

## Chapter 3

# Questionnaire Answers Analysis

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### 3.1 Preface

The **Questionnaire on Application of Ground Sensors During Peace-Keeping Operations** has been sent to participants in peace-keeping operations, to Defence Headquarters in various countries and to the United Nations Department of Peace-Keeping Operations (DPKO) which has been very helpful in sending the questionnaire to the headquarters of ongoing peace operations. The return rate of questionnaires was 40-50%.<sup>1</sup> The main results of the questionnaire findings are presented in this Chapter. A full analysis of the questionnaire results, including all comments made by respondents, is given in Appendix I at the end of this volume.

### 3.2 Identification

A total of 114<sup>2</sup> questionnaires are analysed here (see Appendix I: Compiled Questionnaire Answers). The respondents counted 135 participations in 29 different missions, with the 6 missions counting the highest number of

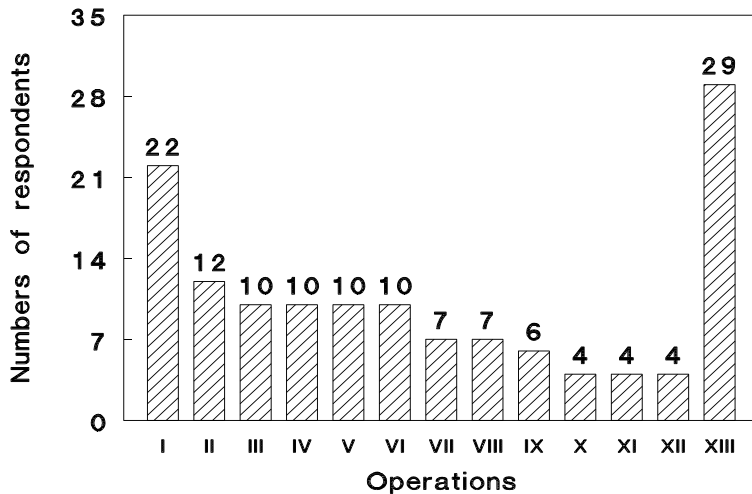
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<sup>1</sup> About 185 questionnaires were sent out directly from the project and an unknown number was sent from DPKO by fax to several mission headquarters which again, redistributed an unknown number of copies. Of the responses received, 71 were on original questionnaires or direct copies and 43 were on redistributed fax copies. (About 50 additional mostly identical responses were discarded. See footnote 2.)

<sup>2</sup> Over 50, many identical, responses have been received from two operations. To avoid biasing the analysis, only a selected number has been included.

respondents contributing 55% of returned questionnaires. Graph 3.1 shows the operations which provided at least four respondents.<sup>3</sup> The location and time-frame of all operations are listed in the Compiled Questionnaire Answers (Appendix I). The time span covered by the peace operations from which the respondents were drawn stretched from 1967 to the end of 1995.

**Graph 3.1: Respondents per Operation**



I UNPROFOR/DENY FLIGHT/PROVIDE PROMISE (former Yugoslavia)	VIII UNFICYP (Cyprus)
II UNAMIR (Rwanda)	IX RESTORE HOPE/UNOSOM (Somalia)
III UNIFIL (Lebanon)	X UNTSO (Middle East)
IV UNMOGIP (India/Pakistan)	XI UNMIH (Haiti)
V UNAMIC/UNTAC (Cambodia)	XII US ON-SITE INSPECTION AGENCY (United States, Russia, other countries)
VI UNDOF (Syria)	XIII Other missions <sup>4</sup>
VII MINURSO (Western Sahara)	

<sup>3</sup> Some operations are grouped because these took place in the same country or succeeded each other.

<sup>4</sup> GOC UNFYROM COMMAND/UN PREVENTIVE FORCE, UNOMOZ, COMMONWEALTH MONITORING FORCE, UNEF II: 3 respondents each. UNAVEM II, MFO, UNIMOG, UNTAG: 2 respondents each. ULSTER, CEASE-FIRE MONITORING KOREA, UNIKOM/DESERT STORM, OPERATION HAVEN, UN SPECIAL COMMAND IRAQ,

## Type of Operation

Of the surveyed respondents 84% served in peace-keeping operations, 7% in peace-enforcement and 3.5% in disarmament missions. In terms of their **primary role**, survey respondents in the various missions polled included: 108 (95%) military officers and 4 (3.5%) civilians working for the United Nations or non-governmental organisations (NGOs).<sup>5</sup> Almost one third of the 108 military officers served as commanders, ranging from company commanders to force commanders. Of the remaining 74 military officers, 36 (49%) served as United Nations military observers. Answers to the **principal function/principal mission of your organisation** showed that about 60% of the military officers surveyed belonged to the combat arms branches, of which, 70% served in the field and 30% at headquarters. More than 50% of the respondents indicated as their **regular activities** sensor-friendly activities such as base security, patrolling, search operations, checkpoint operations, cease-fire monitoring, cease-fire violation investigation, cantonment security, disarmament verification, and information collection.

### Analyst's comments:

*The number of the returned questionnaires, the number of respondents with experience in a variety of peace-keeping operations, about 60% of which belonged to the combat arms branches with the majority of them having served in the field and over 50% having performed activities susceptible to the use of ground sensors, qualify the compiled answers of the questionnaire as a reliable base for further policy-making.*

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UNOMIG/UMOT, OSCE SPILLOVER MONITOR MISSION, ECMM, OSGAP: 1 respondent each.

<sup>5</sup> Two respondents failed to indicate their primary role.

### 3.3 Usefulness and Importance<sup>6</sup>

#### 3.3.1 The Usefulness of Sensors

Only 27% of the respondents had previous experience with sensors, mostly with battlefield surveillance systems such as REMBASS, ZB-298 and ANPPS-4, in use with some Western armies. Therefore the answers of the remaining respondents (63%) to the questions concerning the usefulness and importance of sensors are mostly based on their professional (military) judgement, supported by the information given in the annexes to the questionnaire. If differences in the answers between respondents with and without sensor experience were significant, these differences are mentioned where applicable.

Of all the respondents, 90% considered sensors useful in principle, while only 7% did not see them as such. Of the respondents with previous sensor experience 94% considered sensors useful in principle. The usefulness of sensors (summarised in Graph 3.2) for traditional military tasks such as surveillance of a cease-fire line or monitoring/securing of enclosed areas (weapon collection points, barracks, etc.), is considered high. The usefulness of sensors in monitoring buffer zones and demilitarised zones and the usefulness of portable sensors, is judged slightly lower. An evaluation of the usefulness of sensors in monitoring a safe haven was not sought, though based on the score for importance (para. 2.2), this would be significantly lower.

Respondents with previous sensor experience expressed more confidence in the use of sensors for monitoring cease-fire lines (94% against 82%), buffer zones (84% against 70%), enclosed areas (87% against 74%) and the use of portable sensors (77% against 73%) than those without such previous experience.

In the additional comments section respondents mentioned the following as applications for sensors during peace-keeping operations:

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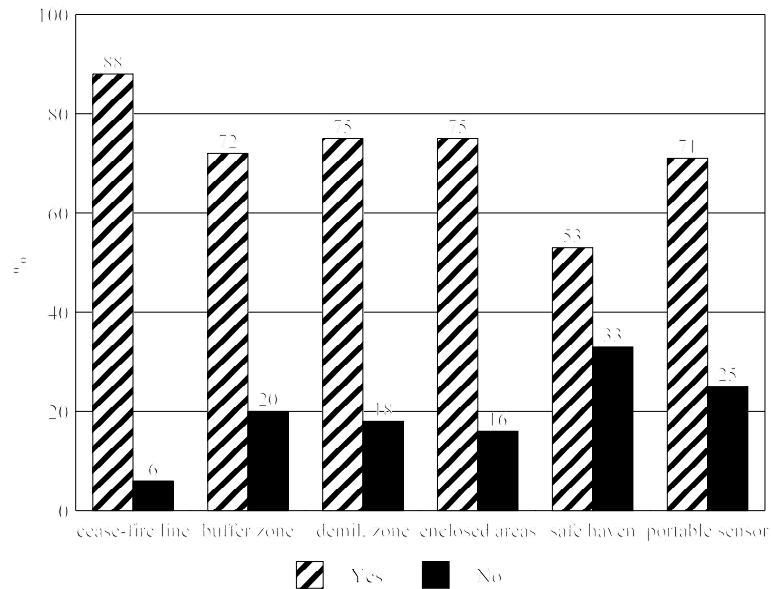
<sup>6</sup> In completing the questionnaire, respondents were not asked explicitly after having marked "No" for usefulness, to skip the rest of the question and to continue with the next one. As such, it could happen as in Question 2, that although 97 respondents marked "Yes" for usefulness, 107 answered the question on importance, of which 100 marked "Yes."



### 3.3.2 The Importance of the Use of Sensors

Sensors are judged by 88% of respondents as an important asset for surveillance tasks like monitoring a cease-fire line (Graph 3.3).

**Graph 3.3: Importance**



The importance of sensors in monitoring buffer zones, demilitarised zones and enclosed areas is confirmed by an average of 74% of respondents, while an average of 18% think otherwise. The use of portable sensors during patrolling is seen as important by 71%, and as unimportant by 25%. Concerning safe havens, 53% of respondents assessed the use of sensors as important, while 33% did not. In general, respondents were less favourable to the concept of safe havens as such, as is obvious from the mostly negative additional comments.

Concerning the importance of using sensors for monitoring tasks, respondents with previous sensor experience were significantly more enthusiastic than those without such previous experience: for cease-fire lines

(94% against 85%), for buffer zones (74% against 68%), for enclosed areas (77% against 71%), and for safe havens (58% against 49%).

Under Question 2, under the heading “If no, please give arguments”, the following comments were noted:

- once the operating system is compromised the sensors can be fooled;
- sensors are useless in densely populated areas; and
- monitoring by United Nations military observers is mostly done by patrols at irregular intervals; a continuous use of sensors would increase the need for personnel.

Some respondents who answered “Yes” to the question on “importance”, added comments such as:

- reliability must be very high; and
- of course tampering which affects the sensors’ effectiveness, cannot be completely ruled out.

In Question 9 respondents were asked for ideas as to other applications for ground sensor systems. The responses given can be summarised as follows:

- to use airborne sensors (mounted on remotely piloted vehicles, tethered balloons and aircraft);
- to monitor borders (e.g. when cessation of outside military assistance is included in a peace or cease-fire agreement);
- to monitor coastal waters (part of a demilitarized zone or a border);
- to guide United Nations military forces (e.g. to track movement and location of own patrols, checking their time schedule on assigned routes);
- to control convoys and to trace the distribution of humanitarian aid (food and material);
- to account for permitted large weapon systems (electronic tagging); and
- to detect certain classes of prohibited weapons at depots (e.g. with a chemical sensor module).

**Analyst's comments:**

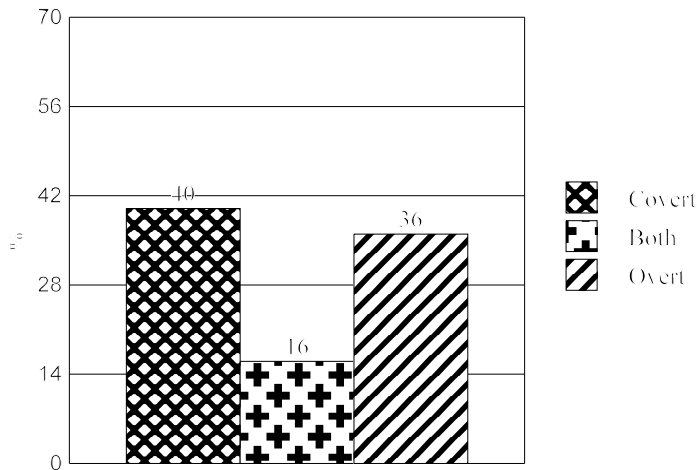
*The respondents completed the questionnaire voluntarily. In total, over 75% of them assessed sensors to be useful in peace-keeping operations and also over 70% deemed the use of sensors as important. This leads to the conclusion that further development of (more) sophisticated sensors and their incorporation into the inventory of armies is worthwhile. International peace operations could benefit from this.*

### 3.4 Covert/Overt Installation and Encrypted/Open Communications

#### 3.4.1 Covert/Overt Installation

The questions regarding the openness or covertness of sensor installation showed a division between the defenders of United Nations neutrality and those who adhere to the military principle of “see without being seen”. Covert installation of sensors is preferred by 40% of the respondents and another 16% wanted the capability to go covert. Overt installation of sensors is favoured by 36% of respondents (Graph 3.4).

**Graph 3.4: Covert/Overt Installation**

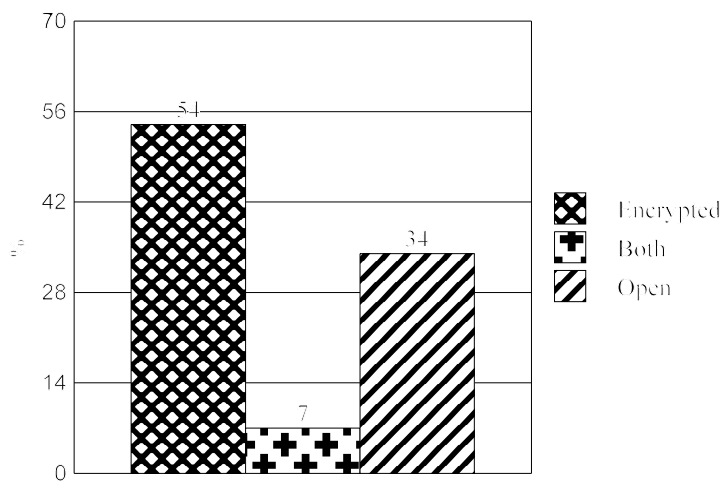


Respondents with previous sensor experience were significantly more in favour of overt installation than those without previous sensor experience (48% against 33%). Also a smaller proportion of respondents with previous sensor experience wanted the capability to go covert (10% against 16%).

### 3.4.2 Encrypted/Open Communications

The majority of respondents (54%) opted for secure (encrypted) sensor communications and another 7% wanted the capability to change from open to secure communications. Open communications were preferred by 34% of respondents (Graph 3.5). Secure communications are a military requirement, and several respondents viewed this also as serving the goal of United Nations neutrality (no information on a faction is accessible to the other).

**Graph 3.5: Encrypted/Open Communications**



### 3.4.3 Relation Between Covert/Overt and Encrypted/Open Communications

A clear relation exists between covert installation and encrypted communications. Of the 46 respondents that favoured covert installation, 24

(52%) also favoured encryption. Of the 64 respondents that chose (the capability for) covert installation, 41 (64%) also wanted (the capability for) secure communications. The survey showed no relation between “rough” missions and “covert installation and secure communications”. Of the respondents who served in Somalia and the former Yugoslavia, less than 50% chose the covert option.

The choices of overt installation and open communications are not clearly related. Of the 41 respondents that chose overt installation only 17 (41%) also opted for open communications. Asked if their answers would differ in special cases, many respondents explained their choice. Several respondents stated that the use of sensors will differ in peace-keeping operations, peace-enforcement operations, and war. Others, more academically, wrote that the decisions on “covert or overt” and “encrypted or non-encrypted communications” depend on the type of the mission, the threat assessment and the situation— one should plan adequately enough for handling the most hostile of the belligerents. Other remarks explained that covert installation serves to record unauthorized activity without the subjects’ knowledge, while overt installation can be used to enforce the rules and as a deterrent against violations.

Covert installation and secure communications seem a logical combination. The covert use of sensors and encryption should be considered the most efficient solution, as it would allow for immediate military reaction when violations are observed, provided that a rapid reaction force is available to respond to alarms initiated by sensors.

Several respondents argued that “the United Nations has no secrets and has nothing to hide” and that therefore overt installation and non-secure communications should be the norm. Many of the about 35% of respondents who favoured overt installation and/or open communications, however, also stressed a number of negative points associated with these options such as the risks of vandalism and theft or the provision of information on one faction to another, which could violate impartiality.

**Analyst’s comments:**

***Decisions on the overt or covert installation of ground sensors have to be made in the mission area, therefore the “appearance” of sensors should be***

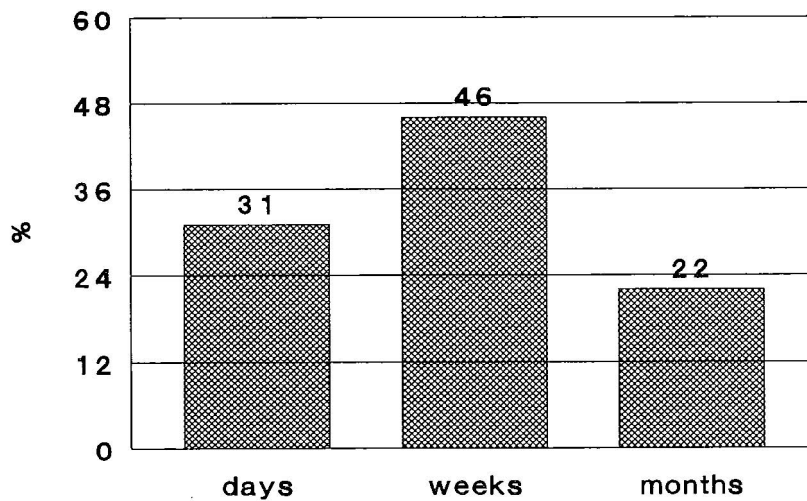
*suited for covert installation. Communication between sensors and data centres/operators should be in line with the Standing Operation Procedures on communications in many armies and the United Nations' principles of impartiality and neutrality and therefore, in principle, be secure.*

### 3.5 Requirements<sup>7</sup>

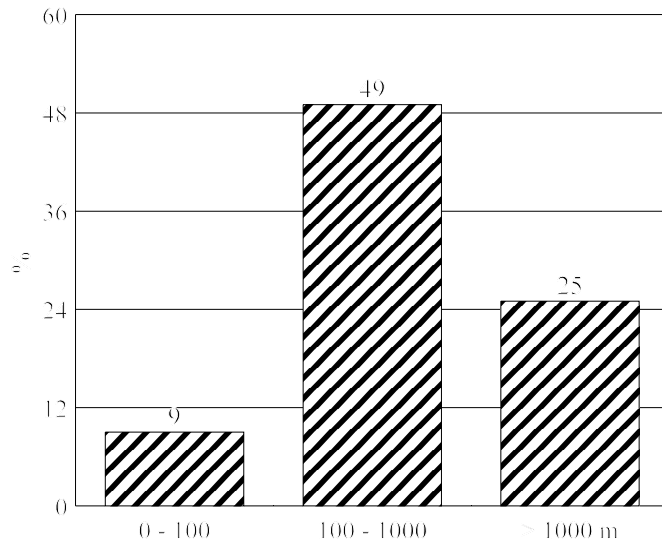
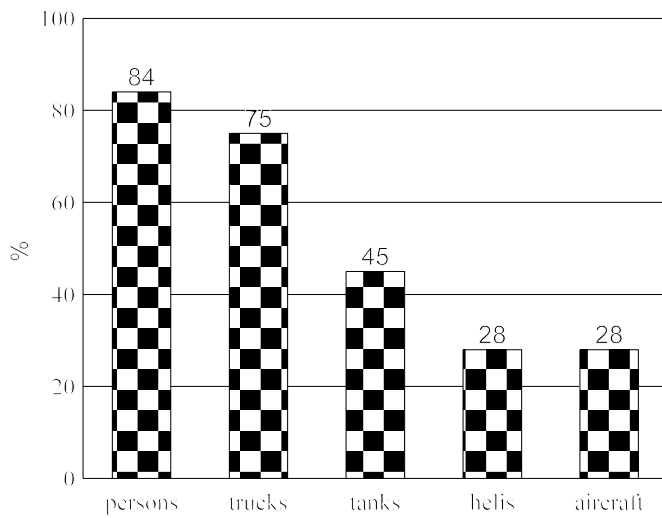
#### 3.5.1 Specified Performance Requirements

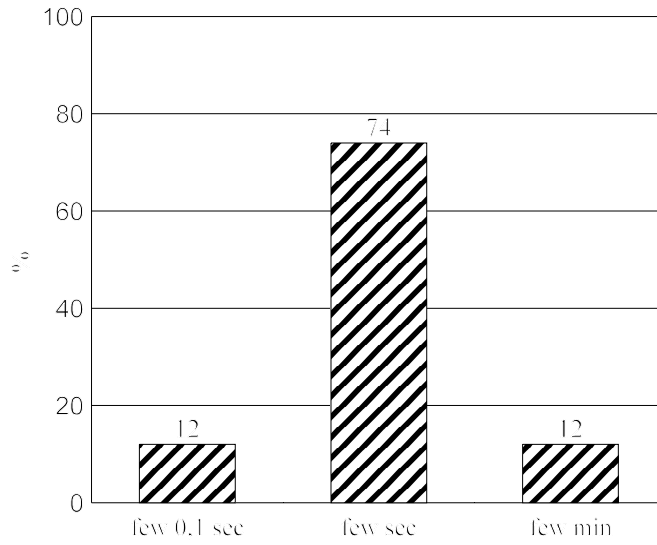
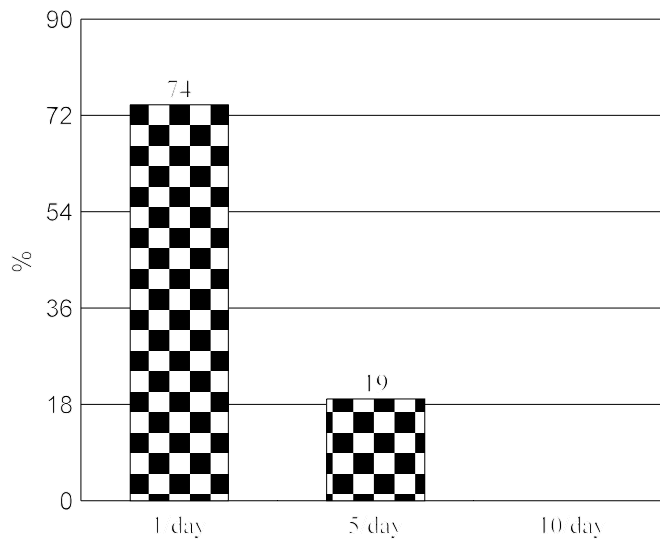
Sensors should be daylight independent (90%) and weather independent (94%). The respondents' opinions on the duration of unattended operation, detection range, main objects of detection, time delay of alarm, acceptable rate of false alarms and acceptable training time are shown in Graphs 3.6 to 3.11 inclusive.

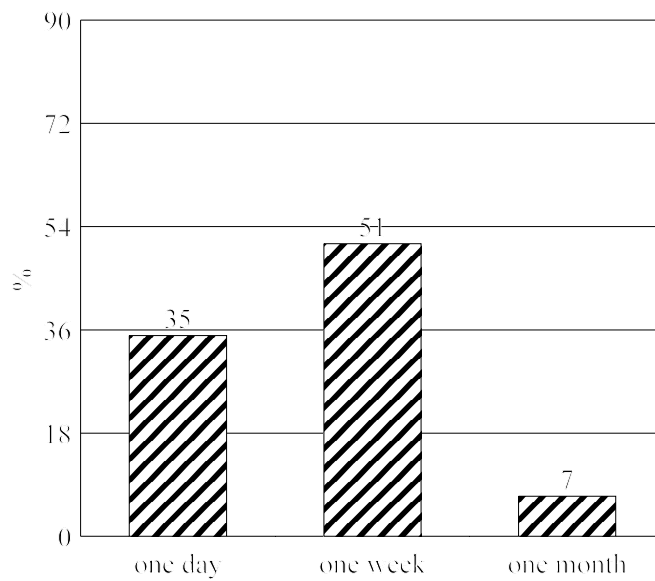
**Graph 3.6: Duration of Unattended Operation**



<sup>7</sup> The table in Question 2 was printed incorrectly in some questionnaires. Only 70 questionnaires had the correct format and one questionnaire was (except for the identification page) left blank. Therefore the maximum of number of answers is 69. Percentages have been calculated relative to this number.

**Graph 3.7: Detection Range****Graph 3.8: Main Objects of Detection**

**Graph 3.9: Main Objects of Detection****Graph 3.10: Acceptable Rate of False Alarms**

**Graph 3.11: Acceptable Training Time**

Respondents requested that sensors be compatible with:

- civil and military computers, software and power;
- existing ultra high frequency/very high frequency, and satellite communications;
- other sensors and surveillance systems;
- digital terrain maps on personal computers; and
- local area networks.

### 3.5.2 Other Requirements

Other performance requirements for sensors mentioned by respondents included:

- types of vehicles etc. identification capabilities;
- friend or foe identification capability;
- low number of false alarms;

- automatic, nearly real-time, highly reliable data transfer, using military communications bandwidth so as to provide sufficient reaction time for peace-keeping troops;
- observations recording and storage capabilities;
- simple design to simplify training, operating, maintenance and not require extra specialists in deployed units;
- durability and with a low failure rate;
- portability, ease of installation, and camouflage;
- autonomous operations and power supply;
- electronic warfare-proof, hard to sabotage or to shut down;
- deployable at a distance over up to 1 km;
- remote control capability at distance of 2-3 km;
- theft-proof installation; and
- sensor-initiated alarms.

In Questions 4-7 on buffer zones, demilitarized zones, enclosed areas, safe havens and portable sensors, respondents were asked to specify sensor performance requirements if different from those given for the monitoring of cease-fire lines. A summary of received answers is provided below.

For the monitoring of buffer zones ground sensors should have:

- a remote on/off switch (e.g. to activate them at the beginning of a curfew);
- a remote switch from a “catch all” mode to an “except persons” mode; and
- a capability to differentiate between animals and human beings, and between armed and unarmed persons.

Ground sensors for monitoring demilitarised zones should be:

- capable of identifying weapon systems; and
- augmented by airborne sensors to cover larger areas.

Sensors for monitoring enclosed areas could have a shorter range, making the use of wires less problematic.

Portable sensors for use by patrols should be:

- compact and lightweight;
- easy and quick to install;
- rugged and “foolproof”;
- passive with a high resolution;
- battery operated;
- capable of transmission over at least 5 km; and
- low-cost and if possible expendable (self-destruction at the end of battery life).

**Analyst's comments:**

*In combination with the respondents' opinion on the importance of sensors, the postulated performance requirements for sensors show the desire to have peace-keeping troops equipped with sensors with the following specifications:*

- *be day-and-night and all-weather capable;*
- *have about 30 days of unattended operation;*
- *have an effective range, depending on sensor type, from 100 m to over 1 km;*
- *be capable to detect and differentiate between persons, trucks, tanks, and preferably also helicopters and aircraft, gunshots, artillery, and mortar fire;*
- *give maximally one false alarm per day;*
- *be remote control capable for on/off switching and change of operating mode;*
- *have nearly real-time reporting capabilities using (if necessary secure) communications;*
- *be able to record and file observations (within sensor or in data centre);*
- *have a high reliability with a high Mean Time Between Failure;*
- *have a simple and rugged design to facilitate: easy transportation, installation, operation and maintenance, and training in maximum one week;*
- *be suited for covert installation; and*
- *be compatible with existing computers, communications and surveillance systems.*

*The requirements listed above are useful for sensors used in monitoring cease-fire lines, buffer and demilitarised zones. For monitoring enclosed areas certain requirements could be neglected. For portable sensors (expendable?) a number of specific requirements have to be observed.*

### 3.6 Problems

Under Question 3 (on buffer zones) respondents were asked what problems they saw in the use of ground sensors, and under Question 11 they were asked to list organisational or other non-technical problems. Some respondents also mentioned problems in comments to other questions. Under Question 3, 90% of respondents listed problems. Under Question 11, 55% foresaw problems, while 38% did not.

**Operational problems** frequently mentioned included:

- civilian activity, all sorts of noise, wildlife and livestock, and own movements (e.g. patrols) which could overwhelm the sensors and could cause numerous false alarms;
- too many false alarms could cause a tendency to be less alert and/or a less prone to action attitude on the part of the operators;
- sensors may be stolen, damaged, sabotaged or fooled and may be vulnerable to electronic warfare;
- sensors will increase the need for troops, to check/guard the systems and to react on the reports from the data centres; and
- procedures for the employment of sensors have to be developed, sensor use should be related in a sub-plan to the overall plan.

**Technical problems** frequently mentioned included:

- the degradation of sensors' capabilities due to terrain features, weather factors and built-up areas;
- the inability to differentiate between persons, vehicles, etc., and especially difficulties in identifying or distinguishing between warring factions;
- the reliability of the systems and the power supply;

- the interoperability of systems and linkage to automation and personal computers;
- the translation/interpretation of received signals into operational/intelligence reports; and
- the presumed complexity of sensor systems.

**Personnel problems** frequently mentioned included:

- the need for technical expertise in general;
- the need for skilled operators/interpreters for the introduction of the systems and around-the-clock operations; and
- the difficulties in recruiting and training the required quantity and quality of soldiers.

Maintenance was seen as an important **logistical problem** and costs (procurement, training, operating and maintenance) as a **financial problem**.

Several respondents dwelt on the **political problems** regarding the use of sensor systems, as has been the experience with the use of electronic warfare systems. It was mentioned that all sophisticated equipment tends to be considered by the factions as intended for spying. Therefore the use of unattended sensors should be included in the mandate for a mission. For peace-keeping missions at least, their purpose needs to be clearly defined and monitored. On the one hand, the wealth of information gathered by sensors will reveal more about the status of the parties which could potentially lead to greater involvement in the conflict by the United Nations forces. On the other hand, the information provided by sensors could help to bring warring factions to the negotiating table. A liaison and negotiating mechanism to handle this and to resolve problems that sensors might reveal, would be useful.

Decisions on the deployment of sensors in missions should be based on cost-effectiveness analyses, but political reasons could demand low technology, high manpower operations for visibility and symbolism, regardless of technological possibilities.

Some respondents commented on the likely conflict associated with the use of ground sensors under the United Nations term "military information". The two specific comments made in this regard, were as follows:

- “Currently, the United Nations does not allow the use of the term military intelligence (for military information). Peace-keeping forces should be allowed to use all necessary systems for execution of their mission, including ground sensors that cross the line between Information and Intelligence”; and
- “For the United Nations, intelligence is still a ‘dirty word’.”

***Analyst’s comments:***

*Most of the problems foreseen are covered by the respondents’ requirements for sensors’ performance. But clearly, the introduction and use of sensors will not go without problems. In general, the use of sensors will require some technical background and in times of declining defence budgets it could be difficult to get the procurement of a sufficient number of ground sensor systems funded.*

*The deployment of sensor-equipped peace-keeping troops should be prepared politically, in the agreement and/or the mandate for a mission. A common doctrine and standard operating procedures for the employment of sensors should be put in place, as well as mechanisms to handle the information obtained. Modern sensor systems can cope with the problems of terrain degradation and weather conditions, but there will still be the risks of theft and vandalism.*

*The costs of sensors will not be totally covered by savings in personnel costs. With the same number of personnel a sensor-equipped unit will have the capability to cover a larger area and to function more effectively. The around-the-clock reporting sensors will cause more around-the-clock operations than before.*

*Whether called Intelligence or Military Information, information-gathering including the use of sensors might cause problems going beyond those of traditional peace-keeping operations.*

*The potential of sensors for delivering continuous non-biased data, that will provide useful information, could neutralize these problems.*

### 3.7 Improvement of Efficiency

That the widespread use of sensor devices could make peace-keeping operations significantly more efficient was confirmed by 78 (68%) respondents, while 33 (29%) disagreed. Only 57 (73%) of those answering “Yes” gave a quantitative estimation of the potential percentage of increase in the efficiency of peace operations, which averaged out to 35%. Significantly more respondents with previous sensor experience expressed their confidence in an increase in the efficiency of peace operations, than those without former sensor experience (74% against 66%).

According to respondents, the potential increase in efficiency to be gained through the use of sensors depends on the type of operation, the terrain, and the type and availability of sensors. The increase in efficiency will accrue at the point where collected data can and has to be used. As one comment clearly stated: “If there is no adequate back-up, then there is no increase of efficiency at all”. On the one hand sensor systems could cause a (small) reduction in the operational manpower requirement for a mission, while on the other hand a certain number of operators and maintenance personnel will be needed.

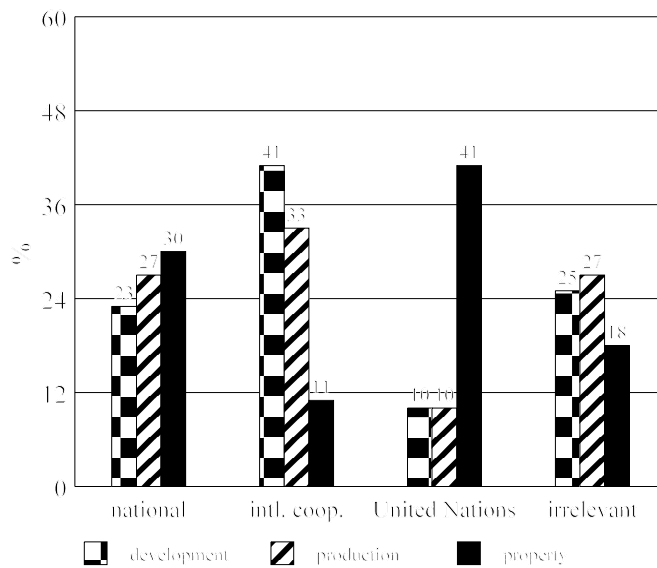
#### Analyst’s comments:

*The 3 blank, the 33 “No” and the 21 “Yes” answers with comments like “I do not know/not significantly/unmeasurable,” leave 57 “Yes” answers, exactly 50% of all respondents, which assessed an average increase in the efficiency of peace operations of about 35%. The increased efficiency will occur primarily in the first echelon of the surveillance system and in the monitoring of enclosed areas. New doctrines and procedures are required to exploit the increased possibilities offered by ground sensors. Then the introduction of ground sensors will make it possible to do more and to do it better with about the same amount of manpower.*

### 3.8 Organisational Set-up

An average of 23% considered the issue of the responsibility for the development, production and ownership of sensors as irrelevant, at least for the time being (Graph 3.12).

**Graph 3.12: Organisational Set-up  
Development, Production and Property**



Concerning the development and production of sensors, a majority of respondents preferred international cooperation above national initiatives. Only 10% of respondents saw the United Nations as capable or appropriate for managing technical projects.

As far as the procurement and ownership of sensors is concerned, respondents, aware of shrinking defence budgets in many countries, notwithstanding several comments on the bureaucracy and budgetary problems of the United Nations, would like the United Nations to provide the systems for use in peace operations.

***Analyst's comments:***

***International cooperation on development and production seems the most economical way of getting the required sensors on the market. Common sense will lead to procurement by nations.***

## 3.9 Costs and Priorities of Sensor Systems

### 3.9.1 Maximum Acceptable Costs

Only less than one third (37) of respondents answered the question on maximum acceptable costs for sensors. Question 13 of the questionnaire asked respondents to relate the costs of using sensors to the usual expenditures for peace-keeping operations (equipment, communication, vehicles, operation costs), or to give these in terms of dollars/km<sup>2</sup>. However even with the examples given in Annex B of the questionnaire, not many respondents dared to provide figures.

One respondent would accept a cost of US\$ 50,000 to equip a monitored site (e.g. a weapon collection area). Another would accept a cost of US\$ 5-8 million for installation and less than US\$ 1 million for maintenance.

One respondent related the costs of sensors to the total costs of the equipment and basic load for a mechanized infantry battalion (about US\$ 200 million) and accepted a cost of US\$ 1 million for additional sensor equipment. Two respondents would accept 5-10% and 10% respectively of the budget for the mission as costs for sensors. Two others related the costs to the ground to be covered: US\$ 1,000 and US\$ 100-7,000/km<sup>2</sup> respectively.

The well-documented peace-keeping mission in Cambodia (UNTAC)<sup>8</sup>, in which 18 battalions participated, had a budget of US\$ 1.2 billion per annum. Related to the UNTAC budget, acceptable costs for the respondents would vary, based on their examples, from US\$ 6-18 million for investment and operating costs, to US\$ 120 million for a mission per annum (which for expensive missions like the one in former Yugoslavia would be much higher). This artificial comparison shows clearly that even those who gave a quantitative estimate provided wide-ranging numbers. As one respondent wrote: "Unable to estimate since the present expenditures or the amount allocated willingly to a certain operation are unknown. It varies, systems would of course 'pay back', since it would step up effectiveness and thus reduce the amount of money

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<sup>8</sup> *The United Nations and Cambodia 1991-1995*, The United Nations Blue Book series, Volume II, New York and Geneva: United Nations, 1995, p. 54.

‘wasted’ in ineffective activities (like using too few men to monitor a large area, which of course is almost useless)’.

Other respondents argued that more and better work can be done with the same manpower and that sensors can work in areas dangerous for peace-keepers to operate in, and thus maybe save lives. Others stated that the costs for sensors should be offset by savings in manpower, and that there is a difference in costs between contingent-owned equipment and United Nations-provided equipment. Cost was also seen as a political issue; can we put a price on peace?

### **3.9.2 Differences Between Costs for Applications**

Asked if there would be differences in maximum acceptable costs for certain applications only 16 respondents gave an opinion. The overall opinion was that the expenditures for sensor systems depend on the nature of the mission, the intensity of the conflict, the tasks of the units and the value of the information sensors can provide. Some general remarks included:

- using portable systems and covertly rotating their locations brings more value for less money, thus one should not invest in large static monitoring systems;
- systems must be low-cost systems, it is better to have enough low-cost sensors for detection of infiltration of soldiers than a few expensive systems that can detect high-tech weapon systems such as tanks, aircraft, etc.; and
- in relatively peaceful situations, where sensors are a “nice-to-have” adjunct, costs, reliability and maintenance are important. When situations are more hostile and the safety of personnel is at stake, sensor costs are less important. When sensors are a necessary part of the mission design, costs have to be traded off against conventional, fully manned alternatives (e.g. a sensor array and rapid reaction forces versus a series of manned static observation posts).

#### **Analyst’s comments:**

***Blending the foregoing comments, a priority sequence for allocating defence funds for sensors could be: enclosed areas, cease-fire lines, buffer and demilitarised zones, and safe havens.***

### **3.10 Conclusion**

Based on the number of questionnaires returned, the average profile of the respondents, of which 75% are convinced that sensors are useful in peace-keeping operations and 70% have the opinion that the use of sensors is important, and a majority assessing peace-keeping operations aided by the use of sensors as more efficient, it can be concluded that further development and introduction of sensors in peace operations are worthwhile.

The summarised sensor performance requirements show that a variety of sophisticated sensors can be used for monitoring cease-fire lines and buffer/demilitarised zones. Systems for securing enclosed areas could look like civilian systems already in service for securing objects. The sensors to be used by patrols have to be as portable as a rifle and could have different performance requirements. This could lead to an adapted version. Still, standardization should be an important objective.

In peace-keeping operations, nothing can take the place of a good, alert, well-trained and well-led, professional soldier. Sensors will be another (sophisticated) tool of great value, which can become a force multiplier when properly applied. Applications can vary from observing secondary areas where supposedly nothing should move to monitoring important points. Peace-keeping with sensor-equipped troops will be more efficient, especially when the gains made in the first echelon of the surveillance system can be exploited using common doctrine and adequate procedures.

The introduction and use of sensors will not be without problems. Not underestimating (practical) problems concerning personnel, operations and logistics, the political hurdles that have to be surmounted could be many and difficult. The costs of developing, procuring, operating and maintaining ground sensor systems will be substantial and will not be completely offset by manpower savings. With sensors however, it will be possible to do more with about the same amount of manpower, and to do it better.

It seems that international development and production, and national procurement will be the most economical way to get units equipped and trained with sensors, which could provide an edge to United Nations peace-keeping forces.