Analysing National Responses to COVID-19 Pandemic using STPA

CATAPULT High Value Manufacturing

Centre for Connected & Autonomous Vehicles

UKRI UK Research and Innovation

WMG THE UNIVERSITY OF WARWICK

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MIT STAMP Workshop 2021

Agenda

- Motivations
- Analysis
- Key findings
- Summary & Acknowledgement

Motivations

To understand:

- How STPA can be applied for Socio-Technical Systems.
- How we could have improved the responses and save more lives.

Why STPA?

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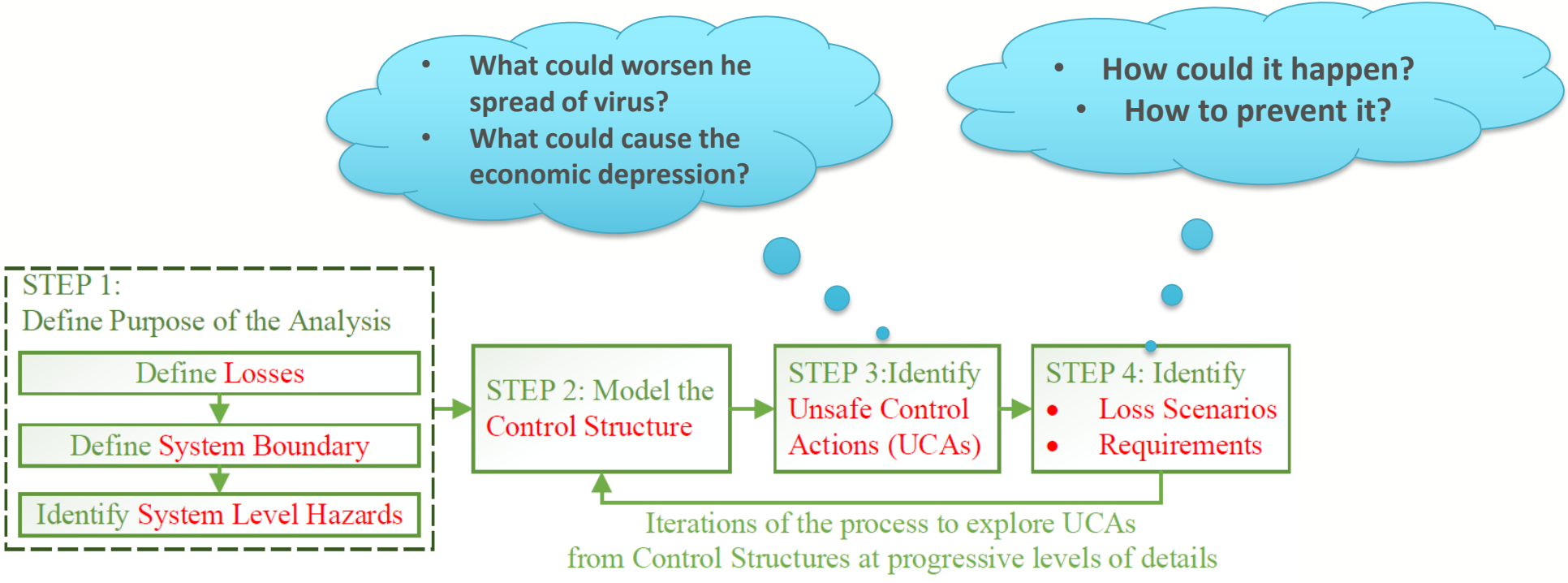
- With the top-down nature of STPA, results identified from STPA will directly contribute to the improvement of the responses to the pandemic.

- During initial phases of COVID-19 pandemic, available information regarding the responses from public and governments were very limited. This is enough for the start of STPA.

- STPA identifies a diverse range of causal scenarios, including flawed process, processing delays, communication issues, conflicted controls, misinterpreted feedbacks, which can be easily overlooked especially in a socio-technical system.

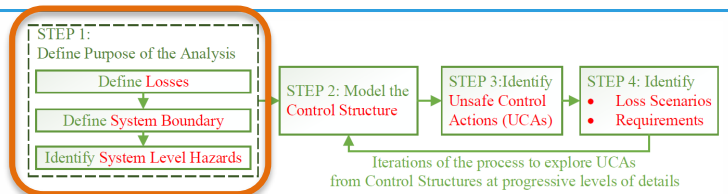

What could worsen he spread of virus?
What could cause the economic depression?
How could it happen?
How to prevent it?
STEP 1:
Define Purpose of the Analysis
Define Losses
Define System Boundary
Identify System Level Hazards
STEP 2: Model the Control Structure
STEP 3:Identify Unsafe Control Actions (UCAs)
STEP 4: Identify
Loss Scenarios
Requirements
Iterations of the process to explore UCAs
from Control Structures at progressive levels of details

Step 1: Define Purposes of the Analysis

- Define **Losses**

Losses	
L-1	Loss of human life / damage to health and wellbeing (e.g. long term concerns with COVID)
L-2	Loss of economic stability (e.g. closure of business / increases in unemployment, decrease in purchasing power)
L-3	Loss of functioning democratic society (e.g. loss of freedom, human right .etc.)

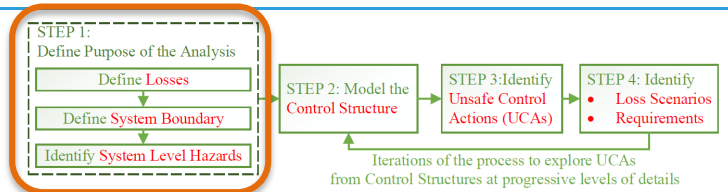
- Define **System Boundary**
  - **System Boundary**: International interactions between different governments and W.H.O
  - **Analysis Boundary**: National-level responses to the COVID-19 pandemic



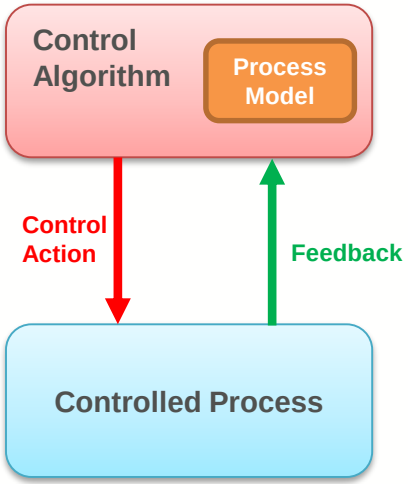
Step 1: Define Purposes of the Analysis

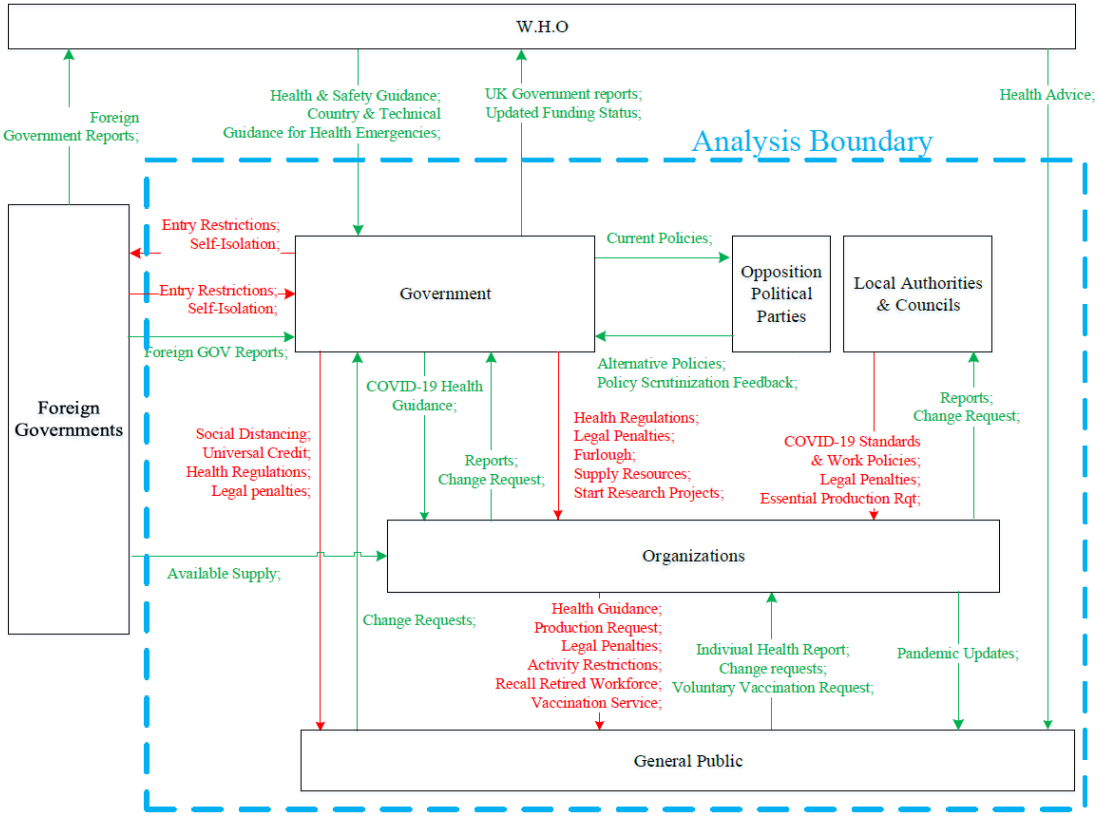
- Identify **System-level Hazards (i.e. National-level)**

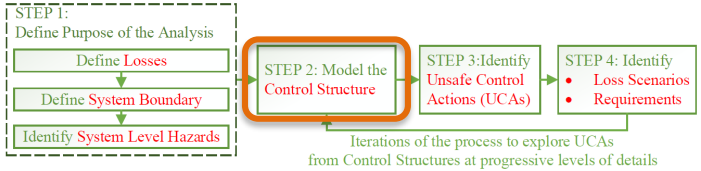
System-Level Hazards		
H-1	The population has an increase in infected cases	**L-1,2**
H-2	Inability of companies / organizations to operate normally	**L-2**
H-3	Overwhelming health system in the nation	**L-1**
H-4	Lack of essential supply in the nation	**L-1,2,3**
H-5	Social unrest in the nation	**L-1,2**
H-6	Discriminations in the nation	**L-1,2,3**

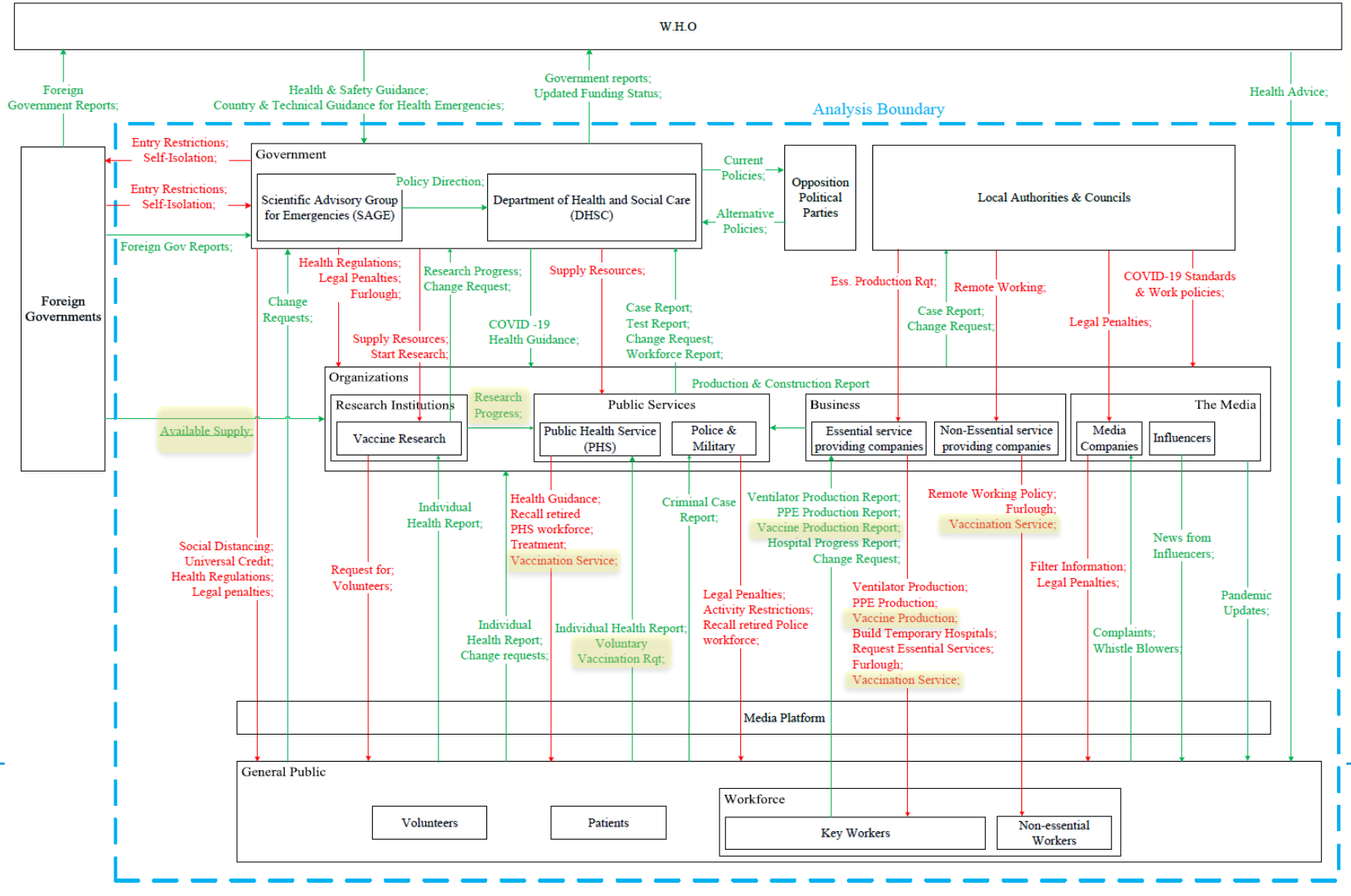


Results – Step 2: Model the Control Structure








W.H.O
Foreign Government Reports;
Health & Safety Guidance; Country & Technical Guidance for Health Emergencies;
Government reports; Updated Funding Status;
Health Advice;
Analysis Boundary
Foreign Governments
Entry Restrictions; Self-Isolation;
Entry Restrictions; Self-Isolation;
Foreign Gov Reports;
Government
Scientific Advisory Group for Emergencies (SAGE)
Policy Direction;
Department of Health and Social Care (DHSC)
Current Policies;
Alternative Policies;
Opposition Political Parties
Local Authorities & Councils
Change Requests;
Health Regulations; Legal Penalties; Furlough;
Research Progress; Change Request;
Supply Resources;
COVID -19 Health Guidance;
Case Report; Test Report; Change Request; Workforce Report;
Ess. Production Rqt;
Case Report; Change Request;
Remote Working;
Legal Penalties;
COVID-19 Standards & Work policies;
Supply Resources; Start Research;
Organizations
Production & Construction Report
Research Institutions
Vaccine Research
Research Progress;
Public Services
Public Health Service (PHS)
Police & Military
Business
Essential service providing companies
Non-Essential service providing companies
The Media
Media Companies
Influencers
Available Supply;
Social Distancing; Universal Credit; Health Regulations; Legal penalties;
Request for; Volunteers;
Individual Health Report;
Health Guidance; Recall retired PHS workforce; Treatment; Vaccination Service;
Individual Health Report; Change requests;
Individual Health Report; Voluntary Vaccination Rqt;
Criminal Case Report;
Legal Penalties; Activity Restrictions; Recall retired Police workforce;
Ventilator Production Report; PPE Production Report; Vaccine Production Report; Hospital Progress Report; Change Request;
Ventilator Production; PPE Production; Vaccine Production; Build Temporary Hospitals; Request Essential Services; Furlough; Vaccination Service;
Remote Working Policy; Furlough; Vaccination Service;
Filter Information; Legal Penalties;
Complaints; Whistle Blowers;
News from Influencers;
Pandemic Updates;
Media Platform
General Public
Volunteers
Patients
Workforce
Key Workers
Non-essential Workers

Step 3: Identify UCAs

CA	Type	UCA
Vaccination Service (from PHS to Public)	**Not Provided**	**UCA-1.1:** Vaccination Service is not provided when R>1 and there are no effective therapies for the coronavirus. [H-1,3,5]
	Provided incorrectly / when not needed	**UCA-2.1:** Vaccination Service is provided to people with a severe allergic reaction. [H-1,5]
		UCA-2.2: Vaccination Service is provided incorrectly (e.g. inadequate arrangement of the procedure, no social distancing etc.) when there is a large amount of people attending the vaccination appointment. [H-1, 3]
	Provided too Early / too Late	**UCA-3.1:** Vaccination Service is provided too early when the vaccinnee has just had the first dose (< 2weeks ago). [H-5]
		UCA-3.2: Vaccination Service is provided too late when the vaccinnee has already had the first dose (> 12 weeks ago). [H-1,3,5]
	Provided too Long / too Short	**UCA-4.1:** Vaccination Service is suspended too soon when <70% of the population has been vaccined. [H-1,3,5]

System-Level Hazards		
H-1	The population has an increase in infected cases	L-1,2
H-2	Inability of companies / organizations to operate normally	L-2
H-3	Overwhelming health system in the nation	L-1
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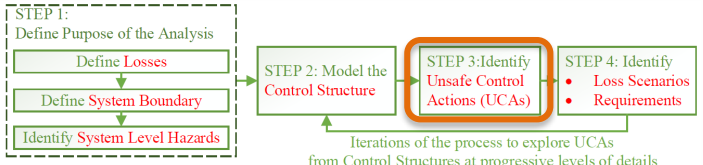


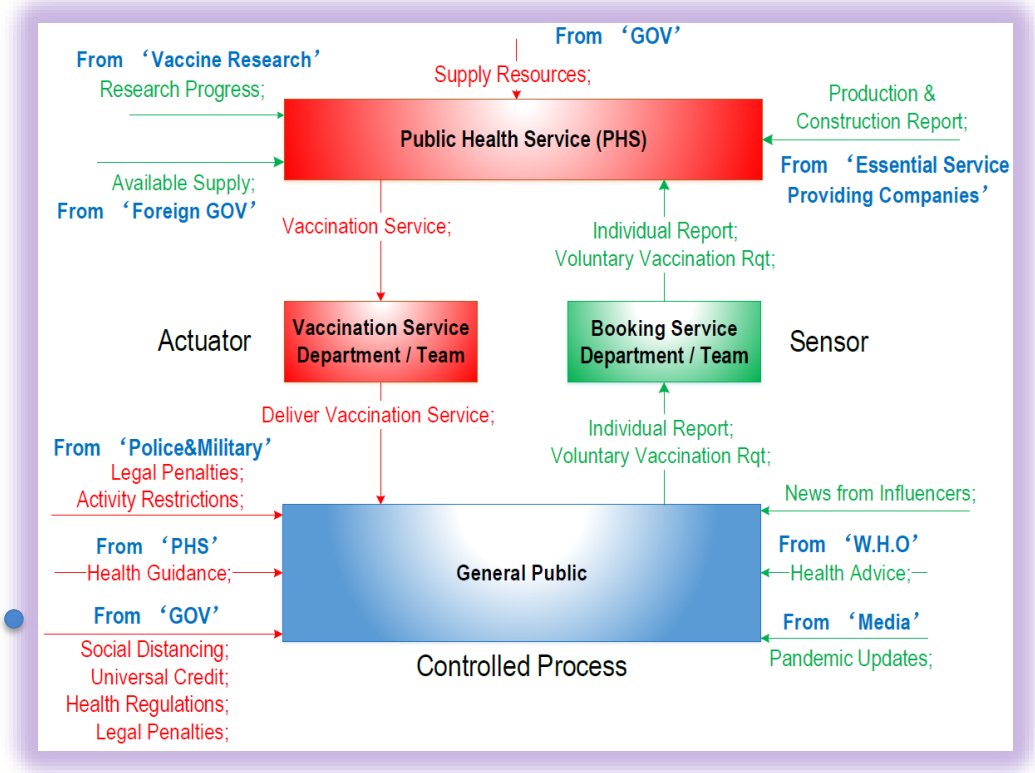
Step 4: Identify Loss Scenarios & Requirements

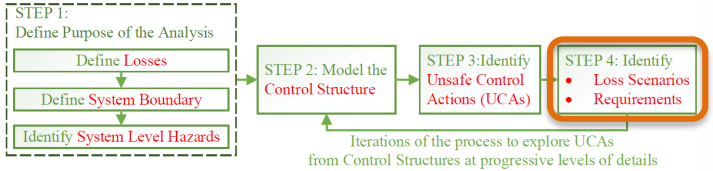
Two UCAs to be discussed in this presentation:

UCA-1.1: Vaccination Service is not provided when R>1 and there are no effective therapies for the coronavirus. [H-1,3,5]

UCA-2.1: Vaccination Service is provided to people with a severe allergic reaction. [H-1,5]

Observing the Control Loop, there can be many factors leading to the Vaccination Service not delivered / incorrectly delivered, which can be easily neglected…..





Step 4: Identify Loss Scenarios & Requirements

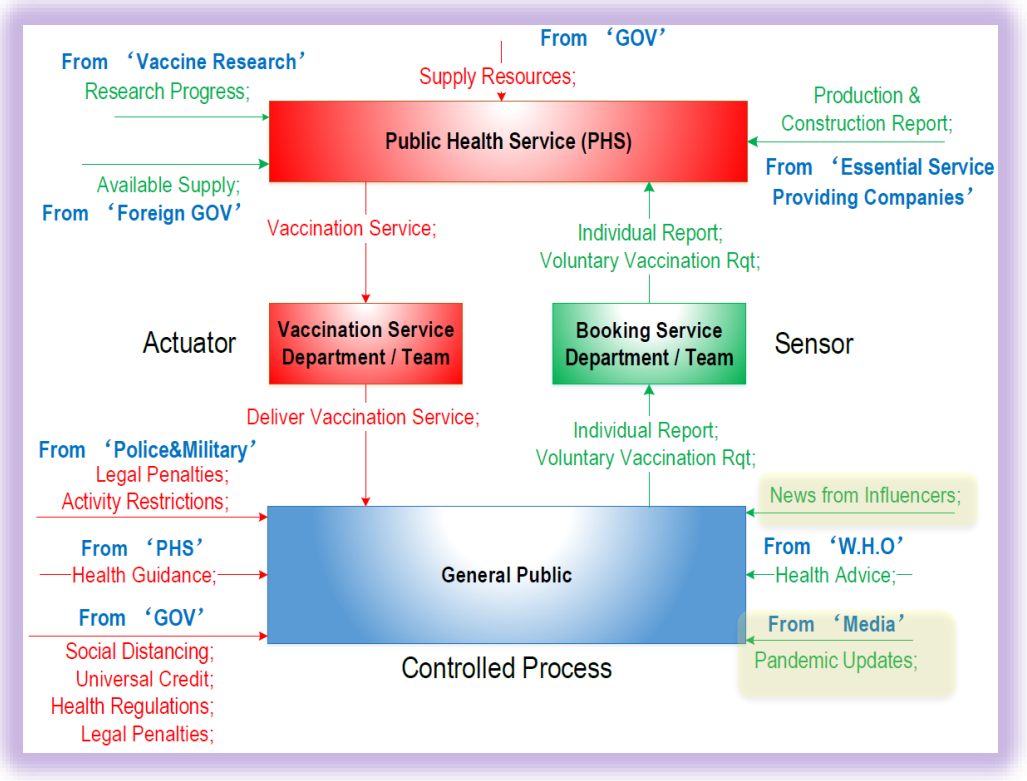
UCA-1.1: Vaccination Service is not provided when R>1 and there are no effective therapies for the coronavirus. [H-1,3,5]

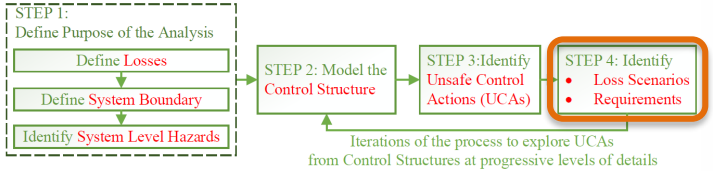
Loss Scenario-1 for UCA-1.1:

Vaccination Service was available to the eligible group of the public, however, due to the **outdated 'Pandemic Updates' from 'Media' / inadequate information from Influencers** (e.g. incorrect descriptions of the side effects after vaccination, outdated announcement of eligible age group for the vaccine .etc), people decided not to take the vaccine.

Proposed Requirements for LS_1:

- The information of **eligible population group** for vaccination must be up-to-date.
- Information regarding **possible side effects** of different types of vaccine must be as **true and objective** as possible.
- Media Companies must **filter out news** which are incorrect and misleading.





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Step 4: Identify Loss Scenarios & Requirements

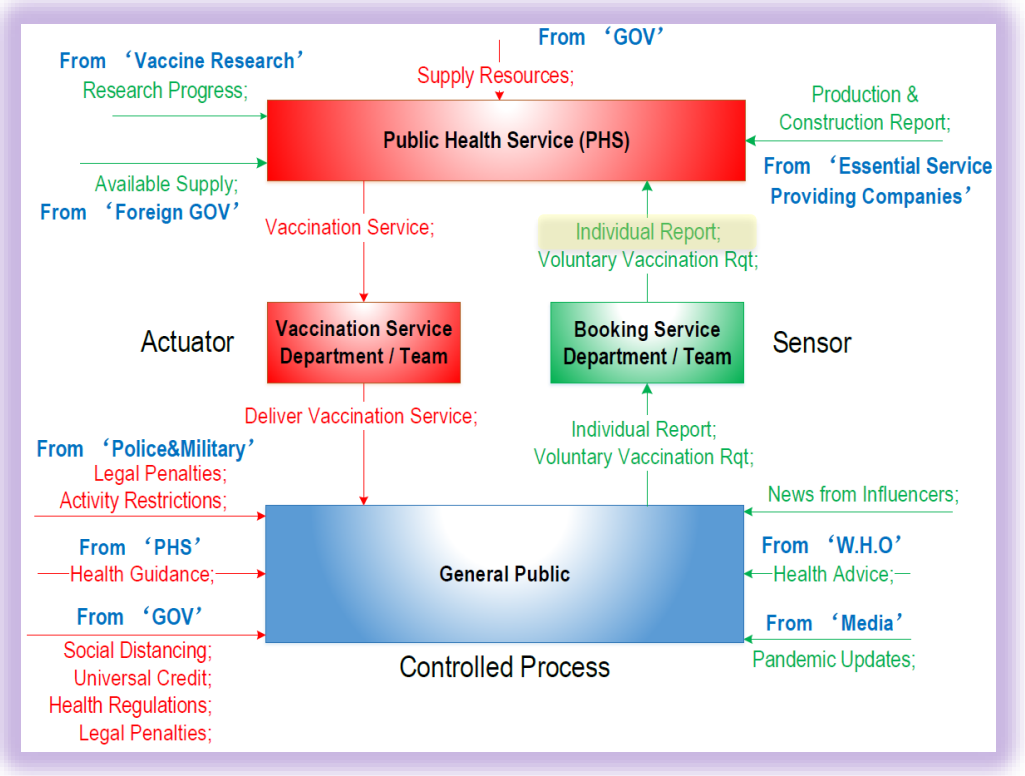
UCA-2.1: Vaccination Service is provided to people with a severe allergic reaction. [H-1,5]

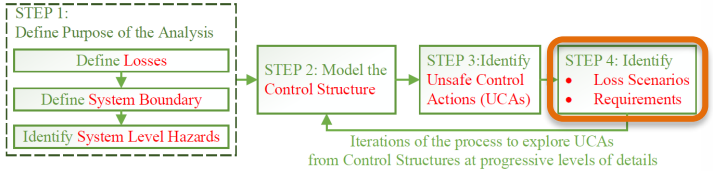
Loss Scenario-1 for UCA-2.1:

PHS was incorrectly believing that the patient has no allergic reaction as they were referring to the **'Individual Report'** from the patient to understand their health status and medical history. However, due to the **incomplete / incorrect information recorded in the report**, the member of PHS serving the patient incorrectly confirmed that the patient was eligible for the vaccine.

Proposed Requirements for LS-1:

- 'PHS' must ensure that **more clear guidance are provided to the patient** to guide them to correctly describe their health status and medical history.
- 'PHS' must also refer to the patient's report **recorded in the database** rather than only rely on verbal communication with the patient to determine their health status / medical history.





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Step 4: Identify Loss Scenarios & Requirements

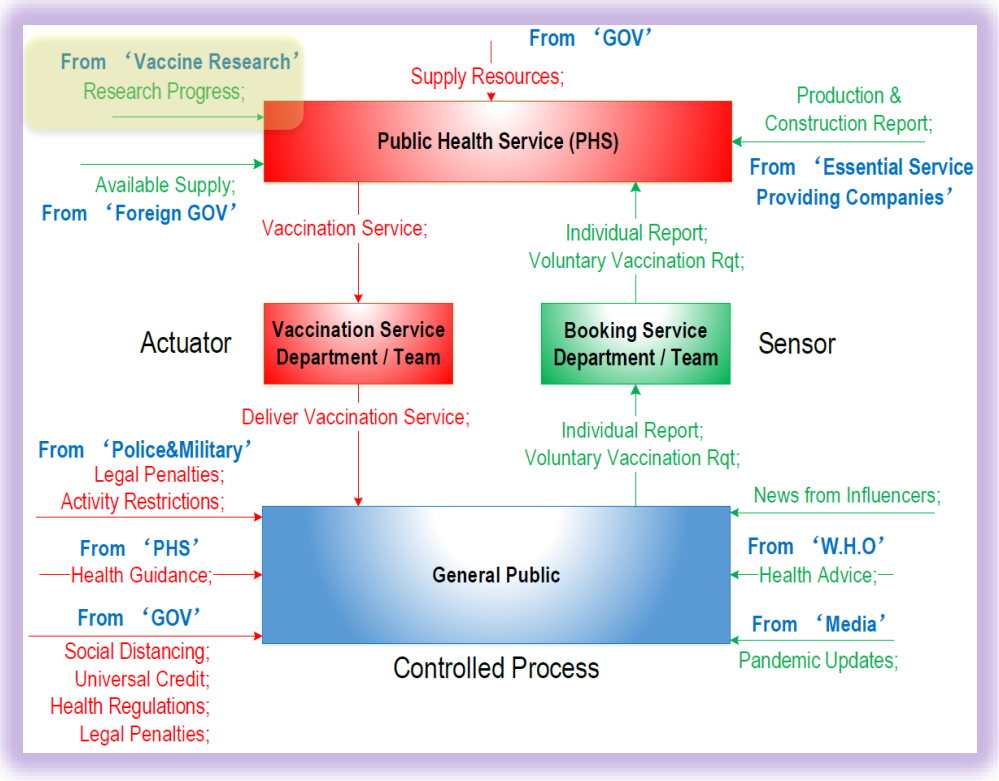
UCA-2.1: Vaccination Service is provided to people with a severe allergic reaction. [H-1,5]

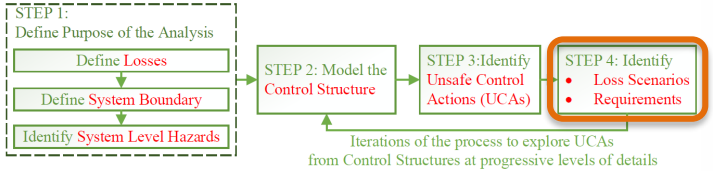
Loss Scenario-2 for UCA-2.1:

PHS was incorrectly believing that patients with severe allergic reaction were also eligible to take the vaccine as they were referring to the **'Research Progress'** from the 'Vaccine Research'. However, due to the **outdated information** regarding the vaccine provided from the research institution, PHS' understanding of the vaccine was outdated. As a result, the vaccination service was provided to people with a severe allergic reaction.

Proposed Requirements for LS-2:

- When there is any update on the research / study of vaccines, the relevant research institution must ensure that the **updated information is delivered to the PHS**.
- Relevant member of PHS must **frequently get in touch** with the vaccine research institution to identify the latest status of the research.





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Key Findings

Key findings from the analysis:

- Public can obtain information from various paths (e.g. from social media, newspaper), whose truth cannot be guaranteed. It is therefore suggested from the analysis that relevant stakeholders shall **guide the public to identify information from authoritative / evidence-based sources (e.g. official GOV / PHS website).**

- It is common that patients are not clear about their medical history / symptoms. It is therefore suggested from the analysis that PHS shall provide a **clear guidance to patients to enable them to understand how to identify the symptoms**.

Summary

In the whole analysis, we:

- Analysed 37 CAs
- Identified 236 UCAs
- Identified 1440 Loss Scenarios
- Proposed 2880 Requirements

For more information:
Journal Publication: Analysing National Responses to COVID-19 Pandemic using STPA.
https://www.sciencedirect.com/science/article/pii/S0925753521000400

Acknowledgment

This work is supported by **UKRI Future Leaders Fellowship (Grant MR/S035176/1)**. The authors also would like to thank the **WMG center of HVM Catapult** and **WMG, University of Warwick, UK**, for providing the necessary infrastructure for conducting this study.

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Thank you… Q & A

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