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Paper 74: Enhancing Enterprise Architecture with Resilience Perspective

Why Resilience? Why EA?

The ability of capability systems to meet their requirements and continue to function in uncertain and often adverse circumstances is often associated with

resilience:

a non-functional capability system's requirement which is fast becoming an integral part of the system design effort and the desired system characteristic

Popular but…

there has been no consensus of what the attributes of resilience are and how to develop and incorporate a holistic resilience approach into the organisational design

Enterprise architecture methodologies could potentially support meeting these challenges by providing a simplified and well-defined common representation of a system's resilience

EA Benefits

EA as a Standardiser

- a standard and systematic thought structure
- a set of standard views and view descriptions
- a standard data structure to retain and relate information
- a standard approach to develop architectures

EA as an Enabler

EA enables the common view of

- business processes, data and systems
- the relationship between the elements
- across the enterprise and its partners.

This common view brings together the primary resources (people, processes and technology), and how they integrate to provide the primary drivers and capabilities of the enterprise

EA Gap in Resilience Representation

We are trying to address

EA Gap in Resilience Representation:

little research exists that reveals formal understandings about defence capability systems' resilience and mechanisms that can be used to identify, assess and improve it

EA Frameworks and Resilience

Existing EA Resilience representations:

- Resilience as a constraint
- EA activities that target resilience
- Resilience as a part of service-oriented architecture
- Resilience as a viewpoint
- Resilience as a taxonomy

EA frameworks do not:

- indicate how to model humans or human behaviour in a system
- have an extensive simulation capability
- permit the modelling of resilience aspects of systems/ SoS
- have optimisation capability
- allow system verification and validation’.

Proposed Resilience Framework and DoDAF Representations

We propose a holistic DoDAF resilience representation informed by the outlined approaches, enhanced with an original resilience framework.

Our comprehensive resilience representation within the existing DoDAF methodology will assist enterprise stakeholders with using a generic resilience representation for their specific capability systems.

Doing so will incorporate resilience considerations in their system's design and help evolve their enterprises with
greater agility.

Our proposed DoDAF representations:

- expanded DoDAF DM2 conceptual model with Resilience Mechanisms as its **13th high-level data construct**
- a novel **Capability System's Resilience (CSR) viewpoint** based on our original Capability System's
- **Resilience Framework** and supported by
- a **Resource States, Resilience Mechanisms and Measures (RSRMM) view**

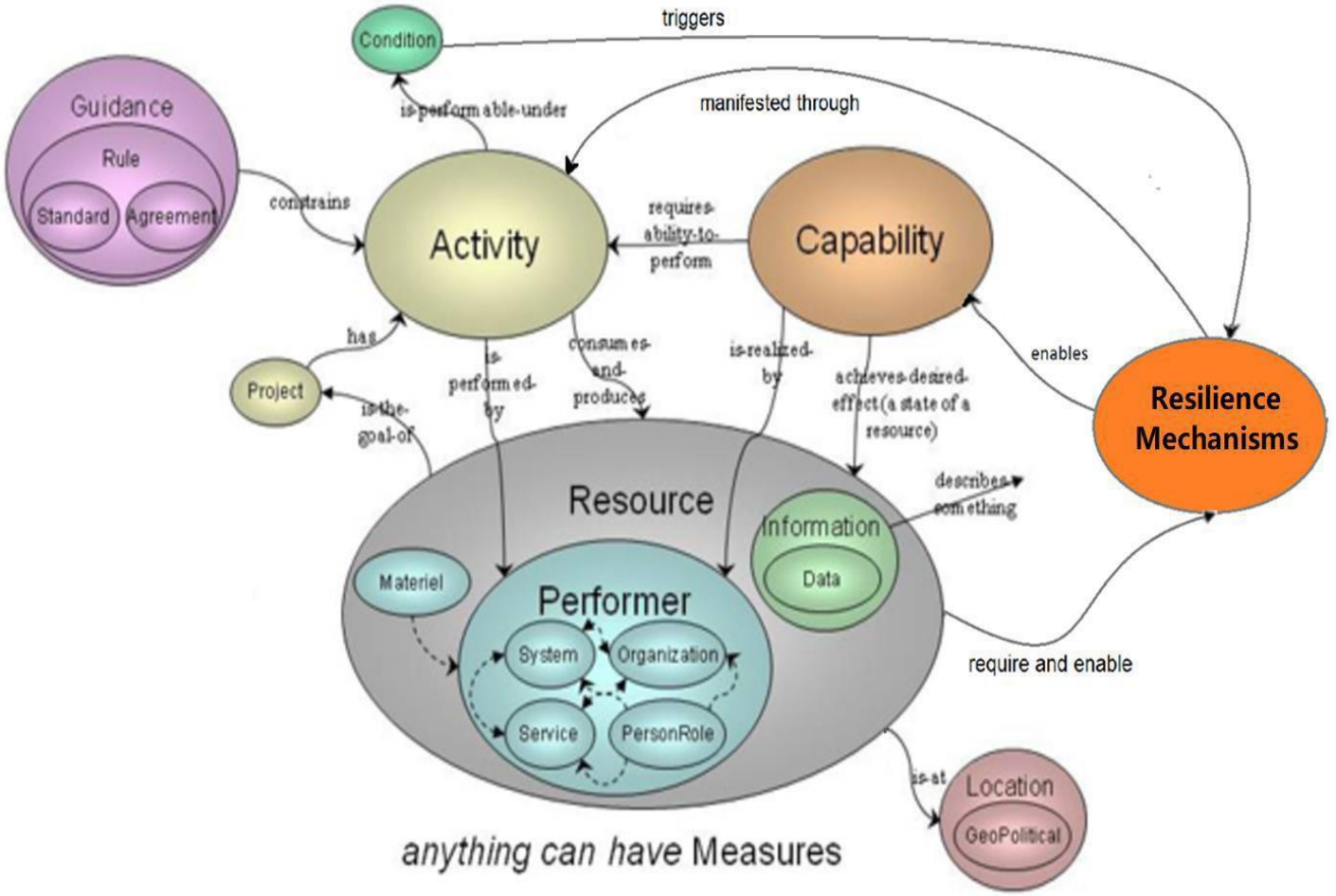
Expanding **Conceptual Model** with Resilience

The existing DoDAF framework comprises of 12 key DoDAF concepts:

(1) Activity; (2) Resource;
(3) Performer; (4) Capability;
(5) Condition; (6) Desired Effect;
(7) Measure; (8) Location;
(9) Guidance; (10) Project;
(11) Vision; and (12) Skill

We propose a new **13th** key concept:

Resilience Mechanisms



13th Key Concept Description

The DoDAF defines capability as

‘*the ability to achieve a **Desired Effect** under specified [performance] standards and conditions through combinations of ways and means [activities and resources] to perform a set of activities*’

13th key concept, Resilience Mechanisms, is proposed to address the issue of achieving capability’s desired effects in a context of uncertainty

Definition: ‘*capability resilience mechanisms are performers that enable resource to continue to perform capability realisation activity after experiencing an unplanned disturbance*’

DODAF Resilience Logical Models

We developed:

- a novel **CSR** viewpoint
- supported by a **RSRMM** view
- based on our original Capability System's **Resilience Framework**

As the project progresses, the supporting views will be further developed, covering:

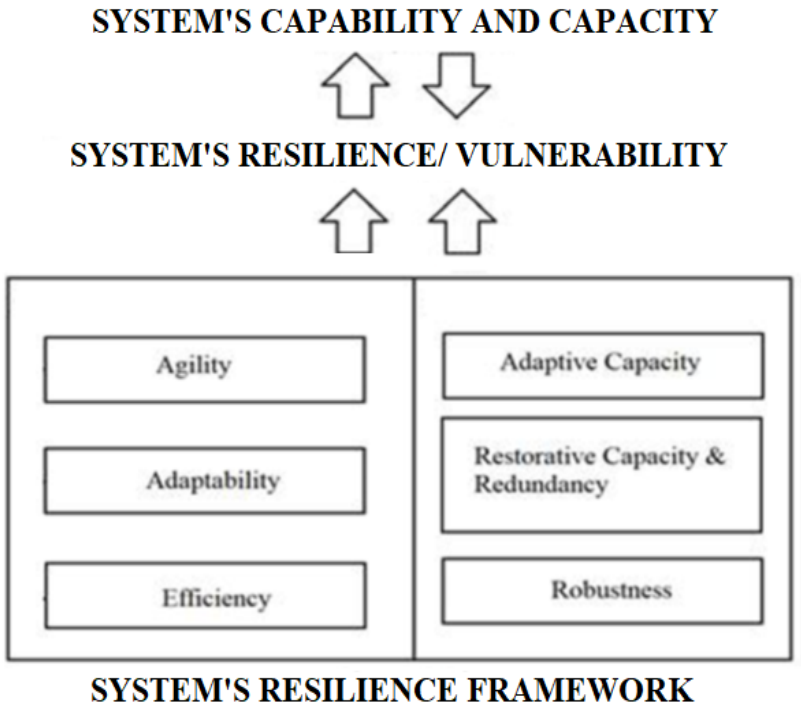
- resilience description
- process flows
- interrelationships with other DoDAF viewpoints and views

Capability System's Resilience Framework

The system resilience is linked with the level of its vulnerability. The higher the system resilience is, the lower is its vulnerability to threats or changes in the system's environment. The decrease in the system's vulnerability can be achieved through:

- **increase in the system's flexibility** [*f* of agility, efficiency, and adaptability]. Flexibility alone, however, is insufficient for a comprehensive system resilience evaluation as it does not capture system's ability to evolve and settle in a new equilibrium
- **increase in system's adaptive capacity** – system's ability to evolve to a new post change equilibrium rather than simply returning to the same equilibrium as experienced before the impact.
- **enhance system design** with increased robustness, restorative capacity, and redundancy.

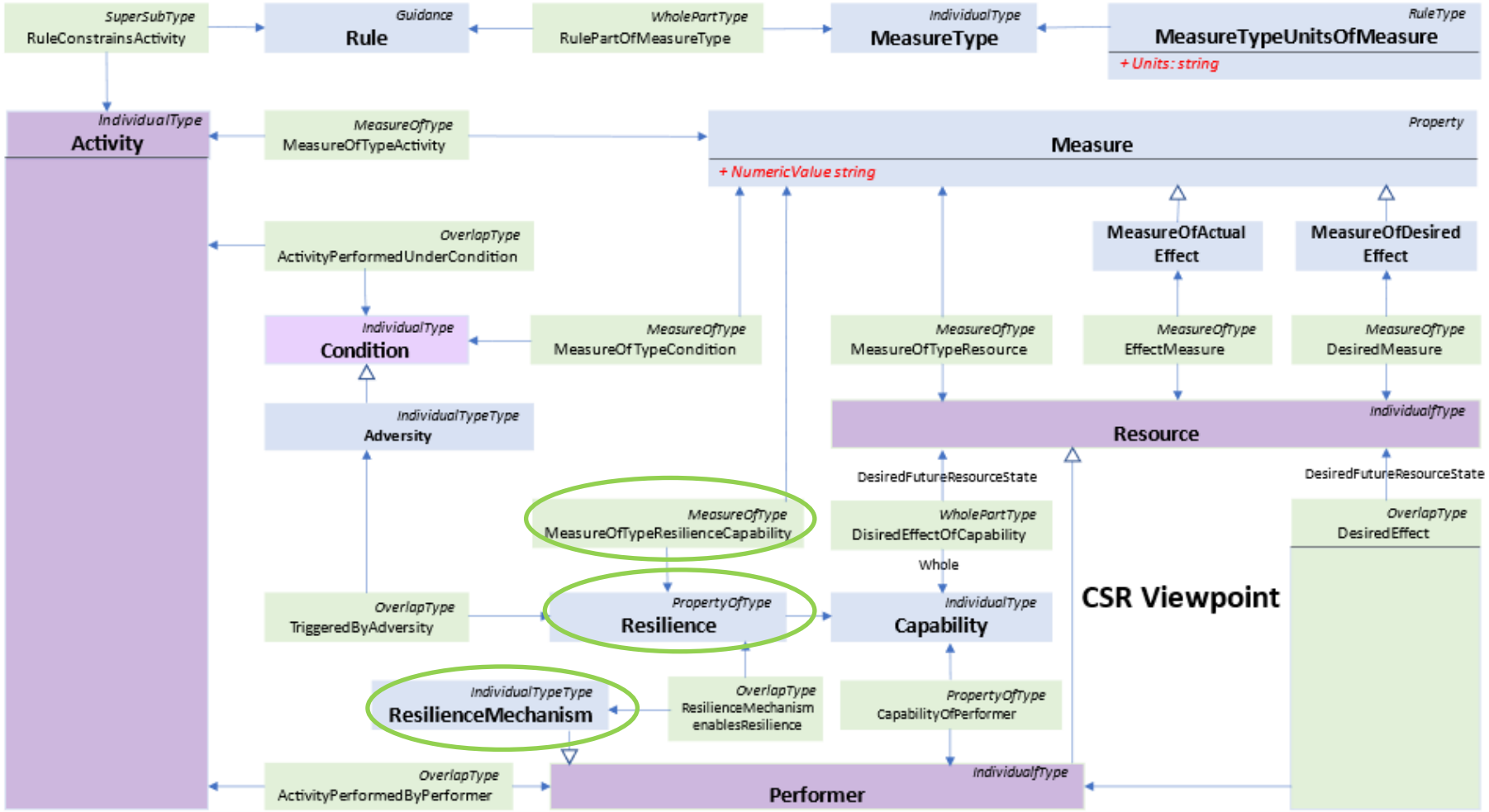
Attribute relationships, however, are not straight forward, with optimisation of one attribute not always leading to improved resilience, and could have an opposite effect.



Capability System's Resilience (CSR) viewpoint

Key factors depicted in the CSR design:

- Adversity (trigger)
- Desired resource states
- Capability resilience
- Resilience mechanisms
- Capability's resilience measure



Resource States, Resilience Mechanisms & Measures (RSRMM) view

- RSRMM view supports **CSR** viewpoint
- resilience is represented as a transition between the system resources' states in response to change

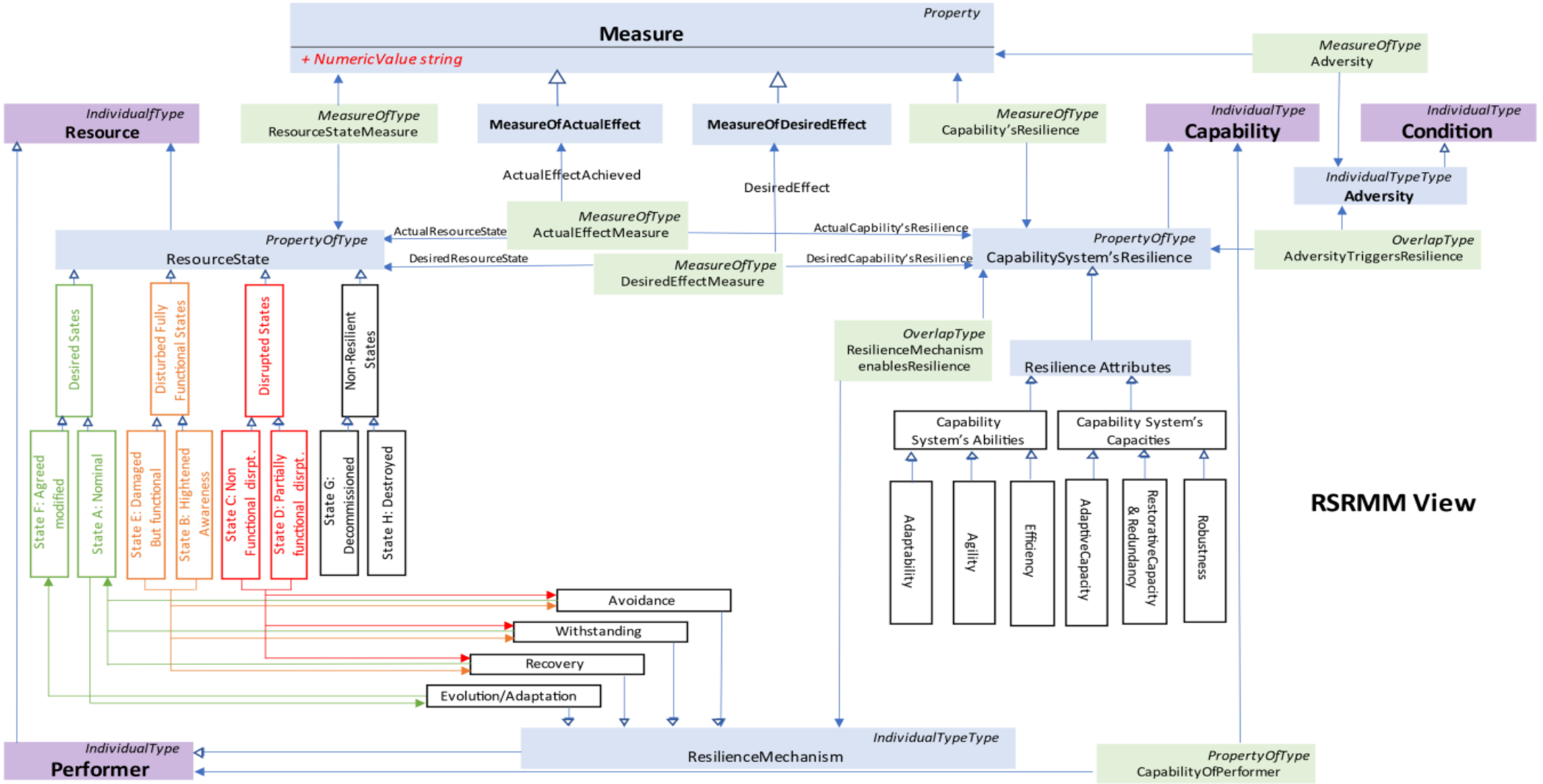
The resource state transition contains eight resource states that we have categorised into the four groups:

- **Desired**: State A: Nominal and State F: Agreed Modified
- **Disturbed Fully Functional**: State B: Heightened Awareness and State E: Damaged but Functional
- **Disrupted**: State C: Non-functional Disrupted and State D: Partially Functional Disrupted
- **Non-Resilient**: State G: Decommissioned and State G: Destroyed

Mechanisms	Associated State		Measures
	On impact	**Post-response**	**e.g.**
• **Avoidance** (avoid)	Nominal	Nominal	strength of disturbance without capability loss
• **Withstanding** (resist)	Nominal Heightened Awareness	Nominal	strength of disturbance without capability loss
• **Recovery** (bounce back)	Heightened Awareness Disturbed functional/ non-functional Partially/ fully disrupted	Nominal	extent of ability loss resource able to recover from
• **Evolution** (evolve)	Nominal + As above	Agreed modified	comparison of the old and new equilibrium

Resilience

Resource States, Resilience Mechanisms & Measures (RSRMM) Diagram



Case Study and Future Directions

Research motto: we are seeking to invoke the statement:

"***what you measure you can attain***"

Resilience remains a great fad unless we can "***measure it***", or from an EA perspective, until "***we can view it***"

The Defence Training System resilience case study has informed the developed resilience representations, attributes, measures and mechanisms, and formed the basis of our future research plans, including but not limited to:

(1) development of a house of quality for the resilience view to report the interrelationships of resilience measures and attributes with their respective weightings tailored by the enterprise executives
(2) Engineering Training System using tools developed within the System Engineering discipline
(3) standardise the survey instrument being used to survey milieu inhabitants

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