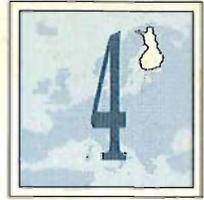


FINNISH  
DEFENCE  
STUDIES



DEVELOPMENT OF MILITARY  
TECHNOLOGY AND ITS  
IMPACT ON THE FINNISH  
LAND WARFARE DOCTRINE

*Markku Koli*

DOCUMENTATION

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*War College Helsinki 1992*

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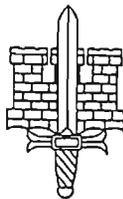
FINLAND

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# 1 INTRODUCTION

Finnish military doctrine from the 1960's onwards has been based on the concept of territorial defence. The goal of this non-offensive and entirely internally directed doctrine is the prevention of the subjugation of the state in all possible circumstances, to prevent an attack through Finland against any third party as well as preventing any invasion of Finnish territory. This goal is endeavored to be upheld through the maintenance of a level of military force whose very existence should suffice to keep Finland outside of serious military speculation. So that this preventative capability can be directed toward fulfilling its goal, it must be capable of a flexible use of military power during varying degrees of crisis situations.

The subjugation of the state could be attempted through a surprise attack in conjunction with an enhanced use of stand-off weapons systems as well as special operations. In such circumstances air and sea defence as well as the protection of key objectives takes precedence over ground force activity. The defender's operations involving ground forces are to be well planned and straightforward. This is realized through employing the best troops in combination with long-range weapons systems aiming for the swiftest conclusion to the conflict. From a doctrinal point of view the operations of the ground forces cannot, with the exception of the flexible level of response to varying degrees of crisis situations, be adapted on a full-scale to the territorial defence doctrine.

Hostile activity directed against a third party through Finland could be undertaken through the employment of air or sea forces or a combination of both. However, due to the breadth of the territory involved coupled with the territorial defence system used to defend it, it can be assumed that any potential invader would not be capable of achieving his long-term objective without the use of ground forces. Likewise, military operations directed towards the goal of invasion are not practical without instigating

wide-scale ground war activity. In such a setting the goals of Finnish military doctrine would be achieved through the repelling or subduing of any possible invader before he reached any strategically decisive area. The main military doctrine is based on the use of ground forces which are complemented through the requisite use of operations carried out by the air and naval forces. For purposes of directing these combined operations Finland is divided into three regional commands, which are further subordinated into military areas, capable of initiating independent campaigns.

The degree and range of modern military power called for in the models presented clearly diverge from each other. The examination of the territorial defence doctrine must be restricted to the handling of its adaptive capability for each individual threat scenario. From the point of view of ground force activity military operations aiming at invasion also form a wider totality to which this work is to be restricted. Owing to the fact that strategic weapons systems and special operations would typically be linked to a surprise attack, they are likewise omitted from the subject to be handled.

The ongoing transition now taking place in the area of ground warfare also lays sufficient challenges regarding the development of Finnish ground combat doctrine. From the recent development trends that have come to light it can be concluded that the large-scale introduction of new military weapon systems is clearly changing the basis of conventional ground combat doctrine whose current roots extend back to the Second World War. In formulating national defence strategy the disregarding of these new developments could prove fatal as the progression of events during the Persian Gulf war demonstrated. Though from a Finnish perspective the fighting capabilities of Iraq cannot be used as any comparable yardstick, one of the most important lessons learned from the war was that the basis of the destruction of Iraq's military forces was a totally false picture of the dimensions of modern ground combat and the equipment used to carry it out.

The goal of this study is to investigate the possible ways to enhance and further develop Finnish ground combat doctrine. Military technology development has been chosen as the point of departure for the investigation. In addition to describing the most crucial technological areas it is also imperative to review

those factors which become significant at that stage when different technologies become intertwined into an integrated weapons and command system. The study will undertake an evaluation of the central elements of future ground combat as well as presenting scenarios of possible operational models that might be employed by a potential aggressor. The interaction between combat doctrine and military technology as well as a review of the factors related to both will form the framework of this work.

## 2 THE INTERACTION BETWEEN COMBAT DOCTRINE AND MILITARY TECHNOLOGY

### 2.1 *The interactive relationship between combat doctrine and military technology and an examination of the time perspective*

A great power can develop its armaments in such a way that parallel research and development objectives can be attempted through numerous types of technologies and systems. This kind of model takes into consideration the risk that some technical systems will fail or of faulty scheduling. Though inevitably there are risks involved in the development work creating new premises and solutions, the model still generally enables the basic concept chosen to be developed. However, the level of development is always restricted to the limits of the assigned technology. The great power development model makes possible, and to some degree also imperative, the wide-scale introduction of up-to-date technology. This kind of possibility and necessity a small country does not possess.

However, a basic conceptual doctrine of ground combat can currently be ascertained without possessing a wide-ranging know-how of high-tech development. The reason for this is that, compared to air and naval combat, ground combat contains a fundamental greater degree of unpredictability and accordingly places a greater emphasis on intuition. Will-power and fear also play more central roles in ground combat than in air and naval combat. These factors bring forth the level to which an examination of ground combat doctrine is so influenced by human factors of strength and weakness that the key elements relating to victory in ground combat can already be found in the thoughts expressed by the Chinese writer Sun Tsu over 2000 years ago.

The incomparability of human sensory and deductive capabilities in relation to those afforded by artificial intelligence, together with the difficulty involved in tracking them, makes it possible to simplify the interplay regarding combat doctrine and

technology. Fixed peripheral conditions such as human operational models and analytical development work based on permanent conditional factors exert continuous interrelated feedback on these two concepts. The course of this interaction is chiefly determined by three factors. The first and most important factor is the development of technology and the degree of economic wherewithal that is invested in it. The second is the threat scenario ascertained through development work, and the third the different types of models laying out orders of importance. These factors are endeavored to be fitted to other systemic factors such as personnel, organizational structure and training systems. The combat doctrine concept that thereby emerges also determines the focus of technological development.

The creation or amendment of a functional combat doctrine can last years, even decades. The most far-reaching time commitments are taken up by the introduction of new weapons systems and the training of their personnel which is a graduated process. Thus an examination set forth during any time frame can only be directed at one relative development situation to which its predecessor and successor phases must be linked to ascertain the logical development pattern. For this reason this work will not attempt to examine that development phase which is to be put into place during this decade since this would tend to dominate to a too large degree the entire examination.

The choice of time perspective is also determined by the general progression of military technology. Though some rapidly developing technological areas of a weapons system may be proceeding with substantial leaps, they only form a part of the total system. The transformation of a weapons system from its operational requirements into a ready concept lasts about 10 years. The period from concept until the system is ready for production takes more years. From a perspective of economic continuity a well adapted system of production should be spaced out over a number of years so that the weapons system is, to a significant extent, in operational use only a few years after the start-up of production. Even if training would be started up during the concept phase, which is often possible, the length of time needed before the system is in operational use is generally at least 15-20 years from the time of defining the preliminary operational requirements.

The setting of an exact time estimate is complicated by factors such as general economic problems as well as the rapid changes taking place in the international political arena. However, it can be speculated that the current situation in Russia and those states economically tied to it will prevent any significant technological innovations for at least ten years. This arrangement is also reflected in the situation regarding western armaments development where the changing nature of the threat scenario is leading to a correspondingly closer evaluation of cost analysis. That combined with the reduced volume of orders, the result of the fierce and wide-ranging armaments technology developments of the 80's, will have the effect of raising costs and slowing development during this decade. This will mean that technology developed in the laboratory will reach production level at a relatively slower rate than at present even though the production methods of industry are constantly being upgraded.

By observing and analysing military technology today one can come up with a moderately reliable assessment of what type of forces, equipment and operational models will be needed in a period of ten years. The basis of the time perspective for this work will be in the area of 15 years.

## *2.2 Factors influencing the combat doctrine of the great powers*

The background to the combat doctrine and armaments development of the former Soviet army has been a powerful and all inclusive military-scientific approach. In western countries in general, and especially in the U.S.A., the corresponding work has rather been based on achieving its aims through an emphasis on technological development. During the final stages of the cold war the great military powers, despite having different points of departure, decided on employing similar frameworks in the development of their conventional forces. The former Soviet army's deep operative reconnaissance strike/fire complexes have the same basis as the U.S. AirLand Operations (formerly AirLand Battle Future). However, due to factors involving differences in the structure of American and Russian industry and especially the divergence in attitudes regarding the commercial development

and production of modern technology, the result is that in certain critical conceptual areas of development in the former Soviet army could not keep pace to that in the West.

Central components of the new technology such as micro-electronics and data processing technology know-how have developed with great leaps in the west. The directing of substantial resources to these areas and the tight control of the know-how obtained has led to a situation in which the U.S. enjoys roughly a ten year advantage in the development of certain key technologies. On the other hand, in some areas such as the weapons application of electromagnetic radiation, the technology has been further developed in Russia than in the west. Likewise the former Soviet army's reconnaissance-strike/fire complexes use in battle may, owing to their firm scientific foundations at the conceptual level, be more functional than the corresponding AirLand Operations combat doctrine. The capability of the armed forces to bring these concepts into fruition, which is a central factor in any evaluation of their practicality, is not possible to evaluate in this work.

The changes occurring in the sphere of international politics have had the effect of inducing surprisingly rapid changes to military threat scenarios. The changeover in development aims towards smaller and more mobile forces and thus less dense battlegrounds has come about during a space of a couple of years. Therefore the development work started up during the 1980's and to which current doctrine is largely oriented to, has been overtaken by the course of events and, to a certain extent, become obsolete even before being introduced. Systems designed for massive deep strikes are not being employed to their optimum if the structure of the target or the operations model does not conform to the operational requirements to which the threat scenario was based upon. The changes in the threat scenario make it incumbent upon a great power that it employs a greater degree of flexibility in its doctrine and that it be more able to adjust to divergent areas and principles. The realization of flexibility in combat doctrine can only be brought about through reducing the maximum requirements of the system.

In light of the aforementioned this examination can use as its basis the following points:

- \* Military systems are rather precisely planned and therefore limited to the bounds of the threat scenario. Changes in the threat scenario cannot be quickly incorporated into system development. Substantial conditional or compositional deviation from the presumed threat scenario can fundamentally hamper the use of the system.
- \* The development of military technology will, in general, continue everywhere to proceed in the direction presented. Differences in resources and emphasis will bring about disparate solutions at the tactical and user level. From an operational standpoint, the systems to be examined will be found to be quite similar.
- \* Among the many parallel development areas of military technology only some approaches will be taken into operational use roughly within the time schedule mentioned. Consequently it will not be necessary to deal with all the development models.

### 3 DEVELOPMENT OF MILITARY TECHNOLOGY

#### 3.1 *The important development trends of military technology*

In recent years micro-electronics has clearly been the fastest developing technological area. Developments in micro-electronics have led to the scaling down of the size of components while also decidedly increasing the performance of different types of these units. This development has made possible a wider introduction of data processing technology applications than were previously attainable. Application development has likewise been offered as a tool for such areas where the insufficiency of processing capability or the insufficient graphicness of the phenomena to be investigated have limited development possibilities. The parallel occurrence of improvements in development and production methods have further accelerated this series of events to the extent that the development trend regarding the finished product has, in certain areas, been exponential. Areas where such progress has come about include the increased performance of integrated circuits as well as the reduction in the required space needed for magnetic mass memories.

Based on micro-electronics and along with it undergoing rapid development is the area of optical applications. Integrated optics, among which are included optical memories as well as optical signal and data handling, accelerate the operation of data processing systems. Fibre optics offers an economical method for the transfer of a great capacity of information along an electronically protected infinitesimal route. With an optronic sensor it is possible to oversee one's field of operations as well as discern and identify targets without the use of sensory equipment and position revealing electromagnetic radiation. Though optronic systems are currently used mainly as fire control elements of weapon systems, they will also be put into limited use as a blinding laser-weapon during this decade.

The enhanced handling speed and data recording capacity of modern micro-electronics during the 1980's has brought about in the area of automatic data handling applications as great a

rearrangement of tasks as that imposed by the development of mechanized industrial automation during the whole of the preceding century. This speed has even led in certain areas to situations where the full possibilities of new data processing technology have not been able to be realized before a new generation of technology is already brought to the fore. In light of these facts it can clearly be seen that any military system based on data processing technology will have already become outmoded by the time it is scheduled to be put into service.

Another problem related to data processing technology is the limited know-how related to systems development. This means that, on the one hand, the total potential benefit of the data system is only partially realized and, on the other hand, that it becomes difficult to get the individual components of the total system to perform together. In the application of military data systems it must be ascertained in each individual case whether it is possible for the chosen procedure to be used manually or is the system totally dependent on its own technical and functional reliability. In military applications the preceding approach is typical of command and decision making systems as well as mechanisms used for intelligence analysis. Purely technical systems can be used to support both intelligence and surveillance systems as well as handling the raw data of the sensory component of weapons.

Other rapidly developing military technology areas are electromagnetic radiation countermeasures and weapon applications, hyper-velocity missiles and cluster weapons, homing and guided projectiles as well as the application of material technology to elements of different weapon systems along with their application to passive and active protection. Though development also extends to narrow special areas such as vehicular suspension systems, developments in these areas will not bring any decisive extra value to the performance of the total system. For this reason the examination will be limited to the previously presented technological areas.

### 3.2 *Micro-electronics*

Manufacturing technology has led to the development of very high speed and large-scale integrated circuits (VHSIC and VLSIC).

During the 1990's there will be achieved a nearly two decade advance in the effectiveness of processors. This means for example that the target acquisition capability of surveillance systems will be increased many-fold provided the performance of the sensor enables a corresponding increase in the receiving capacity of the signals.

The diversified components to be employed in micro and millimetre wave bands will be composed of Gallium Arsenide and other compound-based semiconductor substrates. Integrated circuits based on these compounds will be introduced during the coming years (MIMIC = Millimetric Wave Monolithic Integrated Circuit; MMIC = Micrometric Wave MIC). The advantages of these new technologies over traditional solutions are their increased performance and high frequency bands as well as their substantially lower manufacturing costs together with their higher tolerance to changing types of conditions and attempts at jamming.

The MIMIC and MMIC systems will enable the formation of phased array radar antennas so that each antenna element in both the transmitter and receiver will be capable of functioning independently of the other elements. This type of active antenna increases both the system's ability to control multiple-target situations as well as its combat endurance. Some wider applications of the MIMIC are in navigation & acquisition, IFF and communication. A third significant area of application is in the sensor component of warheads. The reduction of the size of the sensor coupled with the increase of its performance will lead to the development of the first warheads capable of target identification. Use of MIMIC will also expand the tracking capabilities of radar homing missiles. In the optical area the same kind of trend of development is being sought through the use of charge coupled devices. As a recorder of analogical data they will be especially applied to the handling of pictorial information. Besides having the advantage of small size, these components also consume little power which combine to make possible sensory applications involving the identification of figures and forms.

Developments in the preceding areas are also influenced by the advances leading towards the introduction of super conductive components. The reduction of electric resistance to

levels approaching zero will mean, among other things, the possibility of maintaining a substantial quantity of electric current in modest-sized power devices. Similar developments are being effected to temperature levels that can be obtainable also outside the laboratory. Project applications based on the use of super conductive components include accelerated activity of advanced optronic sensors as well as the attaining of the required signal handling speed necessary for the identification of complex figures.

The effect of micro-electronic development can, at the systems level, be compressed into the following: that which today can be implemented only through the use of a fixed system will in ten years be capable of being fitted onto a vehicle. Correspondingly, the system will have shrunk to a size that will enable it to become portable. Thus strategic level system capacity will, by the beginning of the next decade, have been put at least into operational and partially even into tactical use. However, wide-scale total systems will not generally be able to be set up at the battalion level since the necessary short-delay data transfer facilities required for obtaining the full performance value of the system would make it prohibitively expensive. Projectile applications during the first part of the next decade will be placed on putting target identification sensors into operational use. This will not be carried out on a large-scale but rather limited to, at most, a few already expensive weapons systems.

### *3.3 Data processing technology*

Developments in micro-electronics have made possible a significant uplifting in the performance, programmed decision supporting capabilities and degrees of automation of military systems. One consequence of this development is that program methods improve at a pace which makes precise future predications difficult. The reduction in the price of components will also facilitate the utilization of micro-electronics for military equipment used on a mass level. Because of these cost developments new areas of application will be continuously investigated. The quickest development at these mass or tactical levels will take place in areas in which the technology can also be fitted to civilian applications. These include, for example,

personnel and material administrative systems, cartographic-based applications, research and simulation models as well as data transfer and data network systems. When forthcoming civil applications begin to become parts of military systems there will be increased problems related to standardization and compatibility of the data processing technology.

The size of the computer code and the complexity of different kinds of data processing systems together with the increased amount of data to be handled in the unit of time, have led to the development of expert systems employing artificial intelligence that are used as an aid to the operator. With the help of such systems one can systematically collect and use empirical data together with other knowledge. The problems related to developing applications for artificial intelligence will precipitate the shaping of a large body of handling regulations and data files which will be used to arrive at conclusions reached at the expert level. This need for arriving at conclusions is apparent owing to the increased amount of information being garnered from different types of sensors and other intelligence systems.

Another new development area of data processing technology are neural networks. These circuits utilize parallel processing to trace the constituent parts of the human brain, neurons. Thus the circuits formed can be expected to have applications enabling them to carry out learning operations. Neural networks could be employed in those aspects of intelligence collecting related to object identification and the automatic gathering of data. Information gained in this way for the weapon to be deployed would mean that the weapon's total performance capabilities would remain at least at the same level during the duration of the combat situation despite any empirically developed – chiefly passive – countermeasures.

With the aid of target data processed algorithms the different elements of the weapon's system can be tailor-made to operate according to the requirements of the individual buyer which may deviate radically from the specifications laid forth by another customer. Algorithms can be used to direct the operations of a still greater amount of precision guided weapons whose role as the critical factor in different military systems will be decisively heightened. Processed algorithms will also continue to remain a closely guarded secret between the customer and the producer.

Producers and defence departments will not, however, endeavor to conceal the hardware used or its performance capabilities since these are, owing to their commercial applications, generally already well known. However, the development of algorithms will still take years even after the hardware is ready. The phenomenon is therefore quite similar to the general development of data processing technology, only the time-lag is greater.

The role of operational war games and model simulation incorporating the interaction between the influence of weapons and tactics, will be significantly increased in areas related to the analysis of intelligence data as well as preparation for war. Simple models will also become commercially available. Models drawn up on the basis of each user's troop and weapon system plans as well as their deployment will increase decisively in the coming years. With regard to training systems, simulators will become one of the central elements in the development of military preparedness.

The development work involving artificial intelligence has proved to be quite problematical and only preliminary versions of the depicted applications will be able to be put into use during this decade. As far as weapon applications are concerned, artificial intelligence and neural networks will remain at the development stage. It is possible that these two concepts could be employed as part of an electronic warfare system as well as a support system for intelligence and decision-making operations. However, the most important strategic development area will be in formulating software for command, control, communications and intelligence (C<sup>3</sup>I) systems. The effects on these areas during the period of the next ten years is almost impossible to evaluate.

### *3.4 Data transfer*

There will be developed at the strategic level a command and communications system that will be national, and even supranational, in scope. The primary goal will be the establishment of an integrated services digital network. In addition to traditional data transfer such a system will include, among other things, data recording and retrieval services. At the tactical level there will be developed a corresponding mobile network. Digitalization will create the preconditions for the

integration of different services, so that in the same network it will be possible to transfer data, texts and graphical material in addition to voice transmission.

Special attention will be directed towards maintaining data protection and anti-jamming capabilities of the command network. Wide-scale digitalization offers multifaceted possibilities for automatic and necessary data protection. Large capacity optical transmission paths will offer parallel solutions in all those systems in which connection formation time will not constitute a critical factor for optical cables. By the end of the decade difficult to jam laser beams will be in use as linking systems at operational levels of command.

The scattering of electromagnetic waves that takes place in the troposphere forms the basis of tactical linking connections which makes possible a 100–300 kilometer contact distance. At the corps level and above such kinds of links can support strategic and far reaching ground intelligence as well as the operational elements of simultaneous data transfer required for the control of deep battles. At the strategic level these have already been complemented by communication satellites. The general development trends of micro-electronics and data systems point to their coming into service also as support systems at both the operational and tactical levels.

At the tactical level of command, especially involving battalions and their lower chain of command, radio will continue to form the first communication instrument also during the beginning years of the next millennium. Development projects involving VHF and UHF radios will, during the ongoing decade, lead to the introduction of digital voice transmission and spread spectrum radio systems. Developments in portable field links will follow the development pattern of VHF and UHF radios.

Owing to the increasing degree of complexity of the technology involved and the related importance of testing and repairing faults in the equipment to be used, there will be a need for the development of different types of testing equipment and systems. In the future there will be built into both command and weapons systems internal testing systems. These systems decisively speed up testing and servicing tasks. However, a precondition for their efficient deployment is the commitment of large resources for spare parts as well as the placement of well-

trained staff for a servicing system that will already be required at the operational level.

### 3.5 *Optronic systems*

The most important development trends in the field of optronics are spread spectrum optical components, linear detectors fabricated from charge coupled device (CCD) components and CCD-detector matrices as well as shape recognition systems. The performance of these systems is tied to the degree of signal handling speed that is attainable. In the near future an anti-armour missile CCD-detector matrix will be brought into production. A clearly greater processing capability is required for shape recognition which is why its inclusion in the system to be sought is possible only during the next decade at the earliest.

Besides its traditional applications optronics is also overtaking other systems, for example the tasks of radar. This can partly be explained by the fact that while the performance of integrated circuits skyrockets, their cost rises only marginally. With respect to radar-based sensors, the coming into general use of optronic systems can be explained by their greater discrimination capability which enables target recognition from afar. Discrimination also dictates the accuracy of the system. Another essential quality that will be stressed in the future is shape recognition capability, the consequence of which could be the development of so-called "brilliant" munitions. A third advantage will be reached through the simultaneous or phased use of many different types of frequency bands so as to reduce the amount of false alarms as well as making it possible to choose the optimal sensor for each set of conditions.

For the time being – meaning during this millennium – optronics will be developed mostly as parts of multi-sensor systems. Typical development areas are to be found in the target acquisition components of air defence and air-to-air missile systems, the duel sensors of smart munitions, real-time intelligence systems as well as shape recognition equipment. Simple types of optronic equipment that will be taken into general use by tactical forces include control and surveillance equipment as well as weapon sights. The high cost and, at present, substantial

weight of thermal imagers prevents their introduction as equipment for individual combatants.

In expensive and heavy weapons systems thermal imagers will clearly be taken into more general use. As a consequence of this trend product development will mean that both the price and the size of the units will decrease in the future. As a component of weapon systems, thermal imaging technology will overtake the solution afforded by image intensifiers by the start of the next decade at the latest. However, the small size of the latest image intensifiers makes possible their being fitted onto the helmets of individuals so that the weapon system's key personnel are able to operate at close-combat distances also in the dark. The significance of thermal imager technology in independent target acquisition systems increased only at that point when it became capable of affording a panoramic solution to the area under surveillance. Rapid signal handling enables the comprehension of the target situation from a wide ranging area straight to the user's presentation system. The problem with this solution is the great amount of false alarms that occur. As a consequence of this the final system development will be focused upon the next decade.

The systematic development of lasers has, at the strategic level, been carried out mainly in secret. The primary goal of the work carried out has been the development of a beam weapon that could be deployed as a mass destruction laser. At the tactical level laser distance meters have been integrated into different types of fire control systems. Lasers are also used in the process of guidance beam formation. However, only CO<sub>2</sub>-gas lasers, which are currently under development, will enable the use of this type of weapon system in inclement weather. With regard to missiles and bombs which are homing to laser designation, the CO<sub>2</sub> laser would afford fundamental benefits. However, in comparing this system to one employing radar, the dependency on conditions must still be taken into account. As a consequence of this, the use of laser beams in weapon control systems will be limited to supplementary applications. In short-range homing systems the difficult to jam millimetre wave band is being sought as a replacement for lasers.

The laser-radar supplementary system is to be developed because, compared to microwave bands, it affords a better angular

and doppler resolution as well as, in theory, the ability to examine smaller-sized objects. The realization of the lastmentioned supposition is an essential precondition for continued development of laser-radar. The attainment of the required level of performance will require a period of time that will extend to cover at least this decade. As a component of surveillance and weapon systems laser gyroscopes afford the possibility of tens of kilometres of extremely accurate navigation without the need for updating.

The passive nature of optronic systems presupposes the development of active counterweapon systems. For this role there will be developed conventional quick-fire automatic action weapons in addition to systems based on powerful electromagnetic radiation. Powerfully directed laser radiation produces, already in small intensities, a destructive impact to optronic sensors. During this decade such type of laser weapons will be put into service on important weapons systems, for example as close protective equipment for battle tanks. A second area where it will quickly be put into use is as a blinding laser weapon which can be used in both anti-aircraft and anti-armour systems.

At lower frequency bands electromagnetic radiation dissipates to a wide area away from where it has been transmitted so that a precondition for the achievement of the required power density is the employment of bulky electrical power equipment. Though such systems are the natural consequence of developments related to jamming systems, they will not, owing to their size and weight, come into operational-tactical use before the next decade at the earliest.

### 3.6 *Radar systems*

The development of radar systems is invariably linked to the demands set forth by different operational needs. Though radar systems are still called upon to possess a great range, other requirements are increasingly influencing their development trend. The new demands put upon radar are directed especially towards increased jamming resistance, reducing the effects of false targets, the capability to separate small targets also against

the surface of the ground as well as the elimination of dead zones. One factor that is steering development work is the presence of radar homing weapons. In order to reduce their influence both surveillance and fire control radar are striving to control the level of radiation they emit, so called quiet radar.

The performance of radar systems are decisively influenced by the choice of the optimal transmission band and the processing of the received signal. Radar signals, which in the beginning were mainly limited to the processing of video signals, have expanded their operations to include the optimization of the signal in both transmitters and receivers. The reduction of its physical size and power consumption have especially improved the performance of those radar systems employed in weapons and airplanes. For example, the discrimination of synthetic aperture radar is significantly enhanced by a shortening of the processing time which in turn enables the use of radar for deep target acquisition.

The development of phased antennas, and especially that of active antenna elements, have enabled the combining of the different functions of radar into parallel processes. Such processes could serve to perform the operations of surveillance, multiple-target acquisition, passive observation of jamming sources, registration of environmental conditions as well as functioning as a command link to the weapon system's warhead. This kind of radar is difficult to saturate and jam so that, for example, an artillery radar could simultaneously follow the flight of several projectiles without interrupting its surveillance of the horizontal. Target follow-up and electronic countermeasure capabilities are increased through the deployment to the target of fast adaptive pulse waves. This would enable, for example, the radar that was following the path of an attack fighter plane to lock itself automatically onto a missile being deployed from the plane, if this process has been programmed into the radar. Such a solution also influences the development of stealth technology since traditional methods designed towards reducing radar cross-section would thereby lose their effectiveness.

The areas of application for radar will expand from long-range to short-range. In addition to introducing short-range ground surveillance radar, different types of terrain obstacle warning equipment will quickly come into use which will enable,

among other things, helicopters to operate at low altitudes in the dark. During the next decade these types of warning systems will compose only part of these costly overall terrain surveillance and/or fire control radar systems.

However, radar will come into even wider general use as weapon warhead sensors whereupon the key technology to be employed will be that derived from millimetric wave monolith integrated circuits (MIMIC). The attempt to achieve direct-fire from an indirectly-fired weapon presupposes that the projectile will have the capability to independently find the target. However, in many phases of operations involving the use of projectiles with independent targeting capabilities, the limiting factors caused by the interaction of different components with one another must be taken into account. As a consequence of this, an order of priorities involving the different properties of the weapon has had to be laid out. Because of the desire to maximize the effect of the explosive charge, compromises have been directed mainly towards the overwhelmingly most expensive component of the system, the sensor.

By the middle of the next decade only a limited amount of smart munitions will have been put into service. The infrared sensors or millimetre wave band radars of these projectiles will be able to discern a potential target only from a distance of a few hundred metres. The job of target recognition will rest upon comparison through parallel technology. A limitation of this system is the narrow range of the area to be scrutinized. The problem involved with trying to widen the area to be searched, is that it then becomes quite difficult to separate the target from those objects which bear some resemblance to it. The demands placed on signal processing will, in the near future, come to exceed the capabilities for such processing, which together with cost factors may lead to the postponement of these projects.

### *3.7 The combining of sensors and navigation technology*

In command-and-control systems data compiled from many sources is further processed in order to attain an exact and understandable picture of the overall situation. Modern data combining systems are constructed so as to flexibly link up all

types of data which are received. The data obtained from one sensor immediately affects the operation of another and the final scene of the situation is a composite of both. This type of structure can be compared to the interaction of the human sensory system. Development work is currently being aimed towards, among other areas, battlefield command-and-control systems, where work is being undertaken to integrate radar, optronic and acoustic sensors.

Through the use of measured and processed data one can predict the target or target grouping's operating principles, actions and vulnerability. When the picture of the situation is fully formed, precise overall data enables an optimal assignment of different weapon systems towards the target. In this type of total system there are several advantages in employing multi-sensor technology. The operating area is continuously controlled by a joining together of different sensors working out of various observation sectors and operating times. The effectiveness of the system is enhanced through the employment of automatic target-locking and target tracking capabilities. This capability is also maintained during those occasions when the target information obtained from one sensor is insufficient. Target perception capability can be maximized by utilizing the special properties of the sensors. The overlapping activities of the sensors enable target analysis from many different angles and from different wave length areas. The operating capability of a multi-sensor system is also maintained when it is exposed to attempts at jamming. This is the result of both the passive sensors which are contained within the system as well as its capability to analyse received signals. Target recognition is achieved by first grading the follow-up data and then comparing it to that which is contained in the data files of other tactical systems. This totality is then used to draw-up the threat analysis.

The next development areas for precision guided weapons will be in the area of multi-sensors and multi-processors. Multi-sensors could, in the future, be realized through the use of sensors that support the functions of one another in the carrying out of their respective tasks. In such a case the area that remains to be developed is multi-processing. However, the continual increase in the speed of processing will facilitate development in this area as well. The multi-sensor system is, owing to its overall reliability,

considered the most cost effective solution though it is projectile-wise more expensive.

From the point of view of total effective operation of a weapon or command system, it is decisively important to know the placement of each key system. A knowledge of location will facilitate the coming into general use of inertial as well as satellite-based automatic navigational systems. The modest cost of satellite location equipment enables it to be taken into use at the company, and even platoon levels. It is then possible to transfer the information obtained from this system to a multi-service network or other integrated command network straight to the needed data base. This principle enables the commander to quickly direct the flow of troops and firepower, even in rapidly changing situations, according to the tactics chosen.

Though satellite-based position location affords in coverage and accuracy all necessary position, time and speed data, it does not eliminate the need for an independent and undisturbable system. For this reason ground vehicles will mainly be fitted with strap-down inertial navigational systems during this decade. In addition, laser gyroscopes will come into general use as angular measurement systems for the reason that the elimination of mechanical movements and parts will markedly add to the accuracy, dependability and longevity of the system. The same navigational technology will also become prevalent in weapon systems, especially long-range missiles. The intention is to include several parallel systems so that the passivity which is a precondition for undisturbed operation can be maintained in all situations.

### 3.8 *Electronic warfare systems*

The reaching out to higher frequency bands that occurs in electronic reconnaissance systems, always corresponds to where the target system's frequency band has been developed to. In addition to this the systems operate in ever wider frequency ranges. The development of reception technology together with data systems, processing and automation enables the integration of different systems. This means that a weakness in one type of receiver can be complemented through a favourable property

displayed by another. Efficient integrated systems are capable of analysing the signals being emitted from a dense signal environment. Electronic intelligence systems possess the ability to discern both their basic properties as well as their technical solutions. With the drawing together of these areas the systems of electronic listening and measurement reconnaissance could be united. However, this presupposes the use of expert systems. The processing of the data emitted from concealed transmitters would, at present, require the level of performance of a supercomputer which would limit the cracking of data security codes at the strategic level. The pace of modern combat is constantly increasing while development of countermeasure techniques, especially involving electronic warfare, moves at a slightly slower speed than system development. This means that analysis at the tactical level will remain random also in the future.

The integrating together of optical systems to radar and radio frequencies also increases the need for electronic intelligence in this area. Infrared and laser radiation scanners will become essential parts of both large conventional as well as electronic reconnaissance systems. Radar warning systems will employ new integrated circuits which will make them smaller and quicker. The warning systems are drawing nearer to tactical reconnaissance systems in that through them one can maintain a clear picture of the electronic operating environment. The integration of these systems will form part of the process of linking up electronic intelligence to jamming and reconnaissance systems.

Signal routing has been increased in radio networks through spread spectrum techniques especially frequency jumping, data encrypting and temporal shortening of the transmitter as well as digitalization. These solutions set forth significant demands upon the performance of a jamming system. Against sophisticated combat radios there will be initiated quick scanning receivers as well as increased data processing capacity to enable faster tracking and follow-up as well as the direction of the jamming to new frequencies. This last property uses the time division principle as its basis.

The jamming of VHF and UHF radio networks plays an essential part in current tactical warfare. The previously presented radio technology development lines will lead to a widening of

the range of disturbance systems to include areas such as automatic-starting process directed transmitting systems and disposable jamming transmitters. The latter would be deployed in an effort to paralyse the operations of staff or key weapon systems during combat situations. With the aid of developed algorithms these systems could afford optimal frequency control and time attributes whereby their jamming effect could be effectively joined to the planned operation.

Radar jamming systems will become more automatic. They work off a preset threat and operations model scenario which is activated after the parameters of the threat signals emitted from the signal environment are measured. The jamming system is joined with a data bus to the intelligence system which operates with it on the same frequency. Parallel jamming of several different systems can be obtained through utilization of the time division principle. The amount of electronic decoy equipment will significantly increase owing to favourable cost developments.

The problems related to electrical jamming of optical systems are firstly, that the target must first be discerned and secondly, that optical signals are difficult to interpret. For these reasons optical jamming has a different basis than that used against radio or radar frequencies. The development work has instead been directed towards infrared and laser scanners, new flare material and construction as well as the gathering of other sensors into a countermeasure system. In addition to these there will be brought into service during this decade infrared protective smoke as well as infrared sensor influenced laser systems.

Only a great power possesses the wherewithal to develop electronic warfare technology on a large-scale. Smaller states are obligated, owing to cost factors, to seek compromise solutions in which the core requirements are directed towards carefully chosen key areas. This arrangement is not so problematic in strategic intelligence where developments in data technology produce efficient systems at moderate cost. However, the situation is different with regard to electronic jamming if one's goal is to maintain and further develop versatile communications and intelligence systems.

The building up of jamming systems to an operational level is a long-lasting process. It lasts many years for the target systems to develop jamming resistance. For this reason the target systems

are generally a step ahead of purely electromagnetically-based jamming systems. By combining electronic intelligence with lethality – as has been done with radar homing missiles - the arrangement is altered. Though electronic jamming can obtain in the short run a decided effect, it is however only a supplementary system and the more effective means of paralysing a C<sup>3</sup>I-system will also in the future remain lethality.

### 3.9 *Weapon effectiveness*

#### *The general development lines of weapon effectiveness technology*

Warhead development in weapon systems is increasingly tied to overall weapon system development. Development examination begins by analysing the properties of the target and ends by calculating what kind of costs are entailed from developing the weapon system's different components to their desired degree of lethality. Then it will be decided whether to implement an even more comprehensive weapons system or to modernize the existing system. In a comprehensive weapons system concept, the economic significance of the warhead is extremely small, so that within the limits imposed by structural and size factors, it is generally possible to optimize the warhead. However, comprehensive concepts are so expensive, that the greater part of development work is directed towards the graduated development of existing systems.

When approaching the question from the target point of view the examination produces three parallel lines of development. The first line seeks to compress the warhead's combat charge to the smallest possible dimensions of size and mass while still enabling it to achieve its desired effect. This requires the selection of the most vulnerable part of the target for the point of effect. In anti-armour weaponry the attempt would be to effect the target from above or below. The most effective targeting direction for an aerial target would be from above. The second line of examination involves effecting a degree of hit probability for the warhead correspondent to its range. Hit probability can be improved only by either better utilizing the information received from the target, by shortening the time-lag

or by significantly extending the warhead's area of effectiveness.

Hit probability is strongly tied to the choice of the target's most vulnerable area. An example of this type of development line are independent homing projectiles or target seeking explosively formed short-delay fired projectiles. Cluster weapon use is also based on this same point of departure. In working with these systems it is accepted that the level of hit probability involving the hitting of specific elements of the target can not be raised to a high level. However, since targets employed for ground combat operations contain, with a few exceptions, many tens of elements, a well dimensioned technological response employing cluster weapons could be a very cost effective total solution.

Development in weapon effectiveness technology is significantly slower than in similar micro-electronic sectors. However, research and development techniques are exerted from the same point of departure. Significant steps forward have been achieved only through the assistance of developed data systems. The key area has been the development of simulation and model construction into computer assisted development processes which have helped, for example, in converting experimental flow dynamics into a complicated design model and then into a graphic form.

This development will lead, during this decade, to the putting into service of optimized conventional warheads which can be deployed against the chosen targets. Typical types of systems to be deployed will be hyper-velocity munitions and missiles, multi-effecting programmed cluster weapons as well as explosively formed projectiles.

### *Warheads*

By the end of the decade hypersonic speeds will also become capable of being arrived at on the ground. The great density of air will present exceptional demands regarding the maintenance of aerodynamic control of projectiles. For example the achievement of a speed five times the speed of sound would mean that a mass in abundance of 10 kilograms would possess the capability to completely destroy a main battle tank. Hyper-velocity long-range anti-tank missiles will become a dominant element in open area

tank combat. In other weapons systems the increase in speed will decrease the reaction time of the system and thus heighten its impregnability. The problems involved in directing the missile during its fierce acceleration phase limit the use of such hyper-velocity weapons in close-combat.

Cluster weapons began to be introduced into general use already during the 1980's. Though clustering the munitions used in artillery and air weaponry has decisively increased their effectiveness compared to that achieved through conventional high explosives, they are in some respects looked upon as a transitional solution. Cluster weapons are at their optimum effectiveness in those type of situations in which the target is located in an open area without effective protection, such as heavily armoured or well-prepared fortifications. In covered or soft terrain the range of fragmentation effect of the clusters becomes almost nonexistent. A jet of small calibre hollow charges are quickly checked by effective cover.

The reduction in the strength of combat forces coupled with the increased mobility requirements of firepower will mean that individual target elements become valuable objects of interest. These type of targets can only be sporadically affected by conventional explosives. Cluster weapons are most effective when they are released deep into enemy deployments. At long distances the weakening of hit probability is a factor that also must be taken into consideration. In approaching the actual combat area the great scattering of cluster weapons as well as the high risk of duds together with the density of explosives fundamentally weaken their performance. Both problems are capable of being solved through the development of a homing system situated either into the cargo missile or the clusters they are carrying. This development model has been able to be realized only as a result of the extraordinary increase in the performance of micro-electronics. During this decade there will be brought into service cluster weapons chiefly meant for anti-armour purposes but also to be used in anti-helicopter operations. In these weapons the warhead will have the capability to either home in on the target or discern the target and then direct an explosively formed projectile to it. These type of clusters will be discharged from artillery weapons as well as from the air.

### *Other development areas exerting influence on warheads*

From the point of view of weapon effectiveness, explosive development will bring only marginal benefit in the near future. Traditional development areas, such as detonation speed, are being overtaken by demands involving reliability, safety and performance. One example of this is the greater tolerance to launch acceleration and the concomitant increase in range of plastic bonded explosives.

Conventional propellant appears to be near the end point of its possible development. Though the effectiveness and burning properties of propellant will be heightened through the employment of additives, other solutions will be sought to bring about the desired benefits. These include approaches involving the use of disposable burning casement material and unicharge systems. Burning casements are suitable for machine and heavy weapons. However, their suitability for use in hand weapon systems is questionable. One line of development regarding hand weapons is centered entirely around the use of caseless cartridges. This development may however be halted owing to the fact that hand weapon systems will not be forming a focal point in the losses incurred on a modern battlefield.

Burning casements can increase the rate of fire of machine fired weapons and facilitate the distribution of munitions and the operations of an evacuation system. Similar benefits are sought through the deployment of a unicharge system. Especially with regard to heavy gun systems, the use of many different propelling charges leads to a situation where it becomes difficult for them all to attain their optimum use. The result of this type of system is the creation of substantial waste in evacuation and data handling as well as a permanent damage risk which is minimized through the deployment of unit charge systems.

Solid propellants can not essentially improve the specific impulse of a charge of propellant. For this reason the feasibility of using liquid propellants in gun systems is being investigated. Smaller quantities of liquid propellants will be capable of achieving the same maximum pressure of solid propellants. As a consequence of the increase of the total impulse the launch speed and thereby the range of gun system projectiles will be significantly enhanced. The increased muzzle-velocity achieved

due to direct firing also means increased impact energy. The advantages offered by liquid propellants are so great and their development have progressed so far, that systems based on them will be brought into service at the beginning of the next decade, primarily in artillery systems. At the same time liquid propellants will offer an interim solution for the next generation of launch-impulse mechanisms which are under development. Though a theoretical ability to exploit electromagnetic propulsion will also be achieved during this decade, it will not become operational for at least another 20 years.

The development trends of missile propellant mechanisms do not follow the course of gun systems development. Solid propellants will continue to maintain their leading role, however composite propellants will displace traditional double-based solid fuels. The share of metal additives as an inducer of high specific impulses can be reduced with other additives so that smoke formation can be minimized. The problem connected with using solid propellant motors are their limited range. A one-stage motor can not now exceed a firing distance of 40–50 kilometres. For this reason there will be sought supersonic missiles to increase the range possibilities from two directions.

One approach is the use of a two-stage solid fuel rocket motor which can nearly double the range and achieve flexible applications involving different speed and height adaptations. It would thus be suitable for long-range air targets and air-to-ground missiles. However, at present there are problems concerning the reliability of these two-stage rocket fuel motors so that their introduction into operational use has been put off until the next decade. The other solution that will become more quickly operational is offered by the solid fuel ramjet engine. Intended mainly for applications involving air-to-ground missiles but also as a solutions for air-to-air missiles, its problem has been its limited lateral acceleration capabilities.

### *Cover*

The demands brought about by the increase in combat mobility, the use of more effective intelligence, the speeding up of the introduction of fire as well as the increased accuracy and intensity

of firepower, presents great challenges to the field of cover. Cover and protection is provided through the thwarting of the activities of an enemy. Discernability, identification and the choice of target points is encumbered by mobility, dispersal, concealment, the deployment of decoys, structural solutions, the use of armour and fortifications as well as personal protective equipment. The most significant technological solutions are those involved with armouring and added personal protection.

The armouring of main battle tanks is being endeavoured to incorporate into an integrated and modularized system. In an integrated system the greatest possible mass can also be utilized as an element for protection. In a modular system the main armour would be formed from elements which can be either changed or replaced. As a consequence of the latter approach the material and method development can exploit the short time-lag as a factor offering added protection.

The protection of main battle tanks and armoured fighting vehicles as well as, later on, self-propelled artillery will be improved through the deployment of add-on armour. For this purpose there can be used layered constructs, composite and reactive elements as well as harder qualities of steel. However, owing to its high density, steel is being displaced by aluminium and ceramic materials. Substantial added protection against traditional shaped charges is achieved through the fitting of reactive armour. However, double shaped charges as well as explosively formed projectiles work effectively also against armour protected with reactive elements. This development course will lead to an increase in the share of ceramic materials used and later on the development of multi-constructed armour. One development trend is leading towards active armour, which would function on the basis of the threat manifestation before the projectile actually impacts against the armour. For lightly armoured vehicles there will be sought a reactive protection in which the explosive effect would be so subdued that it would not have any damaging effect on the vehicle itself.

The protection of individual combatants against fragments and the residual effects of armour penetration will be fulfilled through the introduction of improved flak jackets and more advanced helmets. The flak jacket material will consist of Kevlar together with nylon which is, despite its greater weight, clearly

cheaper. The material of helmets will consist of reinforced composite plastic and the fabric layers which are joined to it. The protective equipment for combatants will not be able to offer sufficient protection against the simultaneously developing explosive materials, but it will decisively reduce personnel losses in marginal situations.

## 4 FROM TECHNOLOGY INTO WEAPONS SYSTEMS

### 4.1 *The effects of the development of military technology*

The objectives of military systems will remain the traditional ones; the increasing of the range and effectiveness of individual units are still the central goals. In those systems which are reaching the limits of the existing technology the goal must be to aspire to a new solution. A ten year development period is not quite enough time to produce fundamental changes. The performance of weapons systems can be upgraded by making possible the destruction of valuable individual targets with a few projectiles. Individual target-seeking or homing projectiles will play a significant role in land forces' weapons development. There are constantly being found new countermeasure methods to be employed against the newest weapons systems as well as the most developed intelligence equipment, so that the familiar development race continues on. However, its focal point is shifting away from a matter against matter arrangement to one involving applications of electromagnetic radiation.

Development in the leading sectors will be substantial. The introduction of the latest sensors into intelligence systems will diversify the gathering of information. The parallel operations of many sensors together with electronic intelligence systems will facilitate the production of usable information also when any single piece of equipment alone would not possess the capability to perform the given task. Parallel buses will enable the short-delay transfer of a significant amount of data to where it is needed.

However, a wider examination of military technology development during this decade will show only two clearly new areas: great processing capacity and system integration. The great processing capacity which makes possible multi-purpose sensors, smart munitions and expert systems, is also a prerequisite for system integration. As a consequence of system integration complicated overall system operations can be automated and

thereby accelerated. The parts of the system, the individual weapons, can, if required, have their functions changed on short notice. Afterwards, if needed, they can return back to the overall system. In this way the coordination of parallel operations achieves a new dimension.

This sort of course of development does not eliminate the need for a corresponding traditional weapons system. A main battle tank has to be aligned beside its protective armoured fighting vehicle because the weapons system development of main battle tanks is taking it towards becoming a mere anti-armour weapon. Both of these, much like self-propelled artillery, require the direct protection of anti-aircraft units. The development, integration, and total control of this new overall system poses new types of challenges to those responsible for creating and maintaining modern combat forces. At the tactical level the new areas do not bring very dramatic changes, but at the operational level the one who is the controller of the applications development is, right from the starting point, more than a match for the opponent who is unskilled in this respect. The qualitative superiority of weapons and C<sup>3</sup>I-systems will, in the next decade, be brought about through the better control of software and planning tools. However, a precondition for bringing this about will be the investment of substantial economic resources towards the achievement of these ends.

So despite the rapid pace of development there will not be seen in the near future any new types of overall systems. For example, the outward appearance of main battle tanks and helicopters will be the same as before. But, on the other hand, if the basic function of the system remains more or less unchanged, no change in key concepts is possible. That is why, for example, essential parts of the television receiver in 2005 will resemble those from its half century old predecessor, even though the technological solutions arrived at since then should have made it appear quite different.

The fundamental human basis of development directs its progress as powerfully today as before. The commander wants to see the battlefield and strike further than his opponent. Zeppelins and reconnaissance planes had the same task during the first world war that unmanned aerial vehicles and combat helicopters perform today. The main battle tank of that time

equaled in firepower that of a modern armoured fighting vehicle. A consequence of the post Second World War development of main battle tanks has been the birth of an anti-armour system based on hyper-velocity missiles. Developments involving the effects of stand-off weapons effectiveness, protection and cover as well as speed of movement also have a human basis.

It should be borne in mind however, that the development tools of the new data processing technology also offer new possibilities for human innovation. As a result of this it will be possible to develop to the basic system such types of support applications that an outside observer would have difficulty even understanding what in reality is being developed. The introduction of such a system into combat, especially during its initial stages, could decisively change the developing arrangement. Though these types of innovations are mainly linked with electronic warfare, they can be found to have applications to the defensive components of the new weapons systems, such as the self protection system of main battle tanks.

The dissimilarity between current weapons systems and those to be introduced in the future will be most pronounced at the level of their integration. Single pieces of heavy combat equipment, such as self-propelled artillery, will be converted into an independently functioning weapons system. With respect to rocket launchers or self-propelled artillery, the qualities that these overall systems will possess include, for example, own position determination and automatic communication of it, receipt of firing mission, choice of munitions, calculation of firing data as well as timing of firing. In principle, the implementation of these tasks will be capable of being carried out under all battlefield conditions, during the day or at night. Similar types of overall systems will be found in the latest main battle tanks.

While the need for operating crews is reduced under this overall system their maintenance requirements are increased. The operating crew must be a thoroughly trained group and therefore not anyone at all will be fit to join it. In this respect the arrangement is rather paradoxical in that the training of operators for a system that itself will be determining complex tasks should, in principle, be easy. However, the integration of these overall systems eliminates the advantages obtained from single components of the system since the operator must master many

different entities and, in general, it must be accomplished in a shorter time than previously. The complete automation of the integration would erode the flexible use of the system and would render it clumsy and vulnerable in unexpected operating situations.

The increased maintenance requirements will produce new problems in operating these systems. Because of the complicated technology employed the systems' average uninterrupted operating times will be shortened and the amount of required components will inevitably increase. Though the systems can contain continuous testing methods, these will not decrease the expanded need for maintenance. The maintenance occasions will be carried out rapidly if the required components are available. However, the maintenance organization attached to the combat troops on the battlefield can not implement measures that were not defined in advance. Thus the planning of systems' maintenance will become an even more important part of operational planning, nor will it be quickly possible to change its current basis.

In addition to the aforementioned ways the deployment of stand-off weapons systems limits the flexibility of operations. When the operating distance is extended out to an unobservable area, the time-lag in appraising the information received from the target increases. Since the operating accuracy of a weapons system decidedly weakens as the time-lag increases, a way must be found either to freeze the target situation or preserve continuous tracking contact with the target. Through the deployment of deep effecting weapons this goal becomes difficult to achieve. Target situations are then to be obtained either from collecting static targets or the weapon system's warhead must be fitted with wide-ranging target homing missiles. The demand for continuous target contact will lead to the requirement of a scaling of distances and a target acquisition system comprising many elements. Because a modern target is capable of moving, the received information must be passed on without a time-delay and be available for both decision making and for follow-up involving battle damage. Such a system must have the capability to clarify the operations model and structure of the target as well as many different technological and systemic solutions whereupon, from the point of view of the usability of

the system, we are returned to the problems of integrated weapon systems.

#### 4.2 *Factors influencing command and decision making*

Development toward integrated units is not possible without new data processing technology. In preparation for modern ground combat the troop commander must be capable of solving very conflicting demands. He must be capable of protecting his troops against modern intelligence and fire support systems, also against those that are effecting deep into his own territory. At the same time he must do everything in his power to deploy his troops in such a way that sufficient weapons effectiveness is made available to determine the course of battle. The second problem is directed towards the command and decision making processes. In the event that the opposing sides' intelligence and firepower capabilities are at the same level, advantage is to be sought through command and decision making processes that are either faster than the opponent's or timed in a different way.

Conflict solution requires troop mobility since the protection afforded by fortifications would impede the flexible use of troops. Troop movement must be dispersed since great concentrations of men and equipment could be easily revealed by airborne intelligence and are very vulnerable even to inaccurate mass fire. The command of dispersed troops requires a knowledge of their status. In the event that the speed of movement is tens of kilometres per hour, then the status must be discerned in time intervals of less than half an hour. Because the operations and crushing firepower of an opponent may, in the space of minutes, transform the status of some troop units decisively, there must be maintained an ability to follow the course of the battle so that the necessary information could be relayed to troops at the tactical level in the space of minutes. The adaptation of this task to the system would not be possible without modern data processing technology.

Traditional command and communications systems will expand into an integrated regional command, control, communications and intelligence system. With the aid of integrated C<sup>3</sup>I-systems composed of sensors, combat radios,

regional subscriber networks, data processing and decision making support systems, the commanders will have improved capabilities to determine the existing situation and thus implement appropriate measures. The regional deployment and command of troops will be flexible and quick. The breadth and depth of the mobile regional command-and-control system will cover an area of many tens of kilometres. Operational systems will be linked through networks with ranges of hundreds of kilometres. Necessary information can be transferred within a short time-lag to, for example, the chain of command at the battalion level, whose independent functional capabilities are thereby improved. However, a commitment to this type of overall system also affords opportunities to many types of countermeasures. To ensure that the command system maintains a functional capability, its data transfer system must be kept available through the application of several parallel systems employing different types of technology.

With the aid of the decision making support systems – sophisticated war games and simulated models – the commander will have an easier time analysing the interaction of the systems in the given situation. Besides enabling an optimal integrated operation of the weapons systems, it will afford a greater possibility to exploit the opponent's weaknesses. Automated parallel processes will be drawn up based on the work routines and planning of staff which can be carried out as a continuous procedure. The changing principles upon which decision making is based will be able to be more quickly followed. In addition the freeing of the decision makers from their routines will enable them to direct their full capacities to innovative operational or tactical command.

#### *4.3 Development problems and factors influencing the scene of land combat*

In reviewing the previously examined areas of military technology it is notable to point out that not one developed weapon system has been able to meet the demands initially set out for it, nor to become completed in the planned time schedule, nor to remain within the cost constrictions set out for it. The nonfulfillment of these demands is mainly due to the fact that while individual

technological solutions might function in their desired way, the combining of many technologies is not feasible without significant compromise solutions. The more the types of solutions incorporated within a weapons systems, the greater the compromising of the technological possibilities being offered. The compromises are, of course, relative not absolute. They are chiefly precipitated by the need to keep the total dependability of the system at the desired level. This phenomenon influences, above all, the development of independent weapon systems, for example, mobile anti-aircraft systems, main battle tanks and field artillery launchers.

The breaching of time schedules has, almost without exception, been connected to the prevailing marketing setup in which the competitive situation forces those responsible for development to take the risks involved in developing new key technologies. In view of the events taking place related to economic and international political development, the need to take such risks will be reduced. In its place, however, will arise problems involving the controlling of wide-ranging multinational projects. The exceeding of cost limits is hastened by the significant increase in research and development costs. This trend will be maintained although equipment and methods will continue to develop. The most important reason for these high costs is the increase in time-consuming human labour while at the same time generational changes in certain areas of technology occur in the space of a few years. This phenomenon affects above all the elements upon which expert systems rely on. These are, among other things, the systems involved with the collection and analysis of intelligence data, the planning and optimizing systems for firing operations as well as sophisticated weapon system sensors. As a consequence of this cost development, the number of new systems will continue to be further reduced.

The simultaneous existence of the above-outlined problem areas affects also conventional ground combat equipment in which development is operating alongside a similar factor – qualitative arms race. In certain areas – for example electronic warfare and defence against air-to-ground stand-off missiles – the movement is toward a situation in which an advantageous arrangement can be achieved through the employment of only marginal solutions. The basis of this is bound up with the excessively large amounts of different types of demands placed

on the weapons systems in which control of many different target situations is sought. The requirement that a single system fulfils many different tasks has already succeeded in suppressing some operationally functional development work.

A similar course of development will also affect more traditional elements such as, for example, autonomous homing artillery projectiles and artillery anti-battery operations emanating from radar fire-control. However, it was shown during the 1980's that, owing to the economic factors involved, such types of competition produces no victor. While in many ways serving as a insufficient example for comparison, the Persian Gulf war showed above all the importance of the application of tried and tested basic solutions in relation to systems employing a marginal technological benefit. The most concrete example of the latter was offered by the not totally successful hunt for the mobile SCUD-B missile launchers as well as, above all, the operations of the much publicized anti-missile defence.

In assessing the capabilities of the new ground combat systems the following points must therefore be borne in mind:

- \* The implemented solutions can not achieve as great an operational advantage as that which can be produced from a purely technical examination. The overall technical solutions that are arrived at are always compromises which besides containing the chosen strengths also contain essential weaknesses.
- \* The incorporation of many technical systems into an optimal tactical system is possible only in theory. In poorly controlled conditions only a small part of the system's combat effect is realized.
- \* Notwithstanding the disadvantageous factors just listed, the command and firing operations of independent and lightly manned mobile weapons systems are rapid. The activities of the troops are endeavored to be tied to their optimized operations so that the role of lightly armed infantry will be concentrated to secondary tasks. These will primarily involve protection of different phases of attack as well as flank and rear protection.
- \* The effort to increase protection and security will decidedly narrow operational freedom of action. If basic key systems of mobility and firepower are not capable of being utilized, then the parts of the system which are optimized for protective

tasks remain weak with respect to also today's confluence of armoured power. The performance of the system is thus dependent on maintaining the capabilities of new key systems.

- \* Although the capacity of independent systems – artillery and anti-aircraft systems as well as helicopters and tanks – will grow, their valuableness and the reduction in their required numbers will lead to an increased need for cover. The elimination of such key systems would noticeably reduce the combat capabilities of the troops and their replacement on the battlefield would be difficult.
- \* The mobility and protective needs of the best troops extend out to all important systems. Artillery, mortars and mobile command posts are to be sufficiently armoured against bullets and the fragments emanating from light artillery.
- \* Effective intelligence, both general and target orientated, is a prerequisite for optimal operations. Without accurate intelligence data the achieved firepower loses its significance. Though intelligence equipment is not very vulnerable, it is however a neural network, the modern C<sup>3</sup>-system.

## 5 THE LAND COMBAT SCENE

### 5.1 *The points of departure, the increasing significance of time and data*

It is obvious that in spite of the development lines, ground combat will not approach the arrangement which has always predominated in air and sea combat. These are formed from individual elements whose activities can be controlled rather well on the strength of the laws of nature and observation. Air and sea combat, also on the modern battlefield, tend to develop into a competition involving technology and the superior utilization of it. In such cases key factors arise from the performance of sensors, the range and countermeasure capabilities of the weaponry as well as the reaction times of the systems. A borderline factor is naturally, the competence of the operator of the system.

Ground combat seeks the same arrangement. However, since ground combat involves many more individual elements and so many varying arrangements, the straightforward assessment methods of sea and air combat can not be applied to ground action. Human factors are more clearly emphasized in ground combat, including those factors involved with drawing up false assessments. When these factors are combined with the many different methods to process the collected data, then it can be shown that decision makers, also in the future, will be bound up in the traditional fundamental ground combat problems.

Data compiled from each individual situation can be used to form many different overall scenes in which none may necessarily be correct. To ensure the correctness of data the periods of data transmission are being ever shortened and frequently it is necessary to resort to sensory transmissions or electronically accompanied intelligence data. The more secure the method of receipt the more reliable the data. Skillful deception can send even an effective decision making system into disarray. This is because the reliance on automation reduces its flexibility. It should also be pointed out that in so far as the commander has a possibility to receive data from outside his own area, his interest may be directed toward entirely the wrong matter.

Traditional development effecting military technology has brought added firepower and speed as well as enhanced fire accuracy and range to ground combat equipment. This trend will naturally continue but at its side will arise enormous developments in systems enabling fire operations. This will have the effect of increasing the importance of data and, above all, time in relation to ground combat operations. These factors will alter the combat scene chiefly at the operational level. At the tactical level, especially with regard to close-combat situations, the battlefield will function quite similarly as it has in all previous wars. Then the importance of the performance of equipment relative to human will-power and competence will be decisively reduced.

The significance of data is a complex question. Modern data systems can, within a short time-lag, transfer such an enormous amount of data, that it can overwhelm the operations of any organization. Therefore the filtering and handling of data increase as ever more important key factors in decision making. Decisive to all that has been stated in the foregoing is the accessibility and transferability of data. In so far as the tools for this are existing, then in a symmetrical duel the calculator will always win out over that which is human directed. For this reason the consequences of technological and cost development will be that the traditional most important elements of weapons systems – weapon launchers and warheads – will have a reduced significance in the future.

Apart from data the most dominant factor is that of time. Its influence is stressed by the fact that data procurement and handling require time. Owing to the shortening of the handling and transfer times the procurement time emerges as the critical factor. Thus that side which possesses the more sophisticated intelligence system will achieve a decisive advantage if it has enough time to collect the information required for decision making. Time also quickly makes data obsolete. If the data is not updated as the situation changes, decision making becomes caught up with making estimations of what is the prevailing situation. The decision maker who is dependent on mere estimates of the situation upon which he is to make his judgements will naturally come off second best to the decision maker whose judgements are based on received data. The interval occurring

between the collecting of the data upon which the order will be based and the receipt of that order itself, also emphasises the significance of time. Thus the shortening of the time-lag in operations as well as the possession of data emerge as key factors in ground combat command. Time is a critical factor also in combat situations. The acceleration of the firing rhythm of weapons systems will shorten the operating time of firepower as well as narrow the speed of advance and time of deployment of mobile troops during times of advance and deployment. Operating times of firepower will be able to be shortened to even a tenth and that for other activities to even a third.

The development of this kind of technology also involves being committed to it. A consequence of this is that it is not possible to stick to the long-term development of only certain parts of the system but rather development of the overall system must be the final goal. A powerful firing system is ineffective without a functional intelligence mechanism. The benefits afforded by troop mobility can be realized only when their movements can be commanded and followed. The commitment to an integrated overall system also brings forth a second fundamental problem: if the critical parts of the system become inoperative it will be difficult to transfer its operations to a lower level, generally a manual system. This property constitutes the most vulnerable aspect of integrated overall systems.

## *5.2 Range, operations model and the role of the individual*

In the near future the dominant feature of ground combat will be its depth. Firepower in particular can be extended out to a depth of tens of kilometres if the situation warrants. Accurate observable firing operations can be directed towards a distance of a hundred, even hundreds of kilometres. A precondition for this is the possession of sufficient target acquisition capabilities. Deep firing operations aspire to create a situation whereby the attacking or defending ground forces would come against troops that have suffered substantial losses or even, in extreme situations, meet forces that have already been put out of action.

The capabilities afforded by intelligence will aspire to transform the command of combat situations into a kind of a

chess game. Target acquisition and position location capabilities as well as the deployment of precision guided weapons will alter the effectiveness of fire, its selectivity and the amount of firepower required. Thus the cost-effectiveness of firepower will be improved. The time factor will be transformed in such a way that whereas today the time-lag for received intelligence data designed for long-range firing operations can be between ten minutes and some hours, it will, during the next decade, be shortened to a period of from one to ten minutes. The factors influencing decision making can, in extreme situations, be thus changed at the brigade level in the space of minutes. The shortening of all execution times thus develops into a central factor.

This development will lead to a situation in which the objective of the use of a weapons system will be the selective, economical and certain neutralization or destruction of the enemy as well as ensuring the safety of one's own troops. It means the precise choosing and handling of the most important targets and the avoidance of unnecessary targets and the reduction of massive fire. At the same time it means taking advantage of your own technical strengths and your opponents shortcomings so that your own losses will be minimized.

The compartmentalization of the battlefield i.e. its temporal and territorial separation, will become more pronounced. The aggressor will choose his time and place in such a way that he will avoid all those deployed forces whose defeat is not a prerequisite for the accomplishment of his task. He will endeavour through the effects of aircraft and stand-off weapons to cripple or limit the area of those troops which are not worth eliminating through the operations of ground forces. The versatility of the weaponry will afford possibilities for the optimal use of weapons systems in the most economical manner. The fundamental precondition for these operations is a smooth running intelligence system.

When looked upon from the perspective of the individual combatant, operations will become more difficult. Heated round-the-clock activity will be very strenuous for the soldiers and the range of the weapons systems will decrease the possibilities for cover on all battlefields. The acceleration of the pace of operations will impose increased demands for every combatant. The need for commanders to make quick decisions will be heightened by

the simultaneous increase in the amount of information – including inaccurate information – to which he will have access to. The new technical equipment will require a high degree of competence from the operators – and also from their commanders.

### 5.3 *An example of an invader's mode of operation for land warfare*

#### *Preparation for attack*

A modernly equipped military power preparing for attack will, in the first instance, employ existing ready troops. They are thus, at the tactical level, made up of standing forces. The simulated dividing up and deployment of the troops at the operational level is carried out through conventional war games as well as computer-based combat models. The usage and selection of munitions is made to accommodate to the widest possible range of operating conditions.

A prerequisite for the putting into place of these elements is an intelligence system that has, already during peace time, been engaged in continuous operations. Data collected with the aid of satellites is endeavored to be made more complete. This activity is carried out immediately after the decision to initiate military operations has been made. Though the reconnaissance phase attempts to minimize the creation of any possible surprise factors, in some situations it will be more important to ascertain a correct picture of the combat setting than to initiate a quick start-up of operations. In such a case that the defender has been able to reach a decisively heightened level of preparedness, it is more useful to bide one's time so that the target's course of action, organizations, key deployment areas and operational approaches can be better discerned and thereby used as a basis for operations.

The lead troops being directed towards the main area of operations will be equipped with the best possible combat equipment. This will mean great reconnaissance capabilities, a quick reacting command system, great mobility on the part of the troops and their logistics units as well as a high degree of combat endurance. Besides relying on satellites, reconnaissance

will increasingly be based on aircraft, especially reconnaissance planes and unmanned aerial vehicles. Helicopters will be used for reconnaissance only in those type of situations in which it is unlikely that they would become a target for heavy anti-aircraft fire. Satellite reconnaissance will be concentrated towards fixed targets and structures as well as the defining of the fixed command system. The effect of these measures will be to decidedly lessen their significance in the events leading up to the initiation of mobile combat operations. An operational reconnaissance system will also be able to collect data from outside the selected combat area. The reconnaissance also performs a target acquisition role which will make possible short time-delayed firing operations against observed targets. This will signify a significant threat to the defender's troops being moved or already deployed to the theatre of combat.

Operational reconnaissance is capable, in favourable conditions, of easily finding battalion-sized troops within the range of weapon systems. This process can be implemented even with battalion-sized forces. In open areas affording little protection, the longer term operations of companies – the duration of which can be many hours – becomes difficult to conceal. The time of day does not impose any decisive limitations on operational reconnaissance. Without the protection afforded by the shade of a forest, the mobile troops which are larger than company-sized can be detected throughout the chosen combat area by radar-based mobile target indicators. Electronic intelligence can crack in less than an hour a combat radio-based command system as well as locate the most important junctions to facilitate radio traffic analysis and direction finding. It also becomes quickly possible to ascertain the organization and combat division of the troops. Electronic harassment is thus integrated into the operation in such a way that its full effects are employed concurrently with a lethal application of weaponry.

The aim of the first attack is the carrying out of operations employing all available forces for the purpose of quickly breaking the resistance of the enemy in the selected area. The time of attack is chosen in accordance with developments involving the state of the overall situation. The decisive initial phases of the operation are sought to be carried out in the dark. The focus of the offensive is directed towards those areas which can benefit

most from the mobility of the armoured troops. Such types of terrain are cultivated land and other firm-based open areas. In winter it would also be possible to exploit the opportunities for added mobility afforded by frozen bogs and waterways. A decisive factor in selecting the focus of attack is the need to insure the ability of the logistics system to perform its task.

Air power plays an important role in the preparation and start-up phase of attack. The attacker will endeavour to achieve and maintain air superiority over the whole theatre of operations, especially during the decisive initial phase of combat. The use of air power, and especially the deployment of attack aircraft, seeks to prevent the defenders from mobilizing into deployed formations and to cripple those troops who have already deployed within the selected area. Air operations will at first be directed towards targets such as air-defence, the command system, maintenance units and artillery weaponry. Saturation of anti-aircraft systems will be carried out through the deployment of unmanned aerial reconnaissance and target vehicles. Ground operations will be started-up at that point when the joint operations of long-range artillery and air power are no longer capable of improving the initial combat arrangement.

Helicopters will be used chiefly for flanking tasks and in directing surprise operations involving deep-ranging reconnaissance and devastation. In combat involving a wide area, a substantial share of the available helicopters will be tied to tasks involving flank and rear protection. Helicopters equipped with ground surveillance radar will have the capability in sparsely covered terrain to follow the movements of even individual vehicles from a distance of tens of kilometres. This type of procedure will strive to prevent any type of deep-ranging surprise counterattacks being directed towards the flanking areas. In so far as air superiority is able to be maintained during the decisive phase of combat, it will be possible, also in the dark, to prevent relatively large detachments – comprising tens of vehicles – from moving in predominately open areas. It is especially endeavored to prevent the operations of those troops being directed towards operational counterattack.

## *The carrying out of an attack*

Through the utilization of armoured vehicles and air transport, an attacker seeks to obtain a level of mobile combat operations in which the first phase of action would make possible a military breakthrough or an encirclement of the defender. Following the first phase of operations, mobility would be maintained by confronting the defender with a continuous stream of new operational situations. The choice of the method of attack is also influenced by the defender's situation to the extent that the chosen method of action will seek to exploit deficiencies in the defender's state of readiness. A fundamental point of departure for this doctrine is that the defender's inability to fulfil these preconditions will prevent the initiation of combat. After the attacker has chosen the method of combat his resources become committed to its realization. In this regard special attention is to be focused on electronic warfare and concealment. Electronic warfare seeks to bring about an unexpected and wide-ranging disruption of command capabilities. Concealment is implemented during all operational phases and with all systems, including firing support and troop movements.

In so far as mass deployment of direct-fired short-range anti-armour weapons facilitates attainment of the set goals, any attempt at achieving a breakthrough will only be undertaken by the rationally acting attacker if it is absolutely necessary. In this way it becomes possible to achieve the desired aims more quickly and with smaller losses. From the defender's point of view, a breakthrough at the front need not be fatal if it is directed towards a less dangerous sector, the attacker's ground communications are to be cut and one's own forces are quickly able to act against the breach. Encirclement, if it is based on a controlled situation and not the consequence of an unsuccessful operation, is the most difficult for these three arrangements since the attacker can command and direct his troops more quickly and freely when they are in contact with each other.

Airborne operations carried out at the operational level are to be carried out only for the opening of a new front, although it can also be timed to precede the main attack. Through the employment of short time-lag command communications, its range of operations can be extended out to distances of even a

few hundred kilometres. However the area must have the capability of establishing receiving points for the receipt of the requisite maintenance and resupply materials that must accompany the operations. While maintenance materials can be supplied through the air, the available troops can be only lightly armed and thus be carrying out holding operations. Tactical airborne operations are likely only in those situations where one wants to ensure advancement through lightly defended or unopposed areas. It is endeavored to implement these tasks through the employment of firing operations which will quickly cover the same range as that which is to be covered by the tactical airborne operation. Whether the firing operations are carried out by helicopters or indirect fire, the resulting risk to personnel is minimal compared to the other forms of available firepower at the landing area.

Amphibious operations into the rear of the defender are carried out at the operational level only when it has been included as part of the preliminary plan of operation. It ties down such a large number of forces for protective tasks that only a great military power employing its most important resources in every respect against a weaker force has the capability to carry out such an operation.

The deployment area for the armoured detachments is to be situated in such a way that it is the very least, the distance of the range of the most long-range artillery weapon from which the combat is to be conducted from. The troops will be dispersed from the assembly area in such a manner that they will not reveal the magnitude of the forces concentrated nor will the deployment areas develop into destructive targets for sudden concentrations of fire.

The armoured detachments will direct their reconnaissance to the combat area together with that intelligence emanating from the higher chain of command. Mainly carried out from the air it is above all target reconnaissance, upon whose strength the required firing operations are commenced. The great distances involved require the timing of operational reconnaissance to be started-up 3-4 days preceding the planned combat. Firing operations endeavour to create a situation on the battlefield which will be conducive to the attacker's operations model. These activities include the isolation of the combat area, the crippling

of air defences, the weakening of the operating possibilities of the command system and the prevention of electronic means of defence. At the tactical level the most important targets are those reserve forces capable of initiating counterattacks as well as field artillery. The simultaneous commencement of firing operations extending along the entire depth of the combat theatre will be started-up 1–2 days before the advancement of armoured troops into the area. The firing operations are not continuous but rather they are carried out as short bursts of fierce firepower emanating from changing firing locations.

As a support element for the supplementing of the local command and position location systems, the dispersed armoured detachments will be moved to the combat area in a dispersed state. At the division level the troops will be directed to the combat area in, at most, battalion strength detachments in such a way that the channelling of the companies to the chosen attack avenue will occur beyond the reach of heavy mortar fire. At the same minimum distance will be mobilized those firing units supporting the attack and possessing the same tactical mobility as the attacking troops. Right behind the forward troops the self-propelled artillery units will be mobilized to a state of alert before the arrival of the main troops. The firing units will join in to the firing operations preceding any breakthrough, the goal of which remains the crippling of the opponent's possibilities to pursue combat.

As the combat progresses close-in fire support will be arranged in such a manner that the main forces could proceed without having to meet up with organized resistance from the opponent. The close-in fire would be supplied from the most long-range direct-fire weapons as well as helicopters fitted out with rockets. It is essential during this phase of operations that the anti-armour activities of the defender be crippled so that the firepower of the armoured fighting vehicles is put on a level basis in what otherwise is an unfavourable arrangement for the attacker. The purpose of the close-in phase of combat is to scatter the defender's troops and create holes for the next echelon of combat-ready troops to immediately go through.

Small units possessing great firepower will be directed towards objectives whose destruction would most quickly deprive the defender of the capability to continue the battle. The activities

of these troops is to be protected by isolating the combat area beforehand and during advancement, through the quick closing off of threatening flanks by the deployment of mine barriers and guards possessing large amounts of firepower. It will also be possible to direct a fast reacting reconnaissance system to the most important areas. Even during the first phase of operations the desired objectives can be many tens of kilometres away. Owing to the range of reconnaissance and firing operations, advancement connected to one operation can be planned, even in difficult terrain, for distances over a hundred kilometres.

The follow-up development of the situation is more difficult than the start-up of attack. Especially the limited scope for providing roads for advancing and maintenance reduces operational freedom of action and forces the closer keeping together of the troops than would otherwise be prudent. This hinders the precondition for a successful attack, namely the maintenance of a continuous momentum of movement. Sudden massive shifts in the focus of activities take plenty of time and require the commitment of a considerable portion of the troops to protective tasks. During this phase of operations the attacker is most vulnerable to all types of countermeasures. In so far as the attacker strives to attain his deepest objectives, he must remain on his chosen course. If his goal is the destruction of the defender's troops along a broad front, he must either disperse his combat forces or he must strive to concentrate them into a continuous echelon. The latter operations model is the more probable.

## 6 FURTHER DEVELOPMENT CHALLENGES FOR THE FINNISH LAND WARFARE DOCTRINE

### 6.1 *The Finnish land warfare doctrine and the factors which influence it*

In accordance with the territorial defence doctrine the land warfare doctrine, which in this work goes by the name of *territorial combat*, is put into effect by engaging an invader in combat right from the time he crosses the border. The power of the invader is to be weakened through the effecting of continuous losses to both his point and rear. The movements of the invader will be controlled by exploiting the possibilities offered by the terrain and preventing his access to the most important areas. Territorial combat thus develops into a series of combat operations that can extend to a depth of even hundreds of kilometres. The types of combat involved include guerilla operations, limited attacks as well as decisive strikes into enemy positions and a repulsing pattern of defence. Territorial combat obliges the invader to scatter his forces as well as forcing him to apportion a greater number of troops than usually would be required for flank protection. By committing the invader to a series of different combat operations he loses his freedom of action and is beaten by concentrating all available forces to the decisive battles. The formations and the troops attached to them will be used to take the initiative, to establish local superiority and to take part in the decisive combat engagements. The smaller regional troops will hinder the movements of an invader by carrying out continuous systematic combat operations. Combat operations aimed at repelling any attempt to subjugate the state can be initiated, if necessary, immediately upon the realization of any threat.

The performance capability of the ground forces is dependant upon the warfare doctrine employed, the organization and equipping of the troops as well as the training and will to defend of the personnel. The land warfare doctrine is developed in accordance with the chosen main military doctrine in such a way

that the warfare doctrine determines those principles which are followed in combat operations.

The doctrinal basis of the territorial defence system derives from the particular circumstances of Finland; the general educational level of the population, a large pool of trained reserves, the distribution of the population, the breadth of the country, the topography and quantity of road networks as well as flora and weather conditions. A well educated population spread out through all parts of the land possesses the capability to exploit the other particular circumstances of the country. The breadth of the territory enables flexible deep territorial combat. Factors related to topography and the quantity of available road networks limit the capabilities of an invader to direct his movements both on land and along the coast which together with the effects of flora decisively influence the possibilities to secure cover for the troops. Weather and the great changes in weather conditions fundamentally affect the operations of technical systems whose capabilities have not been tested in such conditions. That party who can fully utilize the possibilities afforded by these particular circumstances will enjoy a decisive advantage compared to the party who is unaccustomed to operating in such an environment.

The advantageous factors afforded by the terrain are the cover that is provided over a wide area and the great numbers of coniferous trees, the shade cover offered to the roads, the small size of open areas and lack of open areas as well as the large numbers of waterways and the difficulties attached to the crossing of their banks. These factors restrict the movements of the armoured troops and in most cases direct them to areas where advancement is possible only at the pace of a foot soldier and the range of direct-fired weaponry can be measured in tens rather than hundreds of metres. For the same reasons frontal attacks by the armoured troops are, with the exception of a few relatively small areas, very difficult to carry out. The slowing down of the pace of operations stresses the significance of mass in both firing operations as well as the formation of alternative operations models for the troops. Mobile combat, especially classical tank battles, is not possible except in open areas which, outside of Lapland, are found only in a few places in Finland.

Besides affording protection from optical reconnaissance,

the natural cover of the terrain also offers protection against optronic and radar surveillance. The scale of observable distances even off main roads is generally only a few hundred metres at most. The effective use of thermal imagers during summer conditions is limited by the tree stands and thick ground cover which extends from all observable directions. While these factors do not prevent the operations of reconnaissance systems, they significantly limit the use of weapons systems based on contrast discrimination. The systematic probing for individual mobile targets in covered forest terrain ties up an excessively large amount of capacity in relation to the benefit accrued. For over two-thirds of the year the sky in Finland is overcast. For almost half of this period the amount of damp particles in the air is so great that optronic reconnaissance and the use of optronically-based weapons is prevented.

The foliage of the trees will continue to influence the capability to locate static targets. This will also affect the operations of radar frequency sensors which are to be introduced in the near future. The amount of false alarms emanating from the radars of precision guided weapons clearly increases over waterways and in snowy conditions. Viewed as a whole, it can therefore be seen that the operations of also the new precision guided weapons against mobile individual targets, such as for example weapons intended to destroy main battle tanks, will be possible only in certain areas. It would also be difficult for precision guided weapons to have an effect on tactical command stations that were situated in wooded terrain. On the other hand, fixed structures such as bridges and key fortifications will, conditions permitting, be susceptible to destruction.

The cover afforded by the terrain as well as snowy conditions will also essentially weaken weapons effectiveness. Their explosion at tree tops or the effects of snow cover would dissipate almost all the relative performance advantages of cluster bombs in relation to that achieved from conventional fragmentation grenades. A considerable amount of the effectiveness of direct-fired weaponry is dissipated upon the branches of trees. The most effective weapon that could be employed by a main battle tank operating in typical Finnish terrain would be a fragmentation grenade. However, owing to the course of current development this weapon is being withdrawn from the range of available

munitions. From the point of view of fire control, the reinstatement of fragmentation grenades to the range of available munitions would not be devoid of problems. This is because the thermal imager-based aiming system works by locking onto a target which gives off a clear contrast to its surroundings. Terrain objects do not form a sufficient degree of contrast.

Besides being influenced by terrain cover, the operations of C<sup>3</sup>I-systems are also especially affected by electromagnetic disturbances. Besides affecting the navigation system, these disturbances also influence the transfer of all data. The operating distances of reconnaissance and weapon systems data links as well as the operations distances of communications systems links are both reduced. Occasional powerful disturbances can cut off real time data transfer connections for brief periods.

## *6.2 Starting points and preconditions for development of the warfare doctrine*

It is paradoxical that the development of weapons systems and the warfare doctrine attached to them is shaping the battlefield still more according to the points of departure of territorial defence. In addition the universal development trends tend to clarify the development of the Finnish land warfare doctrine.

In meeting the challenges one must pay attention to Finland's limited economic resources. These limitations impose the first restrictive condition concerning development: the development of the Finnish land forces can not be directed towards symmetrical systems and operations models that are to be deployed against all types of threat scenarios. Development is therefore to be aimed to those sectors which are capable of being developed in accordance with the warfare doctrine concept. The conclusions of this study also assume that the development can be carried out roughly within the bounds of the currently available resources and that the possibilities afforded by the development trends are presented in a relatively optimized fashion. It can be assumed as a point of departure however, that an invader will possess a wider-ranging and more versatile intelligence capability, a wider-covering electronic warfare capability as well as greater mobility and firepower with respect to units and numbers of troops.

Fundamental challenges consist of doctrinal problems of warfare and their inverse form up those factors giving advantage. Despite the advantages obtained from terrain, the operational operations model of an invader will become difficult for a defender if it can be carried out unhindered. A static, inflexible low-level defence arrangement requiring long preparation time, will always be breached by an invader utilizing modern land combat techniques. The great mobility of the armoured units prevents the defender from using individual units more often than once in the same combat setting. With reconnaissance and firing operations extending deep into areas, the need for cover from the rear is almost as great as it is for those units engaging in combat at the front. The surprising start-up of combat in which all elements come together in a striking display of firepower, may produce such types of shock effects that will cause the crippling of combat capabilities in especially those troops engaging in combat for the first time. The operations described can be started-up in all weather conditions though their ability to be maintained at the same level throughout combat requires good visibility.

The challenges are endeavored to be met through the elimination of the most important factors affording advantage, by striking at the weaknesses of a modern aggressor. In so far as an effectively operating modernly armed aggressor is permitted to carry out his concepts, his performance capabilities will be sufficient to carry out the planned operations. Therefore the goal of operations must be the continuous obstruction and harassing of the aggressor's attempts to carry out his systematic activities.

The ground forces, whose basis is a large pool of reserves with the will to defend their country, have a higher resistance to the losses that would be inflicted by a modern aggressive power. They also would afford the possibility for alternating and parallel operations of troops. The significance of these points is greatly heightened as the duration of operations increases and it becomes a powerful factor approximately a week after the initial sequence of combat. A corresponding significance is displayed by the relatively large size of the troop organizations. In close-combat situations quantitative relative strength, which is a more important factor than quality, also afford possibilities for the quick deployment of temporary reserves. Owing to this quantitative

factor, it is possible to achieve a decided local superiority in close-combat situations which serves to reduce losses. The first fundamental element of ground combat will, also in the future, be the endeavoring to force the aggressor into close-combat situations.

The aggressor's greater speed of movement in many combat settings prevents the traditional delaying operations in which the troops are deployed on many levels to the same combat area. However, the great quantity of troops enables them to form up into echelon formations from which operational delaying can be carried out. In place of the traditional delaying operations, the surprising strikes of mobile heavily armed combat detachments can delay the operations of an aggressor for days and thus further the effort of other troops to achieve combat readiness. A second fundamental element of ground combat of the future will be the attempt to freeze the movements of an aggressor in the combat area right from its front edge.

Mass use of firepower will be required to freeze the movements of an aggressor. If the movement of an aggressor is frozen he must mass his firepower which will further slow down his operations. At the same time it creates a symmetrical arrangement which, deviating from what was previously presented, is advantageous to the defender. The terrain also makes it possible to direct the movements of the aggressor by indirect methods. The construction of mine barriers is more advantageous for the party seeking to slow down the tempo of movement than to the one who is striving to maintain it. This idea holds true for both long prepared as well as quick arising situations. That type of terrain from which advancement is difficult affords advantages for surprise for those troops who can adapt their tactical mobility accordingly. A fundamental requirement for operational mobility is the capability to cross the large numbers of difficult waterways.

The depth of the combat area both enables as well as requires the creation of regional C<sup>3</sup>I and logistics systems. When conditions and possibilities are well-known and when peace-time preparations can be made freely, these systems can be kept functional also when the main attack has already passed through. A regional reconnaissance system enables accurate deep firing operations which can also be carried out without the need for

real time aerial-directed target reconnaissance. Those key areas deemed as essential from the standpoint of the aggressor's operations can be monitored and controlled by small regional units whose discovery and crippling would lead to the commitment of substantial resources.

Anti-aircraft and especially anti-armour operations can partially be organized along regional lines. Regional anti-aircraft operations increase the operating distances of fire support helicopters and ground attack planes and thus lessen their operating time in the target-area. Portable anti-aircraft systems can, in low altitude operations directed toward the chosen area, inflict substantial losses and thus render air activities unsafe. Regional anti-armour operations can produce continuous losses for an aggressor bringing troops to the combat area. The advantageous flank firing stations afforded by the terrain and the short firing distances afford possibilities for the destruction of also modern main battle tanks by portable anti-tank weapon systems. A precondition for the expeditious operation of a regional system is a functional command system.

### 6.3 *Development of the warfare doctrine*

#### *Weakening of military power, movement control*

In concentrating his troops in a limited operating area, the attacker leaves open wide areas to his rear which can be utilized for the start-up and maintenance of territorial combat. Operating as a part of territorial combat, guerilla activities are immediately started-up to the rear of the invader. These continuous operations can only be carried out by small units. Company-sized units can advance through the terrain to the selected area and start-up surprise operations from the range of light weapons' fire. For the strike to gain its maximum indirect benefit, it should be directed towards combat service troops, the equipment required for command and electronic warfare as well as artillery and reconnaissance or armour points.

The carrying out of surprise operations leading to the extensive destruction of armour protected targets requires wide-

range utilization of light disposable anti-armour weapons. More weakly protected targets, such as the centres and link emplacements of C<sup>3</sup>I-systems and especially maintenance and transport establishments, are capable of being influenced also by light weapons. The significance of the service sector as a key target is heightened due to the fact that the new technology requires special servicing and armoured vehicles require great amounts of fuel. In addition also random strikes could decisively influence the situation. On the other hand, strikes against fortified command systems will require continuous systematic operations.

The optimal effectiveness of light disposable anti-armour weapons is achieved against stationary or slowly-moving vehicles. The aggressor, for his part, tries to avoid such attempts. This situation can be changed through the massive deployment of mine barriers. The retarding effect on movement in difficult terrain is thus significant. However, their construction requires much time and labour. Mine barriers and other obstacles are to be built as part of the overall preparation for combat. If this is not possible, owing to time and factors related to cover, the focal point of massive mine laying operations becomes the depth of the combat area itself.

The previously presented targets will not progress without a moderate degree of air cover and safety measures. Helicopter patrols which can be quickly directed to different areas hinder the operations of guerilla units during all times of the day if weather conditions are favourable. This means that the operations of the guerilla troops can not be based on a wide-ranging use of all-terrain vehicles suitable for use over terrain, which therefore limits their area of operations. Anti-aircraft protection is essential for the prevention of crushing losses. It can be regionally organized through the use of portable systems.

A precondition for surprise and continuous guerilla operations is the ability to obtain a short time-lagged picture of one's own area. It becomes especially important during that phase of operations when the attacker's lead troops cross over into the selected area of operations. During this phase the regional intelligence system serves at the same time as the reconnaissance and deep fire control arm for guerilla detachments. This kind of system can only operate through the support rendered by a regional command system.

The range of cooperation with the mobile units will vary depending on the phase of operations as well as the extent of the combat area. During the initial phase of combat, cooperation is coordinated carefully and in detail. It will include a dividing up of the areas of responsibility, logistics and transport arrangements as well as mine laying, firing operations and allotment of targets. As the range of distances increases the most important areas of cooperation will involve reconnaissance and fire support. Fire support can be used to exploit those favourable phases of combat in which, owing primarily to the demands of time, it is not possible to deploy guerilla units. In addition to a regional C<sup>3</sup>I-system, such operations call for a firing system which can cover tens of kilometres and whose lethality is also sufficient to pierce light armour. Such a system could also be used as a quick mine laying device in indirect support of the operations of the mobile troops.

#### *The organizing of the operational troops*

The importance of protection for those troops engaged in the decisive phases of land warfare is underscored during the initial phase of regional combat. The troops seek protection through fortified positions in so far as this can be carried out without revealing the design of future operations. If this is not possible, then the most mobile troops must be protected through dispersion and by keeping them on the move in areas affording cover. Both operational models provide for the deployment of reserves who are capable of movement. So that this could be flexibly carried out, the formations should be capable of forming up for their planned combat tasks in the required fashion.

In both operational models the most important tactical principle is that of initiative. For those formations concerned with defensive tasks initiative signifies, with respect to the range of firepower, that the most important repellent effect can be directed out of the range of direct-fire weapons. This requires the formation to be joined up to a regional C<sup>3</sup>I-system. In performing its task the formations must be prepared to continue the combat also in the very likely event that a deep strike of the aggressor separates the troops from each other. For the mobile troops

initiative would mean that their strength would extend to such areas from which a preventative counterattack could be initiated to halt the movement of the aggressor. The type of operations presented by these threat scenarios cannot be carried out by whole formations but rather by units comprising of one or two battalions. Both operational models stress an independent operating capability by the formation's lower chain of command, a precondition for which is the greatest possible amount of indirect-firepower.

For reasons involved with training, it is not appropriate to create more than two or three types of battalions. In support of these tactical formations there could be established an uniform framework, based on a staff and support unit. The uniform framework can be formed in such a way that it will enable the command of the formation's troops also after they have carried out their own mutually independent tasks. Such a structure affords the possibility to, for example, quickly move into two operational sub-formations or combat detachments. The benefit of this type of solution is underscored during the initial phase of battle. The troops carrying out their combat tasks will be dispersed. The ability of these units to continue the fight, if necessary while cut off, requires above all sufficient independent reconnaissance and fire support capability. The achieving of these ends likewise requires a regional C<sup>3</sup>I-system. The formations which are divided along organizational command model and systematic lines, can be flexibly assembled into appropriate formations for new concentrations of troops.

The formations, which are organized in accordance with their assigned tasks, can be employed as operational formations when their capability for movement enables the carrying out of operations over a deep area. Regional formations will be established for those tasks in which operational mobility is not absolutely necessary or, because of the equipping of the troops, not possible. The regional formations can, on the basis of the previously mentioned principle, be divided up into smaller units capable of carrying out combat activities. Over wide areas of open territory this process becomes even a necessity.

## *Snatching the initiative and the decisive battles*

A situation in which the aggressor has a more favourable basis for snatching the initiative can only be resolved by influencing the picture of the situation. When the movement of the aggressor is retarded it becomes easier, even with small units, to take the initiative using surprise strikes. However, if the results of the strike are to be successfully exploited, the force carrying out the strike must be at least of battalion-sized strength. The defensively deployed formations must be able to quickly direct a mobile battalion deep into the aggressor's flank. This phase of combat requires that all operations be concentrated towards supporting the deep strike. A prerequisite for success during the decisive close-combat phase of the operations is weakening of the aggressor's direct-fire capability. For this reason an important task of the attack-supporting firing operations is the crippling of a great part of the aggressor's armoured vehicles.

In areas where defensive battles can not be successfully carried out either large-scale deep surprise attacks or operations designed to entrap the aggressor will be attempted. Large-scale surprise attacks require that the selected area of operations extend out to many tens of kilometres so that the effects of artillery systems can be fully realized over the area. A maximum of one battalion can be used in the direction of the surprise attack but the troops will advance to the area in company-sized detachments. The ability of the mobile troops to achieve a simultaneous effect requires the support of both a regional C<sup>3</sup>I-system and predetermined operations and plans of action. An appropriate degree of regional mine laying is more important in such an operations model than the traditional defensive combat. Achieving a surprise effect would require the laying of mines at a speed which is beyond the capabilities of human labour.

An operational entrapment operation links together large-scale surprise attacks to a repellent defence and by that means the operations of regional formations to that of the operations of operational formations. Surprise attacks can be directed deep within the aggressor's lines, but basically they form the second phase of combat. A central element of this operations model is the capability of the troops assigned to repellent defence operations to maintain their capability to function. A requirement

for this is the ability to decisively weaken the aggressor's firepower, especially artillery. Local defensive superiority will be concentrated over a narrow area only when the terrain or other conditions are exceptionally advantageous.

The above-mentioned solutions impose such challenges, that it becomes difficult at this phase of combat to allocate other operational concepts. To preserve the operational capabilities of the most important troops also for the next operation, the attacks should strive above all to disperse the structures of the aggressor while at the same time to maintain one's own freedom of action. This means that the attack does not strive to attain the widest objectives but rather to perform a local surgical operation. The more decisive the area of operations, the greater the strength that will be directed towards it.

In all instances the key factor is the advanced build-up of the combat sections and troop deployments. Also fire units are to be formed up for support of these operations from an area whose selection anticipates the dividing-up of the tactical formations. Especially the wide dispersal of artillery requires the reliance on a regional C<sup>3</sup>I-system. The anticipation of events as well as the partitioning of the troops also facilitates disengagement from combat. When the defender's control over the situation is inadequate, great numbers of the aggressor's men can become tied down in defensive action through the powerful fire from small troop units. To avoid these units from becoming bound to a fruitless frontal battle, the regional formations must have the capability to initiate limited counterattacks. The troops intended for these operations could thereafter disengage from the combat and move to their new task.

Whenever a situation arises decisive battles, with the aim of locally destroying or defeating the aggressor, will be set in motion. The troops directed to the focus of the attack will be gathered from previously disengaged or unused operational formations. In the flanks and particularly in the depth of the aggressor, regional formations will also be assembled for decisive battles. A prerequisite for the successful performance of this combat is the crippling of the aggressor's total organization.

Several formations will be concentrated to the decisive battles. Some of them will have to be moved to the area from great distances. The process of integrating them will take time

and their arrival at a favourable point of time may be difficult. This stage of activity again emphasizes the protection of the troops. For this reason the operational formation's anti-aircraft arm must have the capability to move with the troops as well as to cover them in any given area. The dispersal of the troops makes this requirement impossible in certain phases of operations. During these periods air cover is to be achieved through passive means and also by relying on the widest possible use of fixed structures.

The required stores of munitions must be secured for the decisive battles. In addition, that equipment which is damaged during combat or in other ways becomes unusable must be put back into working order. The setting up of a regional maintenance system for use in the decisive battles is also one of the greatest challenges for regional combat planning. Because of the unfamiliar terrain and selected operation models, the challenge is still greater for the aggressor.

The challenges for warfare doctrine that have been just portrayed are exacting for any military power. They contain both conflicting demands and considerable problems. Conflicting demands come about for example when the tactical lower chain of command should become independent as far as firepower is concerned just at the same time when the establishment of superiority would require concentrated firepower. The role of deep firing operations, above all from artillery, is of increased importance. At the same time these become important targets for the aggressor's air power as well as radar fire-controlled artillery. To protect them they thus must be either mobile or capable of being fortified. While the main protective resources are being committed to the troops operating in the combat area, also those troops who at the same time advance to the combat area must be protected. The problems of fortification are relevant in this context, too. Large-scale construction of fortifications requires great amounts of time also when they are done in a mechanized way. Because of this they can be easily detected by modern reconnaissance systems. However, successful combat in depth requires the quick support afforded by fortified positions.

A basic requirement for the operating of a regional logistic system is the ability to protect the system, above all by keeping it secret. This task, however, requires considerable preparation.

The regional air defence system is restricted to its chosen operating area, which does not necessarily coincide with the area of operations of the aggressor's air power. The regional C<sup>3</sup>I-system must be able to protect itself from electronic intelligence and from subsequent measures, jamming and weapons effect. A decisive question is also the time of day when the combat occurs. Darkness creates insolvable problems for the side which is unaccustomed to the terrain. The massive use of night vision devices will however facilitate operations over terrain. Thermal imager reconnaissance directed from the air is, owing to the greater contrast difference afforded by darkness, even easier to carry out than a similar operation during the day.

## 7 FINAL ASSESSMENT

Military technology is focusing on new key areas. Developments in micro-electronics enable a continuous stream of new solutions. These, for their part, increase the need and possibilities for applications development and also for individual algorithms which direct the more critical operations of systems. From the point of view of the user, the development will culminate with the task of controlling still more difficult operations in a more simple operating environment. This will be arrived at only by dramatically increasing the automation of processes, whereupon the share of human judgements will correspondingly diminish. At the strategic and operational levels of systems, this trend is a necessity and produces clear benefits for those relying on them. At the tactical level these advantages strongly decrease as the distance to the opponent diminishes. Close combats will also in the future be fought soldier against soldier. Therefore that party which is endeavoring to achieve a technological advantage will try to avoid this arrangement.

Systems integration and enhanced data processing capability will change the dimensions of land combat. System development at the operational level will during the next decade endeavor to increase distances by ten fold and to divide the time period to one-tenth of what it currently is. In so far as these factors are not tied to particular circumstances they may also be realized. Nevertheless, examined already during the planning stage, they will lead to fairly straightforward and therefore predictable operations models. The great question mark will however remain the starting-up of operations which can be simultaneously carried out almost within the entire depth of the battlefield and with many different types of effecting methods.

The large-scale introduction of new types of technologies is possible only for a great power. The high cost of the new integrated systems will limit their numbers more effectively than the conventional arms agreements that have so far been concluded. Thus the amount of combat troops will decrease while at the same time the relative share of the most valuable elements of these troops will increase.

If the previously presented factors are examined with the

aid of the Lanchester combat model, they produce some interesting results. The replacement of quantity by quality factors will weaken the combat strength of the troops which must be compensated through changing the time dimension. Increasing the range will mean altering the time dimension. However, when approaching the close-combat phase the fire-producing capability must be increased so that this advantage is capable of being maintained. On the basis of the models, the pursuit of an opponent who possesses similar systems require a similar quantity of these systems. Though the defender as such has the advantage, it is not very significant in combat which is based on movement.

On the basis of this simplified examination it does not pay to try to obtain symmetrical models with the limited resources available. Rather the advantages are to be found from within the existing basic structure and from well developed original operations models. For Finland these structures are the breadth of the territory, terrain, weather conditions and a great quantity of land forces. When combined, these factors fundamentally alter the solutions obtained when compared with symmetrical arrangements. However, they require some basic factors. These are the direction of the movements of an attacker and the freezing of them, the consuming of his strength and the defeating of his operations models as well as the protecting of one's own forces. To maintain these basic elements one must be capable of evading the ever more efficient intelligence systems.

The special conditions of Finland as well as the arrangements portrayed underscore the importance of the human factor. Operational models must be drawn-up in a manner that is different from that which is common elsewhere. In this way the decisive surprise factor can be maintained also when the forces are, also from the point of view of intelligence, operating from positions of inferiority. In territorial combat the surprise factors are guerilla operations, deep surprise attacks and entrapping the enemy. So that these operations can be flexibly carried out, the importance of deception should be underscored in all operations. An individual acts differently in an operation involving deception than one in a normal situation. Also the fundamental components of the total integrated system – the C<sup>3</sup>I-system and service units – whose significance raises their importance as a prime target for countermeasures, aim for the same goal.

As a doctrine which is well planned, well developed and well instilled into the troops, the Finnish land warfare doctrine fully meets the demands set out by the main military doctrine. However, its development also requires the utilization of some of the latest technical solutions. With regard to the newest weapon systems, development will be concentrated around such key systems which will bring the greatest possible defensive capability for the least possible cost. For the land forces this will mean a heightened role for mobile anti-aircraft and long-range anti-armour weaponry. With regard to those key weapon systems which will effect to the outcome of combat, quality is a more significant factor than quantity. This is because they must have the capability to also exploit those type of threat scenarios in which momentary superiority will be achieved with a marginal difference in performance capability. However, one complete system requires both quality and quantity. The commanding of operations on the battlefield portrayed will not be successful for the defender without a C<sup>3</sup>I-system which is capable of functioning also in difficult situations. The large-scale regional application of this kind of system will play an extremely central role in creating the preconditions for operations on the battlefield of the next decade.

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# DOCUMENTATION

## THE MILITARY DOCTRINE OF FINLAND

Statement by the Commander-in-Chief of the Finnish  
Defence Forces Admiral Jan Klenberg  
Seminar on Military Doctrine, Vienna, 9 October 1991

### SECURITY AND STABILITY IN EUROPE

Finland welcomes the rapid progress made in building a new pattern of security relations in Europe, based on military openness and co-operation. A vital element in this transformation is the reduction and, eventually, elimination of offensive capabilities, and the introduction of stabilizing measures. They remove disparities and suspicions that were connected with the divided Europe. Significant steps in this regard have been taken since we last met in this hall one and a half years ago.

The profound political, military and economic changes underway in Europe testify to the will of peoples and the commitment of their Governments to fully implement jointly agreed principles and ideals. But they also pose new challenges for European States. It is vital that we establish an efficient and credible crisis management capability for the CSCE. We should also be ready to develop further mechanisms for the peaceful settlement of disputes.

The Paris Charter, the CFE Treaty, the Vienna Document 1990 as well as the decisions taken at the Berlin meeting of the CSCE Council are all important achievements in creating conditions for stability and security in Europe.

Parallel to hopeful signs, developments since the CSCE Summit have also given rise to concern. Conflicts, even full-scale armed hostilities are facts in today's Europe. Finland fully supports the efforts of the European Community and the CSCE to achieve a lasting ceasefire and a peaceful solution in the Yugoslav crisis.

Innovation in enhancing stability should characterize the security negotiations to be started after the Helsinki Follow-up Meeting in 1992. We foresee a broad and flexible agenda for the new post-Helsinki forum, covering, as appropriate, reductions and constraints as well as measures for openness and transparency. Subregional security arrangements should be facilitated. In this context, the involvement of all countries responsible for European security is the strength of the CSCE.

The rapid pace of change in Europe highlights the value of a regular dialogue as well as the significance of enhancing conflict prevention, management and resolution. In this respect, the Conflict Prevention Centre in Vienna is a potentially valuable instrument.

## FINLAND'S SECURITY SITUATION

Pursuing a policy of neutrality, Finland is an active participant in the CSCE process. The core of Finland's neutrality is non-membership in military alliances. Through this national security arrangement, we can best protect our own interests and contribute to regional and international stability.

The Finnish Government declared in September 1990 that the stipulations of the 1947 Paris Peace Treaty concerning Germany, and those limiting Finland's sovereignty had lost their meaning.

As a consequence of the end of the division of Europe and in connection with the changes in the Soviet Union and its republics, Finland will be negotiating a new contractual basis for the relations with its eastern neighbour, the Soviet Union as well as the Russian Federation. It is our aim that these agreements will meet the interests of the parties, in accordance with the principles jointly agreed in Europe, and confirm the continuation of their good neighbourly relations.

The basic tenets of Finland's geostrategic position have remained unaltered, while new opportunities and challenges have emerged in our security environment.

The CFE Treaty has made a historic contribution in the elimination of the threat of surprise attack and reducing the danger of great power war in Europe. The emphasis of the CFE Treaty was placed on the

security problems of Central Europe. It is in our interest that the Treaty be fully implemented in the northern flank as well. We expect that our northern subregion will fully benefit from future arms control treaties.

The Nordic region has retained its traditional stability. Every opportunity should be used to strengthen the security of all States in the Baltic Sea region.

The recently concluded START Treaty will have a positive effect on global security. From the Nordic perspective, we must note that the Treaty appears to increase the relative weight of the airborne and maritime legs of the nuclear triad. This will stress the continued strategic significance of the northwestern part of the Soviet Union and the adjacent northern waters – not far from Finland.

We welcome the initiatives taken by Presidents Bush and Gorbachev on mutual unilateral withdrawal and elimination of U.S. and Soviet land-based and sea-based tactical nuclear weapons. Such measures would contribute to stability in our subregion.

#### THE TASKS OF THE FINNISH DEFENCE FORCES

The tasks of the Finnish Defence Forces can be divided into two major categories: (1) protection of Finland's territorial integrity and (2) the defence of the country in case of aggression. As far as various non-military threats – for instance, major disasters and movement of people in large numbers – are concerned, the role of the Defence Forces is limited to supporting other authorities.

The importance of naval and air defence has become emphasized in territorial surveillance and protection of territorial integrity. The Finnish Army, for its part, plays a decisive role when it comes to defending the country and repelling aggression.

The purpose of our military defence is to render planned exploitation of Finnish territory or attack against Finland prohibitively expensive in comparison with the expected benefits. Thus, our military defence aims at preventing attacks and keeping the country out of war.

## TERRITORIAL SURVEILLANCE AND PROTECTION OF TERRITORIAL INTEGRITY

In surveillance and protection of territorial integrity the Defence Forces carry the main responsibility. The Frontier Guard and other authorities perform complementary functions in this respect.

The Commander-in-Chief of the Air Force is responsible for air surveillance. The radar systems are complemented by optical and electronic means. Unidentified targets are identified and intercepted by fighter planes in constant readiness.

The Commander-in-Chief of the Navy is responsible for sea surveillance. It is composed of radar, other electronic and optical observation as well as underwater surveillance systems. Naval and Coast Guard ships as well as Air Force aircraft are used to identify and repel targets.

## THE DEFENCE OF THE NATION

In defending the nation against serious aggression, Finnish military doctrine is non-offensive, but the defence of Finland will begin at its very borders.

Territorial defence is the main military doctrine of Finland. Its central objective is to retain the strategically most important areas. By taking advantage of the depth of our territory we aim at delaying and wearing down the aggressor so that conditions to repel and defeat the enemy can be achieved. By engaging enemy units in both forward combat and full-scale guerilla warfare in the rear, opportunities are created to attain the goals of the defence.

Air defence, carried out by the Air Force and anti-aircraft units, strives to prevent the aggressor from achieving air superiority and protects our most important military forces as well as nationally important objects.

In maritime defence, the aim is to fully utilize the advantages that the unique Finnish archipelago gives to the defender. It is based on fixed coastal artillery and effective mine-laying backed up by mobile units. Focal areas for operations of the Navy are the inlet of the Gulf of Finland and the Åland Islands area.

The overall defence planning has been devised with regard to three different types of attacks: (1) a surprise attack to subjugate the state, (2) an offensive against a third party through Finnish territory, and (3) a large-scale attack to invade the country. By maintaining readiness and defensive capability flexibly corresponding to each threat situation, the use of our territory for the aggressor's purposes can be prevented or repelled.

## THE DEVELOPMENT OF MILITARY DEFENCE

The military doctrines of CSCE States are presently subject to critical examination. Finland, for its part, has not felt a need to change its strategic thinking. Our doctrine continues to fulfil the requirements of our military security and seems to meet the expectations of the neighbouring States as well. It gives a clear signal that we are capable of preserving the integrity of the Finnish territory.

Finland is in a process of rationalizing the command and administrative system of its military defence. In the beginning of 1993, the country will be divided into three regional commands and, subordinate to them, 12 military areas. By this measure, the total number of regional staffs will be reduced by half, from 30 to 15.

The command and administrative system of the Air Force will remain essentially unchanged. There continue to exist three air force wings, whose areas of responsibility will coincide with the Army regional commands. The Navy will have two operational flotillas.

The Army remains the bulk of the Finnish Defence Forces. Of its 27 wartime brigades, two armoured and ten jaeger brigades are the focal point in the development. The mobility, fire-power and protection of these operational units are presently being significantly improved.

The Air Force interceptors currently in service will be phased out starting from mid-1990s. The procurement authorization needed to replace the interceptors is included in next year's budget proposal of the Finnish Government. The radar surveillance system is at present being renewed and updated with sophisticated long-range equipment.

In developing the Navy, we continue to further stress the importance of mine-laying capacity. Parallel to this, we are improving our capability

to repel attacks by procuring fast attack craft and surface-to-surface missiles.

## MILITARY SERVICE AND THE WILL TO DEFEND ONE'S COUNTRY

A thoroughly effective national military service system is the cornerstone of Finnish defence. Our territorial defence could not meet its challenges without the extensive reserves created by conscription and without the strong will to defend the country traditionally prevailing in Finland.

## THE U.N. SERVICE

Finnish soldiers also continue to contribute to UN peacekeeping operations. Since 1957, more than 27,000 Finns have participated in such activities. We have trained peacekeepers in co-operation with a number of other countries. We are convinced that this kind of expertise can be useful in the CSCE context as well.

## SUPPORT FOR THE CSCE PROCESS

Security can be and has been improved by joint international efforts and agreements. Still, in Finland we believe that a small state has to take care of itself by maintaining a credible defence.

As the only body of its kind bringing together all States responsible for the continent's security, the CSCE has a key role to play in the transforming European security architecture. We are committed to participate in this transformation.

# AGREEMENT ON THE FOUNDATIONS OF RELATIONS BETWEEN THE REPUBLIC OF FINLAND AND THE RUSSIAN FEDERATION

Finnish Prime Minister Esko Aho and the First Vice-Prime Minister of the Russian Federation G.E. Burbulis signed on January 20, 1992 an Agreement on the Foundations of Relations Between the Republic of Finland and the Russian Federation. Prime Minister Aho and the First Vice-Prime Minister Burbulis also exchanged notes, signed by the Minister for Foreign Affairs of Finland Paavo Väyrynen and the Minister for Foreign Affairs of the Russian Federation A. F. Kosyrev, stating that the Treaty of Friendship, Co-operation and Mutual Assistance of 1948 between Finland and the USSR has ceased to be in force.

Text of the Agreement:

The Republic of Finland and the Russian Federation, hereafter referred to as the Parties,

emphasizing the significance of the profound historical changes in Europe,

aiming at developing and strengthening good-neighbourly relations and comprehensive co-operation between their countries and peoples,

confirming their participation in the construction of a democratic, peaceful and united Europe in accordance with the Helsinki Final Act of the Conference on Security and Co-operation in Europe, the Charter of Paris and other documents of the CSCE,

expressing their wish to work bilaterally and together with other countries for the promotion of the welfare of the Arctic region, Northern Europe and the Baltic Sea region,

emphasizing the historical contacts between their peoples and the continuing need for open relationships,

confirming their observance in good faith of the rule of law, human rights and fundamental freedoms as well as the rights of national minorities and their promotion of human contacts,

affording particular importance to the advancement of democracy and economic liberty,

recognizing their responsibility for the preservation of their human environment and for global, regional and mutual environmental security,

manifesting their endeavours to strengthen international peace and security as well as to fulfill the principles of justice, fundamental human values and sustainable development in pursuance of the Charter of the United Nations,

have agreed as follows:

#### Article 1

The relations between the Parties shall be based, in accordance with the UN Charter and the Final Act of the CSCE, on principles of international law such as sovereign equality, refraining from the threat or use of force, inviolability of frontiers, territorial integrity, peaceful settlement of disputes, non-intervention in internal affairs, respect for human rights and fundamental freedoms and equal rights and self-determination of peoples. The Parties shall fulfill in good faith their obligations under international law and promote in the spirit of good neighbourliness their partnership in mutual co-operation as well as their co-operation with all other states.

#### Article 2

The Parties shall maintain a regular dialogue at the highest state leadership and other governmental levels on the progress of their countries as well as on issues of mutual and international concern.

They shall promote relations in different fields between elected assemblies as well as between central regional and local public authorities.

They shall negotiate on issues related to their bilateral relations in a constructive spirit and respecting each other's interests.

### Article 3

The Parties undertake to maintain their common frontier as a frontier of good neighbourliness and co-operation, in accordance with the CSCE Final Act, respecting its inviolability and each other's territorial integrity.

### Article 4

The Parties shall refrain from the threat or use of force against the territorial integrity or political independence of the other Party and settle their mutual disputes by peaceful means in observance of the UN Charter, the CSCE Final Act and other CSCE documents.

The Parties shall not use, or permit the use of, their territories for armed aggression against the other Party.

In the case of Finland or Russia becoming the object of an armed aggression, the other Party shall contribute to the settlement of the conflict in accordance with the principles and provisions of the UN Charter and CSCE documents and shall refrain from giving any military assistance to the aggressor.

### Article 5

The Parties shall make every effort to strengthen the operational capabilities of the United Nations and the CSCE in the maintenance of international peace and security. They shall support international efforts directed towards disarmament, arms control and confidence and security building in the military field.

In situations where international peace and security, or particularly the security of either Party, is endangered, Finland and Russia shall contact each other, as necessary, with the purpose of using the means offered by the United Nations and the CSCE in the settlement of the conflict.

### Article 6

The Parties shall devote particular attention to promoting co-operation between Finland and the adjacent neighbouring regions of Murmansk, Karelia and St. Petersburg.

## Article 7

The Parties shall develop their mutual economic and scientific and technical co-operation on the basis of the principles of market economy and mutual benefit.

## Article 8

The Parties shall make every effort to advance their co-operation in the protection of the environment, in the resolution of environmental problems and in the use of natural resources in conformity with the principle of sustainable development.

## Article 9

The Parties shall promote cultural and scientific exchanges based on the rich traditions of the mutual interaction among their peoples as well as on the common European and human values.

The Parties shall encourage contacts and interaction among their citizens in the spirit of a united Europe. In this context, a special attention shall be given to promoting and expanding contacts among the youth.

They shall create conditions for the expansion of direct contacts between individuals, institutions and organizations on the basis of pluralism and openness.

## Article 10

The Parties shall give their support to the preservation of the identity of Finns and Finno-Ugric peoples and nationalities in Russia and, correspondingly in Finland, the identity of persons originating in Russia. They shall protect each other's languages, cultures and historical monuments.

## Article 11

The Parties shall conclude agreements needed to promote the objectives of this Agreement.

## Article 12

This Agreement is subject to ratification and it shall enter into force upon the exchange of instruments of ratification.

The Agreement shall be in force for a period of ten years, after which it shall be in force for subsequent periods of five years each, unless one of the Parties terminates the Agreement by written notice at least one year before the expiry of the period of validity.

Done in Helsinki on 20 January 1992 in two originals in the Finnish and Russian languages both texts being equally valid.



## FINNISH DEFENCE STUDIES

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- 1 *Evolution of the Finnish Military Doctrine 1945-1985*, Pekka Visuri, 1990.
- 2 *Flank or Front: An Assessment of Military - Political Developments in the High North*. Tauno Nieminen, 1991.
- 3 *Non Offensive Defence: A Criteria Model of Military Credibility* Arto Nokkala, 1991.

