# Analysis of complex mission environments: Towards a method for *control by flow interdiction*

**Guido Veldhuis*, Bas Keijser, Sebastiaan Deuten, Maarten Michel**
*TNO, The Hague, The Netherlands*
**Guido.Veldhuis@TNO.nl, +31 (0)6 528 036 83*

TNO innovation for life

**Growing complexity, technological advancements and a new tactical and strategic reality are driving the development of new concepts of operations within the Netherlands. The future operating environment is envisioned as a *complex eco-system*. A tightly coupled system-of-systems in which flows of goods, services, information, capital, people, and material shape the resilience of society, behaviour of actors and the outcome of conflict.[2] In this world view, *flows* and *flow-knots* are the objectives to engage or protect. This is referred to as: 'control by flow interdiction'.[6,7] A new operating concept requires a new way of studying the operating environment.**

## Towards an analytical method

Based on an understanding of flows within the mission environment a commander can select a limited and precise set of interventions. Interventions aim to achieve a desired end-state by strengthening or disrupting flows via effects in three landscapes: physical, human, information. Our work aims to further operationalize this concept and develop processes and tools for analysis that might one day inform a new generation of intelligence and planning doctrine.

**1. Orientation on mission and available data**

**2. Map problem system by nodes and flows**

**3. Identify resilience vulnerabilities (E-COG)**

**4. Assess influence of threat and other actors**

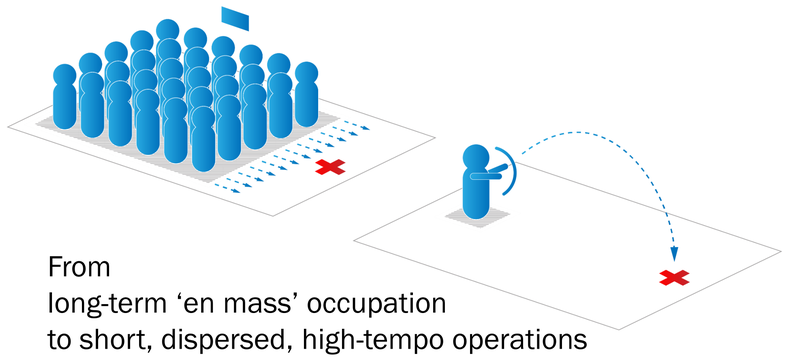
**5. Identify high leverage intervention points ('knots')**

**6. Develop 3L/JIMP CoAs & assess (side)-effects**

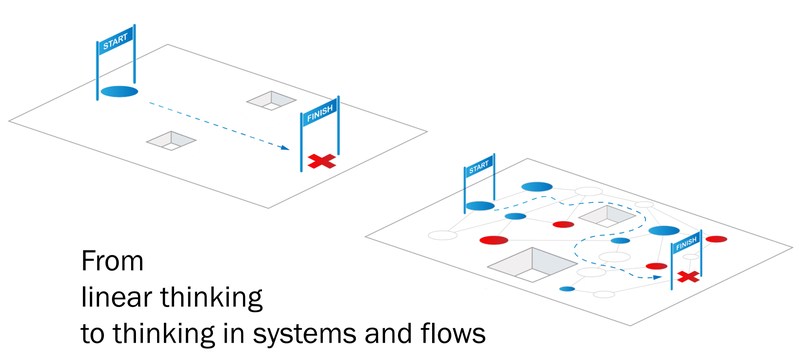
**7. Select CoA**

Outline of the analytical process. Similar to [1,4].

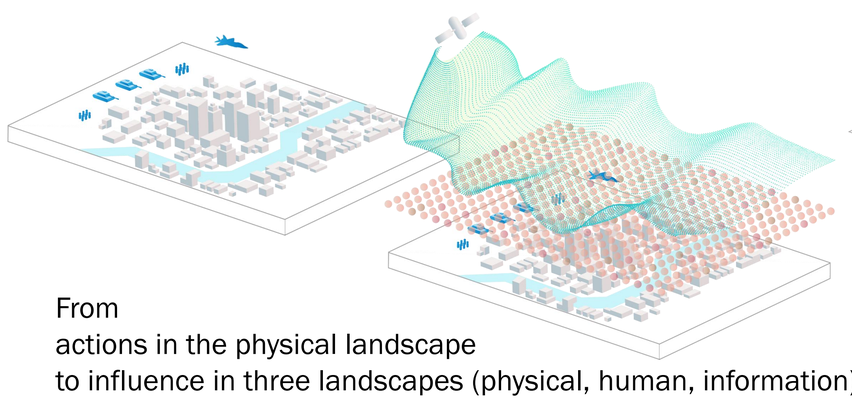
## Innovations in the operating concept that require new analytical methods



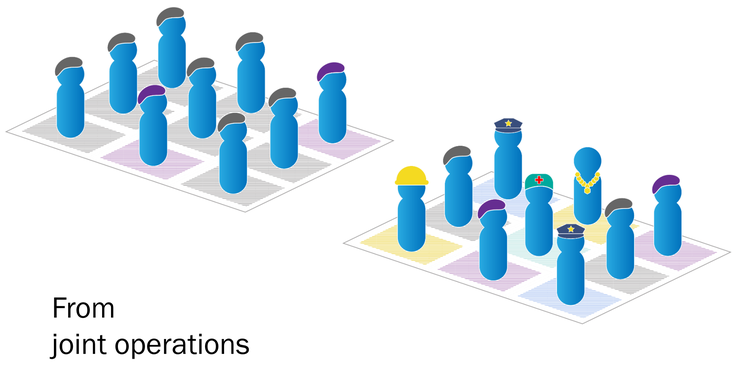
From
long-term 'en mass' occupation
to short, dispersed, high-tempo operations




From
linear thinking
to thinking in systems and flows



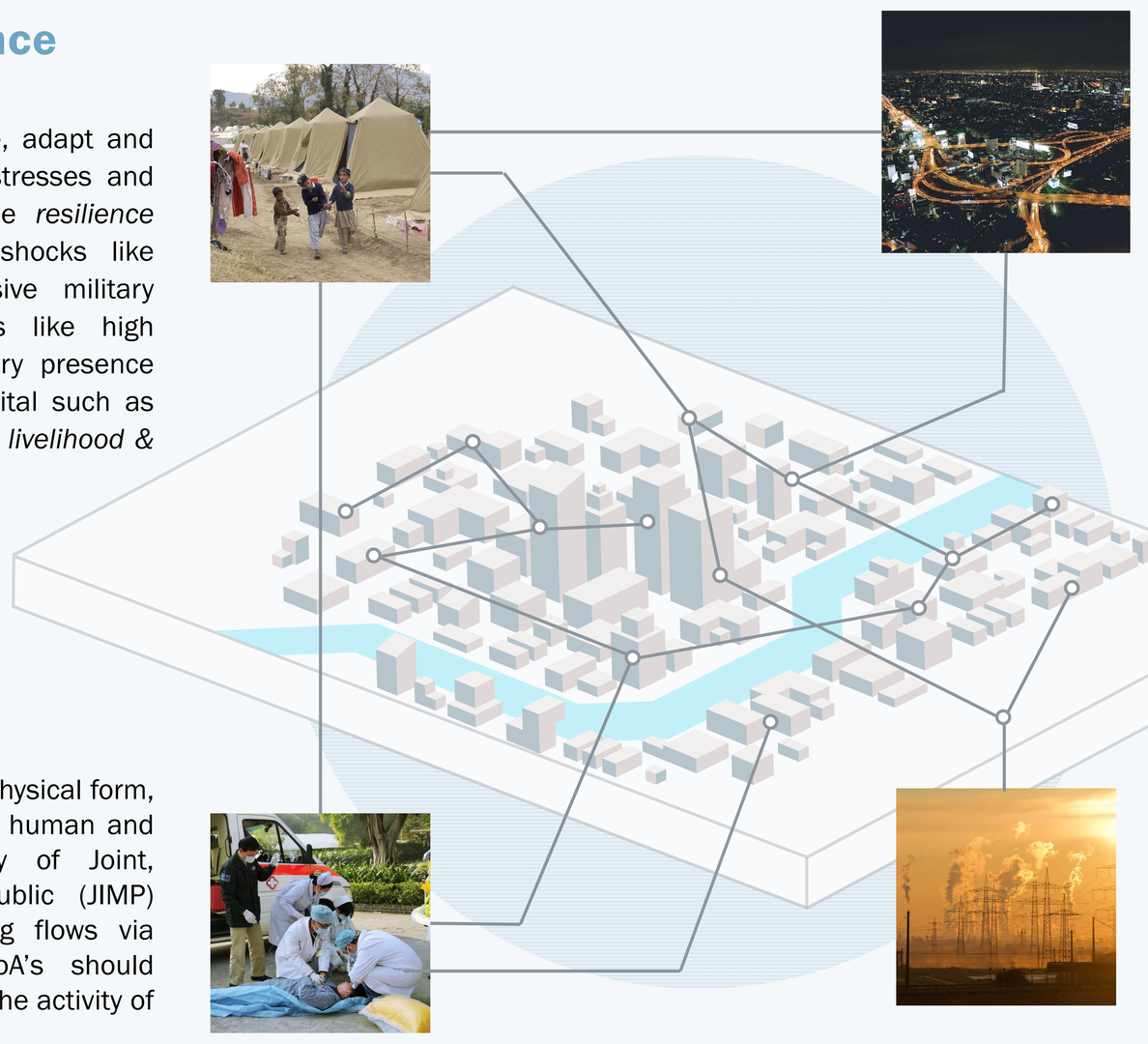
From
actions in the physical landscape
to influence in three landscapes (physical, human, information)



From
joint operations
to joint, interagency, multinational and public operations

## Integration of resilience capitals in analysis

The accumulated means to survive, adapt and grow despite of - or thanks to - stresses and acute shocks, is what defines the *resilience capitals* of communities. Acute shocks like earthquakes, bombings, or invasive military operations; and chronic stresses like high unemployment or long term military presence affects the systems' resilience capital such as the *rule of law, social cohesion* and *livelihood & economic security* [5,8].



## System Analysis

Complex ecosystems consist of tangible and intangible flows and nodes. System analysis can aid in identifying high-leverage points for intervention. The short- and long-term effects of CoA's can be assessed and compared (e.g. effects on a systems' resilience capital and the behaviour of actors). System models combine qualitative and quantitative information to create insight in the pace and mechanisms which balance, or virtuously and viciously alter the system.[1,9]

## JIMP interventions in three landscapes

Although the threat will still have a physical form, effects will also be achieved in the human and information landscape. A variety of Joint, Interagency, Multinational and Public (JIMP) actors are concurrently influencing flows via effects in three landscapes. CoA's should leverage, coordinate and deconflict the activity of many actors[6,7].

## Identifying flow-knots

Environmental Centres of Gravity analysis (E-CoG) can identify (clusters of) nodes and flows that form the vital functions of a system, so-called 'flow-knots'. A military intervention that aims to leave a resilient society in its wake will bolster E-CoGs while still engaging the threat CoG[4].

## Maximize effect

On November 26th, 2008 a trained terrorist cell from Pakistan performed highly distributed terrorist attacks in the business district of Mumbai, bringing the city to a days-long standstill. The attackers exploited internal and external connectedness of the city environment to the utmost and selected target sets with the most disruptive effect. Flow interdiction analysis can support the process of finding targets with the maximal effect on a mission environment with a minimal footprint.[3]

## Prevent side-effects

Since the Iraqi war of 2003 the Bagdad green zone has been the heavily fortified international quarter of the city. The strict security measures surrounding this quarter of the city had malevolent effects on the flow of goods, people and services through the urban landscape. Flow interdiction analysis can support the process of analyzing the effects and side-effects of military operations, preventing military actions that harm societal resilience.

## Bolster resilience

The island of Saint Martin was ravaged by hurricane Irma on September 6th, 2017, causing an island-wide blackout and damaging the majority of houses on the island beyond repair. The Royal Dutch Navy provided disaster response and security provisioning in the days after the hurricane, enhancing societal resilience. Flow interdiction analysis can support the analysis of societal resilience and establish a CoA to strengthen it.

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