Fire Support during Operation Storm, August 1995

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This expert report has been written on request of the UN ICTY. The expert report reflects the professional knowledge, expertise and operational experience of an artillery officer of the RNLA, acting as Subject Matter Expert. The prosecutor in the Operation Storm case has drawn 16 specific questions in relation to the operational use of artillery, rockets and mortars during Operation Storm. The structure of this report reflects these questions and the appropriate answers.

Some additional background information can be found in annex A.

1. **Please explain generally the nature and purpose(s) of artillery in military operations and its effects.**
    a) Fire power encompasses the possibility of delivering direct or indirect fire by land, sea or air based weapons and thereby neutralizing the fighting potential of the enemy. With a mobile form of military deployment the intention is not to systematically destroy all enemy's means, but to break the enemy's morale and physical cohesion through targeted deployment.
    b) **Definition of fire support.** The application of firepower by indirect fire, Electronic Warfare, armed and attack helicopters, maritime forces and air forces co-ordinated with manoeuvre forces to destroy, neutralise, suppress and influence any enemy or opponent.
    c) **Purpose.** The aim of fire support to ground troops is to contribute to own combat power by attacking the enemy and any possible opponent with fire, thereby causing him to suffer losses and/or prohibiting or hindering him from using certain weapon systems, equipments or areas of terrain, and thus breaking his morale and physical cohesion. This purpose leads to the three general tasks that can be identified for fire support:
        i. Create conditions for maintaining the own freedom of manoeuvre, by limiting the freedom of manoeuvre of the enemy / opponent.
        ii. Disrupt the enemy / opponent command and control system, his combat support means and his capacity / ability to execute the operation for a longer period.
        iii. Attack the will of the enemy / opponents to fight.
        iv. **The above stated purpose of fire support leads to the preliminary conclusion that fire support should not be used against civilian targets.**
    d) The fire support system is an integrated system of target acquisition equipment, Command, Control and Communications systems, weapon systems and munitions, supporting systems and coordinating elements in staffs. The fire support system must ensure that the often scarce fire support resources can provide rapid and flexible support for the manoeuvre in particular and the complete operation in general, in such a way that the cohesion of the operation is not disrupted. The total fire support system consists of a number of fire support assets, each with its own characteristics and thus each able to provide a form of fire support specific to that asset.
    e) **Functional tasks of fire support.** The three general tasks to be carried out by fire support, as set out above, can be translated into functions or functional tasks. These have to be planned and executed simultaneously, continuously and at different levels. Any fire support plan will have to fit within the reference framework of these tasks:
        i. Providing fire support to units in contact with the enemy our any identified opponent. In order to carry out this task the fire support system must have the ability to respond to requests for support from units in enemy contact.
        ii. Providing fire support to support the battle of the tactical commander. By carrying out this task the tactical commander influences the progress of the operation through the use of fire support and restricts the enemy's freedom of action.
        iii. Synchronization and coordination of the fire support is the careful harmonisation of activities in terms of time, space and objective in order to achieve the most effective fire support.
        iv. Maintaining the sustainability of the fire support system. In order to guarantee the provision of fire support for a sustained period, measures have to be taken to keep the total fire support system available.
        v. More information can be found in annex A.
    f) **The fundamental functions.** The fire support system comprises a number of fundamental functions:
        i. Target analysis, target acquisition and targeting;

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    ii.   Fire support planning and coordination;
    iii. Target combating and evaluation;
    iv. Command and control.
    v.   A description of the fundamental functions can be found in annex A.

g)   In order to be able to execute the mission assigned to fire support, the fire support system must satisfy certain requirements. The key requirements for the fire support system are:

    i.   To be able to select, detect and evaluate targets, followed by allocation to combat units.
    ii.   Great fire power and availability allowing fire support to be guaranteed, also in high intensity combat.
    iii. Great flexibility on the part of the command organs, support relationships and the organisations, enabling them to be tailored to the need for fire support of the units to be supported, thus allowing the thrust of fire support to be shifted rapidly.
    iv. A high degree of integration of the various fire support components, both with each other and with the (operational and) tactical staffs, so that fire support planning, fire support coordination and targeting can be executed as efficiently as possible.
    v.   High mobility of assets in order to be able to execute or support any (operational) task, in both combat operations and peace support operations.
    vi. Long range, great precision and munitions-effect, in order to use effective fire to inflict (at an early stage) the desired attrition on the enemy, and at low levels of force to be able to obtain fire support superiority (dominance).
    vii. Sufficient capacity to allow round the clock operation in order to contribute to the required combat power and the survivability in every (combat) situation.
    viii. By meeting these requirements it will be possible to guarantee that targets are engaged using the correct equipment, at the correct time and place, and with the right amount of the right munitions, at all tactical levels.
    ix. The employment of the fire support system contributes to the overall effects that must be achieved in order to reach a successful completion of the operation. These effects are:

        1. Destruction fire mission
        2. Destroy
        3. Neutralisation fire
        4. Suppression
        5. Interdiction fire
        6. Harassing fire
        7. Smoke
        8. Mark
        9. Blinding
       10. Illumination
       11. Recent "new" developments: warn, show of force, indicate, cover, protect, secure etc

    x.   The described effects are in the first place lethal direct effects, meaning that destruction or neutralisation of military means (personnel and materiel) occurs and can be assess immediately. Lethal effects however may occur as indirect, long term psychological effects. These effects can become visible even years after the direct effect occurred and may inflict even more damage towards people. These indirect effects may be unintended, in case military targets, close to a civilian area have been attacked. It is very well possible to use the indirect psychological effects as intended effects with the only purpose to harass civilians.

h)   The fire support system is a system that supports and enables military operations and should therefore only be used for targeting military targets. Only in a case of self defence military units (including fire support units) may be forced to fire on civilian targets. The ground rule however is that civilian targets are not engaged in any military operation. Military units must acts within the laws of their own country and international law, which, again brings the conclusion that attacking civilian targets is out of the question. To avoid this and to enforce a correct execution of an operation, countries and coalitions put strict Rules of Engagement on their forces in the area of operations.

2. **Please explain generally the process of decision making in planning a military operation involving artillery, including the process of targeting as an integral part and the targeting cycle at each level of command.**

    a)   **Decision making** can be defined as: a logical and orderly analysis of all factors which could influence the conduct of the mission in order to reach a decision resulting in the optimum functioning of the unit.

b) In the operational decision-making process, **the commander's intent** is the key aspect and the intent of the two immediately senior commanders serve as guidelines. The intent is the effect that a commander wishes to achieve with his operation.

c) The operational decision-making process starts with the receipt of a new mission or if a change in the situation makes it necessary. It therefore is a cyclic process that reacts on every new internal and external information. The process, as it is used in both the preparatory and the implementation phase of an operation, integrates all the functions of military operations, including the use of fire power / fire support. It can be used at all levels, but is primarily intended for use by formations (brigade and higher) at the tactical level.

d) As already stated the operational decision-making process is a continuous and cyclical process. Operations are by definition conducted in a dynamic environment and the decision-making process must reflect that. The commander and his staff must also be aware of the influence of external factors on the decision-making process and on the conduct of operations. Many factors, controllable or otherwise, such as lack of sleep, stress, pressure of time, uncertainty, fear, anger, relief, frustration, physical violence and chance events all affect the process. An accurate assessment of these external factors will contribute to quick and efficient decision-making, without, however, reducing the effects of friction.

e) **Fire Support and the Operational Decision Making Process.** At all operational and tactical levels the fire support personnel in the staff should examine very closely the mission, and in particular the objective, of the tactical commander. Once the commander has issued his guidelines the fire support personnel participate in the development of possibilities during the decision making process. At this stage this personnel can indicate what role may be played by fire support in the tactical commander's plan. The fire support plan is developed in this phase. The role of fire support will be indicated for each possibility developed. Depending on the factors of influence, the size of the area of responsibility and the main point of effort the tactical commander will need to make choices (and take risks) in relation to the deployment of the often scarce fire support assets. If the fire support is unable to cover the whole area of responsibility or when a main point of effort has to be created, the tactical commander has to use areas of deployment to indicate where he wants to deploy fire support. Once the fire support plan is finished it may be adjusted or added to during the execution of the operational analysis (e.g. other/additional areas of deployment). Fire support personnel should coordinate as much as possible with other staff sections (e.g. intelligence, engineer support and traffic and transport) in order to establish as detailed a plan as possible. Once the commander has reached a decision the fire support plan is set out in an order with (fire support) annexes.

f) **The targeting process**
    i.   This is a cyclical process, whereby high value targets are identified and selected, the way in which these targets will be detected and engaged is decided and the attack effect is determined. The commander's intention is taken into account, as are the quantity and quality of the available assets. The targeting process is used on strategic, operational and tactical level. The joint process at strategic and operational level has the same aim as the one on tactical level, although the process is much more complicated and lengthy. In describing targeting in the report only the tactical level is taken into account.
    ii. Targeting can be done by a special targeting group as available on corps or division level, but also by an "informal or ad hoc" targeting group at brigade level. Below the brigade level targeting is not visible as a process, although the cycle of select, detect, track, attack and assess is followed basically when engaging a target.
    iii. The targeting process is an integral part of the command and control process, supports the decision making process and represents a joint effort by commander and staff. It requires coordination between a number of staff officers (often including representatives from the other services), with the ultimate staff responsibility lying with the head of the operations branch. In the targeting process there is a link between the intelligence process and the fire support. On the basis of the results he wishes to achieve the commander can allocate units and resources and set priorities. The targeting process requires fast, up-to-date information on the enemy positions, composition, order of battle, possibilities and vulnerabilities. To obtain this information it is necessary to deploy specific target acquisition systems and other intelligence collection units which can acquire the required information with a sufficient level of accuracy. On the basis of this information the targeting process will select the high pay-off targets in time and space on the basis of quality and quantity, in relation to the available weapon systems.
    iv. **The targeting cycle.** The methodology of the targeting process is based on the functions: target selection, target acquisition/analysis, and target combating and target evaluation

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(Decide, Detect/Track, Deliver and Assess). The targeting process can be applied to both direct and indirect fire, lethal and non-lethal systems. When the targeting process relates to fire support a sixth function can be distinguished, namely fire support planning and coordination. This cycle and the way it is linked to the decision making process is shown in figure below.
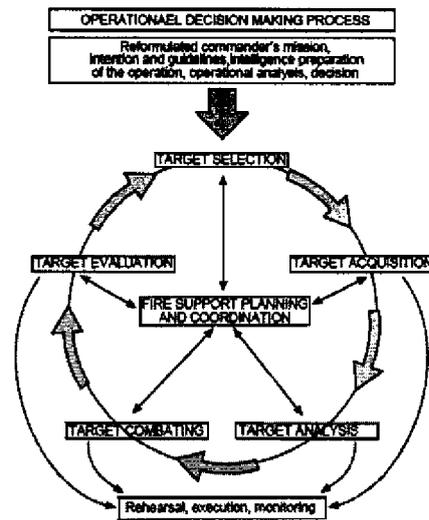

Figure 8-1. Targeting, decision making and command and control

3. **Please explain generally the distinction between strategic, operational and tactical targeting for artillery operations.**

   a)   One of the most important issues in relation to targeting and the use of fire support is the fact that there are no separate artillery operations. Fire support is an integral part of every operation and therefore taken into account in the decision making process and the supporting targeting process. Targeting is not an issue that is done only by artillery personnel. They may have a strong role in that, but all military functions are involved in decision making and therefore in targeting as well.

   b)   There is not a specific difference in targeting at the various levels. The aim of targeting is the same on all levels and comes down to connect selected targets to the best assets available in order to achieve those effects as required by the commander. The difference lies in the nature and the value of the targets. At strategic level one can think about targets that have a political or economical value, which may have to be attacked with military means. Military action involved to accomplish this is most times the use of strategic assets, such as cruise missiles, strategic bomber aircraft, Special Forces, blockades and so on. At the strategic level collateral damage guidelines will be given in order to avoid any damage or harm to civilian targets or military targets in civilian populated areas.. This issue is dependent of national views and national caveats. Commanders on the various levels decide in their decision making what targets need to be attacked, influenced or combated, always taking into account the requirements of the higher commander. Once they have done that they decide, based on the advice of the specialists in their staff, what the best way and the best means are to achieve the necessary effects. Since the use of artillery and mortars can be limited to the tactical level, these assets can be seen used in the targeting process at this level. Especially at the division and brigade level, artillery is a valuable asset for use as one of the available means in the targeting process.

4. **Please explain the considerations that go into targeting, including the levels at which targeting decisions are made, particularly with respect to targets in civilian populated areas.**

   a)   Target selection is the most important function in the targeting process at the tactical level and requires close interaction between the tactical commander and the intelligence, planning, operations and fire support cells. As the first step in the targeting process, target selection provides the general overview and forms the basis for the intelligence collection and combat plans. The starting point for the target selection is the Intelligence Preparation of the Operation (IPB). The results of this process form the basis for the target selection. On the basis of the higher commander's intention and guidelines and the results of the

decision making process (DMP) the High Pay-off (HPT) [1]targets are identified by the commander. The decisions from the target selection are set out in a High Pay-off Target List, a target selection matrix and a target combating matrix (the products of the targeting process). The target combating matrix (a sort of synchronisation matrix) gives a clear picture of the commander's intention. High Pay Off targets are military targets and successful combating is crucial for the positive outcome of the friendly operation. In the decision how to combat such a target representatives of all military functions are present, such as: the intelligence officer, head of the operations cell, Fire Support Coordination Officer, Legal Adviser, Air Liaison Officer, Civil Military Coordination officers and engineers. Combating a High Pay Off target in a civilian populated area can be done, but only with the most accurate asset and taking into account the Rules of Engagement (RoE) and Collateral Damage Estimates (CDE's). Artillery assets can only be used in case the safe distance between the expected impacts and the civilian population is big enough to avoid casualties.

b) Targeting of pure civilian targets will be out of the question, since an operation at the tactical level is planned and executed against military targets. Military targets inside civilian populated areas will only be attacked according to the rules of engagement and collateral damage estimates set by the highest tactical commander or in some cases even by the operational or the strategic commander. The basic rule will always be not to inflict casualties or damage to civilians or their property. In case a lower commander needs to exceed the rules, permission is necessary. Only self protection may be the reason for commanders at lower tactical levels to use force against a military target inside civilian populated areas, thus ignoring the given rules.

5. **Please explain the use of intelligence, Unmanned Aerial Vehicles (UAV's), reconnaissance forces, agents, etc. in the targeting process.**

a) Part of the DMP is the intelligence preparation of the battlefield (IPB). This is a continuous process that forms the basis for the friendly operation. I refer to the phases and steps in the DMP, as described above. The IPB provides as much as information on the operations and actions of any opponent, weather and terrain and on all actors (civilians, NGO's, police forces, government institutions, etc) within the area of operations. Based on this information, intents of higher commanders a list of high value targets is produced. High Value targets are targets which for an enemy commander are essential to the execution of his operation, and thus of great value (often scarce, important or costly resources).

b) As stated before, high pay off targets are derived from the list with high value targets. To discover these high pay off targets an intelligence collection plan is made. All types of intelligence gathering assets will be used to bring in the necessary information. These assets range from forward observers to Special Forces, from UAV's to combat aircraft, from reconnaissance patrols to Joint Surveillance Target Acquisition and Reconnaissance means (JSTAR), and from human intelligence to special agents.

c) All available information will be coordinated during the targeting meetings and based on the outcome of the meeting the commander will decide which HPT's will be attacked, how and when this will be done, which assets will perform the attack, and what attack criteria (the required effects) have to be met.

d) This all is a cyclic process that needs a constant update and requires a very accurate and recent operational picture.

6. **Please explain the considerations and constraints that go into determining whether and how to use artillery fire in civilian populated areas.**

a) Civilian populated areas can never be designated as a military target. It will be judged as a crime against international humanitarian law. These areas do not meet the requirements for being a High Pay off Target, as attacking of a pure civilian area will never contribute to the success of an operation. With respect to this, artillery, rockets or mortars should never be used as such.

b) In case a military target is located in a civilian populated area commanders and staffs have to consider this target along the lines of the targeting process. Doing so all given guidelines, possibilities and restrictions will be analysed. In case such a military target is considered to be a HPT and attack is necessary, the appropriate weapon system has to be chosen. Several considerations will have to be made:
1. The value of the target in relation to the objective of the operation.
2. The exact nature and composition of the target (measures, materiel used, equipment present etc).
3. The exact location, in combination with the possibility of having observation
4. How close is the civilian population?
5. Preparation time for the attack, when should the attack occur?

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[1] High Pay Off Targets are targets from the High Value Target List which, if successfully engaged, will make a crucial contribution to the success of the friendly operation.

6. What is the required effect and what can be the unintended effects?
7. The application of the proportionality principle.

ii. Once these and other aspects have been considered the best available asset for the attack will be designated. As accuracy of the attack, in order to minimise the risk of collateral damage, will be a very crucial aspect, artillery and especially rockets and mortars will be low on the list. Only in case the target is beyond the distance within which collateral damage can occur, the choice to use artillery can be made. This distance is variable and depends on many factors, such as weapon, projectile, weather conditions, position and distance.

iii. The effect required is also important. Artillery is not the weapon system to destroy strong buildings, armoured command vehicles and the like. Artillery can cause damage, casualties and has a great capability as a non lethal weapon system, influencing the moral component of any opponent.

iv. On the other hand: artillery assets can react very quickly, and can operate under all conditions, day and night.

v. Artillery using precision guided munitions will shade another light on the decision which asset to use. Since these munitions are not yet operational, for this report the use thereof is only a theoretical possibility.

7. **Please explain fire support coordination measures and how those measures are transmitted from higher levels of command to subordinate levels.**

a) **Fire support coordination measures**[2] (FSCM) used during planning to combat targets using indirect fire systems and air forces as quickly and accurately as possible, without endangering the security of own personnel and materiel and to avoid the need for (extensive) coordination during the attacks. Fire support coordination measures may be permissive measures, allowing rapid attacks or restrictive measures whereby and prior to any attack, there has to be coordination with the units or formations to be supported. These measures can also be used to ensure that civilian areas, crucial infrastructure (mosques, churches, bridges etc) are secured from being fired upon. Fire support coordination measures are standard measures for use by NATO forces in a multinational deployment. Some of the most important examples are:

i. **Fire Support Coordination Line (FSCL).** This line is established by the appropriate ground force to ensure the coordination of fire power not under his control, but which may affect his current (tactical) operation. The definition reads: A line established by a land or amphibious force commander to denote coordination requirements for fire by other force elements which may affect his current operations. The Fire Support Coordination Line is used to coordinate fire support by ground, naval or air forces, using any type of ammunition against surface targets. The Fire Support Coordination Line should, if at all possible, follow well defined terrain features. The establishment of the fire support coordination line must be coordinated with the appropriate tactical air commander and other supporting elements. Supporting elements may attack targets forward of the fire support coordination line, without prior coordination with the ground force commander, provided the attack will not produce adverse surface effects on, or to the rear of, the line. Attacks against surface targets behind this line must be coordinated with the appropriate ground force commander.

ii. **Fire Support safety Line (FSSL).** This is a line indicating where, on the own side, indirect fire weapons may only fire at the request of or with the authorisation of the commander who established the line. On the enemy side targets can be engaged without coordination without endangering own troops. The Fire Support Safety Line is a line established by the commander in front of each brigade (or division), the aim of which is:

1. To ensure the safety of own troops against friendly indirect fire, delivered by units other than those belonging/allocated to the brigade (or division).
2. To enable the field artillery that does not belong to the brigade or division, to fire without delay at the enemy side of the line, without the need for coordination with the establishing level.

iii. **No Fire Area (NFA).** This is an area within which neither indirect fire nor the effects thereof are permitted. The No Fire Area can be established by formations in order to safeguard areas where friendly troops are deployed (for example, as part of a deep operation) from the effects of indirect fire. Such an area may also be used to protect an important civilian area. Fire is only permitted in the No Fire Area:

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[2] Examples are: Fire Support Coordination Lines, Fire Support Safety Lines, No Fire Areas, Free Fire Areas, Restricted Fire Areas, and Kill Boxes.

1. If the commander who established the area gives (temporary) authorisation to fire in support of the operation in this area.
2. If an enemy unit attacks a friendly unit in the No Fire Area. The commander of this unit may attack the enemy to protect himself. The No Fire Area is indicated in the terrain in an easily recognisable way.

iv. **Restricted Fire Area (RFA).** This is an area in which specific fire restrictions are imposed. Fires that exceed those restrictions will not be delivered without coordination with the establishing commander. The area is intended to regulate fire support in a given area without immediately imposing a firing ban. The area can be established from battalion level. The Restricted Fire Area is indicated in the terrain in an easily recognisable way.

v. **Free Fire Area (FFA).** The Free Fire Area is a specially indicated area within which every weapon system may fire with no further coordination with the commander who established the area. This area can also be used or aircraft to drop their bomb load if they have not reached the target but the aircraft has to return to its own area. The area is indicated as a circle with a solid, black line. In the area the abbreviation FFA, the commander who established the area and the date/time group indicating begin and end of the effective period are indicated.

vi. **Airspace Coordination Area (ACA).** This is an area or air route used by own aircraft and helicopters, within which restrictions are imposed on own weapon systems in order to prevent own aircraft and helicopters being hit by friendly fire. This measure is included as a de-confliction measure in order to plan a three dimensional area on the ground (with a specific altitude) or as a sort of corridor in the air above a specific air route to a target or just above a target. Restrictions can be imposed on firing in or through the Airspace Coordination Area (including a firing ban).

vii. **Restrictive Fire Line (RFL) (fire coordination line).** This is a line established between converging friendly forces (either or both of which may be moving) the aim being to prohibit fires or their effects across that line without coordination with the unit on that side of the line.

viii. **Firing restrictions.** Various firing restrictions may be included in operational orders for fire support systems. These restrictions may apply to time and place of deployment and/or munitions. These firing restrictions may also be used as a de-confliction measure between fire support and manoeuvre or between ground-based fire support and air support to field artillery and mortar units or with the aim to avoid collateral damage.

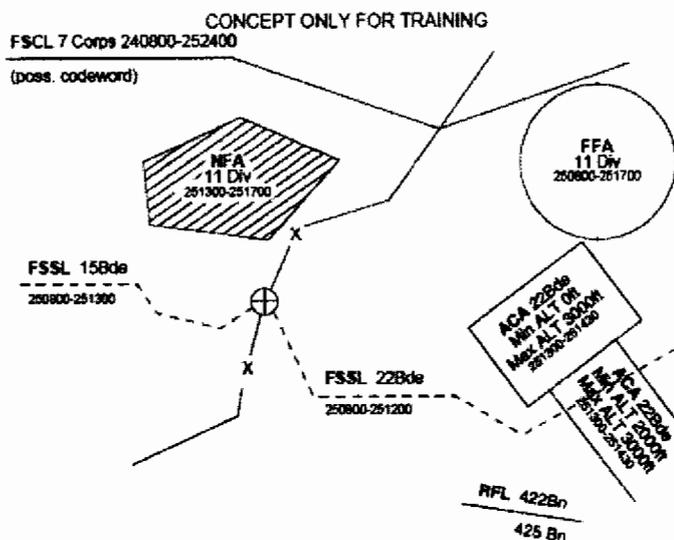b) Below is shown how FSCM can be depicted on maps, as part of operational orders.

Figure 7-8. Fire support coordination Measures

8. **Please explain the use and significance of forward observers, including whether it is appropriate to use artillery without forward observers against targets in civilian populated areas.**

    a) The **forward observer** is the most significant and important target acquisition asset within the fire support system. The observer executes multiple tasks, ranging from acting as a high value intelligence asset, to fire support coordinator at the company or team level. Besides that he is the one who initiates the fire mission, controls and corrects fire, assesses the results and advises his commander how to act. His training, expertise and experience guarantee a correct use of artillery and mortar support.

    b) The forward observer performs these tasks for the fire support from both mortars and field artillery. The tasks of the Forward Observers are:
        i.   To advise the commander on fire support matters within his unit;
        ii. To provide information to the unit he is supporting with regard to the available fire support and the deployment of the mortar and field artillery unit;
        iii. To detect and track targets and request (mortar and field artillery) fire;
        iv. To perform Battle Damage Assessment;
        v.   To provide information to the battalion Fire Support Coordination Centre on the fire plans, the enemy situation and the situation and plans of friendly forces, as part of fire support coordination; more and more Forward Observers have also the task to report any action, activity or movement of any actor they may observe in their operational area;
        vi. To reconnoitre and prepare observation posts;
        vii. To develop fire plans;
        viii.To coordinate the fire support within his own unit.
        ix. To be able to detect, locate, combat and assess the targets (and all other situations) the observer may have many technical means available ranging from binoculars to thermal imaging devices, position-finding (GPS) and direction-finding equipment, advanced fire control computers and laser range finders and / or laser designators. In order to be able to follow the mobile deployments of the combat units the Forward Observers in the mechanised brigades have an armoured vehicle with the necessary communications equipment.

    c) A special group of forward observers are the **Forward Air Controllers**. Their task is to guide and control close air support, as well as fire support from ground based artillery and mortar units. Forward observers and forward air controllers may operate as Joint Effect Observer groups, in order to combine and focus their capabilities.

    d) Forward observers and air controllers are important chain in the decision making process, when it comes on the decision what targets to combat and to advise the commander how to execute this. They must be aware of restrictions, coordination and safety measures and have a broad operational picture.

    e) **Occasional observers.** Cases may arise where a unit (company/squadron) when deployed has to cover such a large area, that observation from more observation positions is necessary to cover the whole width and depth of that particular area. In addition to the organic Forward Observers at platoon and group level, personnel may be available, trained to act as occasional observers using limited resources. Special occasional observers may be Special Forces operating in the area and combat helicopter pilots and observers.

    f) The use of artillery and mortars against targets in civilian populated areas without having these targets under observation of a forward observer should not be done, unless the target is beyond the already described collateral damage distance and the exact location is known. But also in this case the commander will want and will need to know the effects of the attack.
        However, only an observer can bring in additional information or can stop the imminent attack on a very late moment. The alternative is using a UAV or another air based reconnaissance mean.

9. **Please explain the characteristics, including range and effect (destructive power, release of shrapnel, etc.) of the following artillery weapons:**
    *   203mm Howitzer
    *   155mm Howitzer
    *   130mm Howitzer
    *   122mm Howitzer
    *   105mm Howitzer
    *   128mm MBRL
    *   122mm MBRL
    *   107mm Rocket
    *   70mm Rocket
    *   62mm Mortar
    *   82mm Mortar

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- 12mm Mortar
- 76mm ZIS-3

a) The answer on this question will be grouped along the categories of the above mentioned weapon systems: howitzers, rocket launchers and mortars. This grouping can be done since characteristics are the same. The difference in the various systems lies for example in issues such as lethality, range, rate of fire. Examples will be given below. When giving examples I will refer to the M109 system, being used for thirty years in the RNLA, but recently replaced by the PzH 2000NL.
The last system in the list, being an anti aircraft system will not be discussed, since such a system lies outside the expertise of the composer of this report.

b) Details on the munitions can be found in the answer of the next question.

c) **Howitzers.**

   i. Howitzers belong to the category of high angle indirect fire weapon systems. Indirect fire means that their projectiles will be fired against targets that are at such a range that they can not be seen from the howitzer. An acquisition asset[3] is necessary to locate the target. Basically it means that projectiles fired by a howitzer follow a ballistic trajectory after being fired from the barrel in an angle, or elevation, varying between (theoretically) 0° and 90°, or 0 mils and 1600 mils. Howitzers are breech loading weapon systems and have a rifle bore barrel that gives the projectiles a spinning movement around its central axel and therefore provides a stable flight for the projectile.

   ii. Propelling charges provide the necessary pressure to give the projectile its velocity needed to cover the required distance. Propelling charges are loaded separately in the chamber of the howitzer. To provide maximum flexibility in range, up to 8 or 10 separate charges can be used. An example: charge 1 brings a 155mm projectile to a maximum of 3900 meters, and charge 7 to 15000 meters. Higher charges will go beyond that range. The velocities of the projectiles may range between 200 m/s and 950 m/s.

   iii. The combination of elevation and numbers of charges provides the distance that is needed in order to be able to attack/combat the target as requested by the acquisition asset. The combination of charges also gives a certain overlap in ranges. This can be used in order to reach a better accuracy, since the combination of elevation and number of charges is one factor for improving the accuracy.

   iv. Longer ranges can be achieved through a combination of a longer barrel, new propellants, a bigger and stronger chamber (capable to withstand higher pressures), longer and slimmer projectiles and extra propulsion in the projectiles. This last development is twofold: either rocket propulsion or base bleed. Through the combination of factors the range of howitzers can go up to 40kms or more.

   v. The rate of fire will vary per calibre. A 155mm howitzer will be able to fire 2-3 rounds (typically 45 kgs per round) per minute with a well trained crew, but sustained fire will be one round per minute. Modern howitzers have an automatic loading system that brings a possible rate of 10 rounds per minute.

   vi. The available munitions for howitzers bring four main categories of effects towards an enemy: firstly the "neutralizing effect", by which he is prevented from moving, observing or manning his equipment; secondly the "materiel effect", the destruction of equipment; thirdly the "lethal effect", the physical destruction of enemy personnel; and fourthly the "morale effect", the shock or process of demoralisation that results among troops under fire. This may render them unable to use their weapons, even though no physical damage or injury has occurred, and weaken their resolve to do so, even if they are physically able.

   vii. Howitzers can be self propelled (better tactical manoeuvrability) and towed.

   viii. 203 mm howitzers can fire heavy shells (90 kgs) on a range up to 30 kms. These shells have a much greater lethality than the shells of a smaller calibre. Rates of fire are one round per minute or less. 203 mm howitzers tend to be more accurate that the 155mm howitzers. This comes from the combination of a long barrel, the weight of the shells and the stability of the undercarriage.

   ix. 155mm howitzers fire shells with a weight of 45 kgs. Lethality is therefore significantly less compared with the 203 mm. Rate of fire can be substantial higher, which means that the delivered amount of munitions can be equalled. Ranges run from a few kms up to more than 40 kms.

   x. 152 mm howitzers: comparable with the 155mm.

   xi. 130 mm howitzers: has a range up to 28.000 meters. This type can be compared with the 155 mm.

   xii. 122 mm howitzers; a very capable weapon system with ranges up to 18.000 meters.

   xiii. 105 mm howitzers: light weapon system, flexible, high rate of fire, much less lethal shells. Weight of the shells 10 – 12 kgs.

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[3] Acquisition assets may range from the Forward Observer, through radar systems, to Special Forces.

d) **Mortars**
  i. Mortars, because of their ammunition package and characteristic high-angle fire are ideally suited for deployment against targets which cannot easily be reached by 'low-angle' weapons. Given their range and ammunition package mortars are suited to providing fire support to close and rear operations by striking at soft targets (personnel and non-armoured vehicles). They are, therefore, generally assigned to infantry units. Mortars are also suited to delivering smoke and illumination fire.
  ii. **Mission for the mortars.** The mission allocated to the mortars is direct fire. This means: deliver indirect fire support to the direct supported manoeuvre units in contact with enemies, opponents or in case of self protection. In relation with this expert report, this mission shows clearly that no justification can be drawn from there, to use this part of a fire support system and its inherent weapon system against civilian areas, civilian population or any other non military target. Mortars are ideally suited to combat covered, urban areas. Especially 120mm mortars are very lethal weapon systems against soft targets (uncovered personnel, civilians, and the bigger part of houses in the Balkan).
  iii. **Possibilities and limitations of mortars.** The use and deployment of mortars must take account of a number of aspects:
      1. Mortars are characterised by the delivery of high-angle fire at a high rate of fire over a relatively short range to combat surface targets.
      2. The mobility of the mortar system in armoured infantry units renders it ideally suited for support to manoeuvre units in enemy contact.
      3. Fire support can be ensured without interruption, with a very short reaction time and in virtually all visibility and meteorological conditions.
      4. The main point of effort can be rapidly adjusted to (changes in) the combat situation.
      5. Mortars are suitable weapons for combating targets which are behind a hill, in narrow gullies or ravines, in dug-in positions (with no top cover) and in towns.
      6. Mortars have a wider package of illumination and smoke (phosphorus) ammunition than field artillery weapon systems
      7. The high angle of fire (and the long flight of the projectiles) means that mortars are easier for enemy target acquisition systems to detect than field artillery weapon systems.
      8. Mortars in position are more vulnerable to enemy actions from the air or from the ground than mechanised armoured autonomous artillery systems.
      9. The weather (meteorological conditions) has greater influence on mortar projectiles than on other curved fire weapons, such as howitzers.
      10. The current ammunition package has a very limited effect on armoured targets.
  iv. **Tasks of the mortar fire support system.** The mortar fire support system can be used in any operation and in any scenario. Since mortars are flexible and fast operating systems, they are ideal to be brought into action at the lower tactical levels (company and platoon). Mortars are excellent systems to be used in an urban environment. Their will operate as support in close and rear operations and may be used in any campaign theme. Heavy mortars (120mm) have proven to be very effective weapon systems in the Balkan conflict and have caused many civilian casualties, not to speak of the psychological effects of the harassing fires, delivered by these systems.
  v. The greatest strength of mortar support with the current ammunition package within the line of sight is the ability to combat soft targets (personnel and non-armoured vehicles) and deliver special fire, such as smoke and illumination. The exact location and time of most firings cannot be planned in advance, which means that they are delivered at the request of the Forward Observer. As at this level combat actions are partly based on this fire support, the fire to support the close operation must be delivered as quickly as possible at the correct place and time.
  vi. Mortars come in the same category as howitzers; they are high angle weapon systems. They use the same system of combining variable propelling charges and elevation in order to fire at the required distance. Mortars are front loading weapons, which means that the projectiles are loaded ("dropped") at the top end of the barrel. Before loading the necessary propelling charges are connected to an aluminium tail. Mortar barrels are therefore simple steel tubes, that do not have complicated and heavy breeches. Mortar barrels can be rifle bore or smooth bore. In the latter case the tail of the projectile is equipped with special fins to provide the stable flight of the projectile.
  vii. Due to the nature of the mortars their maximum range are less than those of howitzers. The ballistic trajectory is much higher, which causes a high angle of impact. Therefore mortars are ideal to combat targets behind walls, obstacles and in enclosed environment, such as urban areas. Light, man portable mortars are ideal for a direct support role of combat units. Heavy mortars, such as the 120mm series, are very powerful weapons systems.

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viii. Mortars (especially the light ones) have a very high rate of fire, despite the fact that most of them do not have an automatic loading system. This may go up to 10 or more rounds per minute.

ix. The effects that can be achieved by using mortars are the same as has been described in the paragraph on howitzers and the annex.

x. 120mm mortar: A versatile, lethal weapon system, with a high rate of fire (4-6 rounds per minute). Projectiles have a weight of 12 – 14 kgs. Weapon systems can be towed or transported in a carrier vehicle. Ranges typically up to 8 kms.

xi. 81mm and smaller: light man portable. High rate of fire, but low lethality for the single projectile. Ranges up to 6 kms (for the 81mm and 3 kms for the typical 60mm mortar)

e) **Rockets**

i. Rockets are fired by launchers, in principal simple tubes, loaded from the back, without needing breeching systems. As rockets have their own propulsion system, the launchers can be simple and cheap. Changing the propulsion means greater distance. Ranges can be varied by changing the elevation of the launcher.

ii. Because rocket launchers suffer minimal effect from the recoil of the weapon system, they are able to fire rockets simultaneously or in rapid succession. They tend to provide a high rate of fire, yet find difficulty in supplying and loading their munitions to match potential consumption. Rockets tend therefore to be used sparingly to achieve maximum shock effect at specific phases of an operation, or against particular vulnerable targets.

iii. Because rockets use powered flight, their warheads do not have to withstand such high accelerations as do shells on firing. Greater emphasis therefore can be placed on the lethal effects of rocket warheads. These do not need such heavy metal cases as shells do, and they can deliver more explosive in relation to the weight of the warhead. A lighter warhead increases the range still further, or helps to compensate for the additional weight of the rocket motor or fuel.

iv. The warhead of rockets in most cases consists of DPICM, or sub munitions types, ideal to cover a larger area.

v. The effects that can be achieved by using rockets are the same as has been described in the paragraph on howitzers and the annex.

vi. 128mm systems: maximum ranges varying between 12 and 22 kms.

10. **Please explain the margin of error under ideal conditions for each of the weapons identified in No. 9.**

a) Answering this question will be generic and concentrating in howitzers and mortars. Examples from the firing table that are used in order to improve the explanation are based upon the 155mm M109. In general the description is also applicable for mortars, since they are subject to the same basic ballistic rules. Rockets can be designated to be more inaccurate than howitzers.

b) One has always to remember that artillery and mortars are, by their nature, area weapon systems. Through their ballistic "behaviour" they are ideal for combating larger areas, such as concentration of forces, attack formations, troop columns, supply areas and larger command post areas. They are ideal, when large numbers available to prepare an attack by neutralising and suppressing enemy assets. The common used munitions do not have precision capabilities, and are therefore not very suited to engage point targets.

c) Artillery, mortars and their munitions are subject to the rules of ballistics. There is internal ballistics that applies to the barrel, the breech and the shell as long as it is in the barrel and there is external ballistics that applies to the shell when in free flight.

d) All howitzers and mortars tend to show a different internal ballistic character, despite the fact that they have been built according to the same precise standard. This causes for example differences in muzzle velocity. The same statement can be made for munitions. This brings in the first set of variations that one has to take into account and that are shown in the probable errors in range and deflection. Probable errors make that there is a chance that each projectile has its impact on a different place. These differences can reach from a few meters to 55 meters in range and 5 meters in deflection in case a 155mm shell is fired at 14500m with charge 7[4]. At longer distances these errors can be bigger, unless the projectile has separate guidance from a GPS device.

e) A second set of variations is caused by external factors: air temperature and air density, wind speed, wind direction, flight time and height of the projectile, muzzle velocity, propelling charges temperature, precise weight of the projectile. This set of variations can be corrected by measuring the applicable data. Some examples for the same 155mm howitzer and the same charge 7 at 14500m:

i. In case the muzzle velocity increases with 1 m/s, this will cause the projectile to fly 26 meters further.

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[4] Reference to a firing table, which gives all basic data and possible adjustments. A firing table is based upon experience, meaning thousands of test rounds fired under various conditions

    ii.   Tail wind of 1 knot causes an additional 18 meters extra.

    iii.   Lower or higher air temperature cause changes of 20 meters per degree.

    iv.   Air density causes a difference of 60 meters when not corrected.

    v.   The spinning movement of the projectile causes 20 meters to the right, if not corrected,

f)   These sets of variations will have to be brought together and together they will define the accuracy of the single projectile. One can calculate per fire unit, or per gun. The latter method is much more accurate, but requires time, expertise and specialised equipment.

g)   The accuracy is not only dependent of the data mentioned above. The precise locations of fire unit and target are a crucial factor in order to determine the ultimate distance between fire unit and target and the deflection. In case one of these grids is not accurate enough a commander of an artillery or mortar unit has to decide to adjust fire. Adjust fire means firing single shells with estimated data in order to close in on the target until the 50 meter mark has been reached. After that, fire for effect can be delivered. Adjust fire is also necessary in case several of the variable data are unknown and only the standard data (as inserted in a firing table) can be used.

Tactical commanders will always require fire for effect as accurate as possible, since adjust fire warns the enemy and may be the cause that the ultimate effect can not be achieved.

h)   The most important issues summarised:

    i.   Muzzle velocity

    ii.   Temperature of the propellant: can cause significant differences up to -9 and +9 m/s on the muzzle velocity

    iii.   Wind speed and direction

    iv.   Weight of the projectile

    v.   Air temperature and density.

11. **Please describe the nature of the various projectiles that can be used with weapons identified in No. 9, including their destructive power.**

a)   Since the nature of the various projectiles for artillery and mortars is comparable, the same procedure as done in answering question 10 will be followed, therefore focusing on the 155mm.

b)   Effects that can be achieved have been described in annex A.

c)   The most common type of artillery and mortar projectile is the High Explosive projectile. The projectile is formed by a steel / metal case, filled with a high explosive (TNT/RDX) and a fuse. Types of HE can be:

    i.   Blast. A thin case, combined with the HE filling causes a shockwave

    ii.   Fragmentation. A thicker case, formed to break up in fragments. These fragments will have an extreme high velocity, temperature and can range up to hundreds of meters. The absolute lethal distance for a 155mm is 50 meters. The fragments have various shapes, have measures up to 5 cm and weights up to 35 grams. Fragments can be natural, preformed or controlled, causing different sizes and shapes of fragments. One projectile may produce up to several thousands of fragments. Such a projectile also produces blast.

    iii.   Some additional ciphers:

       1. The area covered by the fragments of a 120mm projectile could range to 1600 m² with a height of burst of 0m, and even to 2100 m² when a VT fuse makes the projectile explode at 3 meters height.

       2. For an 81mm mortar these ciphers are: 950 m² and 1050 m²

    iv.   Shaped charge projectiles. These projectiles create a fast moving, very hot steel arrow that is able of penetrating armour.

    v.   Blast and fragmentation are especially effective against "soft" targets. These are personnel, un-armoured and lightly armoured vehicles and weapon systems, buildings (the stronger they are, the less effective the projectile will be), and numerous types of materiel, such as supply storages, rail way equipment, assembly areas etc.

    vi.   There are factors that may enlarge the effect:

       1. The explosion takes place in a concealed area (inside a house, between high walls, such as a street in city). To detonate the projectile at the inside of a house a concrete piercing fuse can be used. This fuse withstands the force of hitting the brick or concrete wall and makes the projectile penetrate.

       2. The explosion takes place between 6 and 20 meters above the ground. This gives maximum effect towards uncovered personnel and un-armoured vehicles. This effect can be achieved by using a VT (variable time fuse).

       3. The angle of impact

       4. The concentration of target elements in one target. The more people there are on a square the more casualties will be inflicted.

       5. A direct hit may even destroy or at least neutralise a main battle tank.

d) There is one special category of HE projectiles, called the DPICM projectiles. The abbreviation stands for Dual Purpose Improved Conventional Munitions. Such a projectile is a combination of a light carrier projectile, filled with a number of sub munitions. A 155mm DPICM contains 88 sub munitions, each filled with TNT and a shaped charge. Part of the sub munitions is pre-fragmented to give them more effect on personnel. When arriving in the target area, the carrier projectile is activated by a time fuse at a height of 400 meters. The 8 layers of sub munitions are pushed out, will be stabilising in the area by a small turning band, that equally takes care of arming the sub munitions. The 88 sub munitions will spread out over an area as big as a soccer field. Upon hitting a target they will explode. These types of munitions are extremely effective and lethal and have been used in many conflicts. Also various air delivered munitions are based on this principle. This type of projectiles is hardly used as mortar projectile, but quite often the only munitions type for rockets.

e) Smoke shells. These projectiles produce white or coloured smoke. They are used for marking of points and areas, for cover of troop movements or to prevent enemy observation in a certain area. Most smoke shells are ignited at a height of 300 – 400 meters by means of a time fuse. 3 to 4 smoke canisters will be dispersed from the cargo projectile, thus covering a larger area.

A special category is the phosphorus shells, filled with white or red phosphor. These projectiles can be used for the same purpose as regular smoke shells, but have also an application as incendiary asset. They are extremely effective when used, in combination with HE, towards uncovered personnel and fuel depots.

f) Illumination projectiles. These projectiles work along the same line as the smoke projectiles. Their main purpose is to illuminate parts of the battlefield to support own troops or to hamper enemy night vision capabilities. Being non lethal they also can be used as a warning signal to enemies or opponents, to state that they have been spotted and that they can be combated with lethal shells as well.

g) Precision guided / course corrected munitions. These recent developments aim at delivering warheads of any type with a high accuracy. Warheads may include anti tank capabilities. The guidance can take place by internal GPS or external laser guidance.

12. **Please explain the use and/or constraints in using the weapons listed in Question No. 9 against targets in civilian populated areas.**

The described weapon systems are systems designed to combat area targets, which consist of soft and light armoured elements. As such their accuracy and their lethality is limited, when brought into action against (smaller) military targets in highly protected area (concrete bunkers, strong buildings with cellars, armoured combat infantry fighting vehicles and main battle tanks). Point targets, such as a command post may be, are less than 50 X 50 meters. Firing at a longer range the probable error of 155mm projectile is also 50 meters, which means that a substantial number of projectiles has to be used for achieving any given effect. The relative inaccuracy and the high number of projectiles needed, form a high risk towards civilians in the same area. It is the balance between the importance of the target, the enormous negative effect of causing casualties to the civilian population, the risks of the own forces and the availability of alternatives that will bring a commander to decide to use artillery or not. In practically 100% one will decide not to use artillery.

13. **Please explain the propriety and possible purpose(s) of uncorrected fire, particularly in civilian populated areas.**

The answer can be short. Uncorrected fire means, that a number of necessary accuracy data are not available or insufficient calculated. This means that the accuracy of the intended fire for effect is absolute below any accepted standard. Therefore uncorrected fires should not be used in civilian populated areas.

14. **Please explain the distinction between "soft" and "hard" targets in artillery operations.**

a) Soft: uncovered personnel, un-armoured and light armoured vehicles, lighter buildings, such as normal brick houses or living facilities in many of the countries where a conflict has occurred.

b) Hard: strong buildings, bunkers, heavy armoured vehicles, underground facilities

c) Soft targets can be combated by artillery, mortars and rockets and the above described munitions with success and a high possibility to achieve effects as destruction or neutralisation.

d) Hard targets can be combated as well, but the effects will be harassing, suppressing, disturbing, causing fear etc.

e) Besides that, the use of indirect fire systems has a huge moral and psychological effect on both opponents and civilians. Long periods of shelling, even when protected, take their toll from people.

15. **Please explain the effectiveness/utility of each of the weapons listed in No. 8 against both "soft" and "hard" targets**

a) See the answer under 14.

16. **Please comment on the references (contained in the below-listed documents) to shelling or putting under/laying down fire on various listed towns.**

    a)   The Offensive Operation Order With Attachments, 2 August 1995 (0342-2520-0342-2538), p. 14;

         i.   *Tasks of artillery-rocket groups: Group and organise the TSs and TRS-2 along the main attack axes, focus on providing artillery support to the main forces in the offensive operation through powerful strikes against the enemy's front line, command posts, communications centres, artillery firing positions and by putting the towns of Drvar, Knin, Benkovac, Obrovac and Gracac under artillery fire.*

    b)   The Order to Attack Attachment for the Artillery, 2 August 1995 (0342-2548-0342-2551), p. 3; the Order For Attack OG Zadar, 3 August 1995 (L009-7877-L009-7893), p. 8;

         i.   *Shell the towns of Drvar, Knin, Benkovac, Obrovac and Gracac.*

         ii.   *and lay down fire on the towns of Benkovac and Obrovac*

    c)   The Order for Attack for the Artillery 112th Brigade, 3 August 1995 (0279-8827), p. 4;

         i.   *Put the following towns under artillery fire: Benkovac, Obrovac and Gracac.*

    d)   General Report on Carrying Out a Combat Task (ET 0609-7506-0609-7510), p. 2.

         i.   *In the first few hours we had no support from the Zadar OG /Operative Group/ except for shelling of the general area of Benkovac without monitoring, and the message at 05:30 hrs of the following contents: "Is anything falling on Benkovac?"*

Comments that can be made on the above mentioned and highlighted extracts from operational orders and a report.

The initial tasks given in the operational orders to artillery units seem to be regular artillery tasks in coordination with the appropriate tactical commanders in order to support the offensive activities of the Croatian Army. These artillery tasks do not differ from all the information given in this expert report and can be judged to have military assets as the targets. The overall effect that should be achieved is the support of an offensive operation. This overall effect will give artillery commanders already a good idea which tasks their units will have to execute.

The exception lies in the order that has been given to shell specified towns. This is an order that is given in the same lines and context of the above mentioned operational orders. No specification or details are given on which military targets have to be attacked. When giving the order to shell a city this must be an absolute precondition: the detailed specification of the military targets in a civilian populated area. The effect that has to be achieved by shelling cities has not been described as well. There is no real aim given for this specific order. The shelling of towns is in one sentence connected to the support of the artillery to the offensive operations in order to break through enemy lines.

The conclusion therefore can only be that this part of the orders is a very unusual and strange order for artillery units. Artillery units need clear guidelines from commanders, especially on the effects to be achieved, the rules of engagements, the collateral damage estimates and a very clear operational picture. Based upon these they need clear and accurate fire missions to be able to combat enemy targets. This specific part of the orders gives commanders the green light to use the effect of harassment at a maximum by firing randomly into the named cities. Doing so fear and casualties will occur, infrastructure will be destroyed, the population will be forced to leave, thus prohibiting the enemy troops to execute their mission in a proper way. This means that the civilian population is targeted to force military units to retreat or even to surrender.

Annex A (additional information) to expert report on fire support.

THE FIRE SUPPORT SYSTEM

The fire support system is an integrated system of target acquisition equipment, Command, Control and Communication systems, weapon systems and munitions, supporting systems and coordinating elements in staffs. The fire support system must ensure that the often scarce fire support resources can provide rapid and flexible support for the manoeuvre in particular and the complete operation in general, in such a way that the cohesion of the operation is not disrupted. The total fire support system consists of a number of fire support assets, each with its own characteristics and thus each able to provide a form of fire support specific to that asset. Fire support is divided into ground-based, air and naval fire support.
Expressed in tabular form the fire support system looks like this:

Collection units (not specifically target acquisition)	FIRE SUPPORT SYSTEM		
	Target acquisition	Weapon systems	C3 and Coordination
Special Forces	Forward Observers	Mortars	Forward Observers
Helicopter pilots	Sound ranging systems	Guns and howitzers	Fire support officers
Aircraft pilots	Light Measuring systems	Missile systems	Field Artillery/Fire Support Coordination elements
Monitoring radars	Acquisition radars	(Combat) drones	Deep Ops elements
UAV	UAV	Combat Aircraft	Fire Direction Centres
EW company	Drones	Combat Helicopters	Targeting Cells
J-STARS	FAC's and TACP's	Naval Artillery	METEO stations
Satellites	Naval gunfire spotter teams	Naval Missiles Systems	ALO and TACP's
			Navy LSO teams

Functional tasks of fire support. The three general tasks to be carried out by fire support, can be translated into functions or functional tasks. These have to be planned and executed simultaneously, continuously and at different levels. Any fire support plan will have to fit within the reference framework of these tasks:
- Providing fire support to units in contact with the enemy our any identified opponent;
- Providing fire support to support the battle of the tactical commander;
- Synchronization and coordination of the fire support;
- Maintaining the sustainability of the fire support system.
- The following paragraphs give a more detailed explanation of these functions.

Providing fire support to units in enemy contact. In order to carry out this task the fire support system must have the ability to respond to requests for support from units in enemy contact. The individual fire support assets will each react to the request for support in their own way, thereby increasing the chances of survival and the freedom of action of friendly units.
- Mortars and field artillery will provide support to units in enemy contact. This support originally focused on close and rear operations at brigade level. With the development of high velocity howitzers, in combination with long range ammunitions, these indirect fire weapons systems are capable of supporting deep operations as well.
- Combat aircraft will provide Close Air Support (CAS).
- Naval guns will provide Naval Gunfire Support (NGS).

Providing fire support to support the tactical commander's battle. In this case the fire support is considered within the total operational framework of deep, close and rear operations. By carrying out this task the tactical commander influences the progress of the operation through the use of fire support and restricts the enemy's freedom of action. One possibility would be to attack the enemy in the deep operational area in order to create favourable conditions for the combat units' close battle. The field artillery supports the deep operation through means such as Counter fire and combating High Pay-off Targets (HPTs). Combat aircraft also provide support through Air Interdiction (AI), Suppression of Enemy Air Defences (SEAD) and combating High Pay-off Targets. Planning, and if necessary ensuring the provision of, fire support in the rear area is also part of this task.

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When drawing up the fire support plan this task requires particular attention: this plan is an important part of the tactical commander's integrated battle plan.

Synchronising and coordination of fire support is the careful harmonisation of activities in terms of time, space and objective in order to achieve the most effective fire support. Synchronisation is both a process and a result and may be the most important, difficult and complex part of the complete fire support system. It requires a unified effort within the whole unit/formation. The fire support coordinator synchronises the fire support system, thereby ensuring that the correct fire support assets attack the correct target at the correct time. There must be synchronisation both within the fire support system and with other battlefield systems, such as manoeuvre, command and control, air defence, intelligence and support. Fire support is synchronised as part of the total fire support planning and coordination process, including the tactical and technical considerations necessary to ensure the correct fire for the correct target.

Ensuring the sustainability of the fire support system. In order to guarantee the provision of fire support for a sustained period, measures have to be taken to keep the total fire support system available. An important factor for fire support units is the supply of, often heavy and bulky, ammunition.

Lethal fire support is effective through the deployment of conventional munitions delivered from land, sea or air. The effect which the commander wishes to produce on the enemy is expressed in terms of 'suppression', 'neutralisation' or 'destruction'. The correct mix of weapon systems, in terms of volume, duration of deployment, lethality, accuracy and type of munitions, must be selected to achieve the desired effect. In order to achieve maximum effort and to achieve flexibility the following must be taken into consideration:

- Fire support should be appropriate and proportional for the activities in the operational framework.
- As a rule fire support is planned centrally and executed in a decentralised manner. In this way it is possible to guarantee constantly the coordination needed between fire support and the other functions of military deployment, without this being at the expense of the speed, accuracy and safety of own troops.
- During the different phases of a conflict it is necessary to set priorities for the deployment of systems which can both gather intelligence and acquire targets. This choice will need to be adjusted in the course of the conflict.
- The mobility, protection and supply of the weapon systems must be harmonised with that of the units being supported.

Fire support units are combat / combat support units which use their specific resources to provide combat support to the combat (of the combat units). In doing so they directly or indirectly frustrate the actions of enemy ground forces, which boosts the freedom of action of own troops. Combat at division and brigade level in particular is determined to a great extent by the available fire power of the fire support assets. Attacking in the deep battle area at brigade, division and corps level, and thereby causing attrition or putting assets out of action, creates favourable conditions for the close battle and reduces the vulnerability of the combat units. At lower levels fire support units can support the front line battle and reduce the risks of open flanks and unoccupied terrain areas. Finally, fire support units make an important contribution to combating enemy fire support units.

THE FUNDAMENTAL FUNCTIONS OF THE FIRE SUPPORT SYSTEM

The fundamental functions. The fire support system comprises a number of fundamental functions:
- Target analysis, target acquisition and targeting;
- Fire support planning and coordination;
- Target combating and evaluation;
- Command and control.

Target analysis. In order to analyse and select targets efficiently and link them to the most appropriate weapon system there will be a targeting cell at division level and above. In preparing for an operation the tactical commander will issue targeting guidelines. The selection process will select those targets which absolutely must be attacked to allow the successful execution of the operation (High Pay-off Targets).

In order to ensure the highest possible effectiveness of target combating the processing at least should take place as quickly as possible. Tactical target analysis is part of the target analysis process. At a low tactical level target selection and analysis will be carried out by the Fire Support Officer (FSO) in the Fire Support Coordination Centre (FSCC) or the Fire Support Element (FSE) and for tactical target analysis by the supporting fire support unit in the fire control centre.

Target acquisition. Fire support systems may have access to a wide variety of target acquisition systems, ranging from the Forward Observer (FO) in the manoeuvre units to aircraft specially equipped for reconnaissance and target acquisition. The fire support system may have access to target information from Unmanned Aerial Vehicles(UAV), optronic target acquisition and mortar and artillery acquisition radars as well

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as air observation by combat helicopters and fixed-wing aircraft and ground observation by Special Forces. In principle, equipment with a specific target acquisition mission should be directly linked to the weapon system. Intelligence agencies (such as reconnaissance units or battlefield surveillance radar) can also provide target data. In such cases information is supplied directly to an intelligence collection body where it is processed. If the processing concludes that a target should be attacked immediately this information is transmitted as soon as possible to a weapon system.

Fire support planning is the evaluation and allocation of the full gamut of available fire support assets, in order to make optimum use of these fire support assets, in harmony with operations executed by friendly units, with a view to increasing combat power. During the preparation phase the fire support plan will emerge as part of the operational decision making process. During an operation the plan established in the preparation phase must be executed and adjusted to the continually changing circumstances. The fire support planning process encompasses:

- all activities, which are part of command and control, required to produce the adequate fire support advice leading to the choice of a possible deployment for fire support;
- the establishment of a fire support plan;
- the (re)grouping of the available fire support assets and allocating of additional resources such as communications and liaison capability;
- the integration and coordination of all available fire support assets into/with the manoeuvre plan;
- The inclusion of all fire support data in plans and orders (including the applicable annexes).
- The fire support planning process takes place in the staffs of tactical formations/units and is executed under the staff responsibility of the operations officer by the (organic) fire support personnel present in those staffs.

Fire Support Coordination is the coordination of the deployment of fire support units and assets to ensure the harmonisation of fire support and manoeuvre, the most efficient use of fire support units and the security of friendly personnel and materiel. The fire support coordination process encompasses all activities necessary:

- to define clearly the fire support responsibilities;
- for the most efficient deployment of all available fire support resources (organic and/or allocated), tailored to and in support of the execution of the mission of the (tactical) unit to be supported;
- to deploy the (organically) available fire support units in the most efficient way;
- To ensure the safety of friendly personnel and materiel, civilian populace and critical infrastructure.

Fire support coordination already takes place during the fire support planning process, including setting down the fire support coordination measures in plans/orders and the various annexes. During the execution of an operation there is constant fire support coordination. As an operation progresses fire support planning activities will decrease and the need for fire support coordination will increase.

Fire support coordination measures[1] are used during planning to combat targets using indirect fire systems and air forces as quickly and accurately as possible, without endangering the security of own personnel and materiel and to avoid the need for (extensive) coordination during the attacks. Fire support coordination measures may be permissive measures, allowing rapid attacks or restrictive measures whereby and prior to any attack, there has to be coordination with the units or formations to be supported. These measures can also be used to ensure that civilian areas, crucial infrastructure (mosques, churches, bridges etc) are secured from being fired upon.

Fire planning is an important element of fire support coordination. Fire planning includes all aspects and activities required to plan and deliver the available fire of a fire support unit as efficiently as possible (preparation of fire). Fire planning entails reserving fire power (including munitions), selecting (priority) targets, coordinating with the lowest (tactical) level and taking measures/giving indications for the delivery of fire. The product of fire planning is set out in a fire plan.

Target combating is executed by the weapon systems of the fire support units. This combating may take place under the direct guidance or control of a Forward Observer, spotter or Forward Air Controller or under the indirect control of other detection resources, such as radar systems or Unmanned Aerial Vehicles. In principle technical target analysis is part of target combating. The technical target analysis is generally carried out in the Fire Direction Centre of the combating unit.

Battle Damage Assessment (BDA) (Target evaluation) is a form of reconnaissance intended to determine the target damage and/or losses inflicted. The assessment of whether the damage requirement was met is usually carried out by the Forward Observer, the Fire Support Officer, and the Fire Support Element or in the targeting cell. The target assessment data is obtained from the appropriate target acquisition systems.

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[1] Examples are: Fire Support Coordination Lines, Fire Support Safety Lines, No Fire Areas, Free Fire Areas, Restricted Fire Areas, and Kill Boxes.

It may be clear that the assessment of a physical attack with lethal munitions may be easier in comparison with a situation when non lethal weapons / means have been used. Battle damage assessment therefore deals with looking to the effects that have been achieved and the control whether the achieved effects are indeed the intended ones. Actions may have the intended effects, but commanders have to take into account the fact that every action always will have unintended, long term effects as well.

Command and control is the direction and management of the fire support system in order to achieve its aim, the provision of fire support. Command and control of the fire support systems comes from the various staffs at corps, division, and brigade and battalion level and from the staffs in the division field artillery group and (brigade) battalions, the (autonomous) batteries and (mortar) companies.

Effects

Effect[2]. In his plan the tactical commander can require (demand) the attack on a target to achieve a particular effect. An effect is the outcome, the result of a certain action, activity, operation or a combination of those. Every effect should contribute to the positive result of the mission given to a unit. On the operational and strategic level this is mentioned to be a contribution to the successful achievement of the (most often) political end state. The losses and/or damage inflicted or the results achieved should be such that the tactical commander's requirements are met. In order to use a standard, the desired effect is related to the losses and/or damage to be inflicted.

- **Destruction fire mission.** Delivering fire with the aim of rendering enemy materiel or an object unserviceable. In the case of a small target it will be necessary to use precision munitions in order to inflict actual damage.
- **Destroy.** Firing at an enemy unit with the intention of inflicting such a high percentage of losses that this unit will be unable to be deployed as a unit for some considerable time. For the purposes of technical target analysis, a target is considered to have been put out of action if through the use of direct and indirect fire or (mine) obstacles the following loss percentages have been inflicted:
  - For an attacking enemy of company size: 30 to 40%.
  - For an attacking enemy of battalion/battalion size: 20 to 30%.
  - For an enemy defending himself: 40 to 60%.
  - The latter result can only be achieved with a great deal of effort, time and munitions. In the case of a target consisting of personnel and materiel the result is deemed to have been achieved if the loss percentages quoted are inflicted on personnel.
- **Neutralisation fire.** Firing intended to inflict such losses and/or damage on an enemy unit that it is temporarily unable to deploy its full combat power in a cohesive manner. For the purposes of technical target analysis, neutralisation is considered to have been achieved if losses and/or damage of 10 to 15% have been inflicted.
- **Suppression.** A fire whereby a target is attacked with such intensity that for a limited period after, or only during, the attack the influence of the target elements on the battle is reduced, without the intention of inflicting significant losses and/or damage (generally less than 5%). The unit under attack is however obliged to modify the execution of its mission in order to reduce its own vulnerability, for example by moving to another position and/or by waiting for more favourable combat conditions.
- **Interdiction fire.** Fire delivered at a point target or area with the aim of preventing the enemy using that object or area. (Scatterable) mines are one means of achieving this effect. Quite useful, when aimed against a civilian area. One can recall, during the Balkan conflict, the illegal attacks on water collection points and market places.
- **Harassing fire.** Fire intended to cause confusion among the enemy, to curtail movement and, by threatening losses, to lower morale. This type of fire is also extremely useful in – impermissible - use against civilian areas. When used it causes physical losses, but more important it influences complete civilian societies in a very disturbing and negative way. I refer here to my personal experience as UNMO team leader during the siege of Sarajevo in 1995.
- **Smoke.** Fire intended to restrict/eliminate the enemy's observation capabilities and thereby impede his deployment, or to mask the deployment of own troops. We distinguish between 'smoke on target' and 'smoke screen'.
  - A **smoke screen** is delivered with smoke grenades as a linear fire with a length of 400 m or more, whereby phosphorus grenades can also be used in the first volleys. The duration, length and direction of the smoke screen, together with the weather conditions, influence the rate of

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[2] In describing the various effects percentages are given, in contrast to the generally valid international agreements. These percentages are intended to give an indication of the degree of effect. One of the reasons for using them is to integrate these terms into automated systems. If tactical commanders require a particular effect in percentage terms, this must be expressly included in the orders.

fire, the quantity of munitions required and the number of fire units needed. The effect of the smoke screen means that coordination with adjacent units is essential. Given the large quantity of munitions generally required and the need for coordination a smoke screen must be requested in good time.

    o **Smoke on target** is obstructing the view of observers or smaller targets using smoke grenades or phosphorus. This method requires less ammunition and does not need to be planned in advance.

- **Mark (marking fire).** A single shot or a volley of shots fired using (coloured) smoke, phosphorus or light to indicate a target or to act as a starting point for a Forward Observer/spotter/Forward Air Controllers to indicate a target for a ship (NGS)/combat aircraft. The marking shot can also be delivered as one of the shots in the last volley of a firing in the vicinity of the target.
- **Blinding (Smoke on target to blind optical/optronic systems)** is usually delivered as surface fire by one fire unit: it requires no specific preparations and preferably should use phosphorus, if possible in combination with 'over-adjusted' flares.
- **Illumination fire.** Fire intended to illuminate part of the battlefield with flares. Depending on the light intensity the functioning of image intensification equipment or thermal imagers can be improved or restricted.
- For suppression, interdiction, harassing or illumination fire or a smoke screen the tactical commander should indicate the time period.
- Recent developments show "new" effects, which are required to be achieved, also by indirect fire systems and the fire support system. These effects can be described as effects to be achieved on the mental component of the opponent and include for example: warn, show of force, indicate, cover, protect, secure etc. These effects also have their influence on civilian populations in an operational area. Every lethal or non lethal round or projectile fired, sends a message, not only to the opponent, but to all actors in the theatre.

FIELD ARTILLERY SUPPORT

Maximum combat power is achieved by synchronising fire power and manoeuvre. A great deal of fire power is provided by fire support. In land operations a major part is delivered by mortars and field artillery. Field artillery assets include target acquisition equipment, guns and missile systems. Because of the great range and accuracy of the weapon systems and the extensive ammunition package and the lethal and non-lethal effects produced, the field artillery is ideally suited for supporting close operations, a major part of deep operations and rear operations, within the operational framework of any operation in any given campaign, ranging from major combat to peace support. Artillery assets are also very suited for shaping a situation in any circumstance. The delivery of sufficient field artillery fire in any operation is ensured by an effective command and control system linked to all operational and tactical levels. And, as already stated above, the provision of fire support allows field artillery units to make a significant contribution to not only operations within a major combat scenario, but also in campaign themes such as peace support, counter insurgency and limited intervention. They can be used to provide and move concentrations of fire rapidly in the area of responsibility, without the need to move the fire units. The introduction of terminally guided and autonomous munitions will further increase the anti-armour capability and the effectiveness of artillery fire.

Mission of the field artillery. The destruction, neutralisation or suppression of the enemy, using indirect fire from gun and/or missile systems as an integrated element of the fire support system, synchronised with the combined operations of manoeuvre units. In recent years this mission has added more elements, such as the use of lethal means to achieve non lethal effects. But, in relation to this expert report, artillery assets may have been used to support military operations, that in fact where aimed against civilian targets. Artillery weapon system, especially the calibres of 152, 155 and 203 are perfect systems to be used against larger areas, such as urban areas. The damage they can cause is significant, as well against soft targets, but also against certain hard targets (bigger building blocks). They may not be accurate enough to combat a command post in the middle of a city, but they are very lethal against personnel, buildings, un-armoured an lightly armoured vehicles. This in combination with the fact that effects can be achieved in a large area within a very short time frame, under all weather conditions and on every moment of the day, makes these systems ideal for a new application of an already existing effect: delivering harassing fires.

5

As the most important component of fire power held by the tactical commander, the field artillery increases the combat and manoeuvre[3] power of friendly manoeuvre units by performing the four functional tasks as described in answering question nr 1.

Field artillery is, in principle, an offensive and lethal fire support asset and therefore especially suitable for deployment in conflicts with a high level of intensity. However, in operations that are planned and executed within other campaign themes, such as counterinsurgency and peace support and where the planning and expectations foresee a low/medium level of intensity, the following considerations relating to the deployment of field artillery should also be taken into account. First of all the required or desired 'escalation dominance' should be analysed. The question is whether sufficient fire power (dominance) should be held in reserve, so as not to be left powerless in the event of an escalation in the conflict. Field artillery can also be deployed in order to protect friendly units (Force Protection) in almost every conceivable operational task. In addition, the use of field artillery support (from being present - 'showing the flag', the demonstration of positions and firing exercises and the firing of warning shots - up to and including full deployment) should be set against the desired military objective. In any deployment the possible collateral damage to infrastructure and direct and indirect effects on non-combatants and the outcome of the complete (political) situation should be taken into account.

Functions and tasks of the field artillery system

The field artillery system is a system characterised by round the clock uninterrupted support, which, under virtually all weather conditions, is able to detect targets spread over the breadth and the depth of a large area and, which, shortly after detecting these targets can strike at them with (concentrated) fire from dispersed positions. **Principal functions of the field artillery system.** In order to fulfil the mission assigned to the field artillery, it distinguishes a number of principal functions. These are:
- target selection, acquisition and analysis;
- field artillery support planning and coordination;
- targeting and target evaluation;
- Command and control.

In addition to the principal functions the field artillery system also has a number of additional and sub-functions:
- establishing and maintaining fire support communications and liaison;
- collecting and disseminating intelligence on matters such as enemy and friendly activities;
- collecting and disseminating meteorological and geographical data;
- providing battlefield illumination and marking shots with (coloured) smoke;
- Providing logistic support (including ammunition re-supply).

The field artillery system assets can be divided into five groups:
- target information evaluation and target acquisition systems;
- weapon systems (gun and missile systems);
- ammunition (shells and missiles);
- ammunition supply systems;
- Command, control and information systems (including fire control and fire direction systems)..

Possibilities and limitations of the field artillery. The use and deployment of field artillery must take account of a number of aspects:
- both centralised and decentralised battle command are possible:
- provided the required communications assets are available, the field artillery is very flexible;
- fire support can be ensured without interruption, with a very short reaction time and in virtually all visibility and meteorological conditions;
- the main point of effort can be rapidly adjusted to (changes in) the combat situation;
- both area targets and point targets can be engaged (in some cases using precision munitions);
- provided target acquisition is ensured, the field artillery can deliver fire under all weather and terrain conditions;
- Active target acquisition systems can be detected and jammed/destroyed. Passive target acquisition systems, however, are much more difficult to detect and combat;
- the characteristics of firing field artillery make it detectable by enemy target acquisition systems, which necessitates dispersed deployment and, depending on the enemy's capabilities, changes of position (mini moves and shoot and scoot);

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[3] The word manoeuvre should not only be related to infantry and tank units. Manoeuvre has a broad meaning and includes every physical and mental movement that can be made to gain a better position than all other actors in the operational area. This is therefore not limited to enemies or opponents alone. There are many players in an operational area that can influence the outcome of the military activities and therefore the end state to be achieved.

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- Field artillery units in position are vulnerable to enemy actions from the air or from the ground. This applies particularly to units with no armoured guns, ammunition distribution resources and command or control vehicles;
- since during (mobile) deployment the field artillery is entirely dependent on radio communications, fire support is vulnerable to enemy electronic warfare actions;
- The limited effect of certain types of ammunition against armoured targets, limits the capacity to put these targets out of action. Only the Improved Conventional Munitions (in the case of lightly armoured targets) and so-called smart munitions, such as Sensor Fused and Laser Guided Munitions can be used effectively against armoured targets;
- the limited availability of specific ammunition, such as smoke and illuminating rounds, and precision guided munitions.

Field artillery assets

The assets which make up the field artillery system are integrated into the total fire support system and also have similarities with the fire support system. Field artillery assets include:
- target information evaluation and target acquisition systems;
- weapon systems (gun and missile systems);
- ammunition (shells and missiles);
- ammunition supply systems;
- Command, control and information systems (including fire control and fire direction systems).

Target information evaluation systems are part of the fire control, fire direction, information and command and control system. At division level and above the evaluation of this target information is often done in a specially created targeting cell. At brigade level and below it is carried out in the Fire Support Coordination Centre.

Target acquisition systems. To execute the support to various operations the field artillery has target acquisition assets such as Forward Observers, weapon locating radars and sound ranging systems. As well as its specific target acquisition assets, equipment with a different task can also be used for target acquisition. Possibilities include the use of Unmanned Aerial Vehicles, drones, air observation from combat helicopters and ground observation by special units. In order to pass on target information for artillery support these assets should, where possible, be directly linked to a combat unit. If the tactical commander decides to deploy these assets for target acquisition, this decision will be followed by a decision by the artillery level to which the assets have been allocated as to how they will be linked to the combat unit. Finally, target information can also be distilled from (specific) intelligence units such as reconnaissance units, electronic warfare units and aerial reconnaissance units.

- **Weapon locating radar** can detect (reactive) firing ground weapon systems. Detection is carried out by means of an active transmitter system, which makes the radars vulnerable to enemy range-finding and jamming activities. The weapon locating radar is able to operate as a single system and to detect rapidly several ground-based weapon systems (more or less) simultaneously. For tactical reasons weapon locating radars are often deployed in clusters of two or three systems. At higher tactical levels the field artillery may have medium range weapon locating radars, with a range of up to about 15 to 25 or even 40 km
- **The Forward Observers** carry out their tasks on behalf of fire support for both mortars and the field artillery.
- **Weapon systems.** The field artillery uses a variety of (mainly) howitzers and rocket launchers. For the howitzers common calibres are 105, 122, 152, 155 and 203 mm. As far as the details of ammunition are concerned, these details can be seen as representative for all calibres. Differences can be found in the actual damage that various projectiles can cause. The bigger the projectile, the greater the inflicted damage can be.

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