadium's existing infrastructure support the IoT and autonomous systems efficiently? • What modifications, if any, need to be made to the infrastructure to accommodate the systems? • How will the systems be maintained throughout the duration of the games? • What potential issues might arise in terms of infrastructure and how can they be mitigated?

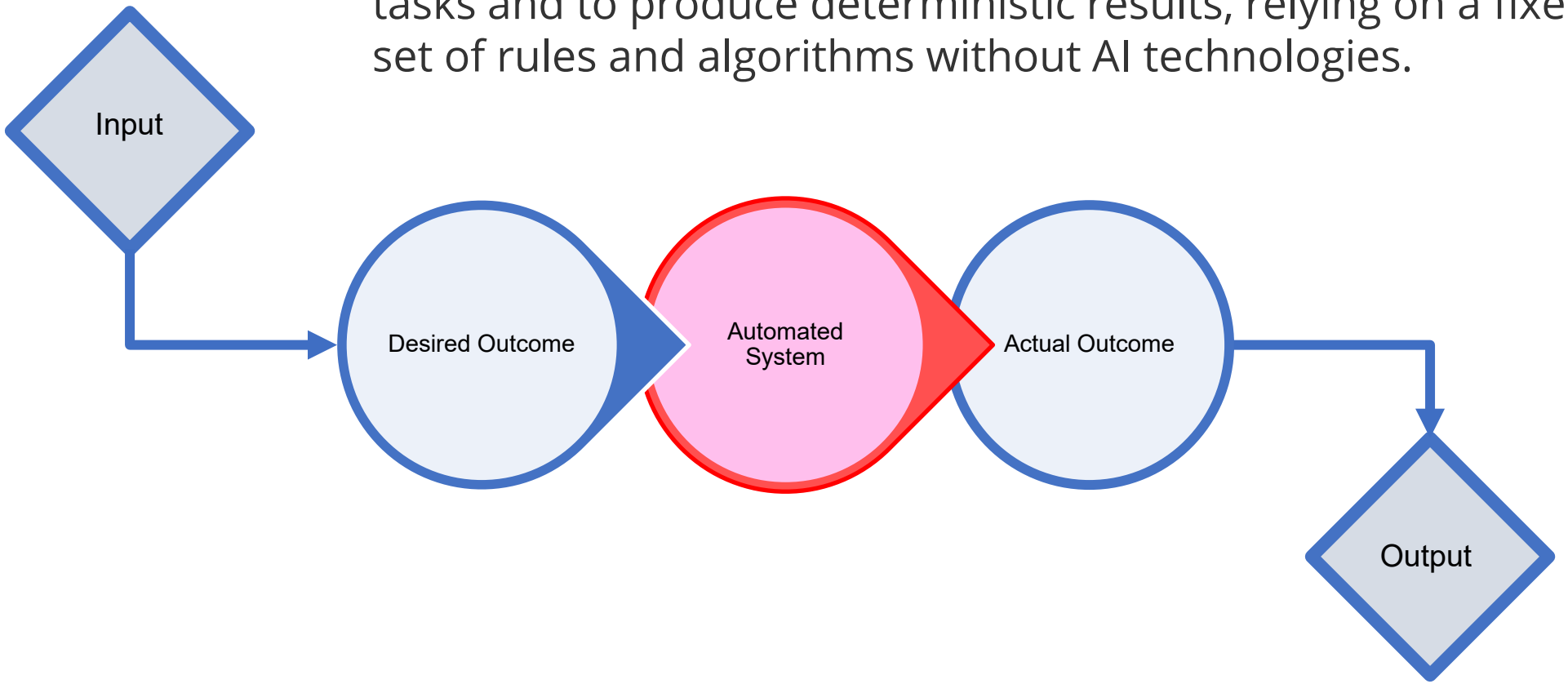
Read, Do and Watch

Topic Objectives

- Identify ethical issues around deployment of automation and autonomous systems in society.
- Understand the ethical implications of automation, such as job displacement and accountability.
- Understand our national initiatives in governing the adoption of robotics and autonomous systems.
- Evaluate ethical questioning in autonomous systems and autonomous system design.
- Leverage the framework of safety and ethics in building autonomous systems.
- Explore regulations and guidelines for autonomous systems.

Automated Systems

Automation is the ability of a system to perform well-defined tasks and to produce deterministic results, relying on a fixed set of rules and algorithms without AI technologies.



Automated Systems Examples

Automated Storage and Retrieval Systems

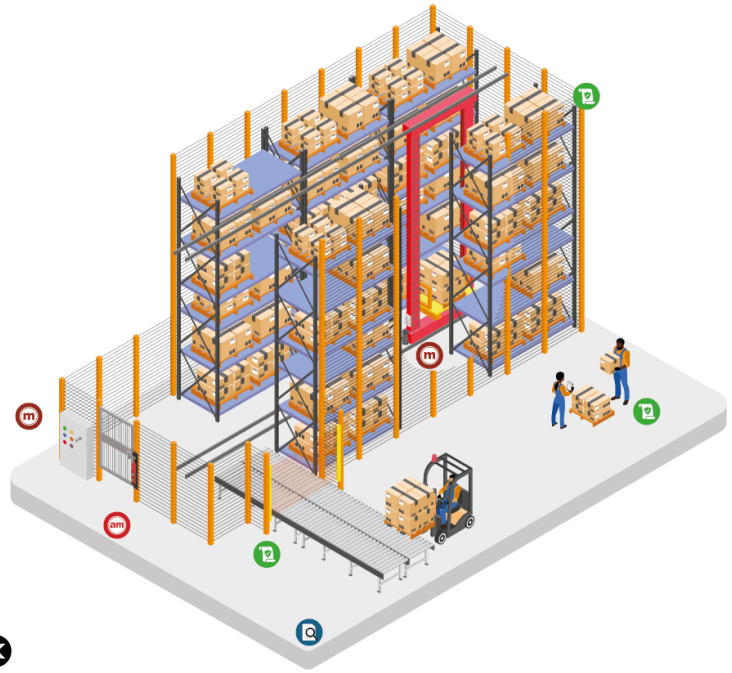
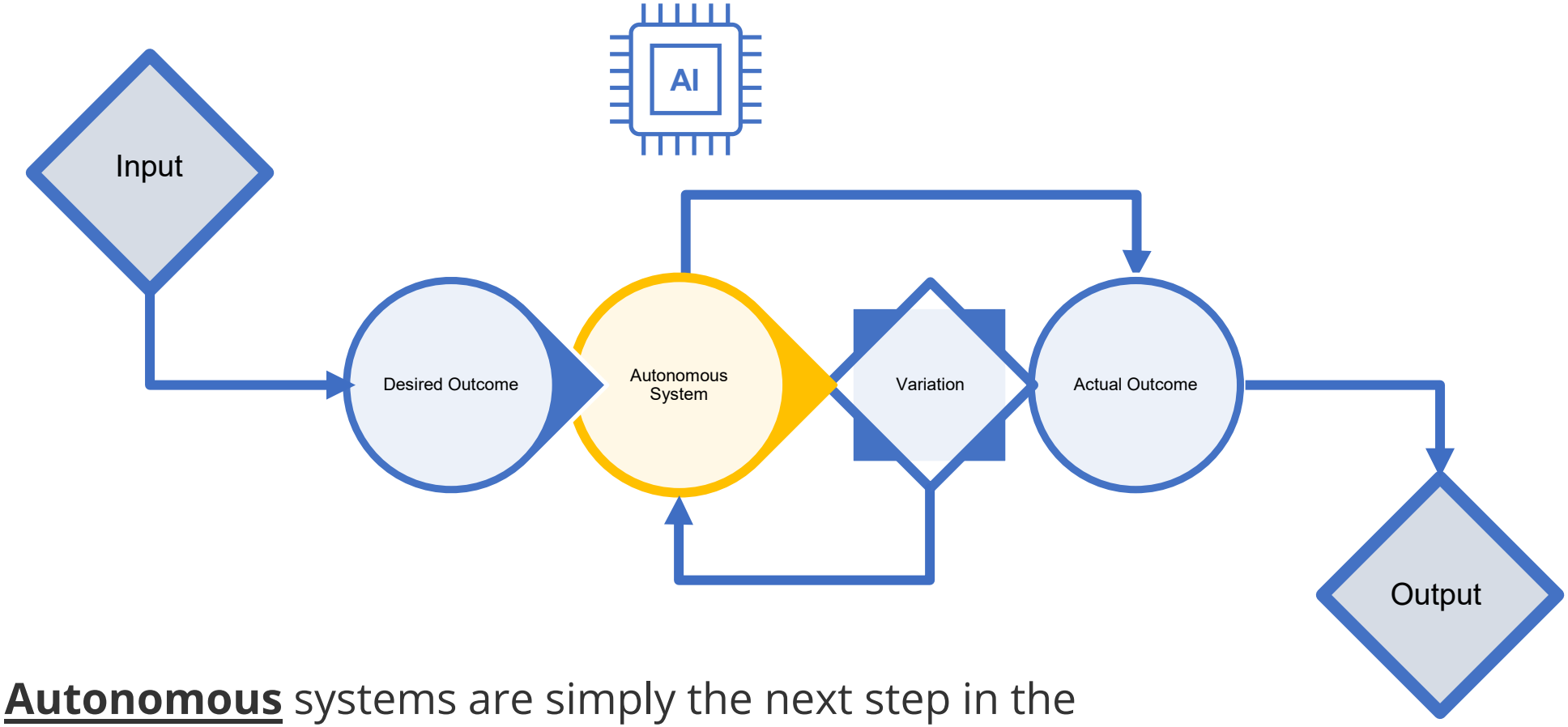


Image Source: Fortress-safety.com

Application Tracking System

Washing Machine

Autonomous System



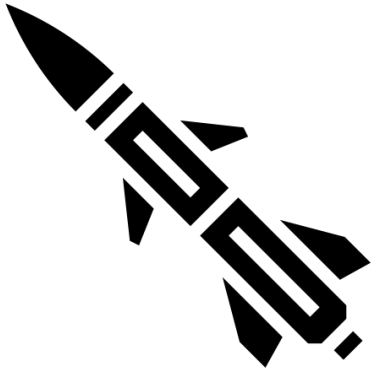
Autonomous systems are simply the next step in the evolution of automation where AI is applied to the systems.

Autonomous Systems Examples

Self-Driving Car

Drones

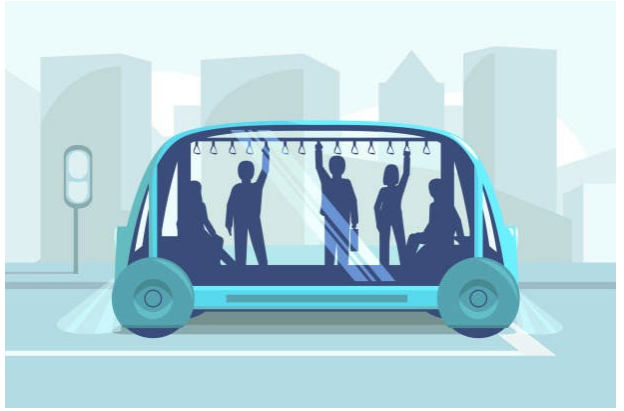
Anti-Missile System



Key Challenges In Autonomous Systems

- Principle of Double Effect

- Autonomous Vehicles
  - When faced with an unavoidable accident, the vehicle occasionally chooses to protect its passengers at the possible expense of pedestrians, even when an alternative action might result in less overall harm but might jeopardize the passengers slightly.

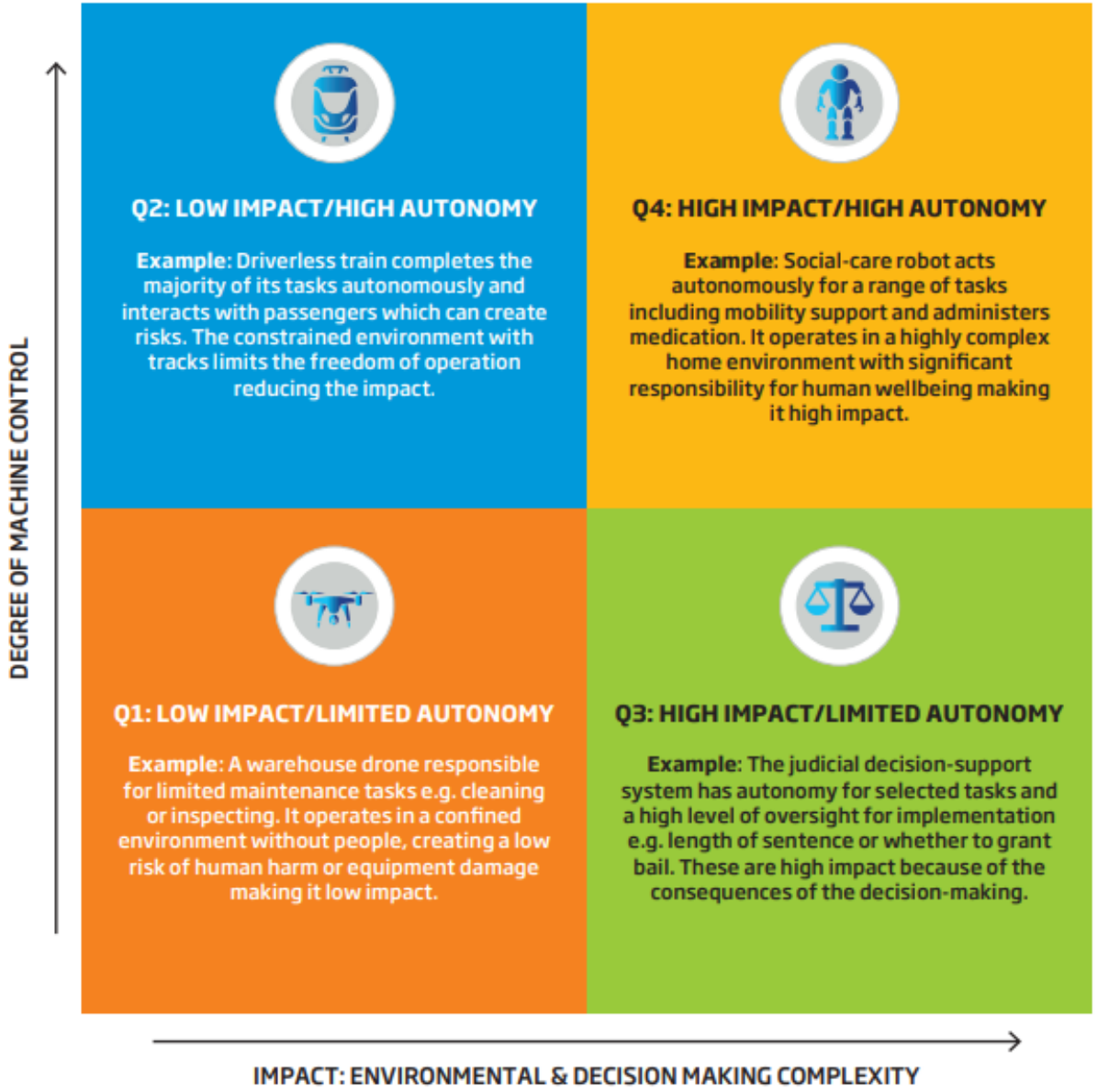


- Autonomous Robotic Systems in Elderly Care
  - Efficiency and the novelty of interacting with the robots, but lacking the ability to provide emotional support and empathy.

RWD (Topic 3: Automation and Autonomous Systems)

Self-Regulated Learning

Automation/Autonomy In Organizations



Impact Of Automation In Organizations

Q1: Low Impact on Decision & Limited Machine Control

- When your autonomous machine/system works in a confined environment, and has a limited set of tasks defined for it, then you face low impact on environmental & low decision making since it's restricted.
- One such example could be your LMS system, where it automatically grades your work.
- The restricted environment limits the LMS from grading non-specific works, and since the system is confined to a platform, then it cannot extend its capabilities elsewhere.

Impact Of Automation In Organizations

Q2: Low Impact on Decision & High Machine Control

- If your autonomous machine's involvement in the grand scheme of your environment is not as significant (i.e., used daily by everyone), then it has a low impact. However, if it is operated autonomously through the majority of its lifespan, then it has a higher machine control/autonomy.
- One such example is the LRT, which is operated autonomously, yet runs on tracks.
- Since it is not used by most commuters around Singapore, its impact on the environment is low. However, since the system is typically operated without a driver, then it classifies as high machine control.

Impact Of Automation In Organizations

Q3: High Impact on Decision & Limited Machine Control

- When your autonomous machine is critical towards the functionality of your service, it subsists as a high impact on the decision making.
- One example are motion sensor machines used by hospitals that detect minute movements or muscular senses. These sensors are used to assist doctors in assessing the health and state of a dying patient, and oftentimes works to provide doctors a second opinion on the condition of a patient.
- As these systems would require human intervention to operate, they are said to hve limited autonomy.

Impact Of Automation In Organizations

Q4: High Impact on Decision & High Machine Control

- When your autonomous machine is capable of making informed decisions based on the environment its in, yet can vary its actions depending on the scenario, it is stated to have a high impact on decision with high machine control.
- One such example are pervasive tech for elderly, where robotic machines can care for elderlies at their own homes.
- Unlike the previous examples, these machines can make informed decisions should an elderly fall down or meet an accident per se. Furthermore, the machines are much more capable and have a larger impact overall.

Automation In NUS

- With the previous diagram, what are some areas you can think of, that can be a type of autonomous system in school?
  - Example: One autonomous system could be the auto-grading system used by lecturers on your LMS, where it automatically grades your quizzes.
  - Example: In some Computer Science (CS) modules, you might have auto-grading for codes as well.

Autonomous Systems In Singapore

- In Singapore's healthcare sector, a lot of resources have been put into the integration of autonomous systems for healthcare.
- For example, **Hospi** and **RoboCoach Xian** are examples of autonomous systems that operate on their own.
- Use sensors to detect patients within the hospital as well as the environment.

RoboCoach Xian

Autonomous Systems In Singapore

- Additionally, in Singapore, the government has been moving towards autonomous healthcare for long term elderly care.
- We have seen how robust autonomous systems can reduce the manhours and resources required to accomplish a task.

Autonomous Systems In Singapore

- The SG government has also established NHIC, the National Healthcare Innovation Centre.
- Focusing on innovation for healthcare, it branches into numerous schemes and programs to encourage technology uptake in healthcare, within Singapore.

Autonomous Systems In Singapore

- However, the adoption of robotics and autonomous systems in Long Term Care (LTC) poses risks and unintended consequences.
- Risks such as the following are among the concerns by the government:
  - How safe is the system towards the elderly?
  - Are the data captured by the system stored safely?
  - Who is liable for the consequence of these risks?
  - Do autonomous systems replace social engagement?
- Thus, it is important to categorize these areas, and derive a methodology to address them.

Considerations of Ethical Automation (I)

Technological risks/ethical issues	Brief explanations
Safety	Robots and autonomous systems veering away from what they have been programmed to do as a result of autonomous learning, especially when deployed in an unstructured environment externally, or when experiencing mode transition internally.
Privacy and data security	Privacy entails both physical privacy and informational privacy. It relates to the extent to which surveillance functions of robotics and autonomous systems are infringing the personal spaces of carers and care recipients. Data security encompasses detailing the purpose and types of data collected, stipulating the level of access to the data by different stakeholders, and ascribing ownership of the data.
Liability	The right allocation of responsibilities and compensation risks in the event of accidents and harms imposed by robotics, autonomous systems, or smart health technologies during the caregiving process.
Effects to the incumbent workforce	The disruptive employment consequences created by the potential replacement of the existing social care workers by robotics and autonomous systems.
Autonomy and independence	The ability of care recipients to exhibit self-determination and assert preferences regarding the extent to which robotics and autonomous systems should be deployed in the caregiving process.

Considerations of Ethical Automation (II)

Technological risks/ethical issues	Brief explanations
Social connectedness and human interaction	The possibility of compromising social interactions and human touch, which are needed to ease loneliness and preserve the well-being of the older people during the caregiving process, when robotics and autonomous systems are applied.
Objectification and infantilization	Undermining the dignity of the care recipients by subjecting them to the command and control of robots and through robot behaviours that potentially infantilize them.
Deception and anthropomorphisation	Counterfeiting authentic social engagement and misleading care recipients to falsely believe that robotics solutions deployed to facilitate their care deliveries are genuine social companions.
Social justice	Preserving social equity by ensuring that the level of access to and mechanisms of distribution of robotics and autonomous systems in LTC (long term care) benefit all segments of the older population.

Balancing Autonomous Systems

- Therefore, from the considerations, autonomous systems can be treated as a tool that will help to automate several areas of our lives, but they **CANNOT**, take over the entirety of our works.
- Similarly, we should consider what are the pros and cons of leveraging on technology for automation and autonomous systems.
- If it brings more disadvantages, are we still going to implement it?

Example

- Example:
  - You have to create a new healthcare robotic sensor, that can help to monitor the motion of elderlies or residents within HDB homes. Your robotic sensor is designed such that it will require multiple sensor points to be installed into the structures of homes, so that it can map the house and detect any movement autonomously. your robot is also capable of interacting with the residents of the house through lifelike manner, as if another human is interacting with them. This cutting-edge technology will be incorporated into homes by a joint development project between your organization and HDB, the Housing & Development Board of Singapore.
- Question:
  - How can you ensure that, although autonomous, there is proper provision of safety and efficacy in your healthcare robotic sensor?
- Autonomy Issue:
  - As a physical sensor, the technology is prone to deterioration over time. This affects the accuracy of the sensor in tracking the movements and different environments within the home.
  - Should the sensor require upgrading of firmware or physical device, who is custodially responsible of this?
  - Since autonomous machines should not inhibit social interaction, how can you ensure that such issues do not surface?

Solution

- As the developer, you can design the system such that it is extensible. You can swap out the sensor easily, and have regular maintenance to ensure such autonomous systems are serviced periodically.
- Action:
  - Constantly conduct safety checks.
  - Guide residents on how to self-serve the safety checks periodically.
- Another alternative is to serve your project through NHICs innovation platforms, that way, you would have a more general guideline for proper care and safety.

Considerations For Autonomy

- Ethical concerns in automation and autonomous systems.
  - How safe is the system towards the elderly?
  - Are the data captured by the system stored safely?
  - Etc.

- Here, we will address these concerns with an ethical framework for automation.

Ethical Framework For Automation

Ethical Framework For Automation

- The framework covers 6 areas that revolve around the core essence of an autonomous systems.
- It is useful to view automation and autonomous systems by asking questions which subsist in the 6 areas.
- This will ensure that as you develop and deploy autonomous systems, or systems for automation, you do not derail from the ethical considerations identified before.

#1 Technical Area

- As developers, it is your responsibility to ensure the safety and assurance of the autonomous systems.

- Questions to ask:
  - Are there safety checks?
  - Are the checks done regularly?
  - Is there periodic maintenance?
  - Are there development of new methods of safety protocols alongside trials and simulations?

#2 Professional Responsibility Area

- As developers, it is your duty to encourage best practices for safety protocols, especially when there is a constant change and improvement in the autonomous system.

- Questions to ask:
  - How can we encourage users to abide by proper and safe usage protocols?
  - Are users using the product properly?
  - Has there been any mishaps due to users wrongly interacting the autonomous system?

#3 Regulation Area

- As developers, it is your duty to enforce relevant regulations that do not hinder the innovative spirit of your product.

- Questions to ask:
  - Are any of the regulations of use misaligned?
  - Should there be new changes to the product, are any of the new regulations to be imposed too restrictive on the usage, such that it forces users to wrongly use the system?

#4 Oversight Area

- As developers, it is your duty to ensure that the transition from development to deployment of your system is just and correct, since deployed systems and developed systems can vary due to certain changes and patches.

- Questions to ask:
  - Is the deployed system similar/exact compared to the developed system?
  - Are there areas of the deployed system that is not included within the regulations or terms of use? If so, developers should aim to include them.

#5 Public Acceptance Area

- As developers, it is your responsibility to ensure that your autonomous system does not intrude too much into the lives of the users, to the extent it replaces social interaction from their daily routine.

- Questions to ask:
  - Is the deployed system going to occupy a huge amount of the users time? (e.g., healthcare robot)
  - Are there periods of time where users will not require to interact with the autonomous systems? This way, users can have allocated time away from the reliance of an autonomous system.

#6 Ethics Area

- As developers, it is your duty to ensure that your system is transparent in its usage and tracking. That way, end users know what to expect and how to use your system. Also, transparency promotes better oversight on the potential areas of danger to avoid.

- Questions to ask:
  - Have you documented the usage of your system properly?
  - Is the tech stack used to deploy the system properly and thoroughly tested?
  - Are you able to disclose, to your best knowledge, the areas that users can pay extra attention towards, to ensure proper adherence to proper safety regulations?

Ethical Framework For Automation

1. You do not have to ask all the questions, however it is great to cover as much grounds as you can.
2. This ensures a greater coverage of the ethical considerations you put in place for the autonomous system.
3. When asking these questions and you find that you are struggling to answer them, you likely have an area to look further into.
4. Lastly, figure out how you would ethically solve the issue.

Example

- Lets relook at a previous example:
  - You have to create a new healthcare robotic sensor, that can help to monitor the motion of elderlies or residents within HDB homes. Your robotic sensor is designed such that it will require multiple sensor points to be installed into the structures of homes, so that it can map the house and detect any movement autonomously. your robot is also capable of interacting with the residents of the house through lifelike manner, as if another human is interacting with them. This cutting-edge technology will be incorporated into homes by a joint development project between your organization and HDB, the Housing & Development Board of Singapore.
- Question:
  - What sort of ethical questions can you derive, after learning the framework?
  - Lastly, through the questioning, how can you ensure that there is proper provision of safety and efficacy in your healthcare robotic sensor?

Further Reading

1. Ultimate Guide to Autonomous Systems
https://blackberry.qnx.com/en/ultimate-guides/autonomous-systems

2. Robots at Workplace
https://www.wired.com/story/robots-fill-workplace-must-learn-get-along/

3. Using robotics and autonomous systems in long-term care
https://www.sciencedirect.com/science/article/pii/S0040162521001189

4. Ethics of Automation and Robotics: Top Challenges and Solutions
Ethics of Automation and Robotics: Top Challenges and Solutions - B2E Automation

Q & A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