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Improving Urban Operations by Integration.
The NIKE Research and Development Program.

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Abstract: Urban operations are without doubt amongst the most difficult military operations and there is a common understanding that the necessity to accomplish such missions will increase in the future. The NIKE program has integrated a great variety of research activities in developing the capabilities for subterranean operations. Being the most challenging part within the triple S (supersurface – surface – subsurface) urban environment, these capabilities are already an added value and currently enable shifting the focus on the needs of future urban operations.

Key Words: urban operations, research & development, triple-S (supersurface – surface – subsurface)

1. Introduction – requirements of urban operations

Urban operations are without doubt amongst the most difficult military operations and there is a common understanding that the necessity to accomplish such missions will increase in the future. In the Austrian Armed Forces, priority has been given to the development of capabilities to operate in the urban environment as THE operational area of the future (Bundesministerium für Landesverteidigung 2021, p. 9). Military operations in an urban setting require highly skilled soldiers, sophisticated equipment and specialized training considering a variety of aspects and knowledge. Traditionally, military training comprises aspects of fighting in built-up areas, but as typical training areas are limited in size, have a few one- and two-story buildings and mostly represent a small village or town the requirements of engagements in big cities are not really reflected in training to the full extent. And – although providing perfect training environments – yet big training areas as Schnöggersburg (Deutsche Bundeswehr 2017) do not represent the environment of a multi-million metropolis but only offer cutouts. Urban areas have been growing horizontally and vertically and multiplied their layout in every respect (King 2021, pp. 66–72), operating under such circumstances requires a good apprehension of the environment as unexpected developments and cascading effects lead via disorder and chaos into complex situations characterized best by the CYNEFIN framework (Snowden and Boone 2007). Therefore, there is a big difference between operational reality and training possibilities. To comprehend the requirements of urban operations the following aspects must be considered:

- **Urban means size**. Soldiers, units and staffs must be made familiar with urban size because military training ranges do not represent those urban environments as they focus on infantry fighting and close-quarter battle.
- **Urban means complexity**. Conducting urban operations must consider a lot more factors and actors than mechanized maneuver in open terrain against a clearly identified opponent.
- **Urban means triple S**: The urban environment must take all three levels of ground movement (Triple S: supersurface – surface – subsurface) into account.

To cope with such challenges requires adaption of armed and other emergency forces as stated by the British Defence Science and Technology Laboratory (dstl) very clearly by writing that

> *"The military will likely have to change its roles and structure to reflect the growing prominence and changing nature of the urban environment. For example, the possibility of task organising a proportion of the UK military to be optimised for urban operations should be given strong consideration." (Bogan et al. 2020, p. iii)*

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2. The path – factors and methods for improvement

Successful mission accomplishment in urban environments is heavily dependent on the interaction of a variety of actors and factors to be considered in a common framework and an interdisciplinary approach (Hofer 2018b, p. 542). Academia, industry, emergency forces, operators and the inhabitants affected must be integrated into the loop of information and action. Effective interaction of those actors pursues three essential core requirements regarding strategically important infrastructure: to prevent failures as far as possible, minimize the extent of damage of occurring events and restoration as quickly as possible - in other words, the infrastructure should be as resilient as possible. Close coordination between all players is essential if hybrid threats are to be countered effectively (Hofer 2018b, p. 543).

To succeed in this floating environment, a methodical approach had to be found which would integrate (1) an experimental capability development, (2) a comprehensive leadership model and (3) a tool for understanding dynamics in triple S structures. This integrated approach reflects the idea of command:

> *"It involves one decisive and unique responsibility: mission definition. However, because a commander is responsible for mission definition, command necessarily incorporates two further executive functions: the management of the mission and its designated tasks, and leadership - the motivation of subordinates." (King 2019, p. 69)*

Experimental capability development optimizes the armed forces regarding personnel, materiel, and training to ensure operational readiness based on previous experiments (Hofer 2018a, 456).

Experienced embracive leaders master difficult conditions, grasp the strategic environment, identify interfaces with other actors in the comprehensive environment and adapt the efforts of their own organization sustainably in their own operational space. Although sounding so logical and building on proven blocks, one must note that it must be learned through experience (Hofer 2021, p. 339).

> *"The S6-model (Safety and Security Strategies for Sub-Surface Structures) was designed to fit into this Embracive Leadership Model and encompasses activities and principles to succeed in an extremely challenging, complex underground scenario by considering six acitvities […] describing WHAT to do and six principles […] HOW to act." (Hofer 2020a, p. 3)*

Interaction of stakeholders in the sense of motivation before a crisis is important, success is built on this experience - this also applies to research projects, where experience in collaboration across various field improves the quality of the research significantly. Another important aspect of motivation is to address various groups of persons and interests using an integrated three-level didactic approach (table 1).

Table 1: Three-Level didactic approach

Level	Capability to	Means of presentation
Craft level	Identify	Picture / appearance
Leadership level	Decide	Sketch / description of function
Trainer Level	Understand	Detailed information

3. Joining Efforts – the NIKE Research & Development Program

The NIKE research and development program (figure 1) is an interdisciplinary effort in joining the expertise needed for urban operations of the above-mentioned actors and factors into a holistic approach with common goals and purpose and coordinate the efforts of different research projects (table 2). Within three lines of development, NIKE research and development group is heading for the following goals: (1) the experimental development of tactics, techniques and procedures within training and exercising, (2) the implementation of the Urban Operations Support Cell and development of the manual for "Subterranean Operations" and (3) the development of an XR environment for operations and training. Full operational

capability of a battalion task force for operations in a subterranean environment was the initial purpose. After completion of the concept and the manual this purpose could be shifted to complex urban operations.

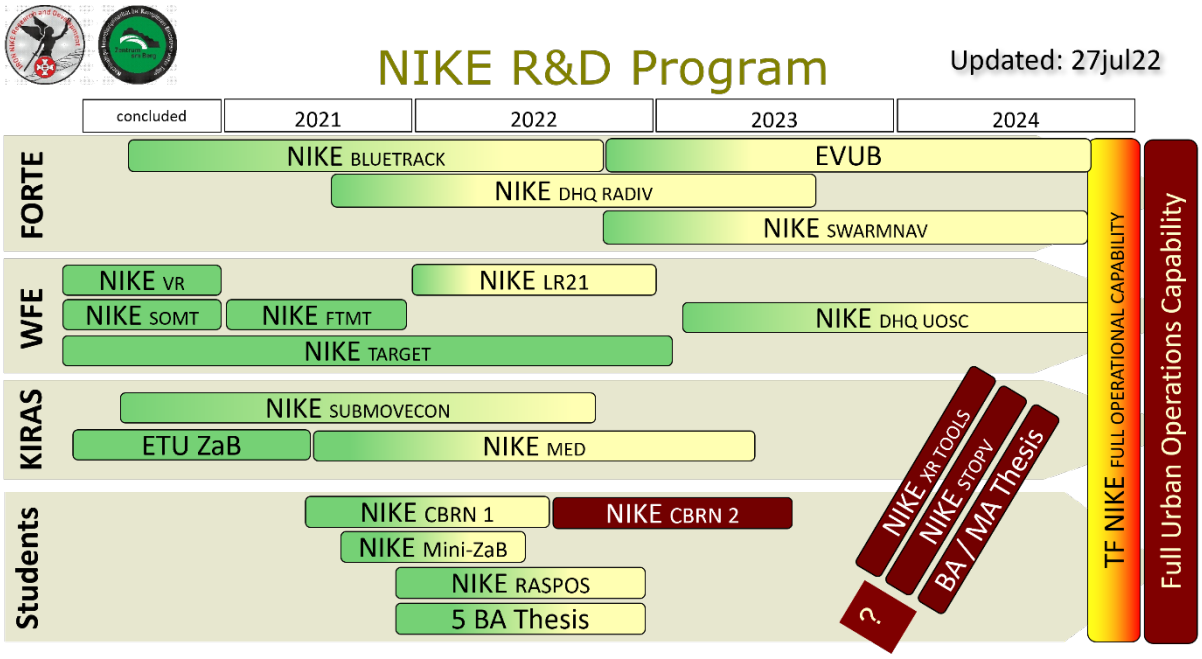

Figure 1: The NIKE research and development program comprises a set of different but interdependent research projects aiming at a common objective (green: concluded, green-yellow: ongoing, red horizontal: proposal submitted, red diagonal: planned / not allocated).

4. Results and Action Items

The IRON NIKE Research Activity and the Urban Operations Expert Talks 2022 both provided a framework for the above-mentioned development by provision of pictures about operational needs for the research partners and at the same time giving the possibility to conduct field-tests with the current research developments. The combination of an annual field training exercise with integrated research constitutes a cycle of continuous development. Furthermore, conducting more exercises on non-military training areas put troops and systems on the test within a lifelike environment and provide valuable insights outside of the laboratory:

> *"A deep understanding of context, the ability to embrace complexity and paradox, and a willingness to flexibly change leadership style will be required for leaders who want to make things happen in a time of increasing uncertainty." (Snowden and Boone 2007)*

The **SSOC (SubSurface Operations Cell)** – initially designed for subterranean operations (Hofer 2020b, p. 668) was a major step then and is now the perfect foundation for the **UOSC (Urban Operations Support Cell)**, combining military and civil background and providing specialized advice for headquarters concerning risks and dangers as well as the capability of integration and visualization of all relevant data sources contributing to a truly comprehensive Common Operational Picture by application of the **RA**pid **D**ata **I**ntegration and **V**isualization (RADIV) process.

A great deal of success has been achieved in the past years, as referenced in the project descriptions (table 2).

Table 2: Description of the projects in the NIKE research & development program.

FORTE (Austrian Defence Research Program)	
NIKE BLUETRACK	**BLUE**force **TRACK**ing blue force tracking for GNSS – denied environments (Mascher et al. 2022)
NIKE DHQ – RADIV	**D**igital **H**ead**Q**uarters **– RA**pid **D**ata **I**ntegration and **V**isualization integration and visualization of heterogenous data for decision-making (Hofer et al. 2022a)
NIKE SWARMNAV	**SWARMNAV (SWARM NAV**igation**)** autonomous UAS-UGV swarm navigation in GNSS-denied environments
EVUB	**E**rfassung und **V**isualisierung **U**nterirdischer **B**ewegungsräume capture and visualization of underground movement spaces for urban operations
WFE (Austrian Military Research Grants)	
NIKE LR21	**L**ecture **R**oom **21** development of an interdisciplinary training environment (Hofer et al. 2021a)
NIKE VR NIKE SOMT	**V**irtual Reality **/ S**ubsurface **O**perations **M**ission **T**ool Command and Control System for subterranean operations (Hofer et al. 2022b)
NIKE FTMT	**F**ast **T**unnel **M**odelling **T**ool quick modelling of XR-capable models for subsurface service structures without 3D-data available (Hofer et al. 2021b)
NIKE TARGET	**TA**ktik**, R**ahmenbedingungen**, GE**fechtstechnik**, T**echnologie tactics, framing conditions, techniques and technology as laid out in the draft Field Manual for Subterranean Operations (Bundesministerium für Landesverteidigung 2022)
KIRAS (Austrian Security Research Program)	
ETU ZaB	**E**insatz**T**raining **U**ntertage **/ Z**entrum **a**m **B**erg development of common subsurface training standards for emergency forces (Galler et al. 2020)
NIKE SUBMOVECON	**SUB**surface **MOV**ement **CON**trol development of technical assistance systems for the evacuation of people from underground infrastructures including activity classification by pose estimation (Perko et al. 2022).
NIKE MED	**MED**ical **t**reatment emergency medical care of mass casualties with injury patterns specific to underground operations.
Students (Students Programme)	
NIKE RASPOS	**RAS**pberry **POS**itioning Development of a smartphone detection and positioning system to assist emergency forces.
NIKE MiniZaB	**Mini**ature **Z**entrum **a**m **B**erg Development of a ZaB model for a wide range of small-scale testing.
NIKE CBRN-1/2	**C**hemical**, B**iological**, R**adiological**, N**uclear development of mission-specific measures and force protection in the event of a release of radiation in an underground incident '(PARKER…) and integration into tcCOP
Planned / not allocated	
NIKE STOPV	**SubTerranean OPerations Vehicle** development of a specialised vehicle with various interchangeable bodies for underground (and therefore urban!) operations

But there is clearly still a way to go, and the following action items will continue to be guiding principles for the future:

The launch of the **#command21** project to develop the future process of staff work in a "Decentralized Command Center" thereby reducing vulnerability by splitting up into several remote and distant forward command posts. One of the major lessons learnt from the war in Ukraine is the vulnerability of mass, therefore one key for successful mission accomplishment will be the decentralization of assets with simultaneous centralization of effects - this rule applies to forces and staffs alike.

Continuation of the NIKE research and development program. The original NIKE program aiming at the subterranean capability development was the core of an interdisciplinary research hub. This is to be continued in the wider framework of the **IRON NIKE Research Activity** to meet a constantly growing demand of urban operations.

Nurturing the network. Success is all about networking. In this sense, the **Urban Operations Expert Talks** are to be held annually, thus enabling a regular exchange in a growing network of experts. This will

not only speed up the development but also provide more comprehensive solutions as an increasing number of experts are looking at the challenges from different perspectives.

Improved integration of training and research. The conduct of integrated Experimental Exercises has shown to be a best practice and must be continued on a regular basis by integration of basic officer's training and research as being applied research at its best enabling a continuous improvement.

Digital twinning and hybrid training in real environments. The necessities of urban operations require a shift in training by augmentation of the training environments. Creating hybrid battle training spaces in real environments will be a critical capability in the future.

5. Conclusion and Outlook

The experience in the NIKE research and development program shows that cooperation between the individual projects is the key to success. Explicit objectives directed at a sustainable purpose and the observance of a main effort combined with maximum freedom of action for the sub-project managers enable maximum agility in development.

The NIKE program started with developing the capabilities for operations in subterranean environments. As being the hardest part of urban operations, these capabilities already provide an added value. Backed by those experiences and developments the program is currently shifting focus on the needs of future urban operations. But nevertheless, to compete with the urban environment on all levels of movement, a lot of synchronized research work still must be done to develop the required capabilities – efficient integration across all actors is the essential prerequisite.

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