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Development of a Methodology for Improving Urban Operations Capabilities

Rozvoj metodologie pro zlepšení schopností pro operace v urbanizovaném prostoru

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Abstract: Most experts believe that urban operations will gain importance in the future, but even though we have sufficient examples and experience at hand, we still struggle with the development of the necessary skills and capabilities. The resulting gaps are a combination of different tasking and shrinking resources in the past decades, the difficulty of training for and a mere misunderstanding of the urban environment and harmful innovations – we seem to find ourselves always in the beginning. Fighting in isolated “prisms of responsibility” requires flexible task forces with all necessary enablers at hand and well-trained commanders exercising mission command and understanding their role, task, and the purpose of action. Mastering the urban environment on all three levels of movement is a very challenging task and requires focused attention on various aspects, inter-actor interaction and interdisciplinary research and development.

Abstrakt: Většina odborníků se domnívá, že městské operace budou v budoucnu nabývat na významu, ale přestože máme k dispozici dostatek příkladů a zkušeností, stále se potýkáme s rozvojem potřebných dovedností a schopností. Vzniklé mezery jsou kombinací rozdílného zadání a snižujících se zdrojů v posledních desetiletích, obtížné přípravy a prostého nepochopení městského prostředí a škodlivých inovací – zdá se, že se vždy ocitáme na začátku. Boj v izolovaných „prizmátech odpovědnosti“ vyžaduje flexibilní úkolové uskupení se všemi potřebnými prostředky po ruce a dobře připravené velitele uplatňující úkolové velení a chápající svou roli, úkol a účel akce. Zvládnutí urbanizovaného prostředí na všech třech úrovních pohybu je velmi náročný úkol a vyžaduje soustředěnou pozornost na různé aspekty, součinnost mezi aktéry a interdisciplinární výzkum a vývoj.

Keywords: Mission Command; Interdisciplinarity; Subterranean Operations; Research and Development.

Klíčová slova: Úkolové velení; interdisciplinarita; podzemní operace; výzkum a vývoj.

INTRODUCTION

Currently more than 80% of the world's population is living in urban centres and clusters¹ and the increasing tendency seems unbroken. Urban areas represent important hubs for government, trade, business, industry, transport, science, education, and will remain of significant importance: “[...] *the massive concentration of population together with industry, manufacturing, road networks, bridges, and electricity-generating facilities that make urban centers essential terrain for adversaries attempting to assert geographical, political, and economic control during periods of conflict.*”² Marawi, Kiev, Bakhmut, or Gaza City – to name just a few recent examples – obviously fighting often converges in cities. Affecting military doctrine around the globe, also the Austrian Armed Forces have assigned priority to the development of urban operations capabilities³. Past and present military operations in which urban areas were heavily contested underline this importance. King states that “[...] *the smaller the armies, the more important cities become [...]*” understanding frequency and importance of urban warfare as a function of force size⁴. Additionally, technological superiority enforces an opponent into areas, where he can decrease visibility and increase mobility as the earth's surface can be observed by satellite or aerial vehicles of all kinds. Richmond-Barak describes an equalizing effect “*As states improve their ability to find and attack their enemies through advanced intelligence, surveillance, and reconnaissance assets, going underground is a natural response for less technologically sophisticated opponents.*”⁵ King mentions that “[...] *because cities have grown so large and, therefore, offer the best protection for insurgents against advanced weaponry, it is inevitable that war has migrated and will move to urban areas.*”⁶ On the other hand, we face a „[...] *phenomenon of nearly a century of cognitive disconnect between the foreseeable demands of urban battle and military preferences and policies.*”⁷ leading to neglecting combined-arms war fighting in urban environments

- 1 PESARESI, M., M. MELCHIORRI, S. ALICE, and T. KEMPER, eds., 2016. *Atlas of the human planet 2016. Mapping human presence on earth with the global human settlement layer.* Luxembourg: Publications Office. EUR, Scientific and technical research series. 28116. p. 41.
- 2 ANDERSON, M.G., 2023. Decided among the Cities [online]. The Past, Present and Future of War in Urban Environments. *Military Review*, **101**(May - June 2023), 25. p. 25. Available from: <https://www.armyupress.army.mil/Portals/7/military-review/Archives/English/MJ-23/Decided-among-the-Cities/Anderson-Decide-among-the-Cities-UA.pdf>
- 3 BUNDESMINISTERIUM FÜR LANDESVERTEIDIGUNG, 2021. *Einsatz im urbanen Umfeld. Querschnittskonzept.* Wien.
- 4 KING, A., 2021. *Urban warfare in the twenty-first century.* Cambridge, UK: Polity. p.27.
- 5 COLLINS, L. and J. SPENCER, 2022. *Understanding urban warfare.* Hampshire: Howgate Publishing Limited. p. 108.
- 6 KING, A., 2021. *Urban warfare in the twenty-first century.* Cambridge, UK: Polity. p. 39.
- 7 KNIGHT, C., 11 Jul. 2020. *Unpacking the Urban Fight* [online]. *Introducing the Twelve Challenges.* 11 July 2020, 12:00 [viewed 11 October 2022]. Available from: <https://groundedcuriosity.com/unpacking-the-urban-fight-introducing-the-twelve-challenges-part-i-of-a-series/Y0WhH9f1D9>

for the past decades⁸. *“The art of war clearly has not kept pace with the progressively more complex global urban environment. As a consequence, the military profession is ill equipped to meet the unique demands of modern urban warfare.”*⁹ That does not seem to be a matter of unwillingness but different tasking, shrinking resources, the difficulty of training for such environments, and the effects of harmful innovations¹⁰ underlined by the two following main shortfalls.

Misperception and avoidance

Time and again, we experienced a misperception of “the urban” during training and exercises. Although the participants have significant expertise and knowledge on company level, they generally lack the oversight and comprehension of the environment and the tasks of the different echelons required to achieve maximum success in an urban combined arms battle. Although top level representatives state the importance of urban training, the fixation on house clearance biases *“training towards a bottom-up process whereby section-level drills are combined up to company level activity with limited combined arms contribution and almost no representation of higher echelon support or joint enablers.”*¹¹ Training centres around the world offer only limited size and are often clean and tidy. Features of urban combat represented by rubble and ash are missing thereby creating wrong impressions and even big training centres do not offer all features of big cities including the civilian population present. *“Still, even the most legally scrupulous military operation in an area like Gaza carries very serious potential for significant unintended civilian casualties.”*¹²

Therefore, the conduct of training in lively urban environments with the presence of the own population provides a more accurate picture of urbanity and the operational necessities also activating civil-military interaction. Since the activities of the individual actors are still stove piped with isolated initiatives of cooperation, inter-actor interaction and comprehensive continuation training are a requirement and must be enforced¹³.

⁸ HOFER, P. and C. KNIGHT, 2024. Conceptualizing an Urban Operations Vehicle within a Comprehensive Research and Development Program [online]. *SAE International Journal of Connected and Automated Vehicles*, 7(1), 53-67 [viewed 29 March 2024]. p. 54. Available from: 10.4271/12-07-01-0005

⁹ SPILLER, R.J., 2003. Urban Warfare. Its History and Its Future. In: W.G. ROBERTSON and L.A. YATES, eds. *Block by Block. The Challenges of Urban Operations*. unkn.: Books Express Publishing, pp. 439-450. p. 442.

¹⁰ KUO, K., 2022. Dangerous Changes: When Military Innovation Harms Combat Effectiveness [online]. *International Security*, 47(2), 48-87. Available from: 10.1162/isec_a_00446

¹¹ SMITH, M. and D. ROBSON, 2023. A Concept for the Modelling and Simulation of Complex Urban Environments. In: NATO MODELLING AND SIMULATION GROUP, ed. *Going Beyond the Limitations of the Real World. Meeting Proceedings RDP: NATO Science and Technology Organization*, 21-1 – 21-17. p. 21-4.

¹² DUNLAP, C.J., 2023. *Why Israeli Operations in Gaza are Legally Complex* [online]. 31 October 2023, 12:00 [viewed 19 November 2023]. Available from: <https://sites.duke.edu/lawfire/2023/10/28/why-israeli-operations-in-gaza-are-legally-complex/?s=09>

¹³ HOFER, P., 2022. Interdisziplinäre Weiterbildung für Einsätze im urbanen Umfeld [online]. *BHM Berg- und Hüttenmännische Monatshefte*, 582-586 [viewed 30 December 2022]. Available from: 10.1007/s00501-022-01305-4

“Operations in urban areas have always been difficult and hazardous for those involved and hitherto military commanders avoided such operations where this was possible.”¹⁴ This avoidance of the urban is directly connected to avoidance of the subterranean level of movement for which we are not really prepared for, although being no new threat¹⁵. This demanding and extremely life-threatening environment requires specialized training and equipment¹⁶ and with a significant number of civilians affected and the necessity of regaining access to critical infrastructure, avoidance is not an option.

The second main shortfall are inadequate tools for planning and exercising command and control. Staff officers planning urban operations cannot develop comprehensive understanding without adequate tools. Maps are inefficient for planning urban operations and tools enriching our perception and applicable in the entire reality-virtuality continuum¹⁷ are needed. In addition, access to expert knowledge is required for a comprehensive understanding of the urban environment. Williams and Selle conclude their study on military contingencies in megacities and sub-megacities with the acronyms URBAN and SMART encapsulating suggestions for successful urban operations with a special focus on the comprehension of the urban operational environment¹⁸. “The dynamic interaction between cities and the military forces operating in them redefines and reshapes those forces over time.”¹⁹ Knowing about these developments in the interaction environment and understanding the centre of historical development is a prerequisite for urban operations, which are determined by size, Triple-S²⁰ and complexity²¹.

1 METHODOLOGY

The methodology to deal with those comprehensive challenges must assist deep dives into the unknown to understand sometimes confusing interdependencies.

¹⁴ RTO STUDIES, ANALYSIS AND SIMULATION PANEL STUDY GROUP SAS-030, 2003. *Urban Operations in the Year 2020. Opérations en Zone Urbaine en l'An 2020*. [Elektronische Ressource]. Neuilly-sur-Seine. AC/323(SAS-030)TP. p. 7.

¹⁵ RICHEMOND-BARAK, D., 2018. *Underground warfare*. New York: Oxford University Press. pp. 1-36.

¹⁶ HOFER, P., 2018. Security unter Tage eine Fähigkeitslücke im Wirkungsverband der Anspruchsgruppen [online]. *BHM Berg- und Hüttenmännische Monatshefte*, **163**(12/2018), 540-544. Available from: 10.1007/s00501-018-0795-8

¹⁷ MILGRAM, P., H. TAKEMURA, A. UTSUMI, and F. KISHINO, 1995. Augmented reality: a class of displays on the reality-virtuality continuum. In: H. DAS, ed. *Telemanipulator and Telepresence Technologies*: SPIE, pp. 282-292.

¹⁸ WILLIAMS, P. and W. SELLE, 2016. *Military contingencies in megacities and sub-megacities*. Carlisle, PA: Strategic Studies Institute and U.S. Army War College Press. pp. 127-128.

¹⁹ SPILLER, R.J., 2003. Urban Warfare. Its History and Its Future. In: W.G. ROBERTSON and L.A. YATES, eds. *Block by Block. The Challenges of Urban Operations*. unkn.: Books Express Publishing, pp. 439-450. p. 446.

²⁰ Supersurface -Surface – Subsurface

²¹ HOFER, P., 2022. Improving Urban Operations by Integration. The NIKE Research and Development Program. In: N. GEGENHUBER and P. HOFER, eds. *#UOET22 Proceedings. Introducing the Urban Operations Support Cell*. Wiener Neustadt: Bundesministerium für Landesverteidigung.

A comprehensive research framework must be firmly tied to military science and its connections to relevant disciplines. Military science can be understood as the entirety of all scientific knowledge on the use and deployment of armed forces²². Jordan also mentions their overarching and interdisciplinary character: “*Military science is defined as a systemized body of knowledge regarding and relating to the theory, application, and employment of military units and weapons in land warfare (i.e. the conduct of war on land) and armed conflict encompassing issues related to the following areas: military leadership; military organization; military training and education; military history; military ethics; military doctrine; military tactics; operations, and strategy; military geography; and military technology and equipment.*”²³ Scharnhorst denoted the benefit of this knowledge for an officer, among other things, to be more capable of using the manuals appropriate to the situation and not only stick to the regulations contained therein²⁴. As the character how to wage war – inherent in every commander, every age, every theatre of operations – is not fixed and unconditional, conclusions of the probable must be drawn with caution from the quantity of the single aspects²⁵. Archduke Karl of Austria also mentioned the requirement of adaption and the necessity for commanders to reflect about historical examples and to train regularly²⁶.

As military performance depends upon quick adaptation to identified challenges, the reflection of current knowledge against the background of recent developments and experience is required. A methodology must be embedded into a comprehensive approach comprising various elements of interaction as offered by the Embrasive Leadership Model²⁷. Connected with risk management and interacting with Comprehensive Consequence Management and Dynamic Resilience Design it can provide valuable support in experimental capability development²⁸ considering the following requirements. By a combination of inductive, abductive, and deductive reasoning the hidden aspects of tacit knowledge should be continuously integrated into the research process. Sequenced elements should deal with a specific problem and observe it in a broader context from different perspectives to ascertain relevant interdependencies. The integration of elements of experimental research provides reliable near field-trials and ensures a wide applicability of the research results. Inter-actor interaction with relevant stakeholders

22 STUPKA, A., 2011. *Militärwissenschaften. Ihre Grundlagen und ihr System*. Wien: BMLVS. Schriftenreihe der Landesverteidigungsakademie. p. 414.

23 JORDAN, K.C., 2013. Military Science. In: G.K. PIEHLER, ed. *Encyclopedia of military science*. Los Angeles: SAGE reference, pp. 880-884. p. 881.

24 SCHARNHORST, G., 1986. *Ausgewählte militärische Schriften*. 1. Auflage. Berlin: Militärverlag der Deutschen Demokratischen Republik. Schriften des militärgeschichtlichen Instituts der DDR. p. 45-63.

25 Ibid. p. 332.

26 KARL VON ÖSTERREICH, E., 1808. *Grundsätze der höhern Kriegskunst und Beyspiele ihrer zweckmässigen Anwendung. für die Generale der Österreichischen Armee*. Wien: Kaiserl. Königl. Hof- und Staatsdruckerey. pp. 42-43.

27 HOFER, P., 2021. Embrasive Leadership. Ein Kompass für erfolgreiche Führung in einem paradoxen Umfeld. *Zeitschrift für Führung und Organisation*, **90**(5/2021), 337-339.

28 HOFER, P., 2018. Dynamischer Schutz. Embrasive Leadership im Rahmen der experimentellen Fähigkeitsentwicklung der Landstreitkräfte. *Österreichische Militärische Zeitschrift*, **56**(4), 451-461.

enables a comprehensive perspective and acceptance. As no military confrontation can be fully compared with another, adaptability to constant changes is a primary requirement. And last, but not least, building bridges from history via the present to visions of a future battlefield contributes to the future relevance of the research. The resulting methodology (fig. 1) combines a sequenced approach with parallel reflections on new operational evidence.

Let us first have a look at the sequenced elements. It all starts with a specific problem (#1) which can be dealt with depending on the available information. Zooming out to the broader context (#2) enables a better understanding of the specific problem on the one hand and better comprehension of its ties and interdependencies on the other hand. The creation of a scenario (#3) is crucial for explaining reasoning and purpose²⁹ of the research as well as aligning the efforts of the single contributions. Exercises offer an environment already close to operations (#4) and are therefore an essential step during applied research. As exercises are associated with a great deal of organizational effort, wargaming (#5) can be used to address arising topics more quickly. Reaching out to an interdisciplinary expert community (#6) enriches the scientific debate and speeds up the developments. Although suggesting an order, the elements are interchangeable, sometimes parallel and must adapt to the chaos, complexity, or disorder of wicked problems not only leaders³⁰ but also researchers are confronted with.

The abduction circle – integrated into the sequenced elements – assists in-depth comprehension and mitigates the effects of harmful innovations especially in the context of the cannibalization of traditional capabilities before innovations have proven themselves³¹. Active scanning of real-world examples provides new operational evidence (Receive Lessons Identified) which must undergo a thorough comparison of new OPFOR (OPposing FORces) approaches (Reconnoiter), the content of own up-to-date manuals (Revise) and forgotten – all too often – tacit knowledge (Relearn). The sound assessment of these three elements enables adoption followed by Lessons Learned to be Relay(ed). Especially the recent fighting in Ukraine and Israel showed the reemergence of tactics, techniques, and procedures (TTP's) well known from the past. Knowledge, we lost sight of due to different requirements in the past years, and which must be adapted to current operational environments also determined by technological developments (e.g., the extensive use of UAVs).

²⁹ Ibid. p. 454

³⁰ SNOWDEN, D.J. and M.E. BOONE, 2007. *A Leader's Framework for Decision Making* [online]. 7 December 2015, 12:00 [viewed 4 July 2022]. Available from: <https://hbr.org/2007/11/a-leaders-framework-for-decision-making>

³¹ KUO, K., 2022. Dangerous Changes: When Military Innovation Harms Combat Effectiveness [online]. *International Security*, 47(2), 48-87. Available from: 10.1162/isec_a_00446

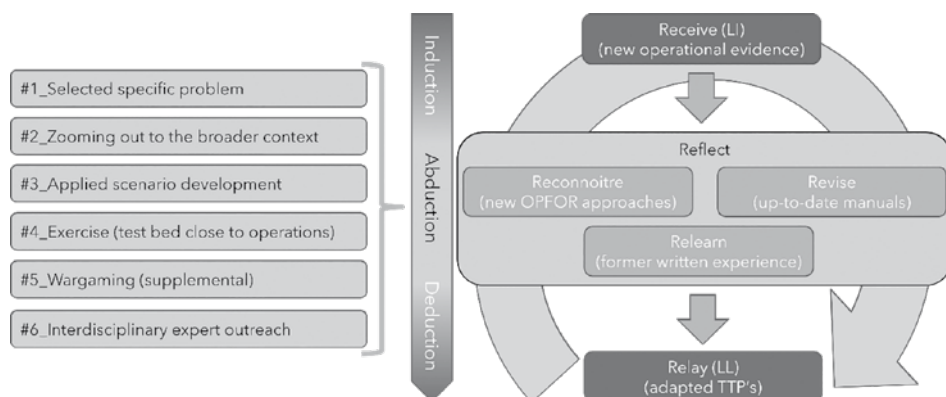


Figure 1: Methodology of Operational Capability Research in the context of the research project

Clausewitz defined four elements determining the nature of war: danger, physical exertion, uncertainty, and chance³². All of them can be found in urban operations, whereby uncertainty and chance need a special form of reasoning: “*Abduction is the process of forming an explanatory hypothesis. [...] Deduction proves that something **must be**; Induction shows that something **actually is** operative; Abduction merely suggests that something **may be**.*”³³ To that end, our methodology must offer the possibility to thoroughly reflect and contextualize the interplay between known facts, uncertain possibilities, and unknown futures. Or as described by Snowden and Boone – and applicable for researchers alike: “*Leaders who try to impose order in a complex context will fail, but those who set the stage, step back a bit, allow patterns to emerge, and determine which ones are desirable will succeed.*”³⁴ The Operational Capability Research methodology presented herein must not be mingled up with Operations Research. Whereas the latter is “*the application of scientific and especially mathematical methods to the study and analysis of problems involving complex systems*”³⁵ and therefore focuses on decision-making IN

³² CLAUSEWITZ, C. von, 1999. *Vom Kriege. Hinterlassenes Werk ; ungekürzter Text*. Neuausg. von UB 34799, 2. Aufl. Berlin: Ullstein. Ullstein-Buch. Nr. 26538. p. 67.

³³ PEIRCE, C.S., 1978. *Pragmatism and pragmaticism*. 4. print. Cambridge, Mass.: Belknap Press of Harvard Univ. Press. Collected papers of Charles Sanders Peirce / ed. by Charles Hartshorne. Vol. 5. p. 106.

³⁴ SNOWDEN, D.J. and M.E. BOONE, 2007. *A Leader's Framework for Decision Making* [online]. 7 December 2015, 12:00 [viewed 4 July 2022]. Available from: <https://hbr.org/2007/11/a-leaders-framework-for-decision-making>

³⁵ MERRIAM-WEBSTER, 3 Sep. 2023. *Online Dictionary* [online]. 3 September 2023, 12:00 [viewed 3 September 2023]. Available from: <https://www.merriam-webster.com/dictionary>. “operations research”.

an operation, the former deals with the qualitative capabilities (be)FOR(e) operations, although sub-disciplines of Operations Research can be useful in certain steps.

2 RESULTS / RESEARCH OUTPUT

With this methodology in mind, we can now formulate a research intent. According to a military intent – the concise description of the commander’s will how to accomplish a mission – ends, ways, and means are brought into line with the detailed research topics (fig. 2).

Element of Intent	Formulation
Own Designation	@rnd.ironnike
Type of Action	conducts research and development on urban operations
Essential Elements of Action	by application of the Operational Capability Research methodology
Designated Elements	with... - developing decision support (systems, processes) for the whole reality-virtuality continuum - adapting tactics, techniques & procedures for urban operations (main effort: subterranean) - integration of all three levels of ground movement (Supersurface, Surface, Subsurface)
Purpose	in order to improve the Austrian Armed Forces’ capabilities for urban operations
Explanatory Statement	because... - TASK: the future of warfare will be urban to a great extent - OPPONENT: will use the urban environment to his advantage - OWN: the AAF are currently not sufficiently prepared for urban operations - TERRAIN: the AAF are currently not prepared for the subterranean environment

Figure 2: The research intent has proven itself a perfect guideline for military scientific research

After setting the stage for the methodology, we will now have a look on the results, which will be presented along the sequenced elements already comprising the outcome of countless abduction circles.

2.1 The selected specific problem: lacking subterranean capabilities

Until 2018 the subterranean environment has been a blank space in the capabilities of the Austrian Armed Forces only marginally mentioned in field manuals. While preparing exercise SCHUTZ 2018 “A risk analysis conducted during the planning phase revealed several shortfalls in connection with the ability to operate effectively and efficiently in

Milestone #1 / Ex SCHUTZ 2018. "A risk analysis conducted during the planning phase revealed several shortfalls in connection with the ability to operate effectively and efficiently in subsurface environments."

*subsurface environments."*³⁶. At that time the US Army had intensified its engagement with the topic³⁷, and published the Army Techniques Publication 3-21.51, focusing on clearly hostile underground facilities^{38,39}. Also, the British Army dealt with the challenge⁴⁰ and Israel had an en-

during and still continuing experience with subterranean operations. Confronted with subterranean infiltration and smuggling at its borders for decades⁴¹ the Israeli Defence Forces have now specialists for engineering tasks in the underground at hand⁴². Conducting a wide range of related research including the foundation of the International Working Group on Subterranean Warfare⁴³ and going into detail as e.g. the experiences of soldiers in subterranean operations⁴⁴ the IDF demonstrates, that preparation is indispensable, as the future role of underground warfare will be „[...] relatively ubiquitous, dangerous for armed forces and civilians, and integrated into long-term strategies [...]“⁴⁵ and still requires a more operational and strategic approach to subterranean threats⁴⁶.

³⁶ HOFER, P., 2019. Coping with Complexity. The Development of Comprehensive SubSurface Training Standards from a Military Perspective [online]. *BHM Berg- und Hüttenmännische Monatshefte*, **164**(12), 497-504. Available from: 10.1007/s00501-019-00915-9. p. 498.

³⁷ MILLS, W., 2019. *The Elephant in the Tunnel: Preparing to Fight and Win Underground - Modern War Institute* [online]. 18 March 2019, 12:00 [viewed 13 November 2023]. Available from: <https://mw.westpoint.edu/elephant-tunnel-preparing-fight-win-underground/>

³⁸ COX, M., 24 Jun. 2018. *Army Is Spending Half a Billion to Train Soldiers to Fight Underground* [online]. 24 June 2018, 12:00. Available from: <https://www.military.com/daily-news/2018/06/24/army-spending-half-billion-train-troops-fight-underground.html>

³⁹ Headquarters Department of the Army. 3-21.51:2019, *Subterranean Operations*. Washington D.C. [viewed 30 October 2023]. Available from: https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ARN19656_ATP%203-21x51%20%20FINAL%20WEB.pdf

⁴⁰ LAND WARFARE CENTRE, 2020. *Subterranean Operations in the Urban Environment. Doctrine Note 20/05*. Wiltshire.

⁴¹ DOSTRI, O., 2019. *The Buildup of Forces for IDF Underground Warfare* [online]. 15 January 2019, 12:00 [viewed 10 November 2023]. Available from: <https://jiss.org.il/en/dostri-idf-underground-warfare/>

⁴² ISRAEL DEFENSE FORCE, 29 Oct. 2023. *Yahalom Unit* [online]. 29 October 2023, 12:00 [viewed 29 October 2023]. Available from: <https://www.idf.il/en/mini-sites/our-units/yahalom-unit/yahalom-unit/>

⁴³ THE INTERNATIONAL WORKING GROUP ON SUBTERRANEAN WARFARE, 19 Nov. 2023. *Homepage* [online]. 19 November 2023, 12:00 [viewed 19 November 2023]. Available from: <https://www.runi.ac.il/en/research-institutes/government/subtwg/>

⁴⁴ STERN, N., U. BEN-SHALOM, N. GOLD, C. BERGER, A. ANTONOVSKY, and D. PELEG, 2022. Tunnel Operations in the Israel Defense Forces: Adapting the Warrior Ethos to Post-Heroic Conflict [online]. *Armed Forces & Society*, **48**(2), 343-363. Available from: 10.1177/0095327X20924040

⁴⁵ RICHEMOND-BARAK, D., 2018. *Underground warfare*. New York: Oxford University Press. p. 53.

⁴⁶ RICHEMOND-BARAK, D. and S. VOICULESCU-HOLVAD, 2023. The Rise of Tunnel Warfare as a Tactical, Operational, and Strategic Issue [online]. *Studies in Conflict & Terrorism*, 1-20. Available from: 10.1080/1057610X.2023.2244191

Milestone #2 / Ex SCHUTZ 2019. A map exercise within a core research team of the Land Forces Command dealt with offensive maneuver in a bigger city.

The doctrinal situation in Austria was unsatisfying at that time. Only a few pages spread over several regulations, were insufficient for deploying soldiers into this extremely demanding environment. Whereas the

US then focused on military subterranean facilities and Israel was faced with smaller diameters, tunnels and drifts intended for smuggling and infiltration, our focus from the beginning have been subsurface service structures⁴⁷ which can be found in every urban environment and also in some rural – yes even remote alpine areas: “Existing underground service facilities include road and rail tunnels, urban subways, underground parking, canalisation as well as energy recovery, transport and storage sites. But also structures out of sight as abandoned traffic systems, former air-raid shelters or nuclear waste deposits are part of the subterranean environment.”⁴⁸ The Zentrum am Berg⁴⁹ was – and continues to be – the perfect partner and facility for applied research and development offering about five kilometers of subsurface structures of different size and quality representing the majority of structures (fig. 3) and covering all needs to develop the required military capabilities⁵⁰.

⁴⁷ HOFER, P., 2020. The SubSurface Operations Cell: High-value Asset for Decision-Making in Complex SubTerranean/SubSurface Operations [online]. *BHM Berg- und Hüttenmännische Monatshefte*, **165**, 666-672. Available from: 10.1007/s00501-020-01060-4

⁴⁸ HOFER, P., 2019. Coping with Complexity. The Development of Comprehensive SubSurface Training Standards from a Military Perspective [online]. *BHM Berg- und Hüttenmännische Monatshefte*, **164**(12), 497-504. Available from: 10.1007/s00501-019-00915-9. p. 497.

⁴⁹ MONTANUNIVERSITÄT LEOBEN, LEHRSTUHL FÜR SUB SURFACE ENGINEERING. ZAB [online]. *Zentrum am Berg* [viewed 29 October 2023]. Available from: <https://www.zab.at/>

⁵⁰ HOFER, P., 2020. Safety and Security Strategies for Subsurface Structures. Preparing Security Forces for Subsurface Operations. In: P. STURM, ed. *Tunnel Safety and Ventilation 2020. Virtual Conference: December 01 - 03, 2020*.



Figure 3: The Zentrum am Berg with different cross-sections and qualities of construction offers a perfect environment for research and development for subterranean operations from fully equipped road and railway tunnels via such similar to the London underground to narrow “Gaza Metro” style drifts. Pictures: Claudia Bendl (left) and author (middle, right).

The design of a battalion-sized task force with specialized elements (fig. 4) for deployment in wide-stretching, multi-level subterranean facilities of great penetration depths was the prerequisite to master complex subsurface operations. Those are characterised by a “[...] *simultaneous breakdown of essential functions (lighting, ventilation, sensing) due to a cyber-attack and ubiquitous threats from armed opponents thereby causing multiple cascading effects, extreme increases in mission duration and logistic demands. Mission accomplishment can be optimized using military techniques, tactics, and procedures.*”⁵¹ With improved understanding of the area of responsibility as an interconnected prism, it turned out as a rule of thumb, that one third of the forces in an urban environment should be capable of subterranean operations.

⁵¹ HOFER, P., 2020. The SubSurface Operations Cell: High-value Asset for Decision-Making in Complex SubTterranean/SubSurface Operations [online]. *BHM Berg- und Hüttenmännische Monatshefte*, **165**, 666-672. Available from: 10.1007/s00501-020-01060-4. p. 667.











Symbol	Specialised Element	Symbol	Specialised Element
	Command & Control Element		Water Element
	Information & Communications Element		Engineer Element
	Reconnaissance Element		Ventilation Element
	Supply & Transport Element		CBRN Element incl. Urban Search and Rescue
	Medical Element		Infantry Element

Figure 4: The elements of TF IRON NIKE, specialized for subterranean operations. The symbols contain the depiction of a tunnel cross-section

Complementary, special solutions could be developed as e.g. mobile brattices for ventilation⁵², blue-force tracking in GNSS-denied environments⁵³, human tracking and pose estimation⁵⁴, comprehensive training standards⁵⁵ and visualization aids like the Fast Tunnel Modelling Tool – FTMT⁵⁶ or the Subsurface Operations Mission Tool – SOMT⁵⁷.

⁵² HOFER, P., M. NÖGER, and M. EDER, 2022. Mobile Stoppings in Complex Subsurface Operations. In: N. GEGENHUBER and P. HOFER, eds. *#UOET22 Proceedings. Introducing the Urban Operations Support Cell*. Wiener Neustadt: Bundesministerium für Landesverteidigung.

⁵³ MASCHER, K., M. WATZKO, A. KOPPERT, J. EDER, P. HOFER, and M. WIESER, 2022. NIKE BLUETRACK: Blue Force Tracking in GNSS-Denied Environments Based on the Fusion of UWB, IMUs and 3D Models [online]. *Sensors (Basel, Switzerland)*, **22**(8). Available from: 10.3390/s22082982

⁵⁴ PERKO, R., H. FASSOLD, A. ALMER, R. WENIGHOFER, and P. HOFER, 2022. Human Tracking and Pose Estimation for Subsurface Operations. In: M. SEIDL, M. ZEPPELZAUER, and P.M. ROTH, eds. *Computer vision and pattern analysis across domains. Proceedings of the OAGM Workshop 2021 : November 24-25, 2021, University of Applied Sciences St. Pölten*. Graz: Verlag der Technischen Universität Graz.

⁵⁵ GALLER, R. and P. HOFER, 2021. ETU-ZaB. Entwicklung von Ausbildungs- und Trainingsstandards für Einsätze in kritischen Untertageinfrastrukturen - ZaB-Zentrum am Berg. In: BUNDESMINISTERIUM LANDWIRTSCHAFT, REGIONEN UND TOURISMUS, ed. *Wissenschaft(f)t Sicherheit. Studienband 5*. Wien: Gerin Druck GmbH, pp. 101-111.

⁵⁶ EDER, J. and L. HAGER, 2021. FTMT [software] [accessed 15 September 2023]. Available from: <https://www.laabmayr.at/tunnel-plus/rd/ftmt-fast-tunnel-modeling-tool/>

⁵⁷ EDER, J. and L. HAGER, 2022. SOMT [software] [accessed 30 October 2023]. Available from: <https://www.laabmayr.at/tunnel-plus/rd/somt-subsurface-operation-mission-tool/>

2.2 Zooming out to the broader context: Mastering the urban operations environment

Dealing with the subterranean environment increased our understanding of the urban environment and enabled a critical reflection of what “urban” really means. Up to now, platoons or companies went to training sites consisting of a handful of single, maybe two-storey buildings using training ammunition and pretending to prepare for urban operations. The message could not have been more misguided and – bluntly said – simply wrong. Soldiers and junior commanders, motivated and keen on the rare possibilities, tried to make maximum use of the built-up terrain and forgot about the broader context - including ethical, moral, legal, health and safety issues – due to the lack of realism and life.

In this regard it seems necessary to refine the definition of “urban”. King states that *“Urban warfare occurs, therefore, in large, dense and diverse human settlements.”* and puts his statement into perspective by pointing out that the urban threshold is reached with 3000 inhabitants⁵⁸. Austrian military terminology refers to urban in the context of complex interconnected systems of significant size and different composition⁵⁹. If the subterranean system is not usable for movement, tanks are not really restricted in manoeuvring and engaging their weapons, communication and mutual support is not restricted by building density, and a paper map offers sufficient level of detail, we should not talk about urban areas but classify it as built-up terrain (fig. 5): *“Complex urban scenarios are determined by the size of the urban system and the number of subsystems, the scale of forces and the fighting style of an opponent, the negative effects on the functionality of the urban system as well as the extent of the operational area (in all three dimensions!) and, due to multi-layered interdependencies, no longer allow a prediction regarding the development of events - the cooperation of all relevant actors is essential.”*^{60, 61}

⁵⁸ KING, A., 2021. *Urban warfare in the twenty-first century*. Cambridge, UK: Polity. pp. 19-20.

⁵⁹ BUNDESMINISTERIUM FÜR LANDESVERTEIDIGUNG, currently updated. *Terminologiedatenbank* [online]. *Begriffliste* [viewed 29 August 2023]. „urbanes Umfeld“.

⁶⁰ HOFER, P., 2023. *The Quadruplicity of Future Military Command* [online]. *Urbanization, Digitalization, Artificial Intelligence and Mission Command*. 17 January 2024, 12:00 [viewed 25 January 2024]. Available from: https://www.milak.at/fileadmin/milak/InstOWB/UEET/_UEET23_Proceedings/2023_HOFER_Quadruplicity_of_Future_Military_Command.pdf. p.2.

⁶¹ HOFER, P., 2022. *Interdisziplinäre Weiterbildung für Einsätze im urbanen Umfeld* [online]. *BHM Berg- und Hüttenmännische Monatshefte*, 582-586 [viewed 30 December 2022]. Available from: 10.1007/s00501-022-01305-4

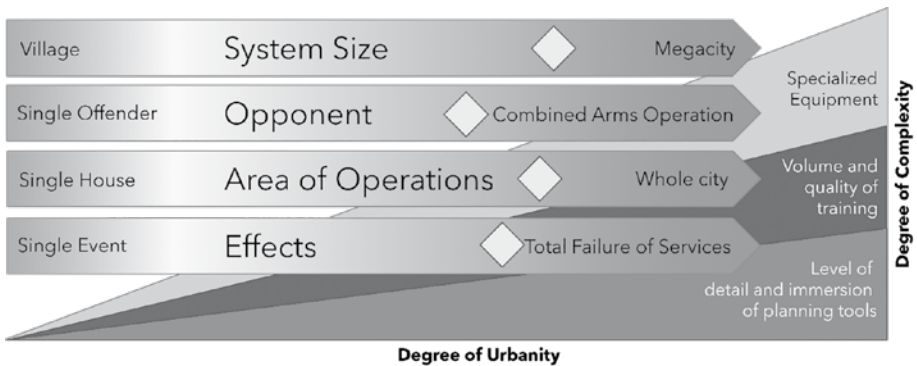


Figure 5: Classification aid for complex urban operations. The more we move the slider controllers to the right, the more complexity the urban environment holds (illustration: author based on⁶²).

2.3 Applied Scenario Development: Maneuver in the urban environment

The complex "DREIKÖNIG" scenario⁶³, developed as benchmark and reference for the IRON NIKE research and development program⁶⁴, needed a real-world complementary. Set in a provincial capital with over 200.000 inhabitants, comprising associated challenges and all the wicked problems of an urban conglomeration this scenario enabled

Milestone #3 / Developing a scenario in a provincial capital with over 200.000 inhabitants, comprising associated challenges and all the wicked problems of an urban conglomeration enabled us to contextualize the term "urban" correctly within the training of staff officers.

the correct contextualization of the term "urban" in the training of staff officers and the newly designed "Urban Operations Course" for battalion and brigade level. This also included the revision of manuals containing planning assumptions (e.g., timings) which are obviously not fully applicable as recent examples show.

⁶² HOFER, P., 2022. Interdisziplinäre Weiterbildung für Einsätze im urbanen Umfeld [online]. *BHM Berg- und Hüttenmännische Monatshefte*, 582-586 [viewed 30 December 2022]. Available from: 10.1007/s00501-022-01305-4. p. 583.

⁶³ HOFER, P., 2021. Komplexe Einsätze unter Tage [online]. *Truppendienst*, (381), 221-228 [viewed 27 January 2022]. Available from: <https://www.truppendienst.com/themen/beitraege/artikel/komplexe-einsaetze-unter-tage>

⁶⁴ HOFER, P., 2022. Improving Urban Operations by Integration. The NIKE Research and Development Program. In: N. GEGENHUBER and P. HOFER, eds. *#UOET22 Proceedings. Introducing the Urban Operations Support Cell*. Wiener Neustadt: Bundesministerium für Landesverteidigung.

Milestone #4 / Apprehending the urban environment requires expert knowledge and visualization tools within a Digital Headquarters.

Understanding cities requires a deep dive into its various dimensions⁶⁵ including the hidden aspects of the collective identity comprising of infrastructure, experience, and socio-cultural aspects⁶⁶ understanding that it is “[...] a living organism that flows and breathes[...]”⁶⁷. Such insights connect-
ed previous research⁶⁸ and improved the understanding of the urban environment in combination with visualization tools for subterranean⁶⁹ and urban environments⁷⁰ along with the specialist support of an Urban Operations Support Cell (UOSC)⁷¹ in a Digital Headquarters.

2.4 Exercise (test bed close to operations): Exercises EISENERZ22 & STEINFELD23

Milestone #5 / Ex EISENERZ 22: The combination of training and simultaneous research was a pivotal step to improve experimental capability development as a core task of applied military sciences.

EISENERZ22 (EE22) was set within a real-world environment combining the city of Eisenerz and the Zentrum am Berg research facility⁷². The combination of training and simultaneous research was a pivotal step to improve experimental capability development as a core task of applied military sciences. Within the IRON NIKE research activity all

⁶⁵ PYTLAR, A. and B. TERRAZAS, 2022. GENETICS. An Urban Stability Framework. In: N. GEGENHUBER and P. HOFER, eds. #UOET22 Proceedings. Introducing the Urban Operations Support Cell. Wiener Neustadt: Bundesministerium für Landesverteidigung.

⁶⁶ HOFER, P., 2024. Mission: COMANND. Conceptualizing an AI Assistant for Decision-Making. In: J. MAZAL and ET.AL., eds. *Modelling and Simulation for Autonomous Systems 2023*, accepted for publication.

⁶⁷ KILCULLEN, D., 2015. *Out of the mountains. The coming age of the urban guerrilla*. London: Hurst & Company. p. 19.

⁶⁸ HOFER, P., 2014. *Die Bedeutung der geschichtlichen Entwicklung für ein umfassendes Konfliktverständnis am Beispiel des Libanon unter besonderer Berücksichtigung der Kohlenwasserstoffe*. Dissertation. Graz.

⁶⁹ HOFER, P., C. STRAUSS, R. WENIGHOFER, J. EDER, and L. HAGER, 2020. Die Rolle von Virtual Reality in der Bewältigung militärischer Einsätze unter Tage. In: J. STROBL, B. ZAGEL, G. GRIESEBNER, and T. BLASCHKE, eds. *AGIT Journal für Angewandte Geoinformatik*. Berlin: Wichmann, pp. 126-131.

⁷⁰ HOFER, P., R. JANKO, F. IBRAHIM, and J. EDER, 2023. Decision Support within Complex Urban Operations. In: NATO MODELLING AND SIMULATION GROUP, ed. *Going Beyond the Limitations of the Real World. Meeting Proceedings RDP*: NATO Science and Technology Organization, 15-1 - 15-11.

⁷¹ HOFER, P., 2022. Interdisziplinäre Weiterbildung für Einsätze im urbanen Umfeld [online]. *BHM Berg- und Hüttenmännische Monatshefte*, 582-586 [viewed 30 December 2022]. Available from: 10.1007/s00501-022-01305-4

⁷² THERESIAN MILITARY ACADEMY, 2022. *Ausbildungsübung EISENERZ* [online]. 22 July 2022, 12:00 [viewed 13 November 2023]. Available from: <https://www.milak.at/eisenerz2022>

Milestone #6 / Ex STEINFELD23:

The showdown with a brigade-sized attack into an industrial urban environment of a lively city has very much challenged all exercise participants and offered valuable insights into the current understanding of urbanity among commanders and soldiers.

partners joined, tested, and demonstrated their developments achieved so far contributing to an improved common understanding of the operational requirements⁷³. EE22 was also a valuable experience for the evaluation of the field-manual for subterranean operations before being published⁷⁴ by embedding it into the urban operations framework and initiated the SubSurface Operations Cell's⁷⁵ evolution to the UOSC.

Exercise STEINFELD23 (SF23) was the recent climax in improving the urban operations capability. Set in and around the city of Wiener Neustadt, the exercise enabled the cooperation with civilian authorities and emergency services countering a demanding scenario. Designed as a hybrid training environment, and seamlessly linking virtual and real elements from brigade down to platoon level *“Many of the gaps identified in the current training estate can be addressed by employing simulation to augment live training, or to provide a fully synthetic alternative where this is not available or feasible.”*⁷⁶ The demonstrator of the S³OMT^{77,78} was a major asset in this synthetic exercise and used to visualize all participating research activities.

The showdown with a brigade-sized attack into an industrial urban environment of a lively city⁷⁹ has very much challenged all exercise participants and offered valuable insights which assets it takes to fulfil a task within an urban “prism of responsibility”.

Urban operations are characterized by positional fight, frequent displacements, and permanently unexpected firefights with an opponent in the rear and the flanks⁸⁰ and tend to disintegrate into a series of small-scale fighting with limited mutual support⁸¹. To

⁷³ IRON NIKE RESEARCH AND DEVELOPMENT GROUP, 2022. *IRON NIKE Research and Development Activity 2022. Nachhaltige Interdisziplinarität bei Komplexen Einsätzen*. youtube channel @Theresianische Militärakademie. NIKE.

⁷⁴ Bundesministerium für Landesverteidigung. DV BH 1001.30:2022, *Einsatz unter Tage*. Wien.

⁷⁵ HOFER, P., 2020. The SubSurface Operations Cell: High-value Asset for Decision-Making in Complex SubTerraanean/SubSurface Operations [online]. *BHM Berg- und Hüttenmännische Monatshefte*, **165**, 666-672. Available from: 10.1007/s00501-020-01060-4

⁷⁶ SMITH, M. and D. ROBSON, 2023. A Concept for the Modelling and Simulation of Complex Urban Environments. In: NATO MODELLING AND SIMULATION GROUP, ed. *Going Beyond the Limitations of the Real World. Meeting Proceedings RDP: NATO Science and Technology Organization*, 21-1 – 21-17. p. 21-7.

⁷⁷ Triple-S (Supersurface/Surface/Subsurface) Operations Mission Tool

⁷⁸ EDER, J. and L. HAGER, 2023. S3OMT [software].

⁷⁹ THERESIAN MILITARY ACADEMY, 2023. *Ausbildungsübung STEINFELD23* [online]. 17 July 2023, 12:00 [viewed 28 October 2023]. Available from: <https://www.milak.at/steinfeld23>

⁸⁰ Bundesministerium für Landesverteidigung. DV BH 2311.01:2016, *Das Jägerbataillon*. p. 80.

⁸¹ Bundesministerium für Landesverteidigung. DV BH 1001.29:2011, *Besondere Gefechtstechniken für den Einsatz im urbanen Umfeld*. Wien. p. 23.

achieve the necessary flexibility to accomplish quickly changing tasks requires an organization based on the company level with organic assets at hand and capable of reducing the cognitive burden for junior commanders⁸². Such organic assets as heavy weapons, mortars, engineers, CBRN, and UAV must be available at the edge, specialised for the urban fight, broader in capabilities and lighter in equipment and yet still have sufficient protection. This requires more purpose-built equipment and tools as for example a specialized urban operations vehicle - UOV⁸³ or visualization aids⁸⁴ assisting to reduce the cognitive burden as e.g., the S³OMT - Triple-S Operations Mission Tool⁸⁵. Deploying elements into subterranean spaces calls for special attention to equipment and training⁸⁶. The character of an atrocious urban battle produces rubble and ash and creates simple environmental conditions. Although the remnants of infrastructure could be available, the functionality of environmental support systems (heating, running water, sewage system, electricity, etc.) could be severely restricted or missing. Harmful effects of concrete dust, blast fumes, and other hazards affecting soldiers, emergency forces and residents alike, must be considered. Evaluating the electronic signatures from exercises, Broyles and Richter suggest training headquarters for establishing urban command posts in such environments, thereby also reducing the signal footprint⁸⁷.

Successful military campaigns in an urban environment are not only about kicking doors but must comprise the orchestrated engagement of all relevant actors. The saturation of the urban “prism of responsibility” must also include to wage a cognitive war combining defensive measures, counter narratives, and offensive activities in which legal aspects play a significant role⁸⁸. With a significant number of residents affected, it is of vital importance to understand, that successful military action in urban environments is a comprehensive, joint, and consistent effort to achieve cognitive superiority⁸⁹.

⁸² LYLE, S., 18 Aug. 2023. Creating a Unit Optimized for Urban Warfare [viewed 18 October 2023]. 11:50 – 24:10. Available from: <https://mwi.westpoint.edu/creating-a-unit-optimized-for-urban-warfare/>

⁸³ HOFER, P. and C. KNIGHT, 2024. Conceptualizing an Urban Operations Vehicle within a Comprehensive Research and Development Program [online]. *SAE International Journal of Connected and Automated Vehicles*, 7(1), 53-67 [viewed 29 March 2024]. Available from: 10.4271/12-07-01-0005

⁸⁴ HOFER, P., J. EDER, and C. STRAUSS, 2022. Decision Support within Complex Subterranean Operations. In: NATO MODELLING AND SIMULATION GROUP, ed. *Towards Training and Decision Support for Complex Multi-Domain Operations. Meeting Proceedings RDP*: NATO Science and Technology Organization.

⁸⁵ HOFER, P., R. JANKO, F. IBRAHIM, and J. EDER, 2023. Decision Support within Complex Urban Operations. In: NATO MODELLING AND SIMULATION GROUP, ed. *Going Beyond the Limitations of the Real World. Meeting Proceedings RDP*: NATO Science and Technology Organization, 15-1 - 15-11.

⁸⁶ Bundesministerium für Landesverteidigung. DVBH 1001.30:2022, *Einsatz unter Tage*. Wien.

⁸⁷ BROYLES, C.A. and C. RICHTER, 2023. Concrete Command [online]. Why Combat Training Centers Should Prioritize Training on Urban Command Posts. *Military Review*, (July-August 2023), 12-19. Available from: <https://www.armyupress.army.mil/Portals/7/military-review/Archives/English/JA-23/Concrete-Command/Broyles-concrete-command-UA.pdf>

⁸⁸ MILLER, S., 2023. Cognitive warfare: an ethical analysis [online]. *Ethics and Information Technology*, 25(3). Available from: 10.1007/s10676-023-09717-7

⁸⁹ SCHULYOK, B., L. GRANGL, and M. GRUBER, 2023. *A Primer On The Functional Trinity Of The Information Environment* [online]. Available from: <https://www.thedefencehorizon.org/post/trinity-information-environment-1?lang=de>

2.5 Wargaming (supplemental): Putting it to the test

A wargaming series accompanied and completed research in various stages using table-top wargames, virtual simulation (Steel Beasts Pro PE and Professional), constructive simulation (CAE), and science-fiction proto-typing. The main parameters of the wargaming possibilities and their contribution during our research are depicted in fig. 6.

Type of Wargame	Participants	Typical time requirement	Contribution	Level of detail perception
Table-top wargaming	teams	60' - 120'	planning	low
	<i>Strengths:</i> easily set up (either purpose driven or as board game), synchronisation of movement and mutual support			
Virtual simulation	solitaire - BN	120' - 240'	current operations	high
	<i>Strengths:</i> combination of battalion tactics with procedures on company and platoon level, high level of detail for all participants (map view and 1st person view) with limitation in dismounted close quarter battle.			
Constructive simulation	HQs (BN, BDE)	240' - 480'	current operations	medium
	<i>Strengths:</i> current operations at brigade and battalion level with limited explanatory power on urban environments			
Science-fiction storytyping	solitaire	Hours - days	future developments	very high
	<i>Strengths:</i> developing possible futures, detailed description of solutions and their interaction			

Figure 6: Typical wargaming characteristics (illustration: author)

Whereas wargaming for research purposes is a well-established method⁹⁰ and has already been used for more objective force structure assessments⁹¹, science-fiction proto-typing seems somewhat unfamiliar at first glance. But it proved to be a bridge into the future and enabled, along with demanding scenarios, a more focused research and development process in collaboration with our partners. *“Wargaming is an act of communication. Designing a wargame is more akin to writing an historical novel than providing an algebraic theorem.”*⁹² Johnson makes a point by referring to the movie *WarGames* as a kind of science-fiction prototype being *“[...] a short story, movie or comic based specifically on a science fiction fact for the purpose of exploring the implication, effects and ramifications of that science or technology.”*⁹³ To that end and within the IRON NIKE research and development program science-fiction proto-typing has been used for

⁹⁰ BURNS, S., 2015. *War Gamers’ Handbook. A Guide for Professional War Gamers.* Newport.

⁹¹ EVENSEN, P.-I., S.E. MARTINUSSEN, M. HALSØR, and D.H. BENTSEN, 2022. Simulation-Supported Wargaming for Assessing Force Structures [online]. *Scandinavian Journal of Military Studies*, 5(1), 323-333. Available from: 10.31374/sjms.128

⁹² PERLA, P., 2022. *The Art of Wargaming. A Guide for Professionals and Hobbyists.* unkn. p. 173.

⁹³ JOHNSON, B.D., 2011. *Science fiction proto-typing. Designing the future with science fiction.* San Rafael, Calif.: Morgan & Claypool. Synthesis lectures on computer science. 3. p. 2-3.

conceptualizing an urban operations vehicle⁹⁴ or an AI agent for decision-making⁹⁵. War-gaming combines different perspectives on a timeline enabling a more future oriented approach to research and development. Although the introduction of new technologies poses a challenge for a game maker in terms of disjointed layering dependencies of rules, it offers the possibility to identify and describe its potentials⁹⁶ supporting abductive reasoning: “*Command in strategy and tactics requires abductive logic – an ability to think and make decisions based on the constant presence of unknowns and unknowable things that may never appear in a historical dataset or past experience.*”⁹⁷

2.6 Interdisciplinary expert outreach: #UOET and UOSC

Reaching out to experts and the scientific community is important for broadening the basis and to challenge the own hypotheses within an academic discussion. This can be achieved within training, conferences, and expert groups. Staff officers on training already have a lot of knowledge in their respective area and provide additional building blocks with their expertise and experience. The connection with industry partners among the research teams is also highly valuable increasing the speed of development. The Urban Operations Expert Talks - #UOET⁹⁸, first initiated in 2022 are the ideal platform for connecting with experts on interdisciplinary issues regarding urban operations being an essential element of the continuation program.

The UOSC (Urban Operations Support Cell) is a group of experts from various fields which consists largely of experts in civil engineering to support headquarters in better understanding the urban operations environment⁹⁹ and assists the outreach within the scope and daily business of its members.

⁹⁴ HOFER, P. and C. KNIGHT, 2024. Conceptualizing an Urban Operations Vehicle within a Comprehensive Research and Development Program [online]. *SAE International Journal of Connected and Automated Vehicles*, 7(1), 53-67 [viewed 29 March 2024]. Available from: 10.4271/12-07-01-0005

⁹⁵ HOFER, P., 2024. Mission: COMANND. Conceptualizing an AI Assistant for Decision-Making. In: J. MAZAL and ET.AL., eds. *Modelling and Simulation for Autonomous Systems 2023*, accepted for publication.

⁹⁶ HOFER, P., 2024. Mission: COMANND. Conceptualizing an AI Assistant for Decision-Making. In: J. MAZAL and ET.AL., eds. *Modelling and Simulation for Autonomous Systems 2023*, accepted for publication. p. 52.

⁹⁷ HUNTER, C. and B.E. BOWEN, 2023. We'll never have a model of an AI major-general: Artificial Intelligence, command decisions, and kitsch visions of war [online]. *Journal of Strategic Studies*, 1-31. p. 19. Available from: 10.1080/01402390.2023.2241648

⁹⁸ IRON NIKE RESEARCH AND DEVELOPMENT GROUP, 2023. *Urban Operations Expert Talks* [online] [viewed 28 October 2023]. Available from: <https://www.milak.at/nike/uoet>

⁹⁹ HOFER, P., 2022. Interdisziplinäre Weiterbildung für Einsätze im urbanen Umfeld [online]. *BHM Berg- und Hüttenmännische Monatshefte*, 582-586 [viewed 30 December 2022]. Available from: 10.1007/s00501-022-01305-4

3 DISCUSSION

As demonstrated by the description of the sequenced elements, the methodology fulfils the requirements, and the following definition can be introduced:

Operational Capability Research is a military science methodology using

- inductive, abductive, and deductive reasoning
- sequenced elements dealing with a specific problem and its broader context, interdependencies, and different perspectives,
- experimental elements as exercises and wargaming,
- interdisciplinary interaction with relevant stakeholders,
- adaptability by real-time integration of new operational evidence,
- and bridges between history, present and visions of a future battlefield,

to enable mission-oriented research and development.

The combination of inductive, abductive, and deductive reasoning offers possibilities to reflect upon the hidden aspects. A perspective going beyond the state-of-the-art by incorporating tacit knowledge neutralizes harmful innovations founded on superficial enquiry or wishful thinking. Of course, one could reply, that those older pieces of knowledge are the starting point of any development anyway and therefore sufficiently considered. But changing requirements and tasks also shift perspectives, alter tactics and procedures, and displace proven practice. The use of sequenced elements dealing with a specific problem and its broader context helps identifying interdependencies from different perspectives. The definition of a complex and challenging scenario resolves the typical shortfalls of stove-piped research and development activities in isolation by changing to the mission-oriented “field laboratory”. Exercises and wargaming are comprehensive environments for applied research and development and foster capability development. In combination with robust scenarios, they provide demanding research and development environments and drive innovation. As field training exercises in the open terrain are often restricted to cut-outs of the urban terrain, visualization and synthetic training settings are of particular interest. Permanent interaction and collaboration across the boundaries of disciplines in the research team and with relevant stakeholders ensure comprehensive and targeted activities. To cope with the manifold challenges of urban operations – including also ethical, moral, legal and health issues – interdisciplinary collaboration is a prerequisite. It does not really make a difference between main and secondary training audiences as every soldier, emergency personnel and operator in this comprehensive environment can assume a decisive role at any time. New operational evidence must be integrated in real-time also regarding the floating research topic and the rapidly growing knowledge base. The triad of relearning, revision, and reconnoitring is extremely powerful to assist the required adaptability. A comprehensive approach is needed to succeed in the most difficult setting of an urban operation, and research activities can therefore be initiated and driven by military science being interdisciplinary by nature.

CONCLUSION

Most experts believe that urban operations will gain importance in the future. Although we have sufficient experience at hand, we still struggle with the development of the necessary skills and capabilities. Fighting in isolated “prisms of responsibility” requires highly specialized forces with enablers and purpose-built equipment at hand and well-trained commanders exercising mission command and understanding their role, task, and the purpose of action. Mastering the urban environment on all three levels of ground movement is a very challenging task and requires focused attention on various aspects, inter-actor interaction and interdisciplinary research and development – indispensable in developing the associated capabilities.

The development of an interdisciplinary methodology suitable for looking into the hidden aspects and contextualizing them with current activities and future developments is a key in developing urban operations capabilities. Operational Capability Research proves to be a well-suited military science methodology, combining sequenced elements with continuous circles of abductive reasoning. This combination contributes to a clearer picture and helps aligning purpose and activities by addressing aspects of past tacit knowledge, recent events, and possible futures.

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