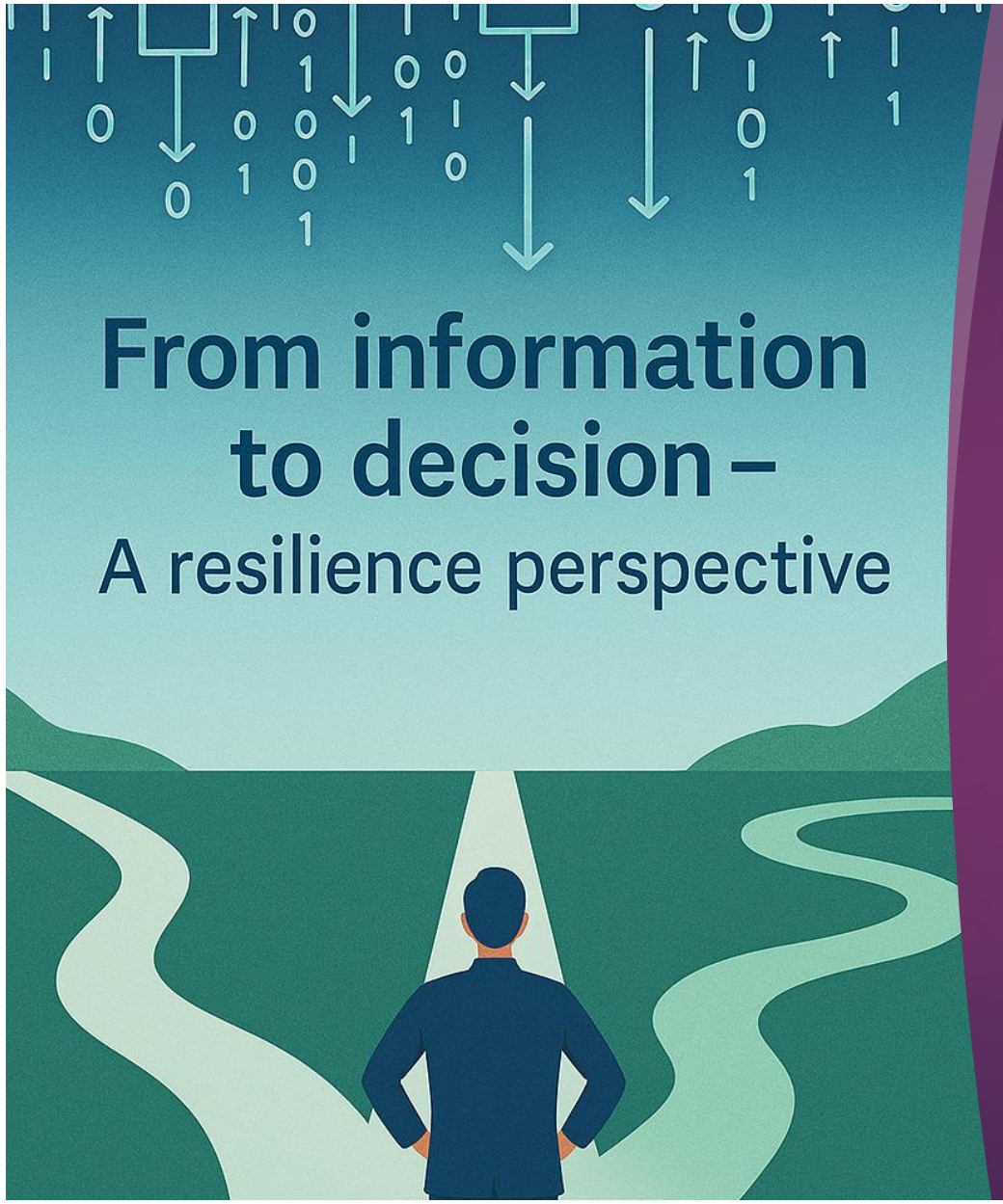


SEDDIT Thematic workshop: Situation readiness and resilience 2025-11-18

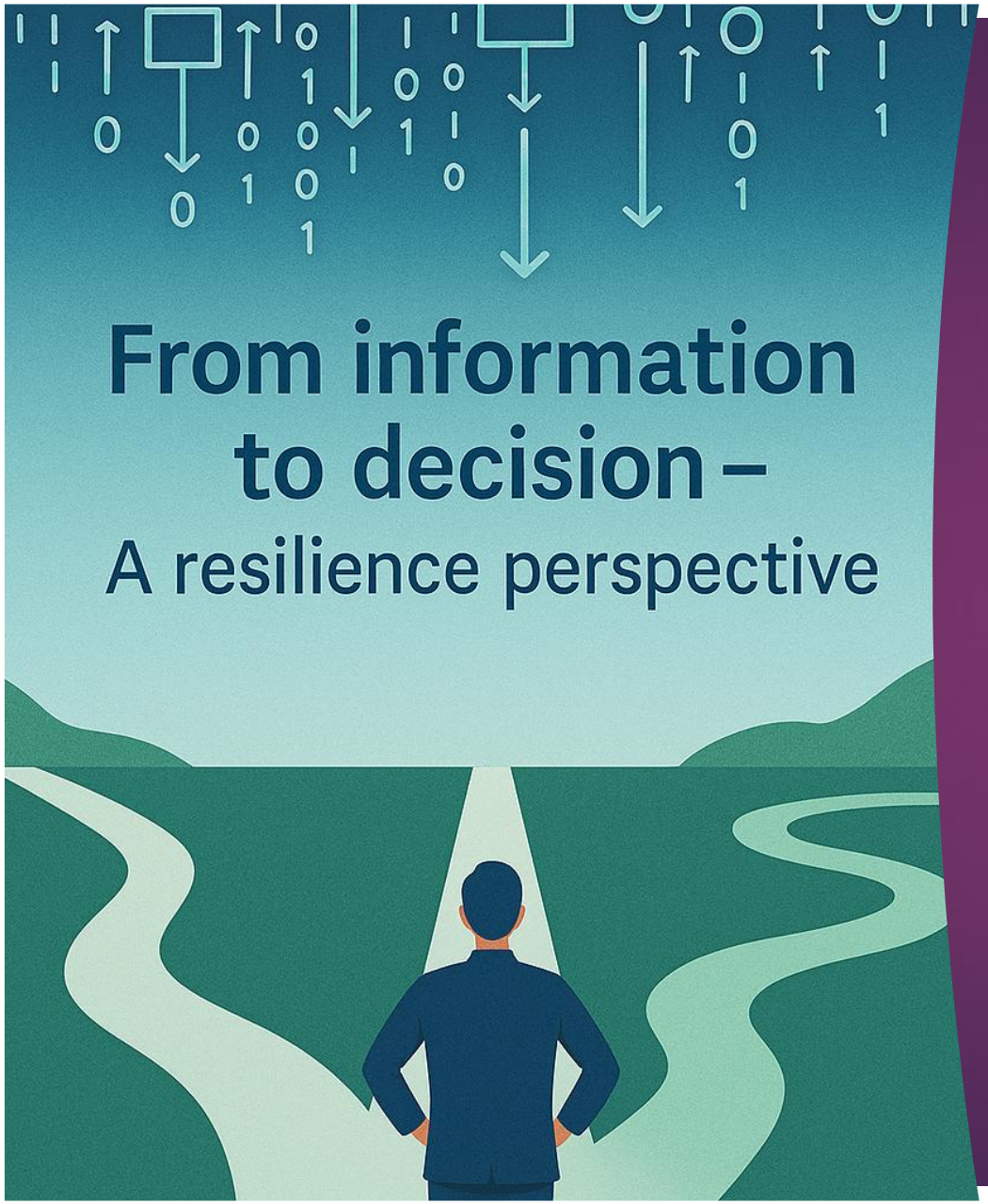
Thomas Ekström

Sensor informatics and Decision-making for the DIgital Transformation (SEDDIT) - "From data to decision"

Agenda

(Mission: ”To contribute to a resilient and sustainable society”)

- Geopolitical and environmental context
- My perspectives on some concepts of fundamental(?) importance to SEDDIT
- Resilience in theory
- Resilience in practise
- Summary



Geopolitical and environmental context

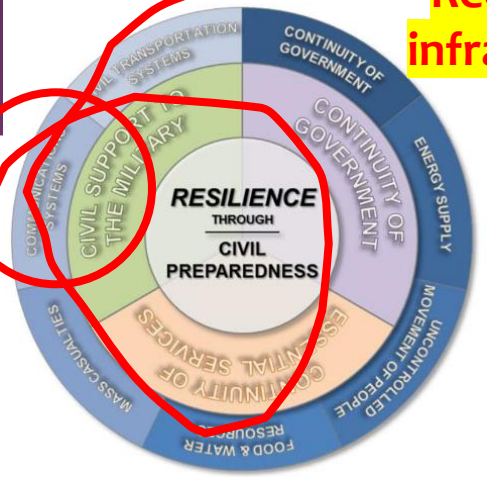
External requirements on societal resilience and total defence

- As a consequence of **environmental changes**:
  - UN:s global goal for a sustainable development #9:
    - Build **resilient infrastructure**, promote sustainable industrialization and foster innovation
- As a consequence of **geopolitical changes**:
  - NATO:s requirements:
    - Article 3 in the NATO treaty => baseline requirements on **resilience in seven societal sectors**
  - EU:s requirements (**to become Swedish Law in 2026(?)**):
    - The CER directive (Critical Entities Resilience) => requirements on **resilience in eleven societal sectors**
    - The NIS 2 directive (Network and Information Systems) => requirements on **resilience in 18 societal sectors**
  - The Swedish Total Defence:
    - **12 new preparedness sectors**

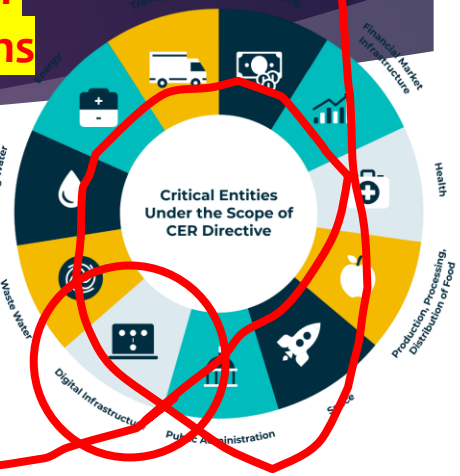
Geopolitical and environmental context: Requirements

Requires resilience in infra-

sustainability and structure systems



Require resilience in infrastructure systems



The domain of information and decisionmaking

Nato	Krim 2014	Natos sju baskrav 2016				
EU	Krim 2014	EUs CER Direktiv 2022	EUs NIS2 Direktiv 2022			
Sverige	Krim 2014	FB 2015 och FB 2020	Ukraina 2022	Nato-ansökan 2022	Beredskaps-sektorer 2022	Nato-medlemskap 2024

Försäkringskassan	Post- och telestyrelsen	ENERGIFÖRSÖRJNING	FINANSIELLA TJÄNSTER	FÖRSÖRJNING AV GRUNDDATA
Arbetsförmedlingen Pensionsmyndigheten Riksgälden Skatteverket Statens servicecenter	MSB Svenska kraftnät Trafikverket	Energimyndigheten Energimarknads-inspektionen Strålsäkerhetsmyndigheten Svenska kraftnät	Finansinspektionen Riksgälden Riksbanken*	Skatteverket Bolagsverket Lantmäteriet Myndigheten för digital förvaltning

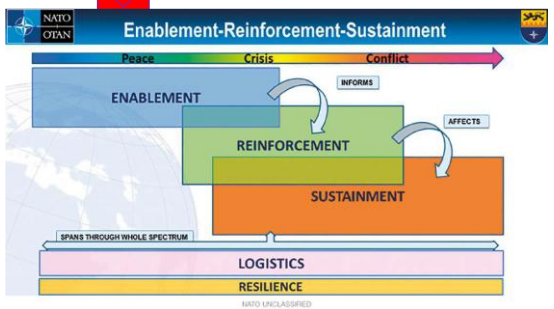
SOCIALSTYRELSEN	LIVSMEDELSVERKET	POLISMYNDIGHETEN	MSB	TRAFIKVERKET
HÄLSA, VÅRD OCH OMSORG	LIVSMEDELSFÖRSÖRJNING OCH DRICKSVATTEN	ORDNING OCH SÄKERHET	RÄDDNINGSTJÄNST OCH SKYDD AV CIVILBEFOLKNINGEN	TRANSPORTER
E-hälsomyndigheten Folkhälsomyndigheten Läkemedelsverket	Jordbruksverket Länsstyrelserna Naturvårdsverket Statens veterinärmedicinska anstalt	Kriminalvården Kustbevakningen Säkerhetspolisen Tullverket Åklagarmyndigheten Domstolsverket	Kustbevakningen Länsstyrelserna Polismyndigheten Sjöfartsverket SMHI Strålsäkerhetsmyndigheten	Luftfartsverket Sjöfartsverket Transportstyrelsen

Geopolitical context: Background

Georgien 2008 | **Krim 2014** | **Ukraina 2022**

Nato → **Natos sju baskrav 2016**

EU → **EUs CER & NIS2 Direktiv 2022**

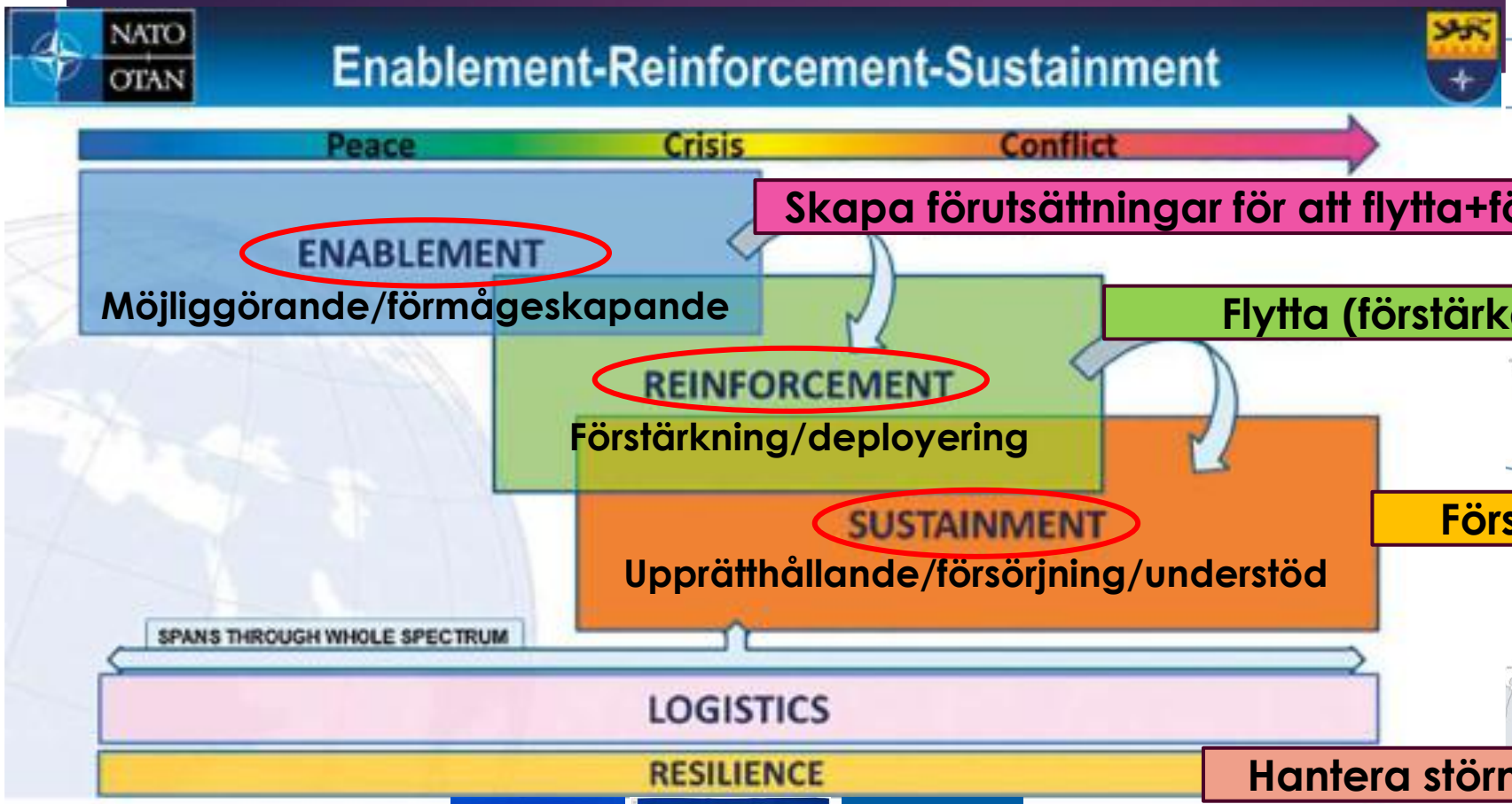


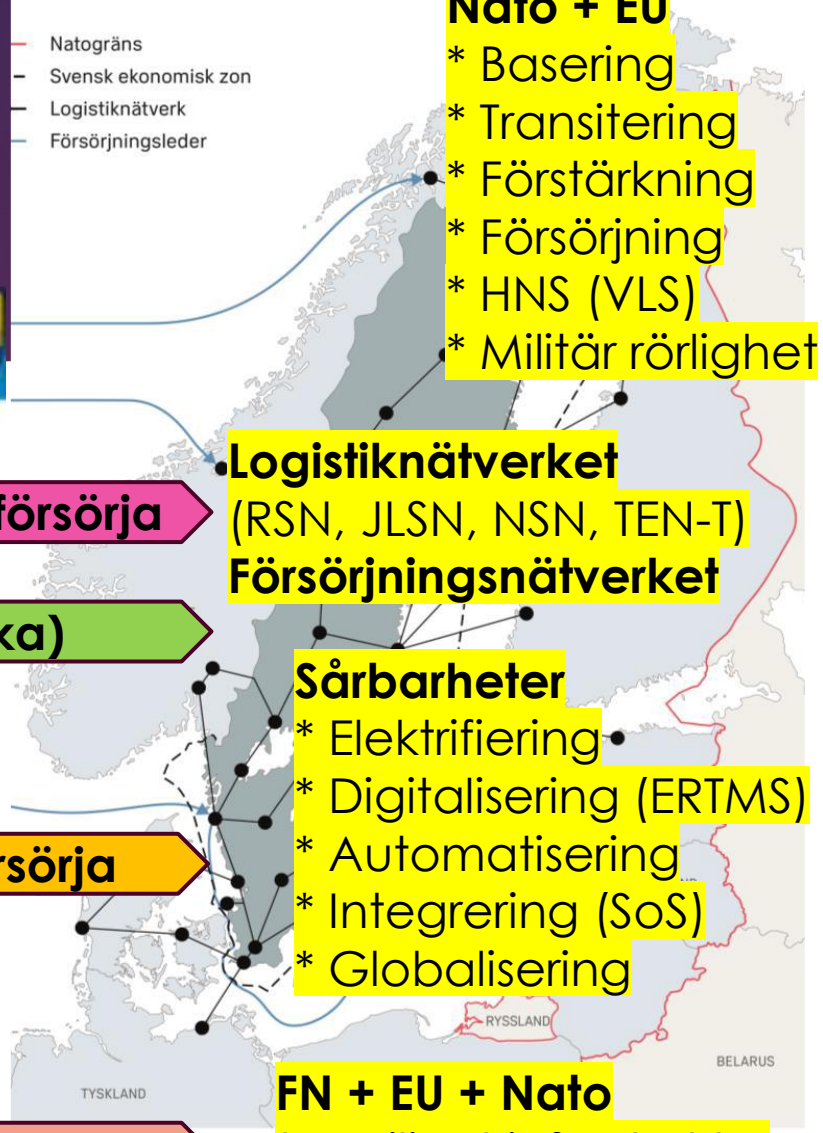
Sverige → **FB 2015 och FB 2020** → **Nato-ansökan 2022** → **Beredskaps-sektorer 2022** → **Nato-medlem 2024** → **FB 2025** → **Beredskaps-sektorer 2025** → **Utgångs-punkter 2025**

Sverige (10+2 = 12 beredskapssektorer)	EU (11 sektorer med kritiska entiteter)	NATO (Artikel 3 => 7 baskrav)
Hälsa, vård och omsorg	**Hälso- och sjukvård**	**Förmåga att hantera stora skadeutfall**
Livsmedelsförsörjning och dricksvatten	**Dricksvatten; Produktion, bearbetning och distribution av livsmedel**	**Resilient livsmedels- och dricksvattenförsörjning**
Ordning och säkerhet		Förmåga att effektivt hantera okontrollerade befolkningsrörelser
Räddningstjänst och skydd av civilbefolkningen		
Transporter	**Transporter**	**Resilient civilt transportsystem**
Ekonomisk säkerhet	Bankverksamhet	
Elektroniska kommunikationer och post	**Digital infrastruktur**	**Resilient civilt kommunikationssystem**
Energiförsörjning	**Energi**	**Resilient energiförsörjning**
Finansiella tjänster	Finansmarknadsinfrastruktur	
Försörjning av grunddata		
	Avloppsvatten	
	Rymden	
	Vissa aspekter av sektorn för offentlig förvaltning	Säkerställande av politiskt beslutsfattande och centrala ledningsfunktioner

NIS: Network and Information Security – CER: Critical Entities Resilience

Geopolitical context: Current activities in EU and NATO





Skapa förutsättningar för att flytta+försörja

Flytta (förstärka)

Försörja

Hantera störningar

Nato + EU
* Basering
* Transitering
* Förstärkning
* Försörjning
* HNS (VLS)
* Militär rörlighet

Logistiknätverket
(RSN, JLSN, NSN, TEN-T)
Försörjningsnätverket

Sårbarheter
* Elektrifiering
* Digitalisering (ERTMS)
* Automatisering
* Integrering (SoS)
* Globalisering

FN + EU + Nato
* Resilient infrastruktur
* Resilient försörjning

NATOs 7 Baseline requirements applies to systems in 7 sectors

1. **Assured continuity of government and critical government services** (Ensuring decision-making, leadership succession, and crisis communication remain functional during emergencies)
2. **Resilient energy supplies** (Securing access to reliable energy sources and protecting energy infrastructure from disruption)
3. **Ability to deal effectively with uncontrolled movement of people** (Managing mass migration and displacement due to conflict or disaster)
4. **Resilient food and water resources** (Safeguarding supply chains and infrastructure for food production and drinking) water.
5. **Ability to deal with mass casualties** (Ensuring healthcare systems can respond to large-scale health crises or attacks)
6. **Resilient civil communications systems** (Maintaining secure and functional communication networks, including public alert systems)
7. **Resilient civil transportation systems** (Keeping transport infrastructure operational to support civilian and military mobility

They all require information and decisionmaking

EUs CER Directive applies to entities in 11 critical sectors

1. **Energy** (Includes electricity, oil, gas, and hydrogen supply)
2. **Transport** (Covers air, rail, water, and road transport infrastructure and services)
3. **Banking** (Institutions providing core banking services)
4. **Financial Market Infrastructures** (Includes central counterparties and payment systems)
5. **Health** (Hospitals, private clinics, and entities involved in the production and distribution of medical products)
6. **Drinking Water** (Providers of potable water services)
7. **Wastewater** (Entities managing sewage and wastewater treatment)
8. **Digital Infrastructure** (Includes internet exchange points (IXPs), domain name systems (DNS), and data centers)
9. **Public Administration** (Central and regional government bodies)
10. **Space** (Operators of ground-based infrastructure supporting space-based services)
11. **Food** (Entities involved in the production, processing, and distribution of food)

They all require information and decisionmaking

EUs NIS 2 Directive applies to entities in 18 critical sectors

1. **Energy** (electricity, oil, gas, district heating, hydrogen)
2. **Transport** (air, rail, water, road)
3. **Banking**
4. **Financial Market Infrastructures**
5. **Health** (hospitals, private clinics, medic… and pharmaceutical manufact…
6. **Drinking Water**
7. **Wastewate…**
8. **Digital Infra…** (IXPs, DNS, TLDs, cloud, data centers, CDNs)
9. **ICT Service Management** (business-to-business IT services)
10. **Public Administration** (central and regional)
11. **Space** (operators of ground-base… infrastructure)
12. **Postal and Courier Servi…**
13. **Waste Man…**
14. **M… …ion, and Distribution of**
15. **…d Production, Processing, and Distribution**
16. **Manufacturing** (e.g., medical devices, electronics, machinery, vehicles)
17. **Digital Providers** (online marketplaces, search engines, social platforms)
18. **Research** (entities conducting critical or sensitive research)

This is a cyber security directive!

They all require information and decisionmaking

Civilt försvar Den 1 oktober 2022

Militärt försvar

Centralt

- Myndigheten för samhällsskydd och beredskap (MSB)
- Centralt beredskapsråd
- Sektorsansvariga myndigheter
- Beredskapssektorer
  - Energiförsörjning
  - Elektroniska kommunikationer och post
  - Ordning och säkerhet
  - Finansiella tjänster
  - Ekonomisk säkerhet
  - Försörjning av grunddata
  - Livsmedelsförsörjning och dricksvatten
  - Hälsa, vård och omsorg
  - Räddningstjänst och skydd av civilbefolkningen
  - Transporter
- Särskilda beredskapsområden
  - Psykologiskt försvar
  - Cybersäkerhet
  - Skola och förskola
  - Migration

Regionalt

- Civilområdeschefer med Beredskapskanslier (förslag 6)
- Samverkansregioner (6)
- Länsstyrelser (21) med regionala råd
- Regioner (21)

Lokalt

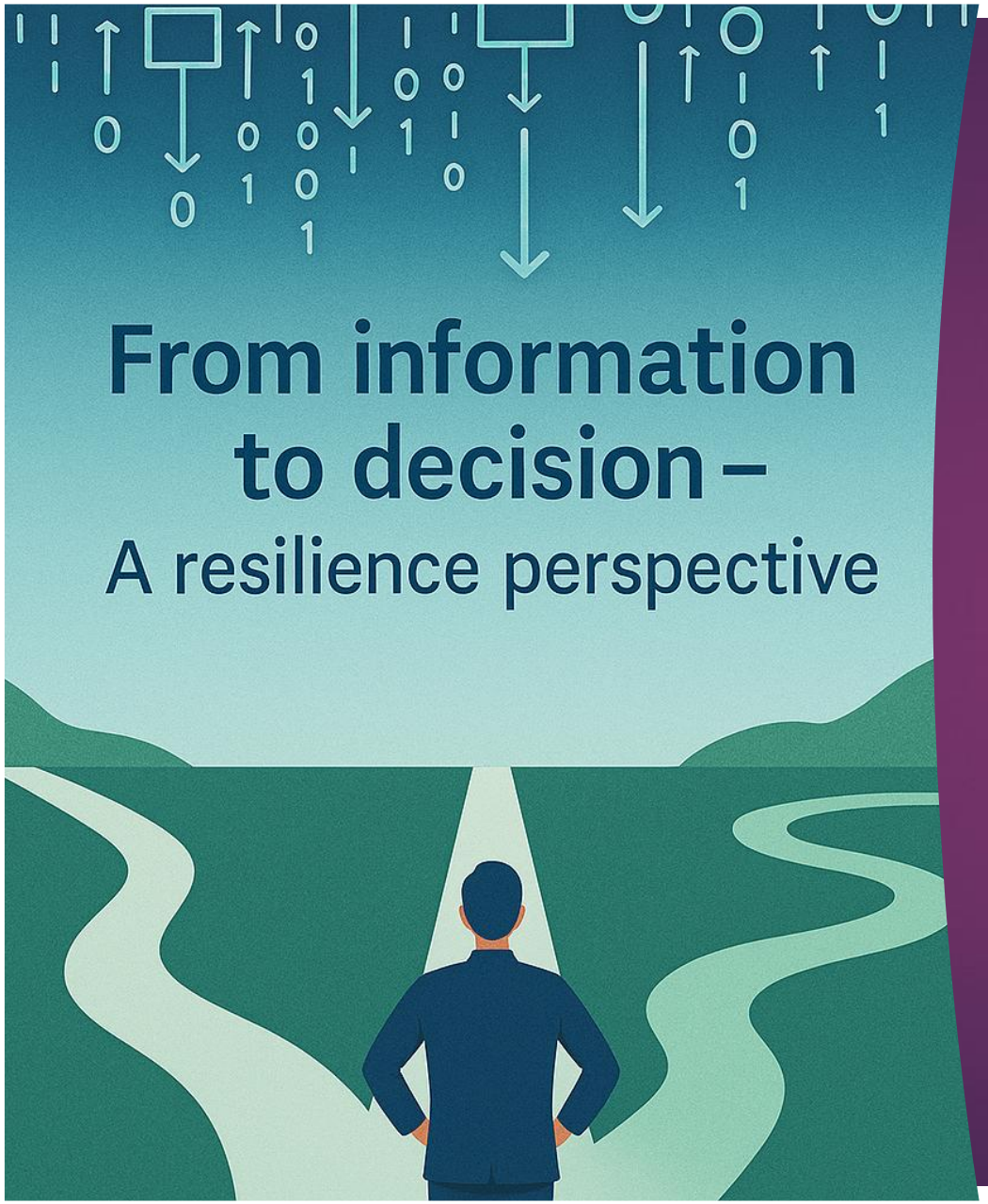
- Kommuner (290)

Militärt försvar

- Försvarsmaktens Högkvarter

- Militärregioner (förslag 6)
- Garnisoner (regementen, flottiljer, etc.)
- Militära förband

They all require information and decisionmaking



My perspectives on some concepts of fundamental(?) importance to SEDDIT

Comfort zone versus deep water

Comfort zone	In between	Deep water
Resilience	Information	Situation readiness
Decisionmaking		

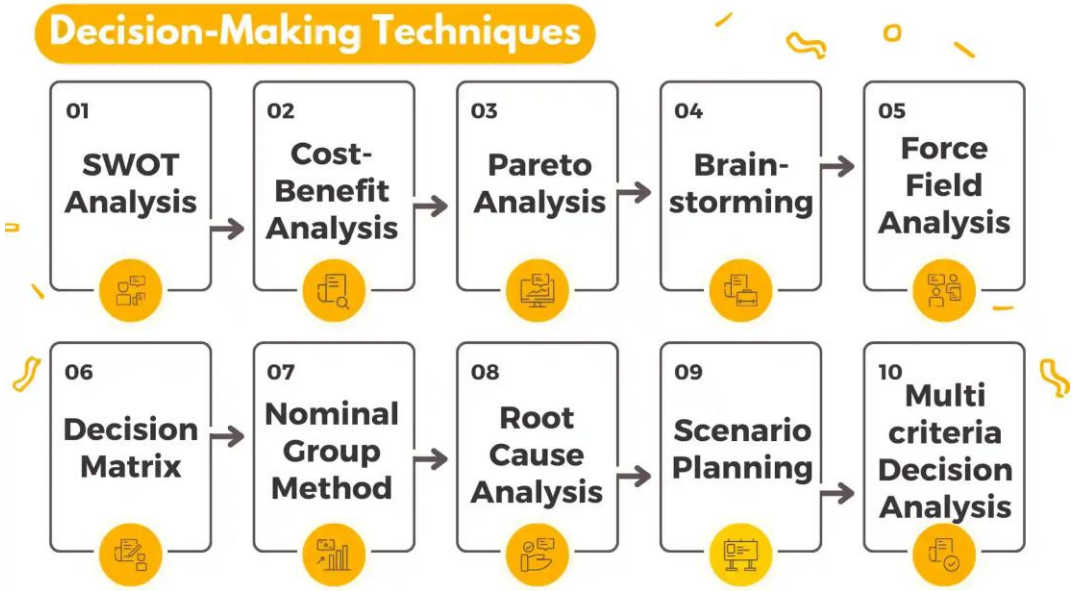
My (Copilot´s…) perspective on situation readiness

(Ergo: deep water)

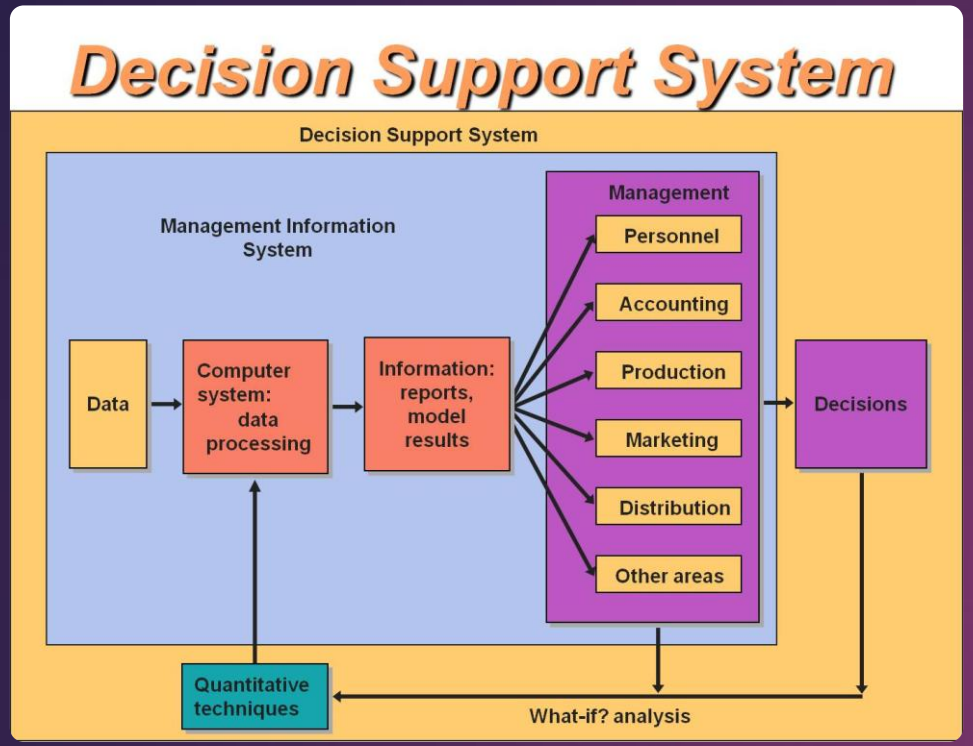
- Situation awareness (**used in the military**):
  - The ability to perceive, understand, and project the status of elements in a dynamic environment
- Situation readiness (Copilot):
  - The state of being prepared to act effectively in a specific situation, based on available resources, plans, and awareness
  - Refers to an individual's or organization's ability to effectively respond to a specific context, threat, or opportunity by combining preparedness, adaptability, and decision-making capacity".
- Aligns very well with my understanding of resilience.

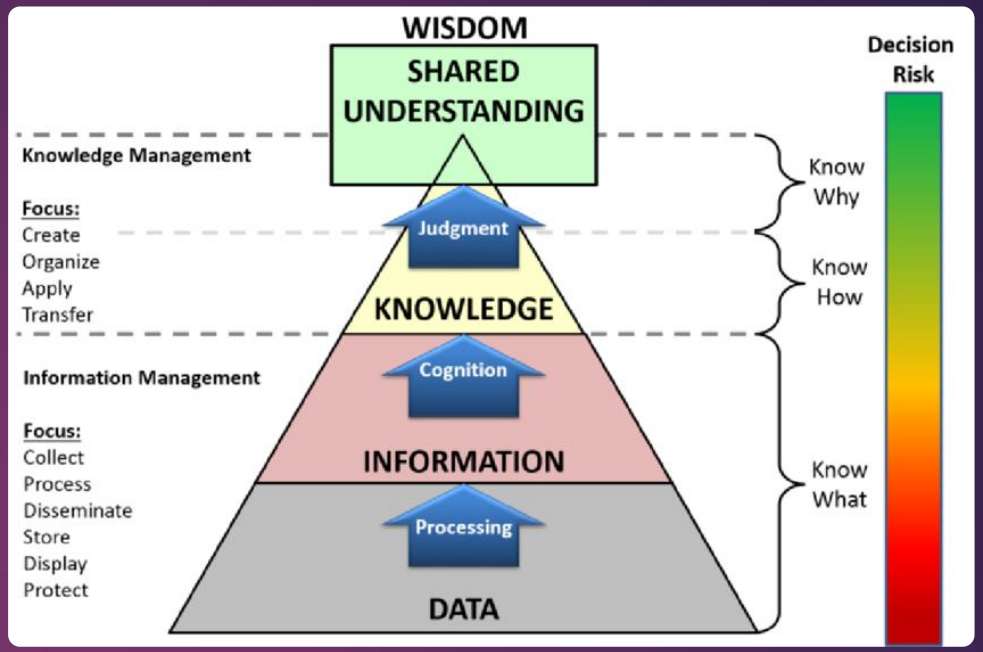
Decision Making Process Factors

My (OR) perspective on decision-making and decision-making techniques



The 10 Best Decision Making Techniques in Management - Risely





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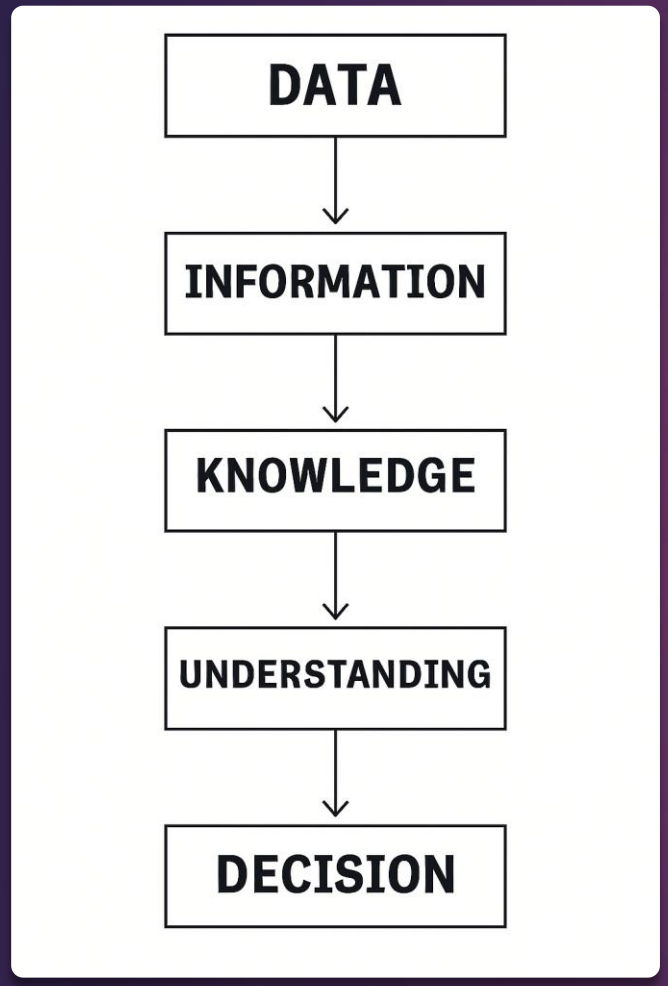
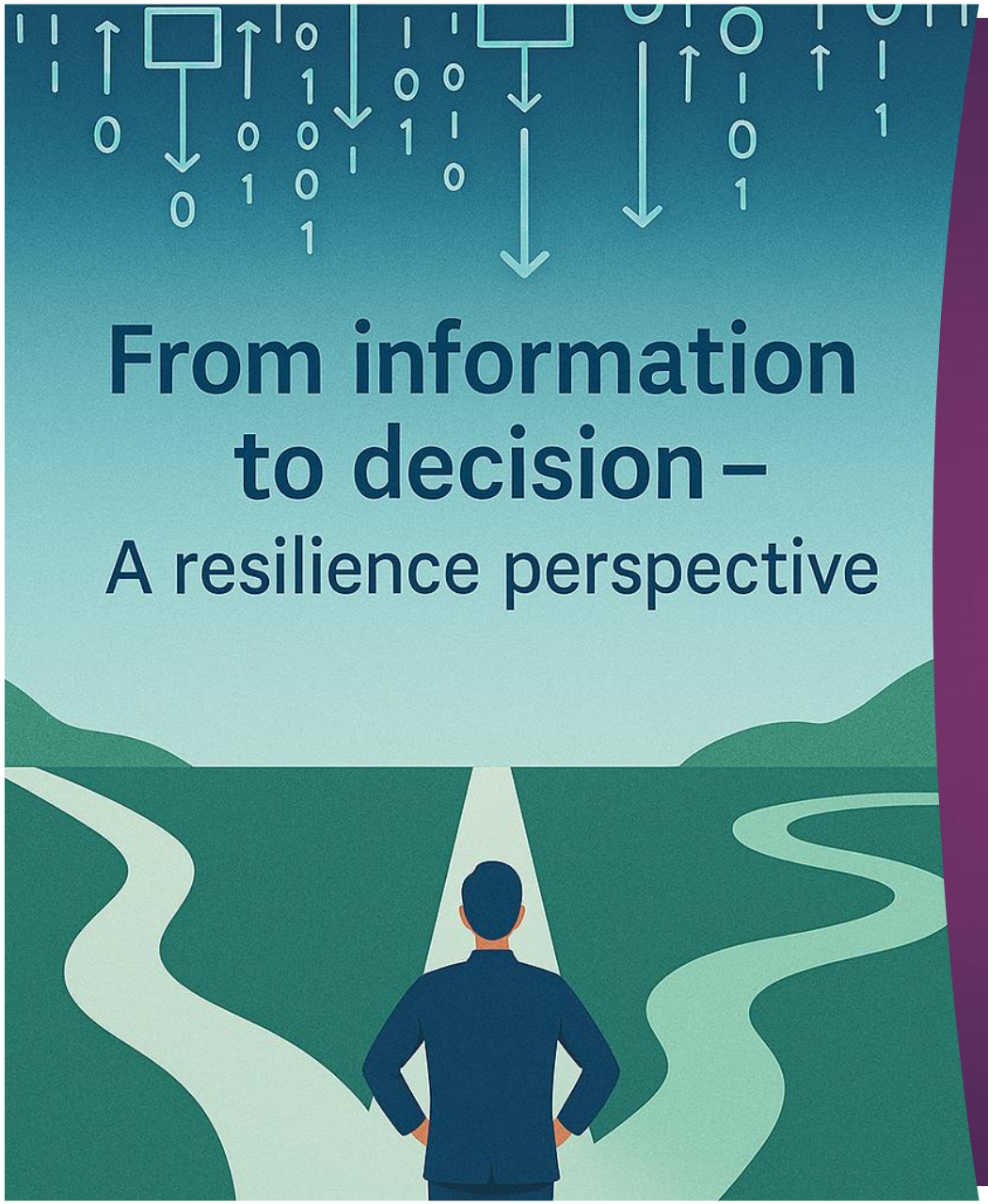
My (OR) perspective on information: It is essential for decision making



From raw data to informed decision – What can possibly go wrong and how can we prevent it from going wrong?

I assume that this is your area of expertise?

So, I will focus on mine



Resilience in theory

A picture is worth a thousand words…

Everything is connected => Robustness and resilience require a holistic perspective!

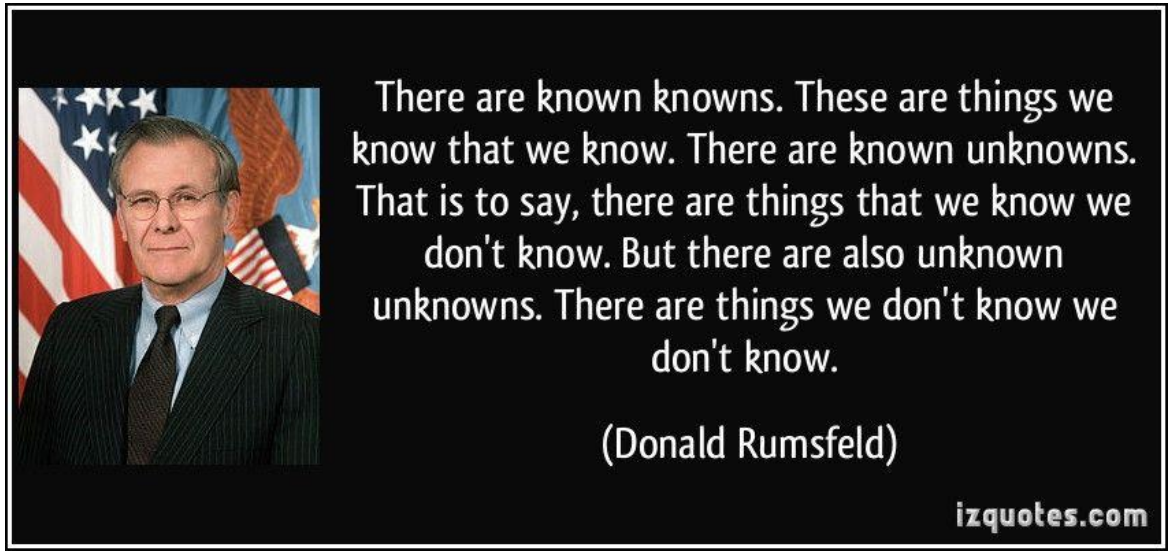
"On August 14, 2003, a cascading failure of the power grid plunged more than 50 million people into darkness in the northeast US and Canada. It was the most significant power outage ever in North America, with an economic impact north of ten billion dollars".

Questions we could/should ask

- What does resilience mean in theory and practise?
- How do we operationalise, quantify and measure it?
- How does it relate to
  - robustness?
  - resistance and recovery?
  - redundancy, flexibility and agility?

Requirements on resilience: Against what?

- Disruptions ≠ risks/uncertainties – We do not know probabilities or impacts
- Disruptions = Black Swans = "Unknown Unknowns"
- (Very) High Impact - (Very) Low "Probability" ("Very large ignorance") = HILP
- Categories:
  - Natural disasters
  - Cyber attacks
  - Pandemics
  - Terrorism
  - War

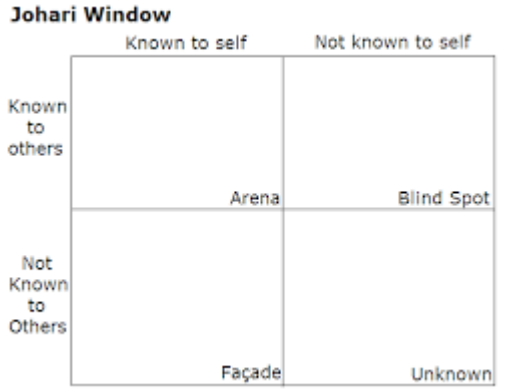


BRASKLAPP I

Resilience against one disruption, does not necessarily mean resilience against another disruption!

BRASKLAPP II

Some define disruptions as risks/uncertainties, to be dealt with by traditional risk management methods…



Requirements on resilience: Against what?

- A combination of Classical/Modern Decision Theory and the Johari Window

Decision-making under certainty

- Deterministic knowledge
- Event occurs with certainty and leads to known consequence
- Requires neither SCRM nor SCDM

Decision-making under uncertainty

- Incomplete probabilistic knowledge
- Event occurs with only partially-known probability and leads to known consequence
- Area for SCRM

EVENT

Decision-making under risk

- Complete probabilistic knowledge
- Event occurs with known probability and leads to known consequences
- Area for SCRM

Decision-making under ignorance

- No probabilistic knowledge
- Unknown event occurs with unknown probability and leads to unknown disruptive consequence
- Area for SCDM

Resiliens

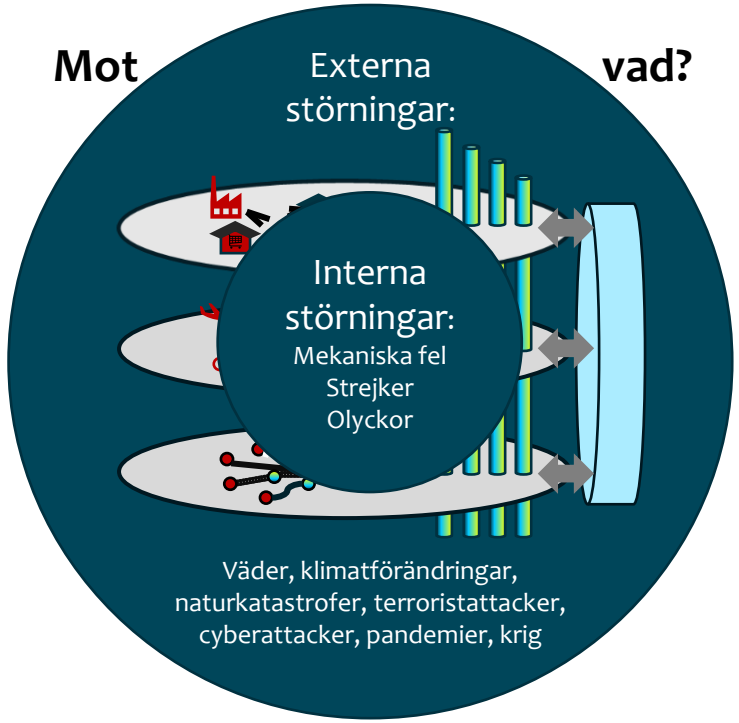
Översättning?

Betydelse?

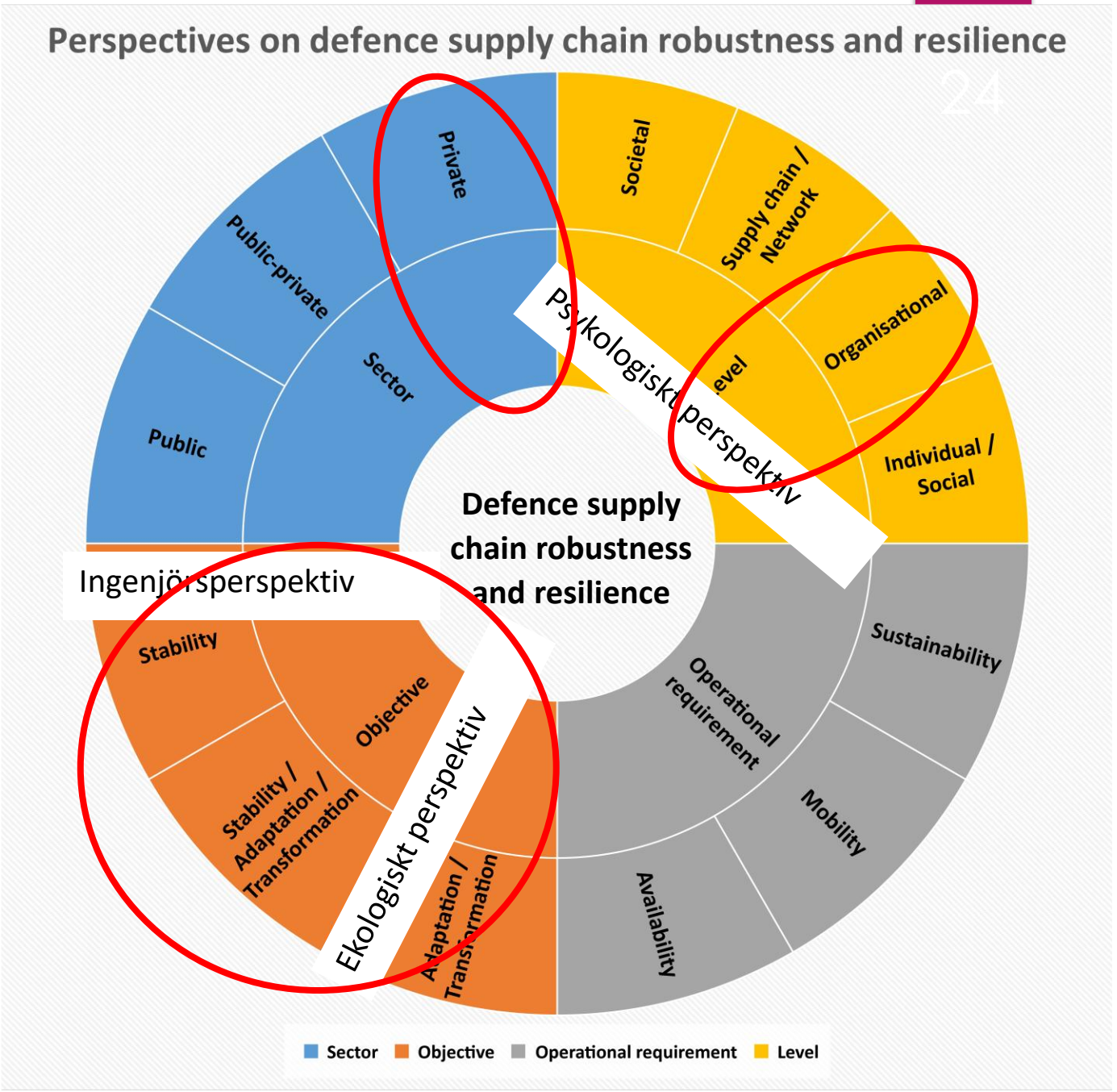
Krav på ”resilience”

There is no consensus – Neither in theory nor in practise

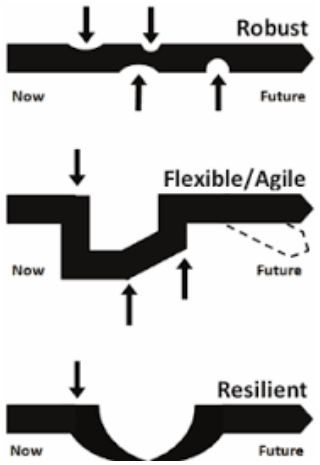
Teoretiska perspektiv

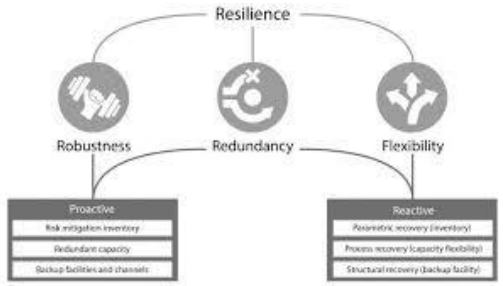


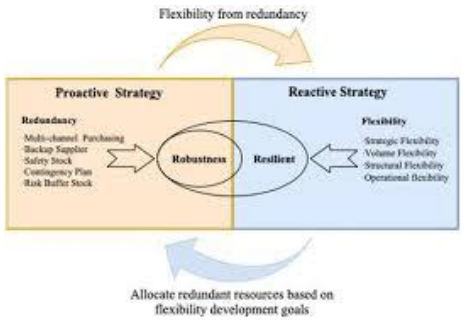
Different theoretical perspectives on resilience

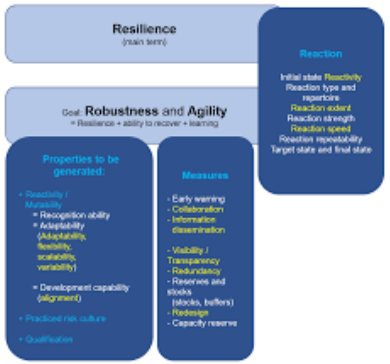


Robustness and resilience in theory: Disagreement







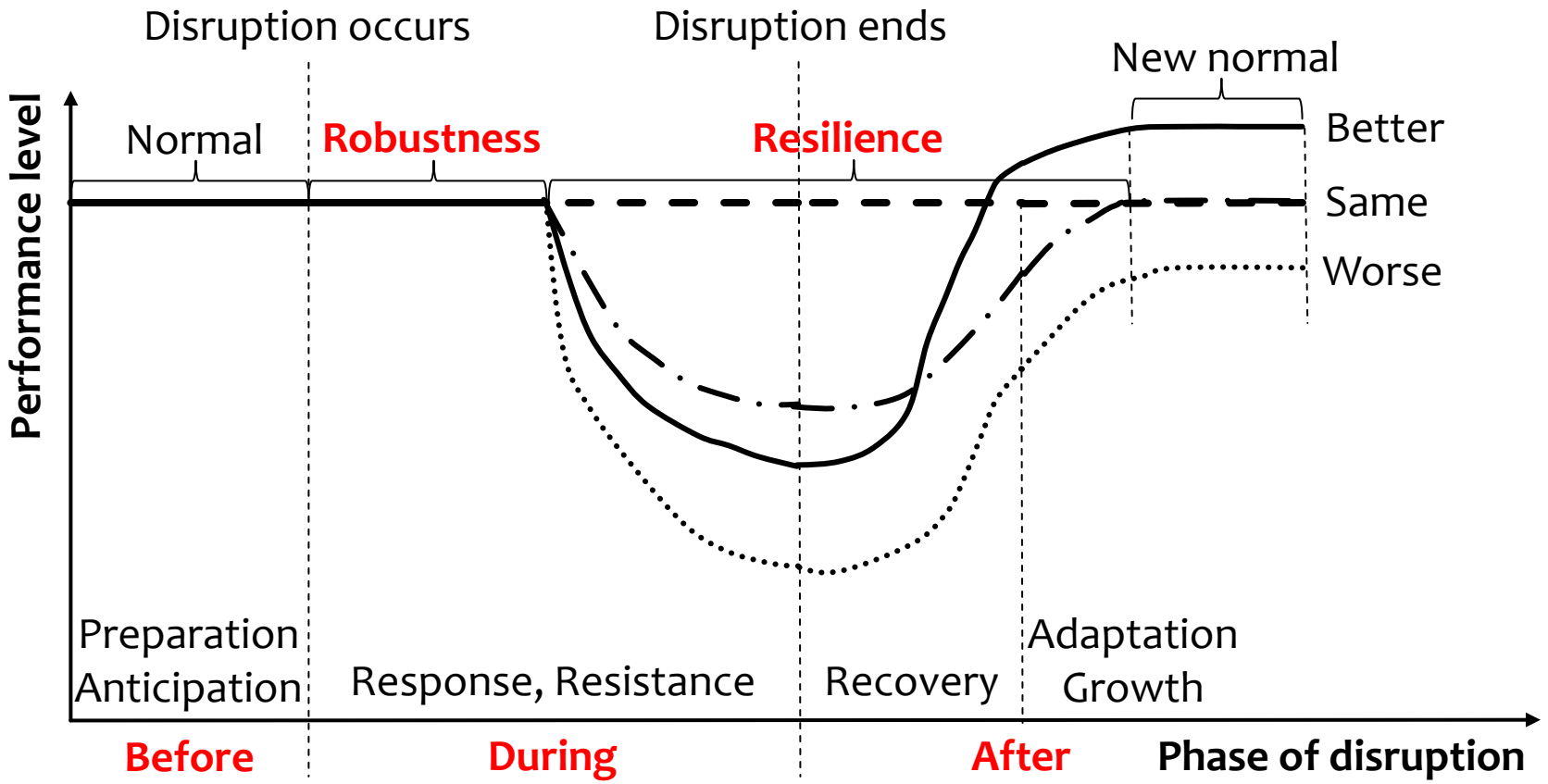


All definitions, models and theories cannot be true simultaneously…

Robustness and resilience in theory: Agreement

- Four most common strategies:
  - Redundancy (reserve capacity, security stock)
  - Flexibility (ability to change, alternative suppliers)
  - Agility (ability to change rapidly)
  - Cooperation (postponement, risk sharing)
- Numerous tactics in each strategy
- Many tactics can be used in several phases:
  - Proactively
  - Reactively

Robustness and resilience in theory (my interpretation)



CAVEAT III

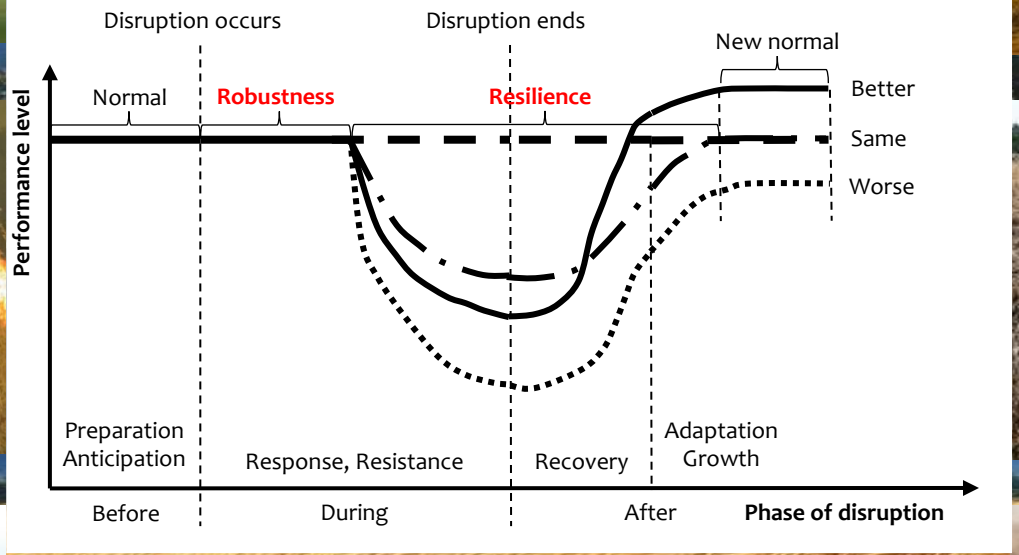
Not necessarily consensus regarding concepts, definitions and relationships…

Before disruption:
Proactive strategies = Redundancy (e.g. security stocks)

During and after disruption:
Reactive strategies = Flexibility (e.g. multiple suppliers)

Purpose:
Ensure survival
Minimise deterioation and downtime

Resilience vs. robustness



Some systems are both, some are either or

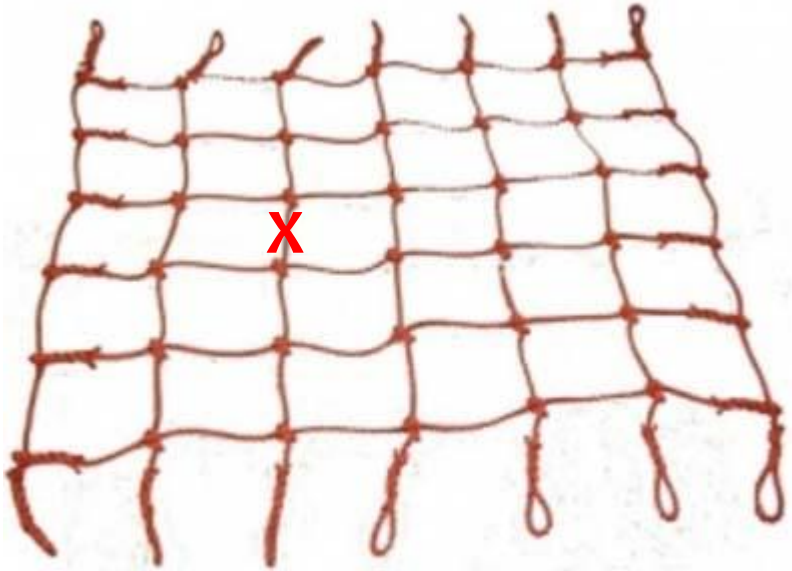
Properties at different system levels (system vs. SoS) – Risk vs. vulnerability

Ingen funktionalitet

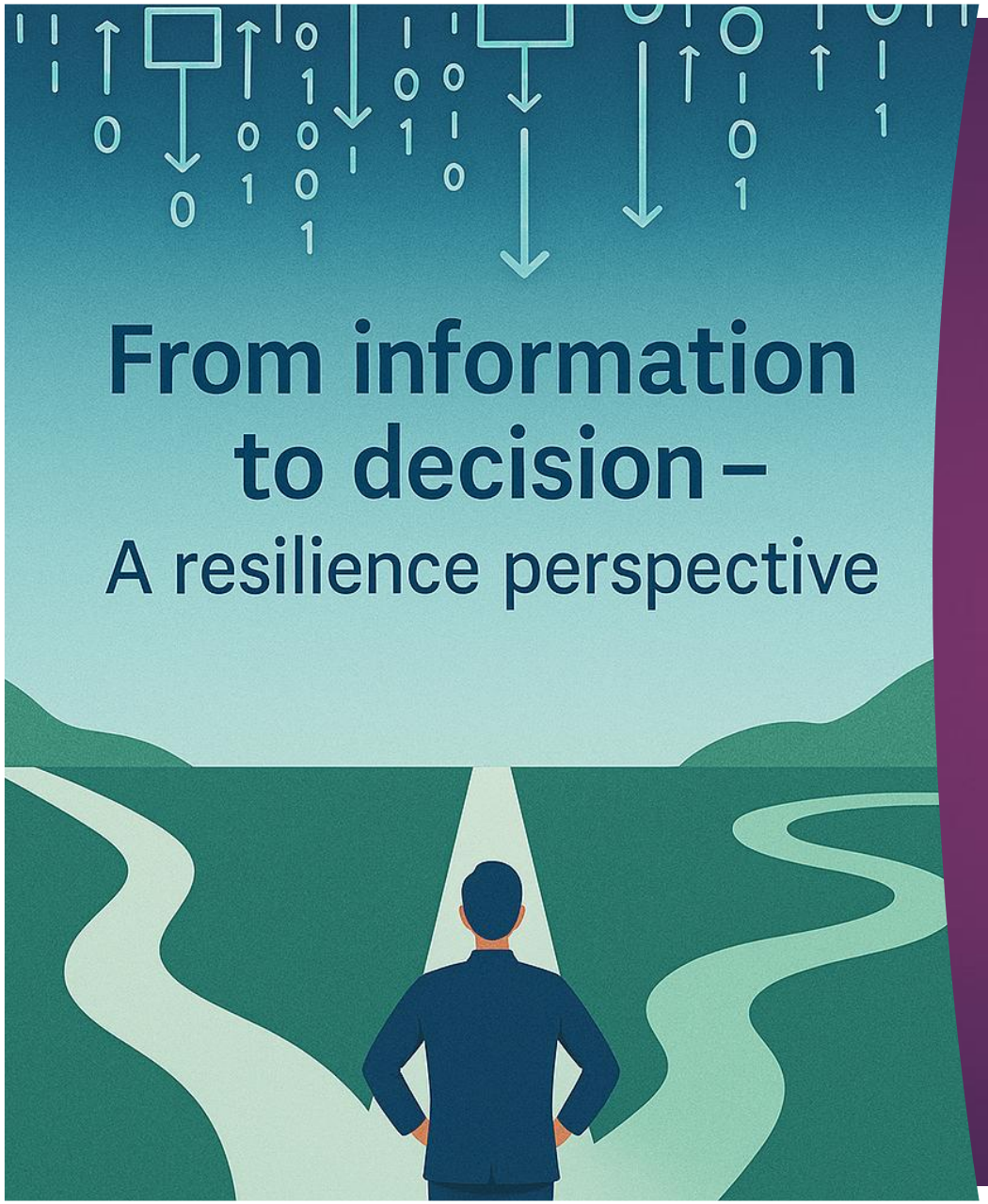
Risk vs. sårbarhet

Försämrad funktionalitet

Nästan fullständig funktionalitet



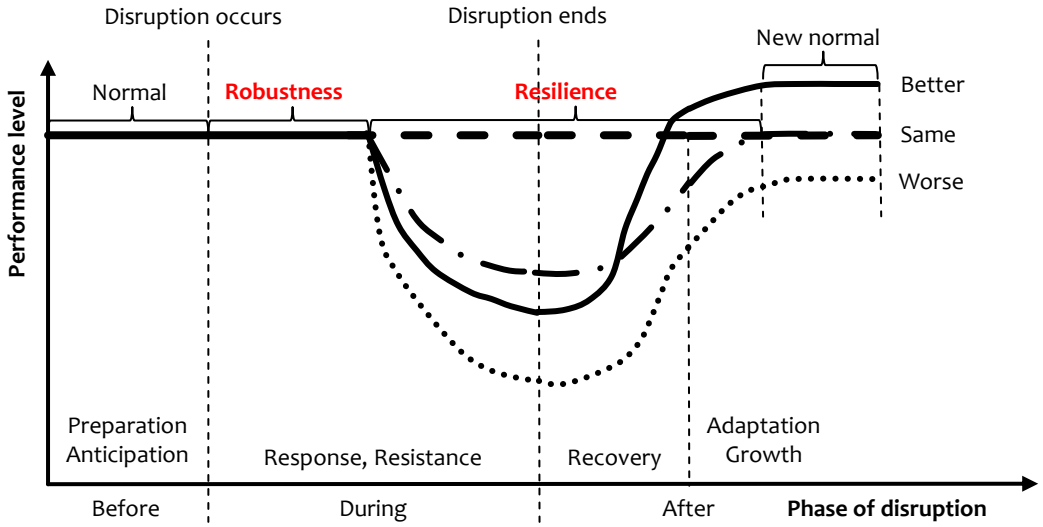
Properties at different system levels (system vs. SoS) – Risk vs. vulnerability



Resilience in practise

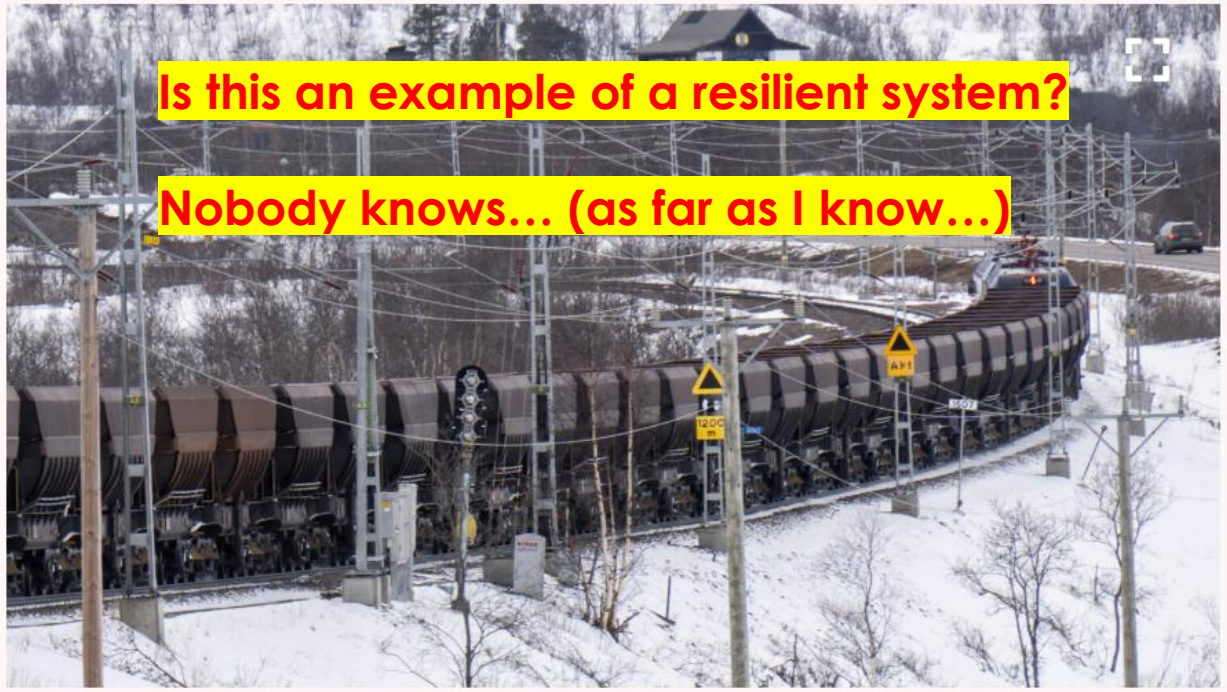
More questions we could/should ask

- Vilka störningar skall vi dimensionera oss för?
- Hur skall vi förbereda oss (strategi)
- Vilka system/förmågor måste vara robusta? Hur länge?
- För vilka system/förmågor kan vi acceptera en nedgång i prestation?
  - Hur stora nedgångar är acceptabla?
  - Hur lång tid är en nedgång acceptabel?
  - Vilket nytt normalläge är acceptabelt?
- Så vitt jag vet ger varken NATO eller EU oss svaren på de här frågorna…



More questions we could/should ask

Stopp på Malmbanan – igen



Trafiken stod still på Malmbanan i 76 dygn på grund av två urspårningar i december och februari. Nu är det stopp igen. Bild: Fredrik Sandberg/TT

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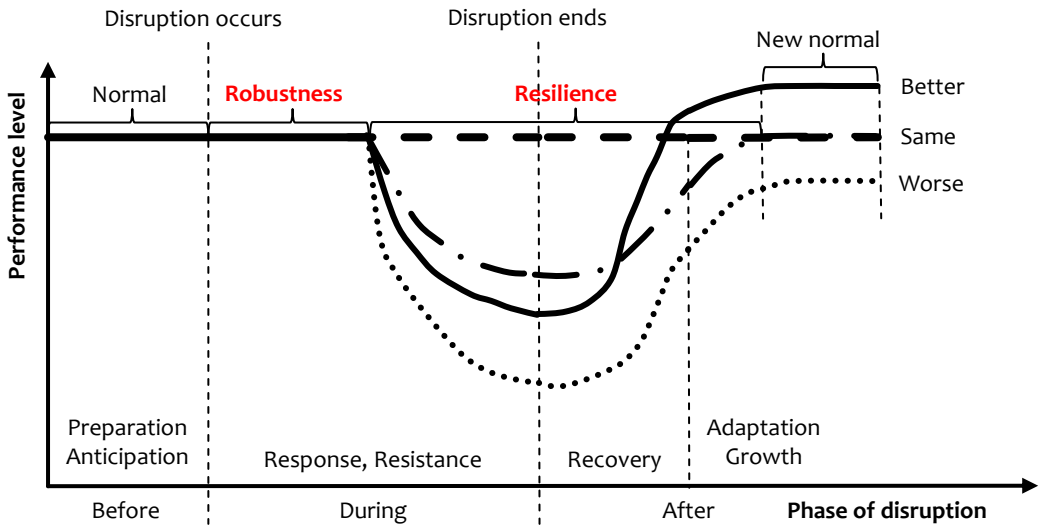
n på de



The war in Ukraine

- Lessons to be learned:
  - Logistics is targeted
  - Logistics infrastructure is targeted
  - Railways, roads and bridges are targeted
  - Telecomminications and energy infrastructure is targeted
  - Hospitals, civilian housing, etc. is targeted
  - All the infrastructure that must be resilient according to EU and NATO is targeted
    - By kinetic warfare
    - By cyber warfare

Ukrainian resilience explained

- Well developed cyber security => well prepared for cyber warfare (resilient against)
  - Experience 8 years of cyber warfare since 2014
  - Proactive help from NATO
  - Reactive help from BigTech
- Not as well prepared for kinetic warfare, however:
  - Partly unmodernised infrastructure (designed by USSR to function in WW3, still under modernisation => over capacity, old tech (half railway system electrified), etc.
  - Relatively resilient because of a large number of reactive measures (and a lot of external help)

Lessons: Reactivity (ad hoc) that could have been proactivity

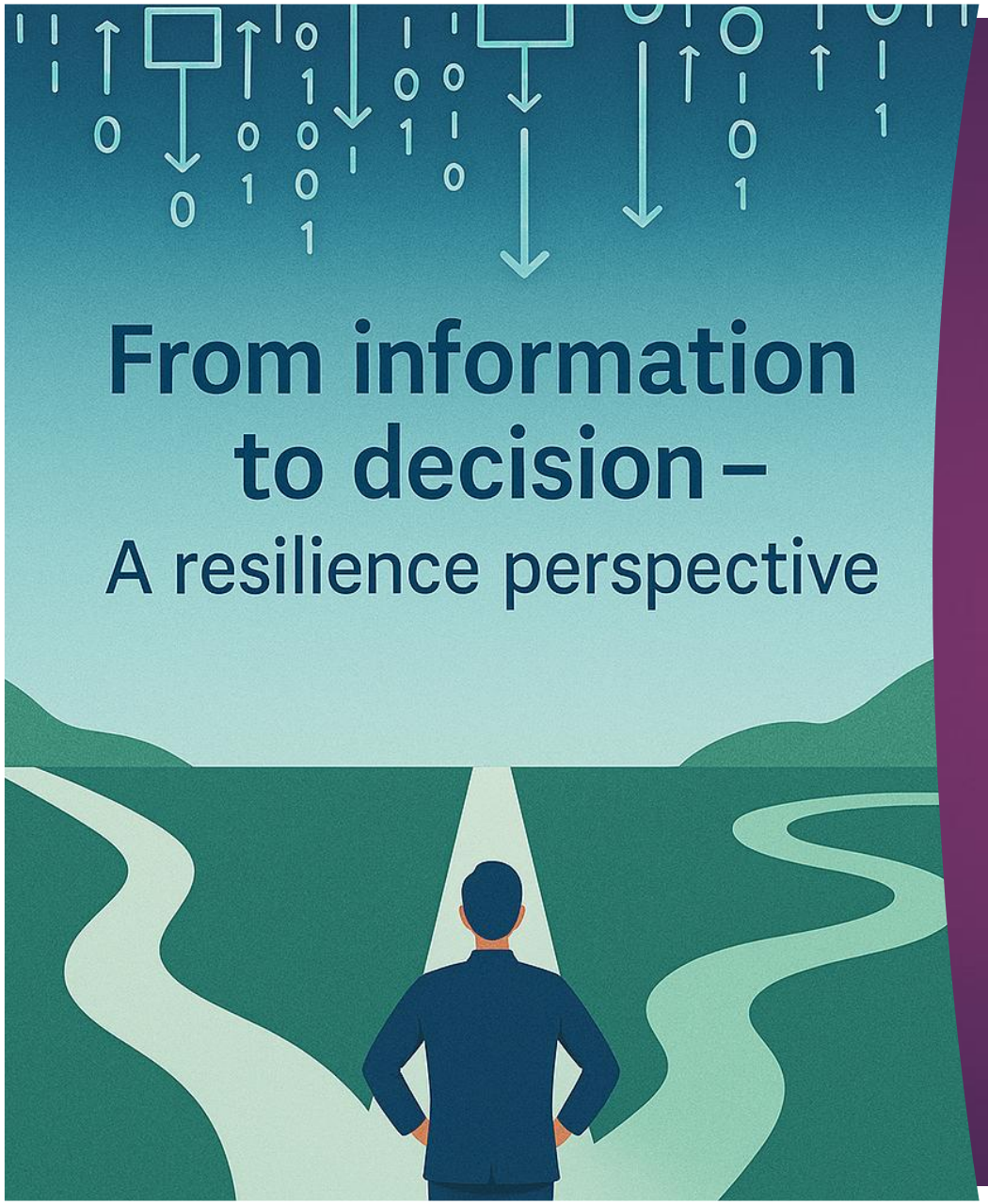
- Lagstiftning, tullar och regelverk
  - Ukraina har varit tvunget att snabbt göra ändringar, exempelvis genom att:
    - Ta bort tullar på generatorer, tillåta större lagring av drivmedel hos företag och enskilda, etc., etc.
- Redundans och flexibilitet
  - Fanns delvis pga. omoderniserade system, men Ukraina har också varit tvunget att skapa detta
- Systematiskt lärande
  - Ukraina har varit tvunget att systematisera de lärdomar de successivt dragit under kriget
- Offentlig-privat samverkan
  - Fanns delvis, men har utökats på både offentligt och civilt initiativ

Lessons: Reactivity (ad hoc) that could have been proactivity

- Personal- och kompetensförsörjning
  - Ukraina har varit tvunget att successivt skapa ett system för detta för att omhänderta frivilliga, krigsplacera andra, omhänderta pensionärer, omskola personal, etc.
- Reparationsplanering, Reservdelsförsörjning, Förnödenhetsförsörjning, Lagerhållning
  - Eftersom Ukraina inte var förberett på den omfattande kinetiska krigföringen fanns ingen beredskap för dessa områden
- Energilagringssystem
  - Eftersom Ukraina inte var förberett på den omfattande kinetiska krigföringen fanns ingen beredskap för detta

Lessons: Reactivity (ad hoc) that could have been proactivity

- Lokal produktion och lagerhållning, Diversifiering av energiproduktion, Alternativ energiförsörjning,
  - Fanns delvis på plats, men Ukraina har varit tvunget att utveckla detta under krigets gång
- Backuper och reservförfaranden
  - Eftersom Ukraina inte var förberett på den omfattande kinetiska krigföringen fanns ingen beredskap för detta
- Prioritering, omdirigering och ransonering
  - Ukraina var inte förberett på stora folkförflyttningar, omfattande elavbrott, etc…



Summary

Paradigm shift 1 – Requirements on resilience

- EU and NATO require societal resilience
- We must move from focusing on cost-efficiency to focusing on resilience
  - In the global supply chains
  - In the critical infrastructure
- Including measures for increasing redundancy and flexibility
- This will drive costs – Who should pay for what?

Paradigm shift 2 – New area of operations

- NATO will have a new area of operations in the North
- Today, supply chains and critical infrastructure systems have a north-south focus
- This must be complemented with a west-east focus
- Including measures for increasing redundancy and flexibility
- It is also likely to include investments in new infrastructure systems
- This will drive costs – Who should pay for what?

The need for resilient, cross-border, critical infrastructure – Paradigm shift from efficiency to resiliency and north-south to west-east

- Past: Bottom-up, unilateral, north-south focus, within national and organisational areas of responsibilities – Focus on efficiency in subsystems
- Present and future: Top-down, multilateral, west-east, holistical view of critical infrastructure, etc. – Focus on resiliency in cross-border systems-of-systems
- Present and future: Cooperation between nations, authorities and companies

Thank you! Questions?