

## Are the major weapon platforms obsolete?

### Session 8: The case against major weapon platforms – redundancy

#### Looking into the Crystal Ball

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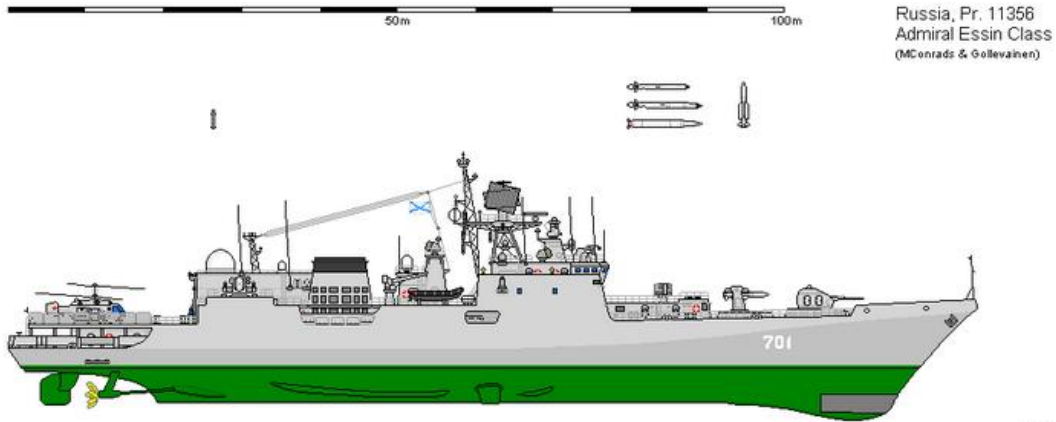
*NATO SAS-174*

*9<sup>th</sup> May 2023*

Location Harstad



- Flagship: Admiral Makarov
- Cost: ~750 Mio \$



www.shipbucket.com

Source:

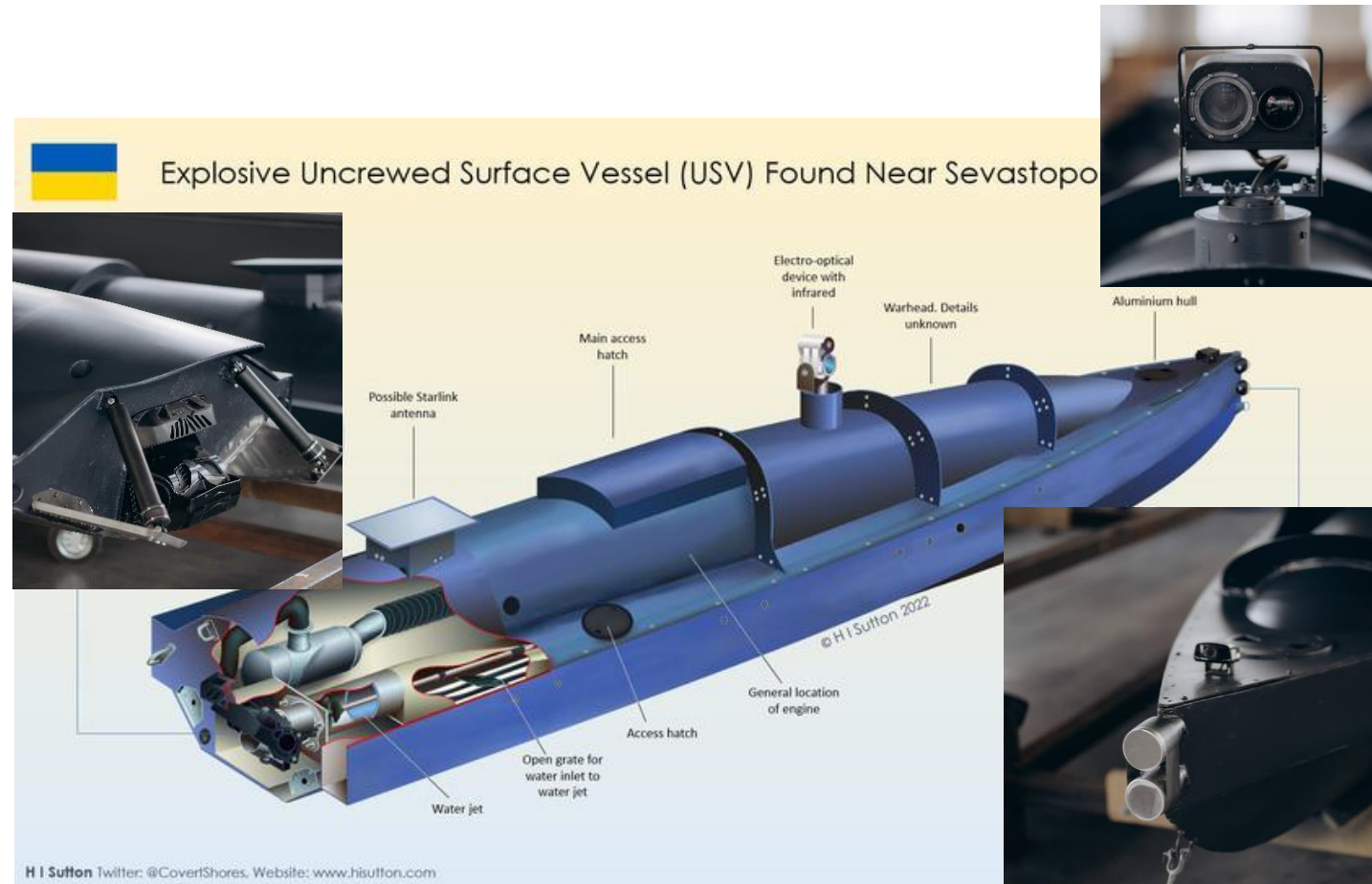
[https://de.wikipedia.org/wiki/Datei:Saint\\_Petersburg\\_Baltic\\_Fleet\\_Admiral\\_Makarov\\_03.jpg](https://de.wikipedia.org/wiki/Datei:Saint_Petersburg_Baltic_Fleet_Admiral_Makarov_03.jpg)

<https://exxpress.at/milliarden-vernichtet-die-liste-der-teuersten-verluste-putins/>

- New Drone – „Swarming“
- Cost: 250 K\$ x 16 = 4 Mio. \$

Length	5.5 meters
Full weight	up to 1000 kg
Operational radius	up to 400 km
Range	up to 800 km
Autonomy	up to 60 hours
Combat load	up to 200 kg
Max speed	80 km/h
Navigation methods	automatic GNSS, Inertial, visual
Video transmission	up to 3 HD video streams
Crypto protection	256-bit encryption

Source:  
<https://u24.gov.ua/navaldrones>  
<https://gagadget.com/de/weapons/184738-die-ukraine-wird-eine-flotte-von-seedrohnen-zum-schutz-von-wassergebieten-einrichten-zelenskyy/>





- Example:  
Battleship – Dinsaur of the sea

- Maintenance costs each:  
**1 Million per year**

=> Easy updateable in capabilities?  
– probably difficult

=> Is there a „cheaper“ way?

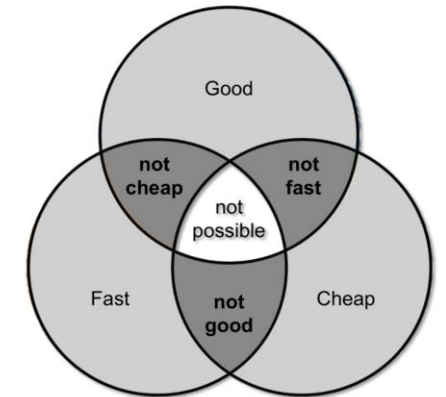
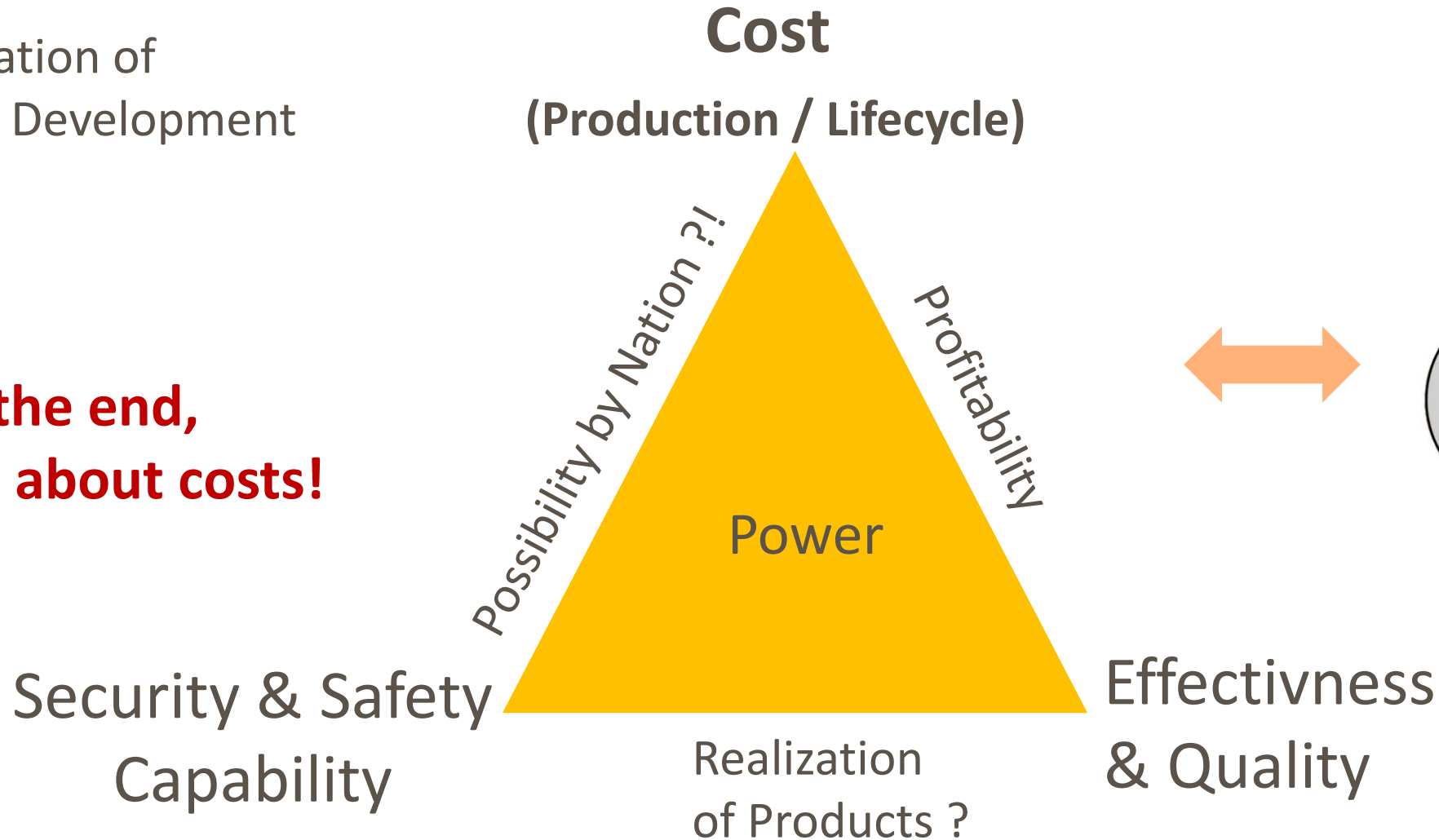


<https://nationalinterest.org/blog/reboot/uss-missouri-best-battleship-earth-199001>

<https://www.military.com/history/why-50-year-old-battleships-were-critical-part-of-operation-desert-storm.html>

- Foundation of Future Development

**=> In the end,  
it's all about costs!**



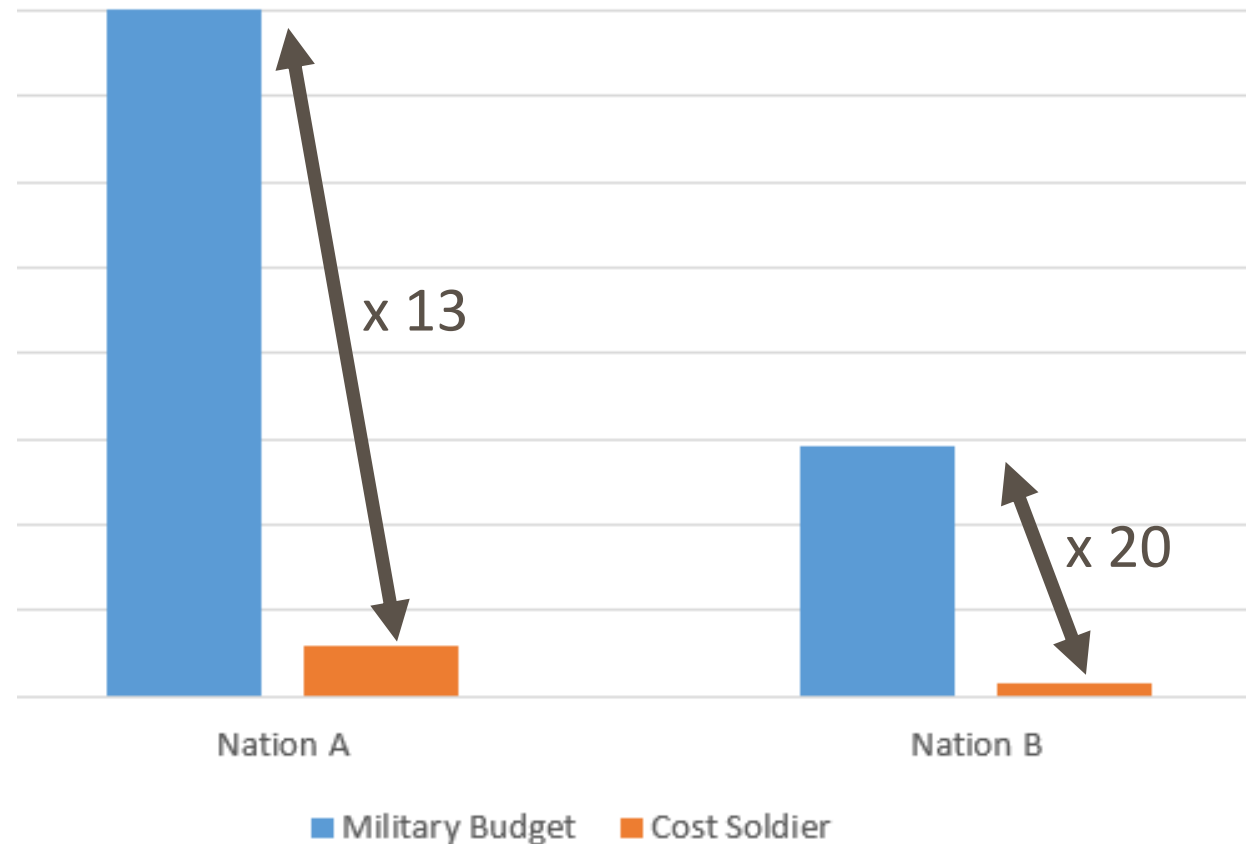
“Fast, good, cheap:  
pick any two.”

- Who is more effective?

**=> More precise:  
It's all about  
costs relations!**

Avg Soldier Payment (US-\$)

- Russia (66b): 4500
- Ukraine (5b): 5500



Source:

<https://www.telepolis.de/features/Geben-die-USA-fuer-das-Militaer-wirklich-sehr-viel-mehr-als-China-und-Russland-aus-4058306.html>

<https://tradingeconomics.com/ukraine/military-expenditure>

[https://en.wikipedia.org/wiki/List\\_of\\_countries\\_by\\_military\\_expenditures](https://en.wikipedia.org/wiki/List_of_countries_by_military_expenditures)

<https://www.n-tv.de/politik/So-viel-verdienen-ukrainische-Kaempfer-an-der-Front-article24064895.html>

from scenario



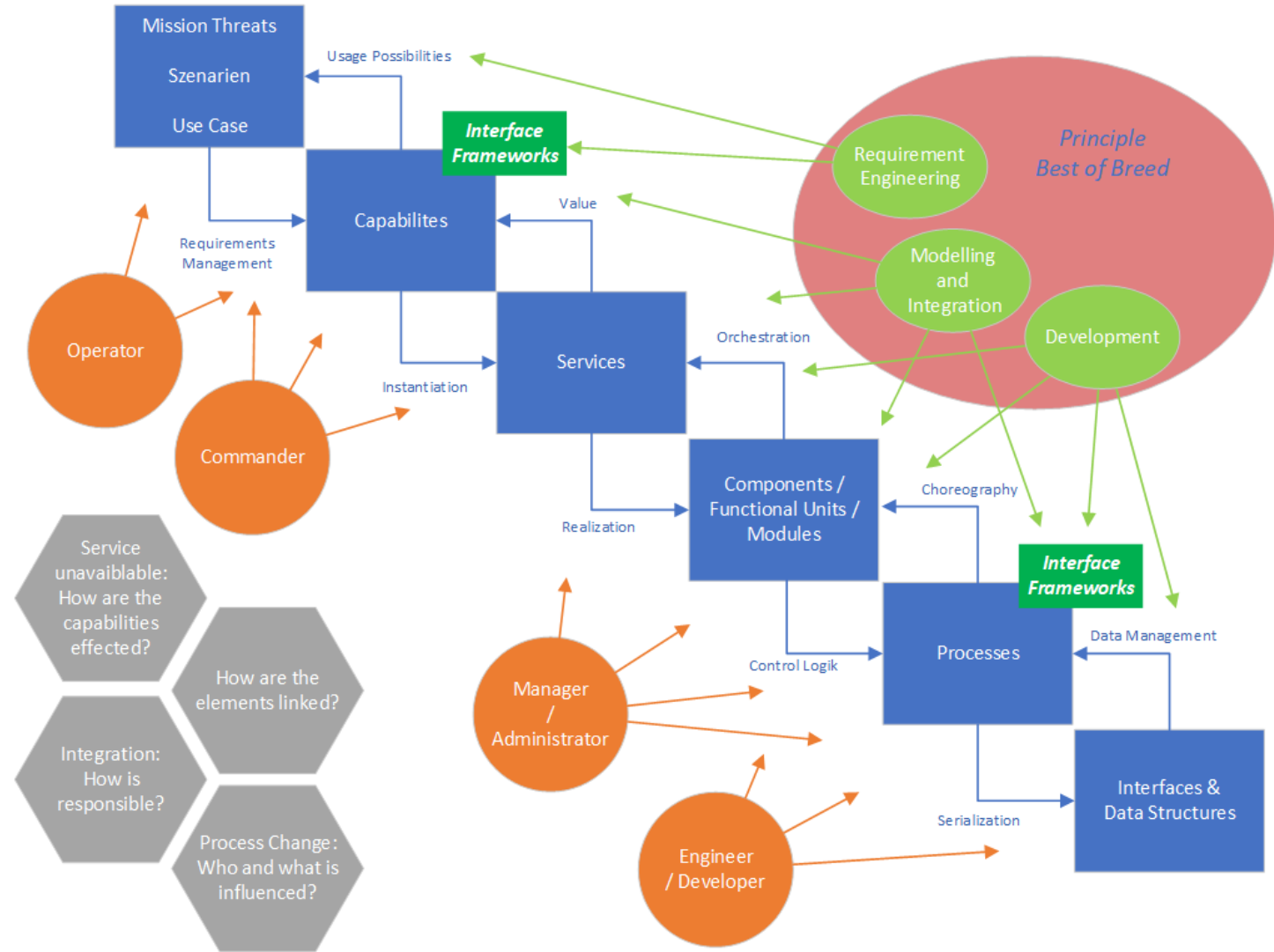
over services



to realization

=> Open minded

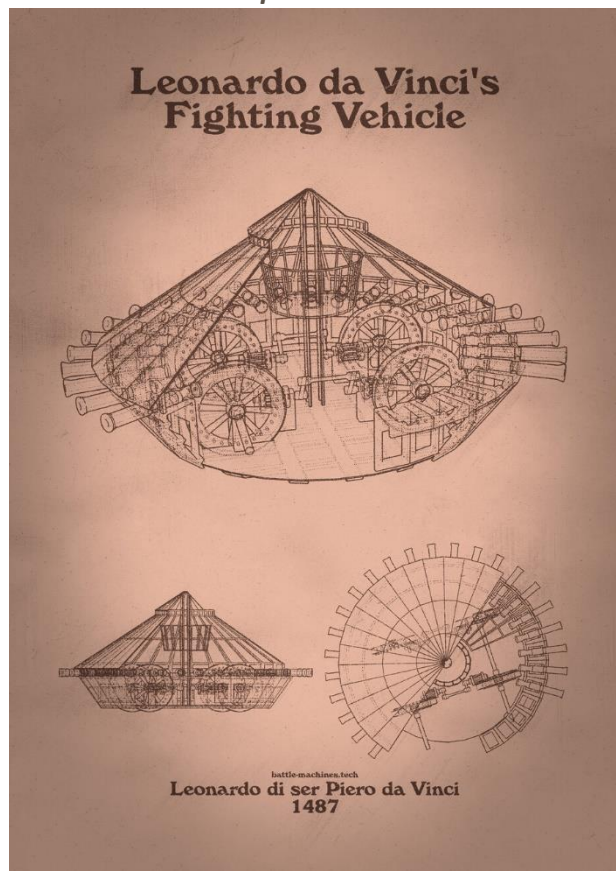
=> **Disruptive innovations**



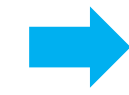


# Capability Evolment: Example Plattform Tank

Protection  
*Not in operation*



Overcome barrier  
*Expensive and not effective*



Multiple  
*Longterm usage unclear, too heavy, logistic problems, stuck in mud*



*E-Mobility?*

<https://www.europosters.de/marketplace/da-vinci-tank-patent-art-old-paper-v81219>  
<https://www.dailymail.co.uk/news/article-4462368/British-WWI-troops-went-battle-UNARMoured-tanks.html>  
<https://www.stern.de/digital/technik/so-stark-wie-der-leopard-ii---rheinmetall-stellt-jagdpanzer-lynx-120-vor-31651340.html>



# Paradigm shift: Exchangable-Capability Plattformen

## ■ Example Platform Boxer

- Command
- Transporter
- Tank
- Anti-Air
- Medic



=> **Specific Capability Thinking**

=> **Cost Reduction in Development**



<https://www.n-tv.de/wirtschaft/Rheinmetall-uebernimmt-Radpanzer-Sparte-article21114436.html>

<https://apps-cloud.n-tv.de/img/21114492-1561721260000/4-3/750/Rheinmetall-Image-Boxer.jpg>

<https://www.welt.de/wirtschaft/article174525984/225-mal-Boxer-Rheinmetall-gewinnt-Mega-Panzerauftrag-in-Australien.html>

<https://www.pressebox.de/pressemitteilung/rheinmetall-ag/Move-Sense-Strike-Rheinmetall-praesentiert-umfassendes-Produktportfolio-fuer-die-ueberlegene-Operationsfuehrung/boxid/908429>

<https://soldat-und-technik.de/2021/06/mobilitaet/27527/gtk-boxer-bundeswehr/>

<https://www.dw.com/de/litauen-kauft-deutsche-boxer-radpanzer/a-19492012>

- Will Platform-Thinking help in longterm?



Leopard 2A7v

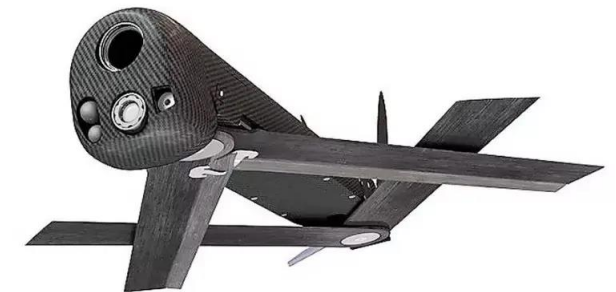
~ 9 Mio €

~ 5k € per main shoot



Javelin – Fire-and-Forget

~ 80k €



Swissblade

~ 6k €

**=> Very effective in cost relations!**

<https://www.armadninoviny.cz/nejnovejsi-tanky-leopard-2a7v-pro-nemeckou-armadu.html>  
[https://de.wikipedia.org/wiki/Javelin\\_Medium\\_Antiarmor\\_Weapon\\_System](https://de.wikipedia.org/wiki/Javelin_Medium_Antiarmor_Weapon_System)  
<https://www.edrmagazine.eu/switchblade-300-the-combat-proven-munition>  
<https://i.redd.it/9rh93hm5mx781.jpg>



- **Upgradeability** - Modular Examples
  - Guided Rockets by US – Update Software, exchange chips and sensors
  - Software-defined-radio – FPGAs and deployable “Apps”
  
- **Miniaturization of “capabilities”**
  - Cost Reduction
  - Faster than large platforms
  - Harder to detect

=> Harder to counter

**=> Design with future “growth” (functional) in mind!**



Tomahawk  
~ 2 Mio €



[https://en.m.wikipedia.org/wiki/Tomahawk\\_\(missile\)](https://en.m.wikipedia.org/wiki/Tomahawk_(missile))

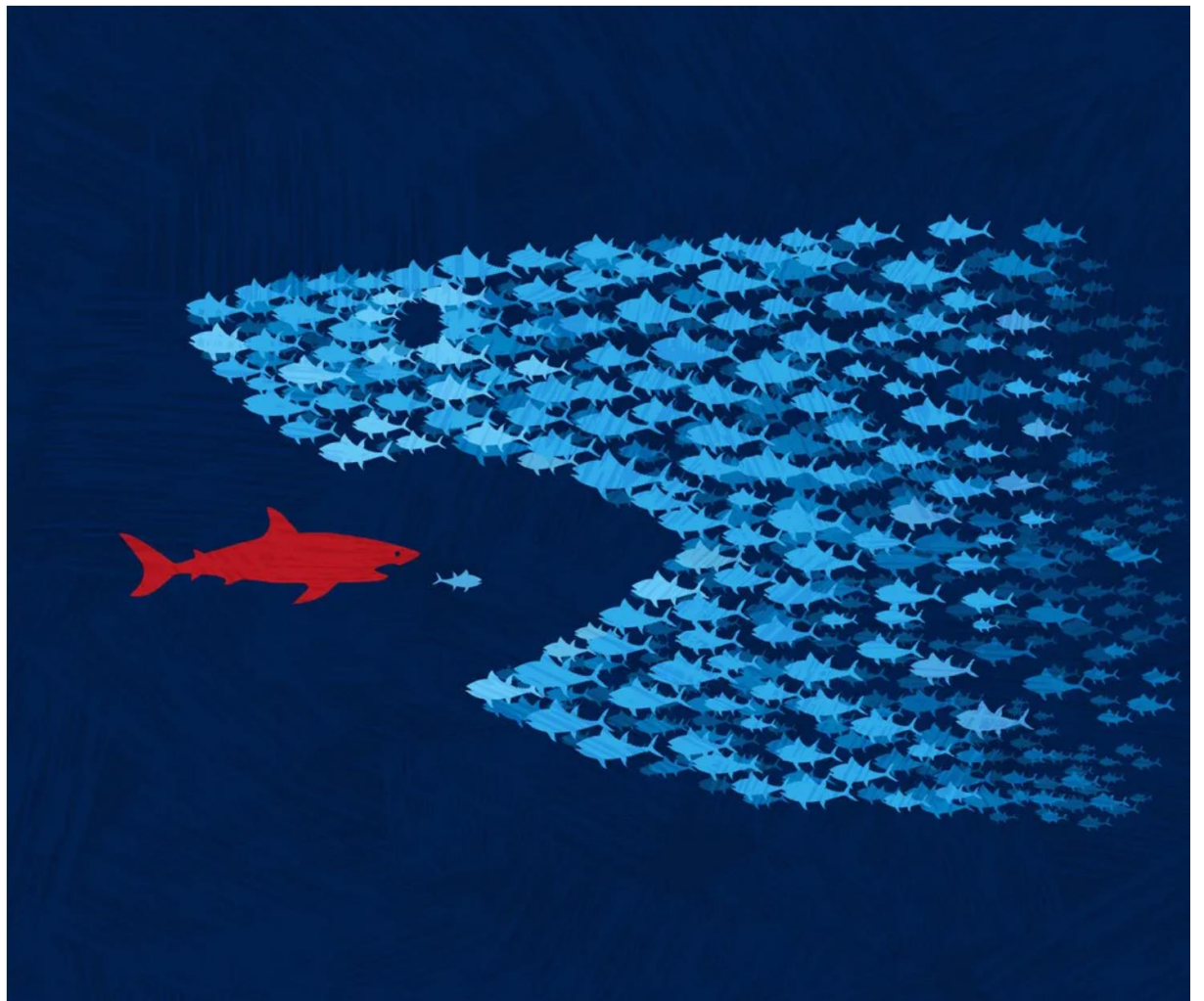




Prof. Karcher

# Swarming

## New Concept's - Next Generation -



<https://www.vectorstock.com/royalty-free-vector/little-blue-fish-join-forces-to-attack-red-shark-vector-37115946>

## Manned-unmanned Teaming

- Supporting Drones (Loyal Wingmen)
- Pioneer: Air Domain is forefront (less sideconditions)
- Other domains will follow (mixed too)



Project Future  
Combat Air System



Project Carrera  
drone for F-35  
(Lockheed Martin)

<https://www.aerotime.aero/articles/32182-lockheed-martin-presents-loyal-wingman-drone-for-f-35>



# Wignmen by nation

- USA
  - X-61A Gremlins
  - Kratos XQ-58A
  
- China
  - FH-97A (Supersonic)
  
- Australia
  - MQ-28 Ghost Bat
  
- Russia
  - RSK MiG-Skat
  
- Great Britain – Mosquito  
(canceled)



<https://www.golem.de/news/loyal-wingman-fh-97a-china-plant-ueberschall-kampfdrohne-fuer-tarnkappenjaeger-j-20-2304-173188.html>  
[https://de.wikipedia.org/wiki/Dynetics\\_X-61\\_Gremlins#/media/Datei:GremlinsFlightTestNovember2019.jpg](https://de.wikipedia.org/wiki/Dynetics_X-61_Gremlins#/media/Datei:GremlinsFlightTestNovember2019.jpg)  
[https://de.wikipedia.org/wiki/Kratos\\_XQ-58A#/media/Datei:Valkyrie\\_deploys\\_Altius-600.JPG](https://de.wikipedia.org/wiki/Kratos_XQ-58A#/media/Datei:Valkyrie_deploys_Altius-600.JPG)  
<https://www.airrecognition.com/index.php/news/defense-aviation-news/2022-news-aviation-aerospace/november/8819-airshow-china-2022-casc-unveils-fh-97a-loyal-wingman-autonomous-drone.html>  
<https://www.turbosquid.com/de/3d-models/3d-model-boeing-mq28-ghost-bat-1956052>  
[https://de.wikipedia.org/wiki/RSK\\_MiG-Skat](https://de.wikipedia.org/wiki/RSK_MiG-Skat)  
<https://breakingdefense.com/2022/07/the-uk-killed-its-project-mosquito-drone-program-but-a-follow-on-could-come-soon/>



- Development and Production
  - Low production costs (less than 25 %)
  - Low operation costs (less than 80 %)
- Capabilities advantages
  - Mobility
  - Rapid deployment in combat
  - Stealthy
  - No personnel loss
  - Simple operator training
  - Single information space of the theater
- Techniqual Requirements
  - High technology – powerful microchips
  - Communication link
  - Navigation system



<https://www.businessinsider.com/the-air-force-is-developing-swarms-of-mini-drones-2015-5>

<https://www.uasvision.com/2018/06/28/suppressing-air-defenses-by-uav-swarm-attack/>

## Future Example

- Sensor: long range, rough details
- Sensor: short range, very detailed
- Electronic Warfare
- Defence - counter attack (like Lenz Drones with BriteCloud DRFM)
- Attack and other effects
- Transport things

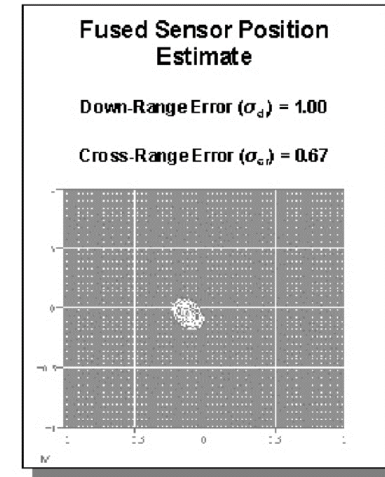
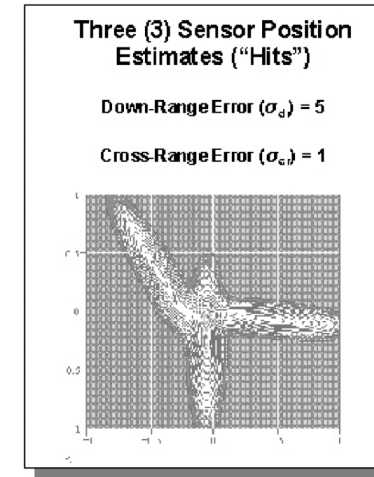
## Purpose

- Observation
- Combat
- Special purpose
- Supporting
- Multi-role

=> Redundancy of failed systems

## Operations possibilities

- reconnaissance
- neutralization
- electronic countermeasures
- communication and relay
- target designation
- fire correction
- assessment of damage done
- Blanket a large area
- Immediate support of “Specialists”
- search and rescue operations
- minefield detection
- cargo delivery
- border and territory protection
- ...



Quelle: Alberts NCW - Payoff of Sensor Fusion, 2000, S. 151



<https://www.uasvision.com/2018/06/28/suppressing-air-defenses-by-uav-swarm-attack/>  
<https://www.cnet.com/news/privacy/china-launches-high-tech-bird-drones-to-watch-over-its-citizens/>

- How could a swarm look like?
  - 100 units operate in parallel
  - Systems with mixed capabilities
  - Large redundance of capabilities

**=> Diverse Capabilities**

**=> Provide so many targets  
that they cannot be dealt with**

**=> Waste of munition in engaging low value targets**

**=> Overwhelm and confuse radar systems**



<https://defence.pk/pdf/threads/united-states-air-force-is-developing-swarms-of-mini-drones.378184/>  
<https://www.uasvision.com/2020/10/12/raf-tests-drone-swarms-against-air-defenses/>  
<https://electronics.leonardo.com/en/products/britecloud-3>  
<https://www.youtube.com/watch?v=C2qzjq88Do>



## ■ Technologie Consequences

- Sensors => create a lot data => need of information sharing
- High Communication Requirements
  - Radio Systems - broadcast: limited, easy to counter
  - Direct link - laser: line of sight mandatory
- Growth in electrical and computing power - chip embargo
- Retain mission functionality with a degraded or interrupted network
- Problem in Coordination / Choreographie - coordinated activity
- Difficulty in Controlling - collision avoidance



## => Reduced Complexity and Dependence

- **Controlling**
  - **Coordination**
  - **Communication**
- } **autonomy**

<https://www.uasvision.com/2020/10/12/raf-tests-drone-swarms-against-air-defenses/>  
<https://www.nationaldefensemagazine.org/articles/2021/4/12/pentagon-consolidates-counter-uas-programs-as-menace-grows>

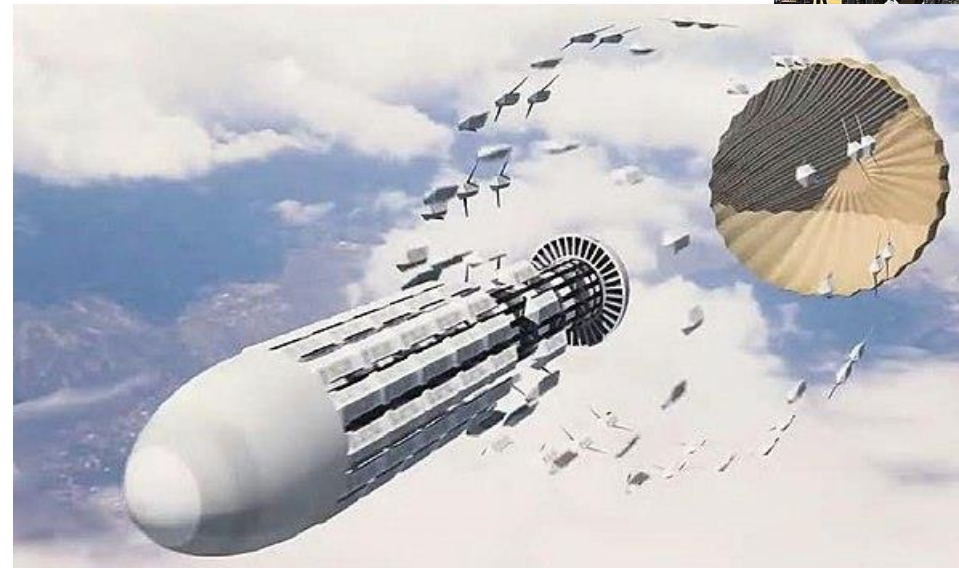
## ■ Survivability

- Quadcopter - 3 days
- Wing aircraft - 6 days

## ■ Limited Speed and Range

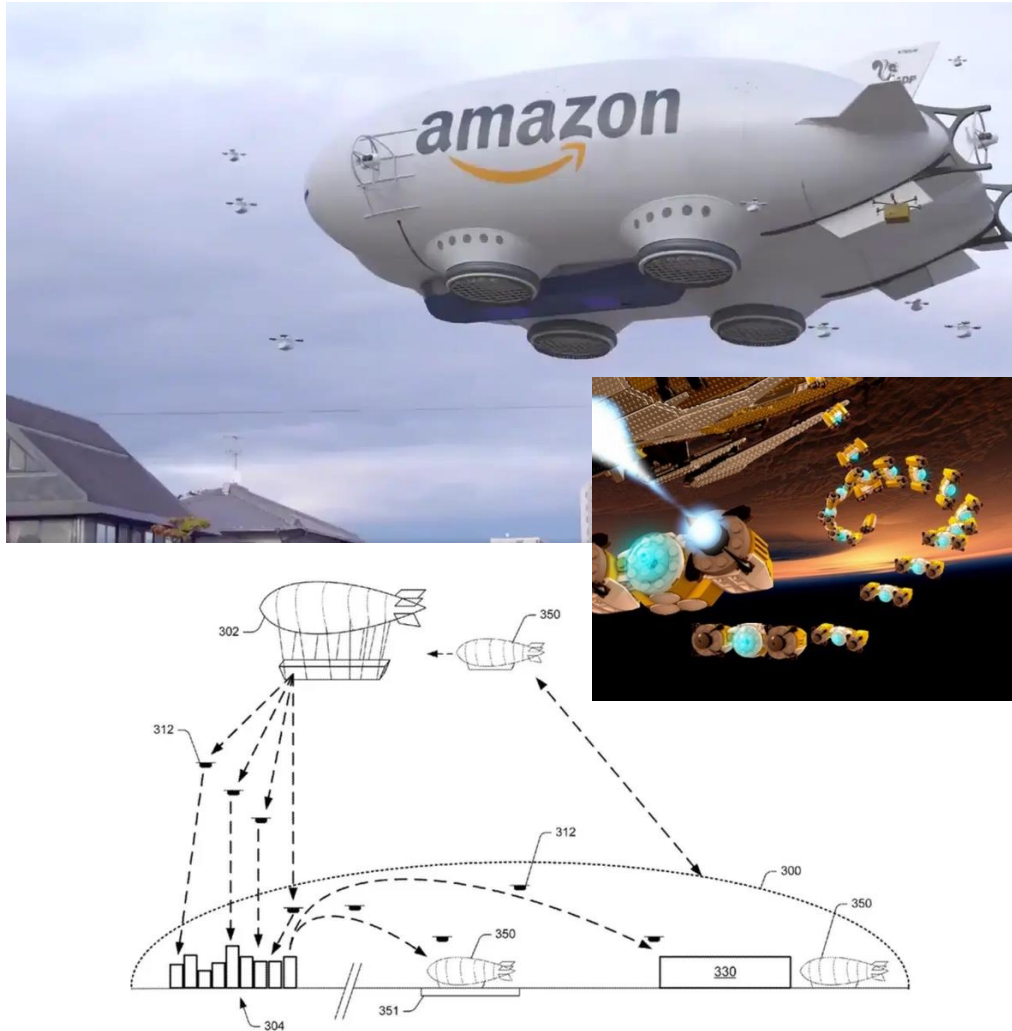
## ■ Controlling

- Remote (1 operator per drone)
- Objective autonom (swarm control)
- „Full“ autonomous (commanded)



A Rapid Dragon module being loaded on a C-130 for airdrop.

# Future - Future ?



Boeing X-37B

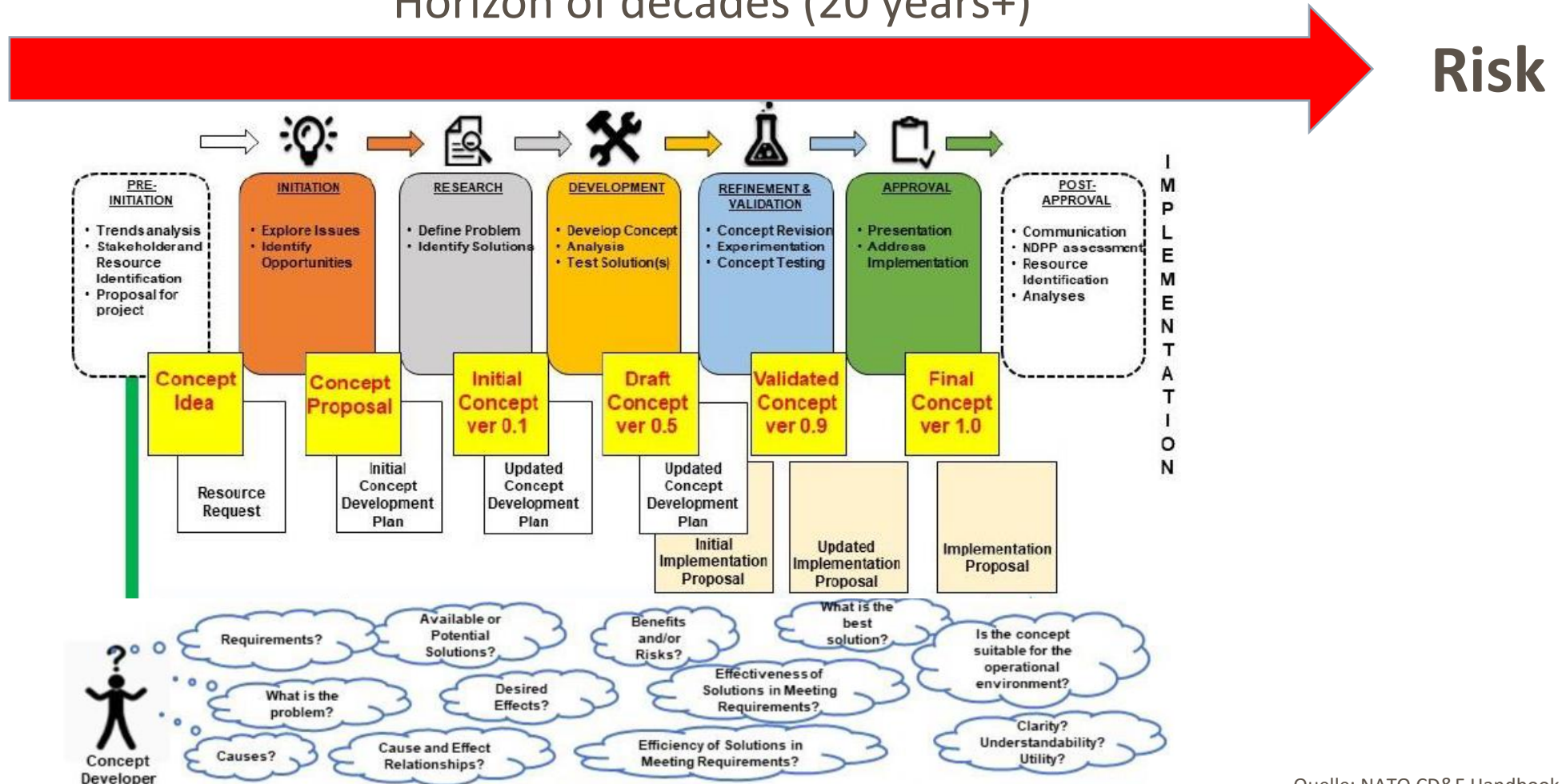
<https://www.bbc.com/news/technology-38458867>

<https://www.businessinsider.com/amazon-blimp-delivery-drones-viral-video-is-fake-2019-4>

[https://de.wikipedia.org/wiki/Boeing\\_X-37](https://de.wikipedia.org/wiki/Boeing_X-37)



Horizon of decades (20 years+)

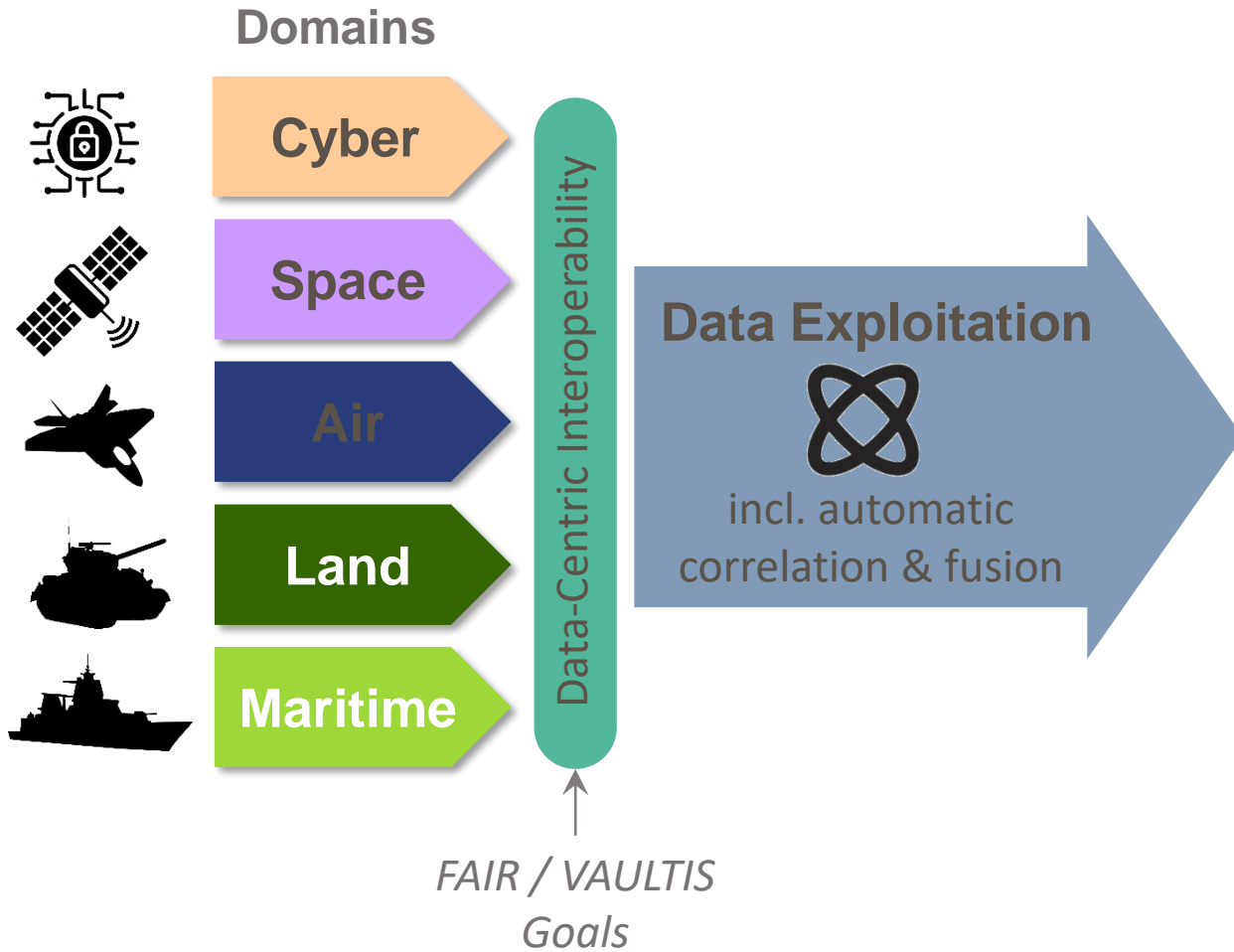


Quelle: NATO CD&E Handbook, S. 11ff

# Data-Centric Interoperability for Multi-Domain Operations



Projekt NEOS  
(Network Enabled Operations Support)



## Key Tenets:

- Inter-Connectivity
- (Meta-) Data Management
- Automation
- Secure Processing
- Open Standards
- Federation

Gernot FRIEDRICH, NATO HQ C3 Staff: Architecting for NATO's Digital Transformation, TIDE Sprint, Spring 2023  
<https://www.mindev.gov.gr/wp-content/uploads/2023/04/05-NCIA-ACQ-2023-06756.pdf>  
<https://esut.de/2021/08/meldungen/29034/neos-netzwerk-vernetzte-operationsfuehrung/>

# Key Facts for Future Systems

1. It's all about **costs relations!**
2. **Capability driven evolution**
3. Design systems on **modular and updatable services**
4. Handle complex controlling by „full“ **autonomous Systems**
5. **Inter-Connectivity based on standards**

**=> Drone Swarm have large advantages**

<https://imgflip.com/memetemplate/409920318/Ironman-v-Tank>

