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EDU2016-2184

From Behavioural Drilling Towards Social Cognitive Learning

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This paper should be cited as follows:

Mattila, J., (2016). **"From Behavioural Drilling Towards Social Cognitive Learning",** Athens: ATINER'S Conference Paper Series, No: **EDU2016-2184.**

Athens Institute for Education and Research
8 Valaoritou Street, Kolonaki, 10671 Athens, Greece
Tel: + 30 210 3634210 Fax: + 30 210 3634209 Email: info@atiner.gr URL: www.atiner.gr
URL Conference Papers Series: www.atiner.gr/papers.htm

ISSN: 2241-2891
19/04/2017

From Behavioural Drilling Towards Social Cognitive Learning

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Abstract

Military training is still seen more as a discipline than a method for creating competence. The disciplined approach is founded on the requirement of preparing individuals and units to enter harm's way. Combat calls for soldiers to perform physically and mentally demanding tasks under stress at the highest possible skill. When the technical complexity of Signal units increases, at an exponential rate, a holistic training approach covering understanding, skills and attitude needs to be introduced. One possible source for failures in introducing technically complex systems to fighting forces may be their training method. Is there an evolutionary model that military training has been following and can explain the possible defects in producing contemporary forces? This paper creates a hypothesis of evolution in military training and instructions based on advances in education, force generation, and knowledge creation. Further on, the hypothesis is trained through a general evolutionary model using a knowledge-oriented approach. Both evolutionary and revolutionary paths are reflected by available military sources. Furthermore, the implications of a training evolution model are reflected in the Signals training and force generation of Finnish Defence Forces. As a result, the paper introduces a practical model for Enterprise Architects to assess the stage of military training at an organizational level before they plan the implementation of the ICT system. The model helps to avoid the misalignment between the technical and social parts of the same system. Consequently, helping to mitigate usual challenges in building socio-technical military capabilities.

Keywords: Military training; Information and Communications Technology; Complexity; Organizational Learning

Introduction

The history of war repeatedly tells tales of devastating losses when soldiers break under the pressure of combat, abandon their tasks, and run away (Dupuy, 1987). Evidence of this goes as far back as the Persian wars in 480 – 479 B.C., where commanders were struggling with the integrity of their citizen phalanxes (Keegan, 1993). The concern is still valid since:

> "Military training has to prepare individuals and units to enter into harm's way and perform physically and mentally demanding tasks at the highest possible levels of proficiency" (Fletcher and Chatelier, 2000).

Behavioural drilling has been the primary educational method for military troops since the Prussian 1840's infantry armed with breech-loading weapons (Smith, 1998) was generated and utilized superiorly against nations of that time. Discipline is still the foundation for all military training and force generation, but warfighting has become more complicated, and soldiers in the field face a wider spectrum of events to prepare with only repetitional training. Moreover, the Communications and Information Technology (ICT) has infiltrated the battlefield as the military seeks information dominance and operational superiority over the adversary. Soldiers, who provide ICT services and operate information systems as they reconnoitre, manoeuvre, acquire targets, and engage them, need to learn more and faster to adopt new enabling technical systems and adapt to emerging situations.

There is evidence that some of the ICT systems introduced to troops are not adopted entirely and sometimes even abandoned (Mattila, 2014). Naturally, there are several causes behind these failures: systems may not have been migrated well, processes may not have been transformed fully, or people are not transitioned through their doubts (Burnes, 2014; 306-311). Therefore, the training and instructing are essential enablers in a change of socio-technical complex systems like military force (Trist & Bamforth, 1951). Thus, the question is, how can an architect assess or foresee these challenges? Is there a roadmap that reflects the patterns of existing knowledge creating in military organization and can it also define the need to improve the training as technology increases complexity?

This study seeks solutions to improve training of technically oriented soldiers, officers, and units in military force generation mitigating the challenges when introducing ICT technology. First, the study combines individual learning methods (Hergenhahn and Olson, 2005) with an organizational learning framework (Nonaka and Takeuchi, 1995). Second, the hypothetical sequence of learning methods undergoes an analysis using general evolutionary theory (Mokyr, 1998). The outcome of the analysis is a possible evolutionary roadmap for military technical training varying between dimensions of individual and social learning. Furthermore, the roadmap is challenged by the available information on general military ICT systems related training. Finally, the roadmap is tested against observations made in the Signals force generation of the Finnish Defence Forces.

The study is a part of wider research in trying to find, why so many military ICT development programs fail to provide benefits (Mattila, 2016b). Since one of the possible sources of failure is the lack of the operators and users' competence, the interest is on how the technical training is provided to troops and if there is a misalignment between technical complexity and the method of generating troops. Accordingly, the approach for research is pragmatic, a search for a solution (Creswell, 2014) but trying to maintain critical realism when approaching social organizations (Ackroyd, 2012). The method of research is an embedded mixed using qualitative data (Patton, 1990) acquired both by literature and business case study in the context of evolution and Enterprise Architecture (Ross, Weill, and Robertson, 2006).

Hypothesis - Evolution of Military training, learning and knowledge acquisition

Military training is often stereotyped being a process of instruction from theory to practice and then executing 10,000 repetitions under the critical eye of a drilling sergeant on the exercise field (Smith, 1998). At the other end, there is Peter Senge (1990) explaining how the systems thinking and learning organization approaches are providing better results in complex organizations like the Finnish Defence Forces (KOULOPAS, 2007). Subsequently, there must be something in between, paths that military training followed as it evolved together with the society military represents. These paths should have stages that can be observed and defined based on their implications in real life. Furthermore, would these paths and stages provide a model to explain the readiness or ability to learn for a military force in adopting technology and efficiently utilising new capabilities in a battlefield (Luttwak, 2001: 32-38).

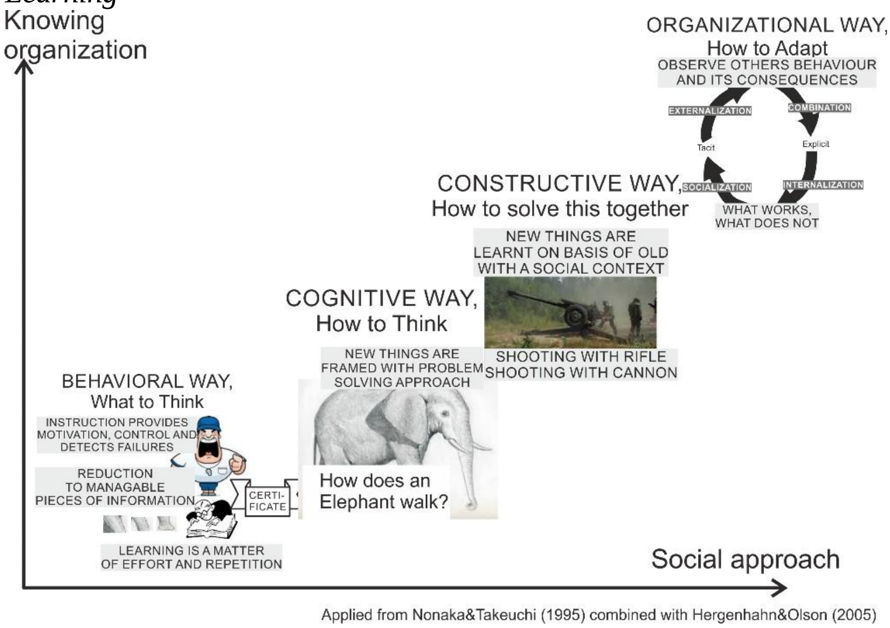
The military force is an open, socio-technical system (Mattila, 2016a) that consists of individuals representing its society, educated by its schools, using technical systems manufactured by its industry, and utilized in an organization that is following common trends of military and civilian organizational behaviour (Pipping, 2008). Consequently, there are three levels of social structures in the military organization: individuals, groups and force as a system (Katz and Kahn, 1978). Personal and group learning can be defined by educational theories of behaviorism, cognitition, constructivism and social constructivism as explained by Hergenhahn and Olson (2005). Similarly, the SECI model, introduced by Nonaka and Takeuchi (1995) showing how knowledge is shared and created in the organization. When these two models are combined, an evolutionary staged model for military training can be created as follows:

1. Behavioural way what to think
2. Cognitive way how to think

3. Constructive way how to solve problems together
4. The organizational way how to adapt to ad-hoc situations.

These stages are further explained in the following chapters. Figure 1 depicts the possible stages of military training and organizational learning using two dimensions: knowing organization and social interaction.

Figure 1. *Possible Evolutionary Stages of Military Training and Organizational Learning*



Drilling what to do and think with Behavioural Drivers

Drilling has been the tool for military training as documented vividly in Sun Tzu's Art of War (2014) or Prussian army (Smith, 1998) when a soldier was manufactured as a standard, predictable, reliable, and reproducible unit to operate their new breech-loaded rifle. Drilling is the foundational way of socializing tacit skills (Choo 1998) when the instructor (master) first shows how to do the movement to soldiers (apprentices). Secondly, it makes soldiers repeat the action continually and thirdly provides correcting feedback.

The original corrective focus has evolved with a behavioural approach, where a soldier gets positive feedback from proper behaviour and accomplishment. The feedback is especially effective when the standard of required performance is gradually increased, and an award from appropriate behaviour is direct and public. In a combined arms force composed of specialized units, soldiers and troops need to exercise as part of the bigger fighting system. The right context in behavioural drilling helps achieve the automation level of the skill, provides cues to warriors (Duhigg, 2013) of their fellows' action and enables one to fulfil their given role routinely even under stress.

This “industrial” (Smith, 1998: 45-48) way to generating and training troops may not be the best way to build soldiers for sense and decision making. Harford (2011: 37-79) argues that if the doctrine being educated is not applicable in the real situation, then soldiers fail to adapt to the emerging situation.

Understanding how to think with Cognitive Drivers

General James Cartwright (2008) calls after educating ‘how to think’ and improving the pace of learning to meet the current speed of change. First, understanding the soldiers’ ability to realize their space of operation, teams, and systems, other combat supporters, supported and adversary as a system where various parts interact with one another and with the environment (JDP 04, 2010). ‘How to think’ requires more cognitive approach in training.

The cognitive learning mostly follows the human (both analytic and synthesis) way of processing information and creating an understanding. New things are learned within a familiar orientation model. Problem-solving is using a cognitive approach, where one learns a new way of thinking (schema) and may use this “tool” further in solving other similar problems. After learning these schemas, there remains a challenge of mapping a problem to a right pre-existing schema. The mapping needs logical models like systems thinking (Meadows, 2008:10-34) or operational analyses (Giadrosich, 1995:271-273).

Secondly, Cartwright expects the training to meet the pace of change in the business (3 months), technology (18 months) and warfighting (30 days). Accelerated pace requires the ability to create knowledge by bringing together explicit and tacit knowledge from several sources (McChrystal et al., 2015). Combining explicit and tacit information (Nonaka et al. 2015: 23) needs systems thinking, critical thinking, and operational analyses executed in social space. Teams of soldiers need to achieve a synthesis of action (Nonaka et al. 2015:33) when processing towards an understanding of the situation (UK MOD JDP 04, 2010).

Agile skills are learned mainly by team training to allow socialization of experience with increasing challenges tailored to each team. Repetition as a part of the bigger system is a discipline, but the use of skills in different situations and the environment is a driver for successful execution in the progressively challenging environment.

Experimenting with Constructive Drivers

The knowledge conversion by Nonaka and Takeuchi (1995) explains the process of Socialization – Externalization – Combination – Internationalization (SECI) used in experimenting. Individual shared experiences of one’s trials (tacit knowledge) with peers and together (socialization) assumes the causality for their experience. They publish (externalization) their findings in the lessons identified (explicit information) board. Later, someone else faces a similar challenge, finds these lessons together with few more similarities, and fuses (combination) the teachings (explicit) to solve the situation in hand. One learns (internalization) from this successful trial and increases his (tacit) knowledge.

Constructivism emphasizes social and cultural interaction in learning (Hergenhahn et al., 2005). Information is understood in the context of prior knowledge, experience, and skills. Interaction with more capable peers, experienced leaders, or cognitive tools creates mental constructions that enable students to recall learned things longer. Instructors support students per their maturity. As subjects become more internalized, instructor support is gradually withdrawn. The mentoring methodology includes phases. First, the instructor is encouraging enough to get students over their first fears. Secondly, he provides a safe environment for the student to experiment, fail, and learn. Thirdly, he gradually leaves the student with more room for independent action. Jorgen Muth (2011: 190-191) analyses that the constructive experimenting provided a competitive edge (utilized in Mission Command) to German officers over their allied counterparts during the II WW.

Military as Knowledge-creating Organization Driven by Social-cognitive Learning

The competitive edge may be gained from continuous organizational knowledge creation and learning by “starting to talk and getting to work” as Weber (1993) says. Conversations are the way of knowledge through which workers discover what they know, share it with their colleagues and in the process, create new knowledge for the organization (Davenport & Prusak, 2000: 88-106). Conversations are one way of mitigating the constraint of one man’s understanding of military decision making.

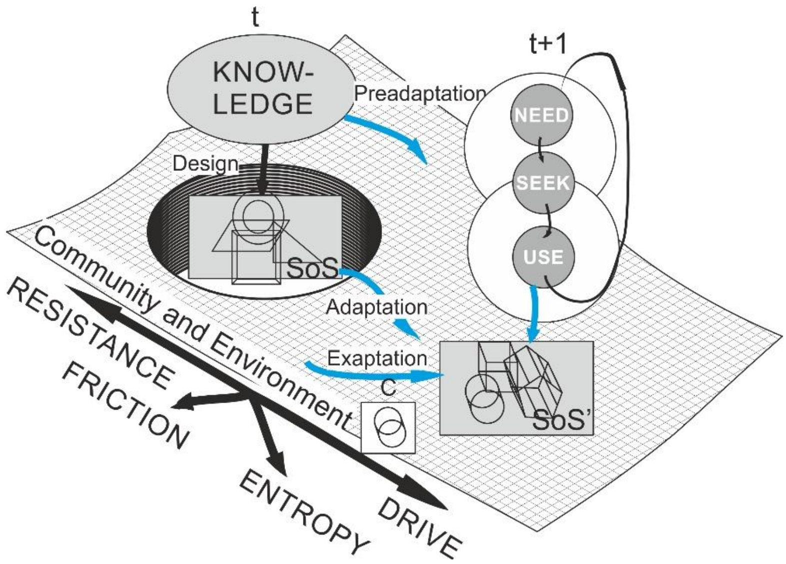
A knowledge conversion can be enforced by social-cognitive learning (Denler et al. 2014). The behaviour of learner changes because of observing others' behaviour and its consequences. Several factors decide whether watching a model will result in behavioural or cognitive change. These factors include the developmental status of the learner, the noticed prestige, and competence of the model, the recognition received by the model, and the relevance of the model's behaviours, and consequences to the goals of the learner. Also, the student’s belief in his or her ability to perform similarly as the example, effects in adaptation. Artificial Intelligence can currently learn limited causalities just by observing them on screen or in audio and achieving seemingly superhuman capabilities (Boyd, 2015).

Machines and men of a modern military force are collaborating, sharing information, creating understanding, learning from experiences, and striving for the asymmetric superiority over the adversary. This calls for training early to need (Faris, 2013) and requires including machines into the process of continuous learning (Mattila, 2014).

Map of Evolutionary Roads with Possible Leaps, Downgrades, and Revolutionary Paths towards Organizational Knowledge

The four stages, explained in the previous section, can be studied further using the evolutionary model for socio-technical development explained by Joel Mokyr (1998). A simplified and applied model developed by Mattila (2016a) is presented in Figure 2.

Figure 2. *A Simplified Model for Evolution Socio-Technical System of Systems*



A system that composes of individual subsystems that are interrelated is called the System of systems (SoS) (UK MOD, 2013). The SoS is open and interacting with its environment and community that is using it. The SoS has been designed to fulfil a function based on the knowledge that the community possesses and can use. As an open system, the SoS tends to lose its coherence gradually with time. Friction and entropy are micro level powers that change the structure and usage of SoS.

There are three main ways for System of systems to evolve:

1. Preadaptation is driven by the need to develop a new SoS'. It includes research, experimenting, or acquiring new knowledge by other means. Several optional solutions may be produced and explored to find the best fit. Gained knowledge and prototypes are used to design new SoS' to fulfil the requirements of the new function.
2. Adaptation, or learning by doing, happens when the SoS is co-opted gradually for different usages without necessarily understanding why it fits the new function.
3. Exaptation occurs when component C from another system is co-opted as part of SoS' in making it more efficient or better fitting to the purpose.

The optimistic evolutionary model assumes that there is a universal tendency to improve and develop the performance of the community, the systems it is using, and the knowledge it possesses. There are driving and resisting forces that affect the evolution of function and SoS: Resistance and Drive. The next section explains how the model is used to analyze possible paths for the evolution of military training.

Run of the Analysis

Following the evolutionary road on the map of knowledge creation and training, the first step is from Behavioural to the Cognitive way of training. It would be natural to assume that preadaptation or exaptation has provided enough knowledge for the change to occur. Cartwright (2008) signals that this is not the case in the U.S. Armed Forces. They have been trying to leap from 'what to think' towards 'how to think' for decades, but seemingly downgraded back to behavioural basics because of the possible resistance created by:

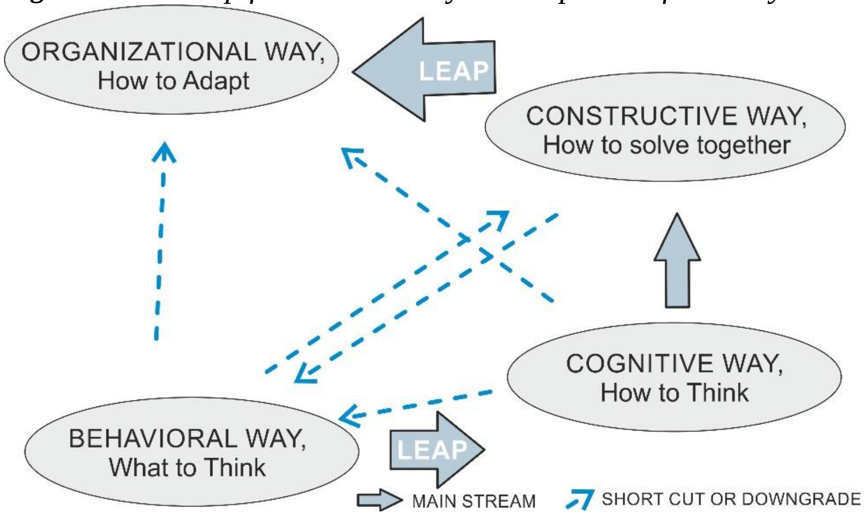
- The gravity of U.S. Armed Forces doctrine, which is based on material and technological dominance. Therefore, they do not have to adapt in the battlefield but perform the usual drill of using massed material (Bolger, 2014:374-).
- The inflexibility of U.S. Command and Control (Finkel 2007:108), which is doctrinal and hierarchical.
- As the core military skills are trained in progressive repetition and the behavioural way (Kylkirauta, 2015), there is a natural pull to simplify all training delivered in the same way. The downgrade happens when training and real needs of operation are not linked to one another.The third step from constructive team learning towards organizational learning is again harder as it requires a change in organisational culture and mind models. There are four recognized forces of resistance preventing this step:
- The first resistant is the culture of information distribution based on the "need to know" only. Traditionally, military information is shared by pushing it from source to predefined needs. The owner of the information decides when and to whom he forwards the information. The push method fails to forecast the emerging needs and is constrained by operational security issues. Accelerated operational tempo requires a Military culture to transform towards "need to share" before the third leap happens on the map (McChrystal, 2015: 138-141).
- The second resistant is the autocratic culture of command and control if it is featured by "shut your big mouth and stop thinking above your rank" attitude (Harford, 2011). The autocracy disables systems, critical, and creative thinking required within an organization for trial and error method with quick loops for learning.

- The third resistant is technology. The boundaries of the ICT system are defining the information system being developed (Doan et al. 2012). The system constrains data because of the vendor attempts to preserve the market with proprietary solutions. National policy is trying to protect dominance in technology (US ITAR) by restraining system integration. Different branches of the military are working to sustain their independence and freedom of movement by abiding interoperability standards.
- The fourth resistant is information itself. Either information is unstructured, so it is not searchable or understandable but by a human. Alternatively, it is modelled in a proprietary way, so data transfer needs interpretation. These problems may be managed with improving semantic structures that frame all pieces of information with standard metadata. Metadata explains data objects and their relationships (Allemang and Hendler, 2011), which makes information understandable both to humans and machines.

Despite U.S. Armed Forces tradition, McChrystal (2015) achieved to take his Special Operations Taskforce from 2003 behavioural level directly to an organizational learning level by 2008. Specifications did not drive the transformation since it was typical migration through adaptation. McChrystal was running rapid iteration cycles of change, assess, and change again while executing an intense period of special operations in Iraq.

Evolutionary review of military training produces the following map of possible roads between the stages represented in Figure 3. There are two major leaps from behavioural to cognitive and from constructive towards organizational as explained earlier. There is evidence of shortcutting the main road when the driving intent has been strong enough. There are also cases where downgrading has occurred because of the forces of resistance.

Figure 3. *Roadmap for Evolutionary Development of Military Training*



Testing the Model in Signals ICT training in the Finnish Defence Forces

The mission of the fighting system of systems and its essential tasks are the source for Signals training requirements in Finland (Mattila, 2011). There is a biannual cycle where performance criteria, training syllabus, and instruction design are measured following the systems approach for training (UK MOD, 2008). Instruction tasks are transferred as guidance for the training of the soldiers, teams, and collectives. The Inspector of Signals enforces requirements as the central authority. The monitoring of individual, team, and troop level exercises and exams assures the compliance to the requirements. The challenge is in generating competent force for the reserve within six months of training.

Individual soldiers, teams, and units of Signals are trained to meet the same standard with similar methods throughout the force. Training is executed following the pace of an average conscript as a learner. Basic combat training occupies the first eight weeks using mainly methods of behavioural and cognitive training (stages 1-2). As individual skills reach the minimum level, team and platoon training introduces more social context (stage 3) to accelerate learning (KOULOPAS 2008: 25-28).

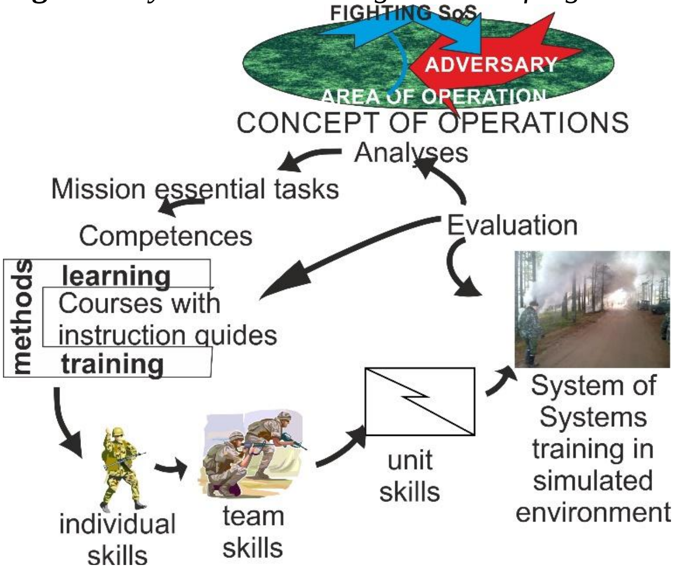
Team training starts from simple processes, and it ends with the team delivering its value in complex situations in alignment with other teams in the context of the whole fighting system of systems. The complexity of training and challenges presented to teams are gradually increased as individuals integrate into teams and teams into units. It takes nine weeks to instruct the essential understanding, skills, and attitude for signal's operator, team, and platoon level. Instructors gradually step back as the cohesion of the team improves and team leaders take more responsibility for the unit's development (stage 3).

The last nine weeks of conscript training is slowly introducing larger and more complex configurations and cooperation with other arms in typical terrain and weather conditions with a simulated effect of the adversary. Skilled individuals are required to work as disciplined teams in coordination with other remote teams to provide Command, Control, Communications, Computer and Information (C4I) Services. They are required to recognize changes quickly and reconfigure complex C4I system of systems in synchronization with other Signals teams (stage 4). The phase measures the teams' ability to apply the theory of technical interrelations in new situations (Pipping 2008). It also requires teams to anticipate the effects of weather, wear, and casualties in their C4I systems (KOULOPAS 2008 pp.62-66). The phase calls for learning together and sharing the lessons to all teams as quickly as possible.

The last training session ends up in live exercise within battalion task force or in brigade composition. All the components of combined arms taskforce are functioning together as a system of systems, and the dependencies between components become visible and understandable. The final Live Fire Exercise brings each task force as close to the real situation as possible with movement, fires, and protection. The taskforce is required to adapt as an organization to emerging situations and adopt variations of learner solutions in managing them.

Teams and units are managed throughout their lifecycle (10-20 years) as coherent components of Signals capability including the technology they use and tactics they learned in their conscript training. Figure 4 illustrates the systematic process for training Signals troops.

Figure 4. *Systematic Training Process of Signals Competence for Conscripts*



After intensive unit training session teams and platoons are send to reserve, where their skills, physical ability, and understanding will deteriorate unless refreshed in mandatory continuation training, in voluntary training, or by self-training in PVMOODLE (eTraining portal for FINDEF) (Hypponen, 2014). Both team and platoon skills should remain feasible about 15 years while in reserve with only a few days of continual training provided over time.

The Inspector of Signals, as the owner of Signals capabilities, is measuring the quality of both the conscript and reservist team and troop competence with biannual evaluation during the field exercises. This biannual competition increases the motivation of platoons and recognition of their instructors. The results of these quality tests are fed back to the training units and their instructors for learning and rewarding purposes. Further remarks and results from exercises are included into biannual lessons identified. Major cap findings in Signals capabilities are included in the building plans for the following years. Signals competence is continuously improving with the steering procedure (Deming, 2015) that effects both lean improvement (Womack and Jones, 2003) and strategic investments. The process of Signals force generation reminds the principles Senge (1990) introduces in organizational learning.

In conclusion, the training of Signals in Finland is using all stages of the evolutionary model fitted in the phase and goal of training. It might be a result of active preadaptation of educational methods followed in the surrounding society. There are no signs of exaptation or preadaptation recognized for organizational learning. Adaptation, on the other hand, is evident with plenty of learning by doing and feedback loops.

The four stages were recognised as phases in training of Signals force. However, there is no evidence of how the training system has evolved through time. Nevertheless, the combination of individual, group, and system learning became evident so the evolutionary roadmap for military training may be useful also to assess the maturity of the existing syllabus for technically challenging education.

Conclusions

This study seeks a working model in understanding the individual, group, and organizational training in the context of Signals ICT and C4I related capabilities. A hypothetic model combines classical educational methods with organizational learning processes. Thus, four stages of behavioural, cognitive, constructive, and organizational are defined as a hypothesis. These four stages are studied by using an evolutionary model for the System of the system to find likely causes and paths of development. Logical forces behind development are recognized and proved with empirical signs in Military training. The model is further tested against Signal training and the force generation in Finland. Consequently, Signals conscript and reservist training in Finland recognizes all four stages of the hypothesis. Surprisingly, they are all in use in separate phases of force generation. It seems that the roadmap is not necessarily to be taken in a sequential way, but also to understand the parallel approaches. It is important to recognise the unit and its training syllabus, before utilising the roadmap for architectural analyses.

The study is approaching military training issues for the first time by combining individual and organizational learning together with evolutionary development viewpoints. There are no primary or secondary quantitative data available to find regression between hypothesis and practice, but many literature sources indicate that the roadmap is valid.

The evolutionary roadmap for military technical training provides a sense-making tool for one dimension in ICT development – user, crew, and organisational training. As the lack of competence is one of the primary reasons why military ICT implementations fail, it is important to align the training and force generation with the implementation of the new technical system. With a developed roadmap, it is easier to recognise the present status of technical training, define the optimum level for future capability and possible paths to develop necessary training processes.

The study remains at the coarse level since the goal is to provide a practical method for Enterprise Architects in creating realistic target architectures. The study does not consider the effects of variants like upbringing, social maturity, organizational maturity, the level of digitalisation of force, or types of tasks force should accomplish. These should be included in further studies if a more accurate model is required. The evolutionary model used in this study is simplified, presenting only major forces affecting training. Both macro and micro level extension are needed for a more accurate model. Evaluating this evolutionary training model against more empirical data is welcome since no raw data is existing per writer's knowledge that can be used in correlating military training, organizational learning, and development of socio-technical abilities.

This work is used as a component when analysing the military knowledge management from the capability for an organization to learn. Together with similar evolutionary maps for sense and decision making, the tool has been used to analyse military business processes from the view of C4I capability development (Mattila, 2016b).

References

Ackroyd, Stephen (2012): Contemporary realism and organizational change. In Boje, B; Burnes, B. and Hassard, J. (eds): The Routledge Companion to Organizational Change. Routledge, London. Pp. 230-244

Allemang, Dean and Hendler, Jim (2011): Semantic Web for the Working Ontologist. Effective Modelling in RDFS and OWL. 2nd Edition. Elsevier, Waltham. ISBN 978-0-12-385965-5

Bolger, Daniel, P (2014): Why we lost. A General's inside account of the Iraq and Afghanistan wars. Eamon Dolan, Boston.

Boyd, Mark (2015): What machine learning can and can't do. The Newstack, Technology, 26 March 2015. Accessible from http://thenewstack.io/what-machine-learning-can-and-cant-do/

Burnes, Bernard (2014): Managing Change. 6th Edition. Pearson Education Ltd. Harlow. ISBN 978-0-273-77896-7

Cartwright, James E. (2008): Leading organizational change to meet new challenges. Presentation in Johns Hopkins Carey Business School. DOI=https://www.youtube.com/watch?v=NcXt-oM359I

Choo, Chun Wei (1998): The Knowing Organization. How organizations use information to construct meaning, create knowledge and make decisions. Oxford University Press, New York. ISBN 0-19-511012-9.

Creswell, John, W. (2014): Research design. 4th Edition. SAGE Publications, Inc. Los Angeles. ISBN 978-1-4522-2610-1

Davenport, Thomas H. and Prusak, Laurence (2000): Working Knowledge. How organizations manage what they know. Harvard Business School Press. ISBN 0-87584-655-6

Deming, Edward (2015): The PSDA Cycle. The Deming Institute. DOI=https://www.deming.org/theman/theories/pdsacycle

Denler, Heidi; Wolters, Christopher and Benzon, Maria (2014): Social Cognitive Theory. Updated on Jan 28, 2014. DOI=http://www.education.com/reference/article/social-cognitive-theory/

Doan, AnHai; Halevy, Alon and Ives, Zachary (2012): Principles of Data Integration. Waltham, Elsevier, Inc.

Duhigg, Charles (2013): The Power of Habit. Why we do what we do and how to change. Random House Books, London. ISBN 978-1847946249.

Dupuy, Trevor N. (1987): Understanding War. History and Theory of Combat. Paragon House Publishers, New York. ISBN 0-913729-57-4

Faris, Chris (2013): A Case for Changing the Professional Military Education Paradigm. https://www.dvidshub.net/news/113386/case-changing-professional-military-education-paradigm?goback=%252Egde_3892863_member_272649445 #%2EUi-R0su9KSM

Fletcher J.D. and Chatelier P.R. (2000): An Overview of Military Training. Institute for Defense Analyses August 2000. Document D-2514

Finkel, Meir (2007): On Flexibility. Recovery from Technological and Doctrinal Surprise on the Battlefield. Stanford University Press. ISBN 978-0-8047-7489-5

Giadrosich, Donald L. (1995): Operational Research Analysis in Test and Evaluation. AIAA Educational Series, Washington.

Harford, Tim (2011): Adapt. Why success always starts with failure. Little Brown, London. ISBN 978-1-4087-0152-2

Hergenhahn, B.R. and Olson, Matthew H. (2005): An Introduction to Theories of Learning, 7th Edition. Prentice-Hall, New Jersey. ISBN 978-81-203-3374-1

Hypponen, Hannu (2014): Seminar on developing reserve and voluntary training of national defence capabilities 10th of April 2014.

Joint Doctrine Publication (JDP) 04 (2010): Understanding. Development, Concepts and Doctrine Centre. Shrivenham. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/33701/JDP04Webfinal.pdf

Katz, Daniel and Kahn, Robert, L. (1978): The social psychology of organizations. 2nd Edition. John Wiley, Hoboken, NJ. ISBN 978-0471023555

Keegan, John (1993): A history of warfare. Vintage Books, New York. ISBN 0-679-73082-6.

KOULOPAS (2007): Kouluttajan Opas. Puolustusvoimat. Manual for Military Instructor in Finnish Defence Forces. ISBN 951–25–1729–9. http://www.puolustusvoimat.fi/wcm/d3ae460048ff0a528d68cd39f241e429/KoulOpas2007_lr.pdf?MOD=AJPERES

Kylkirauta (2015): “Passin aksiisista” tavoitteelliseen toistokoulutukseen. From meaningless drilling towards progressive repetition training. http://www.kylkirauta.fi/index.php/ct-menu-item-9/461-passin-aksiisista-tavoitteelliseen-toistokoulutukseen.

Luttwak, Edward, N. (2001): Strategy – The logic of war and peace. Revised and enlarged edition. Belknap Press, London. ISBN 0-674-00703-4

Mattila, Juha (2011): Guidance for two years’ mission in improving land forces command, control, communications, and computing. Original in Finnish: Kahden vuoden rakennusurakka. Viestimies 1/2011.

Mattila, Juha (2014): Lessons from developing Army Command, Control and Information System for Finnish Land Force during 2007 – 2009. http://c4isys.blogspot.fi/2014/03/lessons-from-developing-army-command.html

Mattila, Juha (2016a): Using Evolutionary Theory in Explaining System of systems Development. http://c4isys.blogspot.sg/2016/04/using-evolutionary-theory-in-explaining.html.

Mattila, Juha (2016b): Military Knowledge Management: Sense-making, Decision making, and knowledge creation. 17th European Conference on Knowledge Management, 1-2. Sept. 2016. ISBN 978-1-911218-03-6

McChrystal, Stanley; Collins, Tantum; Silverman, David and Fussel, Chris (2015): Team of teams. New rules of engagement for a complex world. Penguin Publishing Group, New York. ISBN 978-1-59184-748-9

Meadows, Donatella H. (2008): Thinking in Systems. Sustainability Institute. White River Junction, USA.

Mokyr, Joel (1998): Science, technology, and knowledge: What historians can learn from an evolutionary approach? Presented to the Conference on The Evolution of Science, Santa Fe, May 16, 1998.

Muth, Jorg (2011): Command Culture. Officer Education is the U.S.Army and the German Armed Forces. University of North Texas Press, Denton. ISBN 978-1-57441-533-9

Nonaka, Ikujiro and Takeuchi, Hirotaka (1995): The Knowledge-Creating Company. How Japanese Companies Create the Dynamics of Innovation. Oxford University Press, New York. ISBN 978-0-19-509269-1

Nonaka, Ikujiro; Toyama, Ryoko and Hirata, Toru (2015): Managing Flow. A Process Theory of the Knowledge-Based Firm. Palgrave Macmillan, New York. ISBN 978-1-137-49482-5

Patton, Michael, O. (1990): Qualitative evaluation and research methods. 2nd Edition. SAGE Publications, Inc. Los Angeles. ISBN 978-0803937796

Pipping, Knut (2008): Infantry Company as a society. Department of Behavioural Sciences Publication series 1 number 3/2008. The National Defence University of Finland. ISBN 978–951–25–1892–0

Ross, Jeanne; Weill, Peter; Robertson, David (2006): Enterprise Architecture as Strategy. Creating a foundation for business execution. Harvard Business Press, Boston. ISBN 978-1-59139-839-4

Senge, Peter M. (1990): The Fifth Discipline. The art & practice of the learning organization. Doubleday, USA. ISBN 978-0-385-51725-6

Smith, Frank (1998): The Book of Learning and Forgetting. Teachers College Press, New York. ISBN 0-8077-3750-X

Sun Tzu (2014): The Art of War. Illustrated Edition. Fall River Press, New York. ISBN 978-1-4549-1186-9

Trist, Eric and Bamforth, K. (1951): Some social and psychological consequences of the longwall method of coal getting. Human Relations, Vol 4, 1951 pp.3-38.

UK MOD JDP 04 (2010): Understanding. Development, Concepts and Doctrine Centre, December 2010. Available from www.mod.uk/dcdc

UK MOD DSAT QS 001:2008 in JSP 822 Part 4: SAT - Systems Approach to Training.

UK MOD DTEC (2013): SOSA - System of systems approach open system strategy. https://www.gov.uk/government/publications/system-of-systems-approach-sosa-open-systems-strategy

Weber, Alan M. (1993): What's so New About the New Economy? Harvard Business Review, January – February 1993, 28

Womack, James P. and Jones, Daniel T. (2003): Lean Thinking. Banish Waste and Crate Wealth in Your Corporation. Simon & Schuster, London. ISBN 978-0-7432-3164-0