NATO TACTICAL GROUND C3:
INTEROPERABILITY IS
NOT ENOUGH

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TABLE OF CONTENTS

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EXECUTIVE SUMMARY

Rationalization, the first component of NATO's policy of rationalization, standardization, and interoperability (RSI), is rarely mentioned in connection with NATO C^3 systems or programs. Instead, many NATO officials tend to make the minimum requisite goal of interoperability the ultimate objective of NATO C^3 improvement efforts. Why is this so?

By examining NATO tactical ground C^3 planning and programs, this paper attempts to infuse some practical meaning into rationalization, with particular regard to tactical ground C^3. While NATO RSI efforts have made great progress during the last decade in improving NATO strategic C3 systems, they have, until recently, largely neglected NATO tactical ground C^3 systems.

The U.S. has managed to gain NATO acceptance of a definition of rationalization as "any action that makes more efficient use of the defense resources of NATO and NATO nations." Standardization is "the process by which member nations achieve the closest practicable cooperation among forces," and interoperability is "the ability of systems, units or forces to provide services and to accept services from other systems, units or forces," according to a NATO analyst.*

Thus interoperability can be seen as but a first step, albeit an important one, on the path to rationalization. Interoperability has been NATO's focus as a readily identifiable if not simple task in the absence of a clearly defined guiding concept or longer term goal such as standardization or rationalization for tactical ground C^3 efforts. This emphasis is indicative of a trend, driven by military necessity, toward a new management approach in tactical ground C^3.

Yet tactical C^3 demands optimal information flow and thus cannot be achieved through pursuit of mere technical interoperability. The concept of "rationalization" is too ambiguous to serve as a goal in tactical C^3 planning. Indeed, functional interoperability of all tactical ground C^3 systems at all levels should be the object of NATO tactical C^3 efforts. Yet examination of the divisive forces of national particularism suggests that these pressures can be expected to continue to push national tactical ground C^3 systems down different paths.

NATO can, however, attempt to broaden and redirect this disruptive perceptual consensus toward a unification of the tactical C^3 management structure that would guide two parallel tactical ground C^3 efforts: the short-term quest for technical interoperability and the long-term drive for functional interoperability.

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* Norman Gray, "The NATO Program for Rationalization and Standardization," Signal, 30:81 (May-June, 1976).

INTRODUCTION

> While not disregarding the benefits to be derived from
> standard equipment or commonality of ammunition,
> spares, and other items, I would point out that
> airplanes, tanks, and other weapons systems of several
> nations can fight in the same battle without being
> interoperable. C^3 systems, on the other hand, to
> provide the required lateral and vertical information
> flow, ultimately must interoperate with other systems
> -- across NATO to NATO, NATO to National, and National
> to National boundaries.[1]

This statement by General Herman F. Zeiner-Gundersen, Chairman of the

Military Committee of NATO, says a great deal about NATO C^3 and, more

importantly, about NATO thinking on the subject of C^3 within the Alliance.

First of all, General Zeiner-Gundersen seems to confuse standardization and

interoperability. Weapons systems, by virtue of their function -- to

deliver ordnance on enemy targets -- cannot be interoperable; they could be

standardized, but they do not interoperate. C^3 systems, on the other hand,

control and coordinate the employment of weapons systems -- so they must,

as a minimum, be interoperable and could be standardized.

Moreover, General Zeiner-Gundersen, as do many NATO officials, tends

to make the minimum, requisite goal of C^3 interoperability the ultimate

objective of NATO C3 improvement efforts. Amazingly enough, rational-

ization, the first component of NATO's highly vaunted policy of rational-

ization, standardization, and interoperability (RSI), is rarely mentioned

in connection with NATO C^3 systems or programs. For instance, Dr. Joseph

Luns, the Secretary General of NATO, in reference to the Long-Term Defense

Program, makes a clear distinction between rationalization in general and

interoperability in C^3 in particular:

> It was also agreed that greater emphasis should be
> placed on interoperability between NATO and national
> communications systems and on the importance of

achieving increased cooperation and rationalization in defense projects.[2]

Why is this so? In accordance with NATO RSI policy, shouldn't rationalization, as well as interoperability, be a goal of NATO C^3 programs? Is rationalization related to interoperability in some way?

Rationalization is a rather abstract concept that has defied precise definition. Within NATO it has been the source of much controversy because of the various interpretations and meanings assigned to the term. Nevertheless, the U.S. has managed to gain NATO acceptance of the following definition of rationalization:

> Any action that increases the effectiveness of Alliance forces through more efficient or effective use of defense resources committed to the Alliance. Rationalization includes greater cooperation, consolidation, reassignments of national priorities to higher Alliance needs, standardization, specialization, mutual support or improved interoperability (for both weapons/material resources and nonweapons military matters).[3]

Thus rationalization can be viewed as both an ideal or guiding principle for the Alliance as a whole and, on a more concrete level, a goal related to a specific function or aspect of the Alliance. Although this definition may seem to be a catch-all compromise designed with Alliance politics in mind, it reflects the all-encompassing nature of the principle of rationalization. By examining NATO tactical ground C^3 planning and programs, this paper attempts to infuse some practical meaning into rationalization, with particular regard to tactical ground C^3. Moreover, the relationship between rationalization and interoperability in tactical ground C^3 will be examined to determine what that relationship should be and how it might be attained. This paper focuses on tactical ground C^3 because, while NATO RSI efforts have made great progress during the last decade in improving NATO

strategic C^3 systems, they have, until recently, largely neglected NATO tactical ground C3 systems.

PAST DEVELOPMENT OF NATO C^3 SYSTEMS

To put it bluntly, the development of early NATO C^3 systems was piecemeal and uncoordinated. According to an analysis by Leo Barker and Terry Dressner, "The planning of communications included a major emphasis on connectivity within a user area of activity to satisfy operational requirements."[5] This lack of centralized control or direction created a situation in which major NATO military commands, NATO civilian authorities, and national civilian and military authorities were not completely or adequately interconnected. Driven by local operational requirements, the overall NATO C^3 system assumed the form of a poorly interconnected conglomeration of diverse subsystems, each having a hierarchical, command-oriented configuration.[6]

During the late 1960s, in the face of an unprecedented buildup of conventional and nuclear Soviet/Warsaw Pact forces, NATO authorities recognized the need for complete interconnectivity of all vital military and political elements of the Alliance via a secure, reliable and survivable C^3 system that would enhance both NATO's crisis management and warfighting capabilities. Consequently, in 1970 NATO adopted the concept of a NATO Integrated Communications System (NICS), a more survivable, grid-type network for voice, message and data traffic. In addition, a NICS Management Agency (NICSMA) was established to oversee the planning and implementation of the NICS project. In Herbert Buchs' assessment, "Until NICSMA was formed, no single element of NATO had been charged with overall

responsibility for ensuring that all NATO communications were designed and implemented to best serve both the political and military requirements."[7] In sum, NICSMA was NATO's first attempt at an integrated systems approach to NATO C3 improvement.

THE NICSMA APPROACH

The NICSMA approach to systems planning was a time-phased, evolutionary one. Consequently, the NICS program was divided into two stages. The first stage, scheduled for completion in 1984, entails the implementation of several subsystems: an Initial Voice Switched Network (IVSN), Telegraph Automatic Relay Equipment (TARE), secure voice and data transmission networks. The integration of these subsystems will be the object of NICS Stage II.

The time-phasing of the NICS program made a rationalized, evolutionary strategy possible. Such a strategy would satisfy, according to Barker and Dressner:

> ...the desire to continue the use of existing
> equipments for their useful lifetime, the need to
> satisfy a number of near-term requirements, the desire
> to provide an ultimate goal of a truly integrated
> system which will be state-of-the-art and the need to
> validate the advanced concepts which are necessary to
> achieve state-of-the-art design....[8]

Therefore, implementation of the NICS concept has moved the NATO C^3 system from a haphazard patchwork of diverse hierarchical C^3 networks toward realization of a completely integrated, highly survivable grid network employing the most advanced technologies. However, NICSMA has encountered some problems in implementing NICS. The NICS program has suffered numerous

delays which, according to Sir John Anderson, Director General of NICSMA, can be attributed to:

> ...the time it takes to get all the detailed requirements and actions agreed within the NATO environment; the technical difficulties that have arisen within contracts, not helped by the need for prime contractors to meet production sharing requirements; the difficulties of completing civil works on sites, a national responsibility; and lastly complications which have arisen due to the increased emphasis now being given to Electro Magnetic Pulse Protection.[9]

The difficulties experienced by NICSMA would thus appear to be primarily related to the mechanics of implementation, rather than to the NICS concept itself. Simply stated, NICSMA has been plagued by problems common to most defense-related projects, such as those involved in procurement contracting and in keeping pace with changing requirements. Nevertheless, NICSMA has made significant, measurable gains and has done so within the considerable constraints imposed by a multinational environment's need for consensus. What, then, has been the key to the progress made by the NICS project so far?

Figure 1 depicts three basic management approaches: the insular approach (Model A), the total systems approach (Model B), and the controlled insular approach (Model C).[10] The development of NATO C^3 from the formation of the Alliance in 1949 until the late 1960s is best represented by Model A, the insular approach. As has been noted, until the advent of NICSMA each area user within NATO developed his own C^3 system, adopting a total systems approach (Model B) only within his area of responsibility. While each area user sought to rationalize his own system, there existed no overall plan or guiding concept for the whole NATO C^3 system. Had such a concept existed, the model of early NATO C^3 development might have looked more like Model C, the controlled insular approach. Such
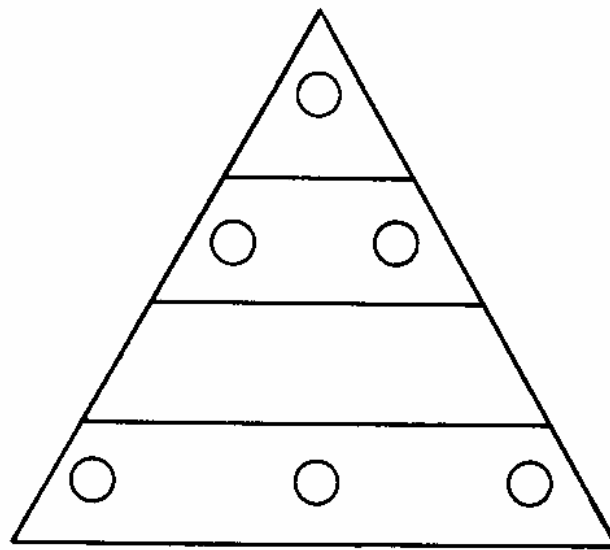
Model A:
Insular Approach
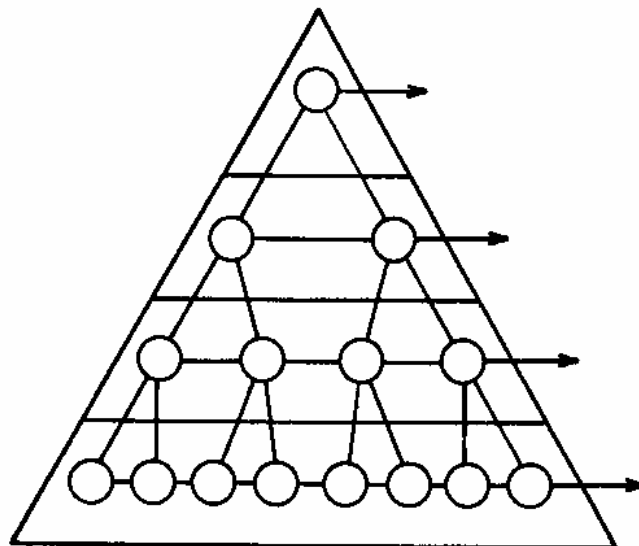
Model B:
Total Systems
Approach
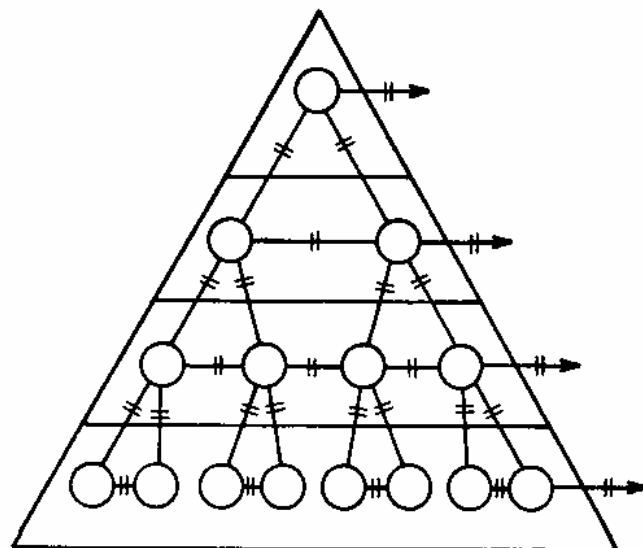
Model C:
Controlled
Insular Approach

Figure 1. Management Approaches to Systems Planning

6

a system restricts the principal task or goal of the controlling authority to rationalization of that portion of the system over which it exercises control, i.e., the subsystem interfaces.[11] In other words, the guiding concept becomes a limited form of rationalization, namely interface management or, in relation to C^3, subsystem interoperability.

When the NICS concept was adopted, however, it moved NATO C^3 planning from an insular approach to a total systems approach. NICSMA did not limit its role to that of a mere coordinator of subsystems, but rather became a total system manager; its goal was total system rationalization rather than subsystem interoperability. However, given NICSMA's evolutionary strategy, interoperability was necessarily one of NICSMA's first priorities; otherwise, there would have been no baseline of interconnected subsystems from which NICS could evolve. Therefore, one could better conceptualize the conversion of NATO C^3 planning to the NICS concept as a transition from an insular approach (Model A) to a total systems approach that encompassed a controlled insular approach for a limited, temporary function (best depicted as Model B superimposed on Model C). Accordingly, NICSMA temporarily wore two hats: that of system manager with the long-term goal of system rationalization, and that of interface manager with the short-term goal of subsystem interoperability. Once interoperability was achieved, the role of interface manager was phased out. It is important to note that during the transition to the NICS strategy, NATO C^3 did not undergo a phase of controlled insular management where interoperability was the primary goal. Total system rationalization was the primary objective and guiding concept of NICS from its very inception, with interoperability as an intermediate goal -- a necessary first step.

However, NICS encompasses only NATO C^3, that is, only C^3 systems associated with the NATO/multinational command structure. Thus the NICS is necessarily limited to strategic functions and extends only down to the NATO Army Group command level, the lowest level of NATO/multinational command. All commands from the Corps level down are national commands, with responsibilities for development and implementation of tactical ground C^3 systems devolving upon national authorities.

Yet the NICS program has also addressed the issue of national tactical C^3 systems. According to T. Baroni, "...since its establishment, NICSMA has been deeply concerned with the interconnection with other National systems."[12] However, the interconnection with which NICSMA concerned itself was the interface between NICS and separate national tactical systems and not the interconnection of national systems themselves. Moreover, although NICSMA may have been concerned with NICS/national tactical C^3 interfaces, it certainly retains no responsibility for such interfaces and lacks authority to deal with them.[13] Instead, these interfaces are managed by means of an ad hoc system of Standard NATO Agreements or STANAGs: STANAGs 5051 and 5040 specify the technical standards to which both NICS and national tactical C^3 systems must adhere in order to ensure interoperability.[14]

NATO TACTICAL GROUND C^3

First of all, one must recognize that NATO tactical ground C^3 is still a goal rather than a reality. In fact, there is no NATO tactical ground C^3 system per se, but rather a collection of independent, diverse national systems, described by Richard C. Bowman as having "poor interoperability

and not much likelihood of early improvement."[15] This current state of affairs can be attributed to the lack of management authority for the development of an integrated NATO tactical ground C^3 system. Early NATO tactical ground C^3 development, like the early development of NATO strategic C^3 systems, was typified by an insular approach, as Figure 1 illustrates. In the late 1960s, when NATO recognized the need for improved C^3 systems and the NICS concept with its total systems approach was adopted for NATO strategic C^3 planning, national tactical ground C^3 systems continued to develop independently of one another, with no guiding principle or concept. At most, the recognition of needed improvement gave impetus to national efforts at rationalizing tactical C^3 within national sectors of responsibility. The result of such uneven development of tactical ground C^3 is best described by General William Hilsman, head of the Defense Communications Agency:

> ...NATO can do very well communicating with capitals and headquarters, but not so well with units across the street. Alliance command and control problems are more serious in the tactical area, simply because until recently they were considered a national problem.[16]

Perhaps tactical C^3 was viewed as a national problem by NATO, but national authorities hardly viewed it as such. In fact, national control of tactical ground C^3 efforts has been seen as a boon to national economies. In the earlier years of the Alliance, European economies were undergoing rapid growth and expansion. Consequently, labor became a scarce resource and investments were directed to rapid growth sectors, primarily in construction and consumer goods. Defense industries in Europe were simply not able to compete in the labor and capital markets. Since the late 1960s, however, with the advent of high inflation and unemployment, defense industries in West Europe have expanded at a tremendous pace,

absorbing excess labor and attracting investment capital that had been
confronted with stagnating economies. Naturally, European politicians find
themselves supporting defense industries as a way of alleviating economic
woes and related domestic political pressures. Unfortunately, this trend
has coincided with the growing awareness within NATO of the need for an
effective, integrated tactical C^3 system. While NATO member nations once
viewed national control over tactical C^3 primarily as a question of
national sovereignty, domestic policies in those nations has cast it
recently as a key element in the struggle for national economic welfare.
With many European capitals considering participation in NATO a heavy
economic burden -- witness the debate over the NATO Long-Term Defense
Program goal of increasing national defense spending by 3% -- it is easy to
understand that national authorities are reluctant to relinquish control
over tactical C^3 programs which, in a sense, are national economic assets.

Nevertheless, the Alliance has attempted in recent years to coordinate
the development of national tactical ground C^3 systems, that is, to move
NATO tactical C^3 planning from an insular management approach to a
controlled insular approach (See Figure 1). Such attempts, however, have
not met with much success. The problem seems to be a structural one which
derives, in part, from national authorities' reluctance to surrender
control of tactical C^3 systems development to NATO. Consequently, efforts
to deal with coordination of separate national programs in this area have
yielded a proliferation of committees and ad hoc working groups, both
formal and informal, within the Alliance. According to T. Baroni:

> There are probably too many committees discussing
> specific aspects of what should be mainly an overall
> study, systematically developed and technically based
> on a system engineering functional approach. No one
> group is responsible for the overall coordination and
> direction....[17]

Thus NICSMA has no counterpart in the tactical ground C^3 field. As a result, NATO tactical ground C^3 planning has been unable to assume a controlled insular management approach, much less the NICSMA total systems approach. As Karl H. Wagner has written:

> ...the controlled insular approach does not work without management, and so there has to be a capable management agency that gives guidelines, controls the projects and surveys interfaces. Otherwise, the approach degenerates to the insular approach.[18]

This structural defect in the tactical C^3 sector has also had repercussions on overall NATO C^3 organization, since any NATO-wide effort would necessarily have to manage interfaces between tactical C^3 systems and other components of the NATO C^3 system. In the absence of a tactical C^3 controlling authority, as in the NICS/tactical C^3 case cited earlier, such interface management must be handled in a piecemeal, ad hoc fashion, if at all. This situation is reflected in the NATO organization for dealing with communications matters which comprises more than 20 bodies with various responsibilities and four separate controlling authorities.[19] In short, according to G.S. Sundaram in the International Defense Review, "there is ... no real concerted effort to bring all NATO C^3 activity under a unified authority...."[20] Nor, it seems, will there be any until the underlying causes of NATO tactical C^3 structural difficulties are identified and eliminated. Do such difficulties derive solely from the considerations of national sovereignty and national economic interests discussed previously?

THE EUROGROUP EFFORT

The skyrocketing costs of research, development, tooling, and component technology have forced nations to cooperate in programs that they

could no longer finance individually.[21] Consequently, in 1968 the European

members of NATO founded the so-called Eurogroup and its communications

subsidiary, Eurocom, in an effort to seek economically acceptable, coopera-

tive solutions to common defense communications problems. Allegedly, the

Eurogroup strategy has been quite successful and, in the analysis of Walter

B. LaBerge, "...is leading these European nations to important integration

of their procurement planning for communications."[22] Yet, such claims

appear specious in light of the following observation by Robert D. Terry in

Signal:

> Seven NATO nations plan to introduce six major new
> tactical communications systems in their land forces
> within the next several years... None of these systems
> will be common with the NATO Integrated Communications
> System. Hundreds of millions of dollars will be spent
> for these systems, and they fail to facilitate effec-
> tive combined operations....[23]

Moreover, the formation of the Eurogroup has served only to divide the

Alliance by de facto isolating the United States as Eurogroup's major

competitor in the tactical C^3 field. As LaBerge has pointed out, "...these

two strong contenders must take special care that the timing and scope of

their new programmes are well discussed... to avoid non-compatibility."[24]

Therefore the Eurogroup, labelled a success by some, has only succeeded in

relegating intra-Alliance competition in tactical C^3 development to

self-regulation. This is hardly a novel formula, nor a viable alternative

to some sort of controlling authority in view of past experience.

Moreover, one must look at Eurogroup itself and ask: "Why did a

cooperative effort of this type yield so many different tactical C^3

systems?" National economic interests, more specifically, vested interests

in national communications industries, undoubtedly played an important role

in causing member nations to pursue separate national procurement programs. On the other hand, national economic interest -- concerns about excessive R&D and tooling costs -- had given rise to the Eurogroup effort. One explanation for this seeming paradox could be that, having reaped the benefits of joint R&D, nations applied technologies gained through such ventures to national production efforts which, it is held, are inherently more profitable than joint production or cooperative procurement.[25] Another explanation could be that, even if joint production schemes were considered more profitable because of reduced tooling costs, additional incentives such as government subsidies in connection with domestic employment policies may have made independent production an attractive option.

The foregoing economic considerations notwithstanding, why are tactical C^3 systems that evolve from national production programs so diverse? One reason might be that nations are technologically "out of step." Different systems can be expected to derive from different technological bases. The ability to draw on a common R&D base such as that of Eurogroup does not mitigate in any way the disparities arising from differences in production technology. Another explanation is related to the tactical C^3 implementation plans adopted by NATO member nations for their respective sectors of responsibility. Some nations, like the U.S. and the Federal Republic of Germany, may decide to take an evolutionary approach in order to maximize utilization of assets already tied up in older systems; others, like the United Kingdom, may directly install systems embodying state-of-the-art technologies.[26] Yet another simple but easily overlooked reason for the development of so many diverse national tactical

C^3 systems is that they are built to different specifications to fulfill different military requirements.

THE ROLE OF MILITARY REQUIREMENTS

A good example of how diverse military requirements can inhibit realization of a common tactical C^3 system and result in a conglomeration of different national systems is the story of the MALLARD tactical communication system. In the mid-1960s, high research, development, and production costs prompted the U.S., the U.K., and Canada to engage in joint development and production of a tactical communications system code-named MALLARD.[27] One must assume, therefore, that this joint venture served each nation's perception of economic advantage. Nevertheless, MALLARD was declared a "dead duck" when the U.S. suddenly withdrew from the project because, according to Sundaram, "it was felt that U.S. requirements were different from those envisaged by the other...countries, and it was feared that the U.S. would be forced to accept equipment not totally suited to its needs."[28] Another joint tactical communications venture by West Germany, France, and Belgium met a similar fate.[29] Consequently, each nation went its own way, thereby giving rise to the proliferation of NATO tactical communication systems cited earlier.

The foregoing discussion suggests that NATO may be able indirectly to affect tactical C^3 development at the national level by influencing military requirements. After all, NATO can do little to reduce the disparities among the domestic technological basis of its member nations. Likewise, the Alliance can do little, other than possibly offering economic incentives or subsidies for joint production enterprises,[30] to prevent

member states from making domestic economic concerns a priority. Further-more, dealing with national economic problems or dispensing economic aid or incentives hardly falls under the purview of NATO. Yet military require-ments do. However, to what extent do national military requirements drive member nations to pursue different tactical C^3 systems? In comparison to national economic concerns, how forceful a determinant of national tactical C^3 policy are national military requirements? One area in which some limited progress has been made in coordinating national tactical C^3 efforts -- employment of ad hoc measures -- may suggest some answers.

Since, as mentioned previously, NATO tactical ground C^3 planning is proceeding under the insular management approach (Figure 1), nation-to-nation interfaces from the Corps level down have been dealt with on an ad hoc basis, as in the case of the NICS-national interfaces between Army Group and Corps level. For instance, an Ad Hoc Committee for Interoperability of Future Equipment was formed within NATO in 1975. As a result, LaBerge has observed, "Nations, while they may continue their present individual programmes, have...guaranteed that there be inter-operability among them."[31] In addition, STANAGs have been approved in order to set common technical specifications and standards for future tactical C^3 equipment. However, as Clarence E. McKnight notes, "although NATO Standardization Agreements (STANAGs) have helped tremendously in formulating long range planning goals, they offer little comfort to NATO's near term C^3 requirements."[32] Thus tactical C^3 has made progress, but has a long way to go. Most important, however, is that the progress that has been made to date can be attributed not to national economic factors, but primarily to the influences of military requirements. In fact, according

to LaBerge, "interoperability is being driven by military necessity...,"[33] despite the divisive influences of national economic realities.

THE NATO POLICY OF RSI

Since the late 1960s, perceptions of a constantly growing Soviet/ Warsaw Pact threat have moved NATO and national commanders alike to make ever-more-frequent and louder appeals for improving NATO defenses. The political problems associated with increasing NATO reliance upon tactical nuclear defenses left NATO commanders with two options: increase NATO's conventional forces or augment the effectiveness of existing forces. Confronted with the previously mentioned national economic realities, NATO commanders chose the less costly alternative -- improving effectiveness. The NATO policy of RSI was born.

What is RSI? Because the components of RSI are often confused, perhaps a review of their definitions would be useful. In general terms, Norman Gray has summarized rationalization as "any action that makes more efficient use of the defense resources of NATO and NATO nations;" standard- ization as "the process by which member nations achieve the closest practicable cooperation among forces;" and interoperability as "the ability of systems, units or forces to provide services and to accept services from other systems, units or forces."[34] Gray sees the interrelationship of these components as follows:

> ...rationalization encompasses the overall effort; standardization is a difficult target in a multinational environment; and interoperability can offer increased operational effectiveness in the near time frame.[35]

Thus interoperability can be seen as but a first step, albeit an important one, on the path to rationalization. It is interesting to note that standardization is quickly written off as "difficult" and that rationalization is seen as the long-term overall goal.

Does NATO share this perspective? Yes and no. NATO does seem to have dismissed standardization as a desirable but highly elusive goal,[36] although the STANAG process has made some progress. Rationalization, it seems, is treated as a rather ambiguous, generalized concept to which much lip service is paid, but which does not serve as a guiding principle or long-range goal in practice. Instead, NATO tends to focus on the short-term goal of interoperability. Indeed, interoperability is seen as the objective, especially in the field of tactical ground c^3. Unfortunately, this preoccupation with interoperability borders on myopia -- to the detriment of the long-term goals of standardization and rationalization which are already being slighted.

INTEROPERABILITY AS A GOAL

The emphasis on interoperability in tactical ground c^3 derives from several factors. First, given the divisive influences discussed earlier, the task of achieving interoperability is not a simple one. As John L. Boyes has noted, "The easiest area to work in is interoperability, except in the case of c^3."[37] Hence, interoperability has received more effort and is an important first step. The question seldom asked, however, is: "A first step toward what?" Standardization? Rationalization? The lack of a clearly defined guiding concept or long-term goal has diverted attention to the readily identifiable, short-term objective of interoperability.

The emphasis on interoperability is also indicative of a trend, driven by military necessity, toward a new management approach in tactical ground C^3. As the push for interoperability intensifies, one could expect to see a move from an insular management approach to a controlled insular approach (See Figure 1). In fact, achieving interoperability is interface management, the basic purpose of a controlled insular management approach. The only element lacking at present is a unified controlling authority. Unfortunately, the pressures of national particularism continue to make ad hoc measures necessary.

Assuming that military necessity prevails over national particularism, would the establishment of a centralized authority for supervision of tactical C^3 interoperability and the concomitant assumption of a controlled insular management approach for tactical C^3 be desirable? Would it fulfill NATO military requirements? First of all, such changes would resolve some of the tactical C^3 structural problems that were identified earlier. Furthermore, the military requirement of interoperability would obviously be well served by such developments. Nevertheless, is interoperability the only NATO tactical ground C^3 requirement? NATO tactical C^3 requirements derive from the notion that NATO tactical C^3 must be improved to increase the effectiveness of NATO forces. What constitutes tactical C^3 improvement? Does interoperability alone meet this objective?

THE FUNCTION OF TACTICAL C^3

The purpose of a tactical C^3 system is to get the right information to the right commander at the right time so that he can, as Paul R. Mallorie has written, "...apply force at the right place, at the right time and in

the right amount, or, alternatively, to prevent force being applied at the wrong time, in the wrong place or in the wrong amount."[38] In other words, tactical C^3 systems should seek to optimize information flow and should therefore epitomize the concept of rationalization, as defined earlier. Those responsible for formulating NATO tactical C^3 military requirements, which have tended to move tactical C^3 planning toward a controlled insular management approach with interoperability as its sole objective, have evidently ignored this reality. An examination of the military context in which NATO tactical ground C^3 must operate could be instructive in this regard.

Figure 2 shows the disposition of forces along a portion of the NATO front. Given the growing Soviet/Warsaw Pact threat and the fact that, according to Louis T. Seith, "a significant advantage to the Soviet-led forces of the Warsaw Pact rests in their ability to select the time, place and nature of attack,"[39] the need for a tactical ground C^3 system that would permit NATO commanders to quickly react to and counter Soviet moves anywhere along the NATO front is readily apparent. However, because tactical ground C^3 development has been handled primarily by national authorities within corps boundaries, this military need of the Alliance was interpreted as a national one, resulting in the fielding of systems that reflect differing national perceptions of that need. Only recently have NATO commanders come to view effective tactical ground C^3 as a NATO-wide military requirement that, like the enemy, knows no bounds. As Bowman has observed:

> ...neither sensors nor modern weapons are limited by
> the boundaries between national forces. Recent studies
> have shown that to obtain full advantages from these
> new systems, the forces of various NATO allies must be
> able to work with other units within their own national
> areas. Moreover, one important study confirmed the

obvious high probability that many of the key battles
would take place on the boundaries between national
corps commands.[40]

The large cross-hatched arrows in Figure 2 depict this last eventuality:

the sobering realization that the enemy will probably concentrate his

forces where NATO tactical ground c^3 is weakest -- along national corps

boundaries.

The need for lateral, cross-corps tactical ground c^3 therefore became

evident. This realization prompted calls for interoperability, the

horizontal linking of national tactical ground c^3 systems, which, as noted

earlier, became an obsession -- an end in itself. Efforts at attaining

interoperability have been piecemeal, but lately have become better

organized, according to Rockwell, et al: "Fielding of a 'paste on' NATO

solution will start...while 'built in' technical military agreements are

well on the way to ratification."[41] The "paste on" method has two

dimensions: the technical and the structural. The technical "paste on,"

better known as the "black box," is of questionable utility. As analyzed

by William E. Stoney:

> Because of geographical placement of national Army
> corps, all lateral interconnections...will be done with
> adaptor boxes. All of the sophistication of modern
> technology and security will be destroyed in these
> boxes. There will be no lateral wideband secure
> speech. Data streams are constricted to voice channel
> band width. End-to-end encryption will not exist.[42]

Where technical "solutions" of this sort are not possible, the structural

"paste on," the time-honored practice of exchanging liaison officers with

their own national communications, is applied.[43] Given the duplication of

equipment and manpower required, such arrangements can hardly be termed

efficient by modern standards. Yet, liaison is still the most frequently

used method of achieving interoperability.

NORTHAG

XXXXX

XXXXX   XXXXX

X
X
X

XXX GE

XXX

XXX US

X
X
X

CENTAG   XXXXX

XX BE

XX GE

XX

XX GE

XX US

XX

XX US

XXX

BE: Belgian
GE: German
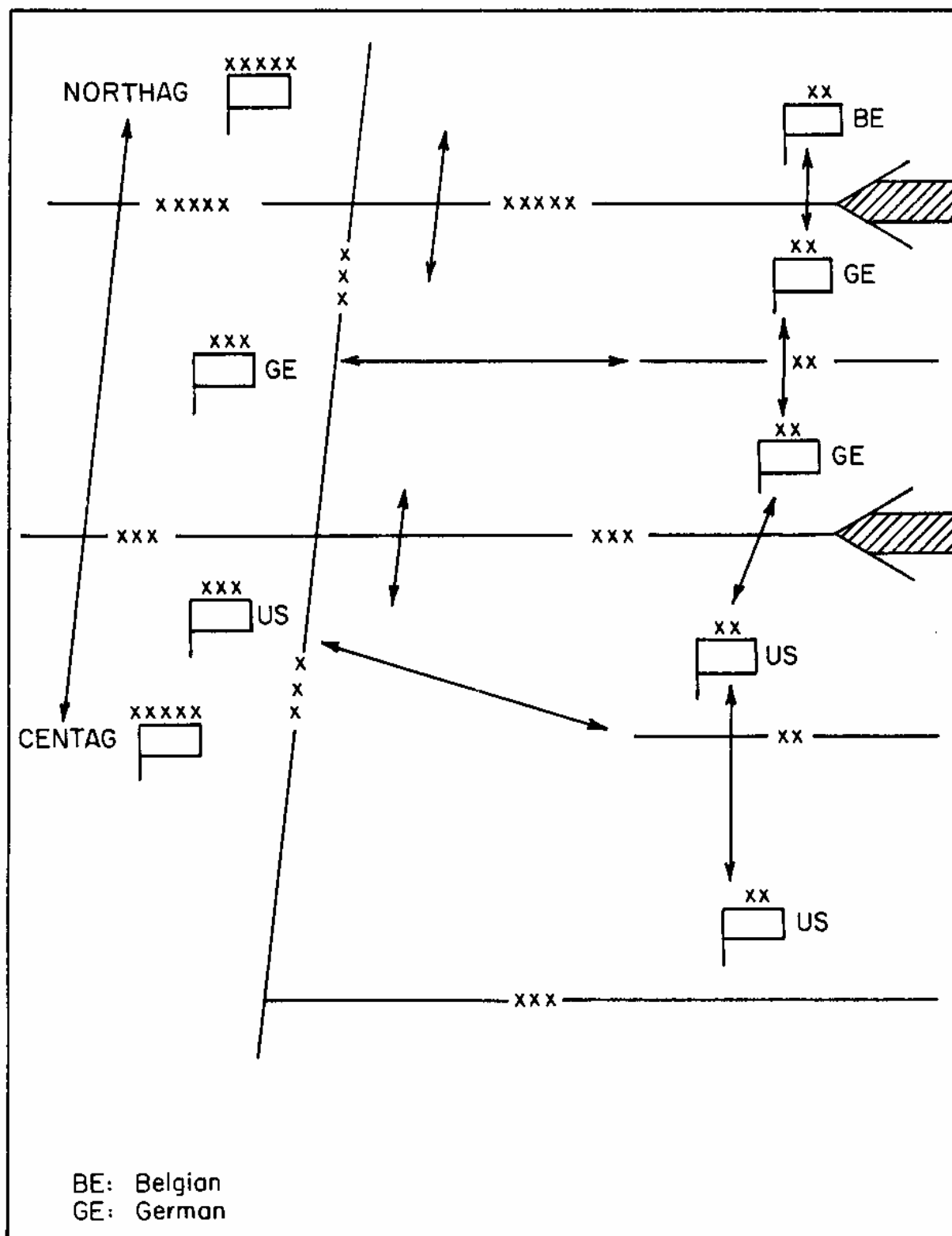
Flow of information (solid black arrows) between units of different nations, regions, and echelons must be possible if NATO is to defend successfully against a coordinated Soviet/Warsaw Pact attack. Large cross-hatched arrows indicate the most likely enemy avenues of approach.

Figure 2. Relationship between Information Flow and Enemy Attack Patterns

21

The "built in" method of attaining interoperability has manifested

itself in the form of international agreements on common technical

specifications for future tactical C^3 equipment. However, even this method

has its shortcomings and can lead to reliance on "paste ons." The

following is an excerpt from a report on the NATO field exercise "Autumn

Forge:"

> Interoperability between allies was a problem...
> Although most of the communications equipment,
> particularly at the lower level, was compatible, this
> did not solve all their problems. The British have
> secure voice equipment to a very low command level but
> the facility did not extend to others on the exercise.
> This was solved by attaching Allied liaison officers
> with radio sets to senior and junior commanders who
> could then communicate on both nets.[44]

Therefore, to some the liaison method, according to McKnight, "still seems

the best approach to solving interface problems where interoperability

becomes counterproductive."[45] But is it? Or, for that matter, are any of

the "paste on" or "built in" methods sufficient to satisfy NATO tactical

ground C^3 needs?

TECHNICAL VS. FUNCTIONAL INTEROPERABILITY

When one considers the function of tactical ground C3, the previously

mentioned methods of attaining interoperability, indeed, the objective of

interoperability itself, appear inadequate to the task. At best, they are

the means used to establish anomalous links between incongruous, often

incompatible systems. Interoperability, therefore, is not necessarily the

best way of getting the right information to the right people at the right

time; it is simply a way of connecting systems, each of which has probably

been designed to get the right information to the right people at the right

time within national corps boundaries in accordance with locally perceived

military requirements. The problem is that interoperability focuses on the

technical dimension of interface management -- in other words, technical

interoperability. However, systems not designed to interoperate function-

ally (as opposed to technically) can hardly be expected to do so -- at

least not efficiently -- when merely patched together.

For example, agreements guaranteeing technical compatibility of c^3

equipment do not ensure, as illustrated by exercise "Autumn Forge," that

that equipment will be utilized to optimize the flow of information. At

what level of command should lateral information flow be established --

corps, division, battalion? Is there indeed some optimal level for linking

different command structures? Could this optimal level depend upon the

type of information to be relayed, such as intelligence versus combat

information? Is, in fact, the lateral flow of information necessary at

other levels, given the existence of integrated NATO commands connected by

NICS at the Army Group Level?

As far as the need for lateral information flow is concerned, Bowman

has written:

> ...at the subordinate unit or tactical system level,
> there is a need for real time relay of target data and
> other combat information across national unit
> boundaries, since communications to NATO commanders and
> back would be much too slow.[46]

Moreover, the time-urgent nature of combat information (raw, unprocessed

data on the immediate combat situation) dictates that, as James Minetree

stated, "...lateral reporting must be accomplished at the lowest possible

echelon, allowing immediate action by the local commander."[47] Thus,

information flow and, therefore, functional interoperability across

national corps boundaries appear to be required at all levels of command, as is the case within national corps sectors.

That this is hardly the case in NATO is obvious from NATO's combined operations training record: "In September 1979, for the first time in NATO history, Headquarters, Central Army Group conducted a field training exercise in which allied corps shared common boundaries."[48] Moreover, even if liaison were established at all levels along corps boundaries, optimal information flow would not be guaranteed, witness NATO's report on exercise "Autumn Forge:"

> Sometimes even this excellent method [liaison] was
> insufficient as it was occasionally apparent that the
> Americans and British were still divided by the same
> language...procedures, tactics and expressions
> differenced and misunderstanding occurred.[49]

These same considerations -- differences in procedures and doctrine -- would likewise reduce the effectiveness of "black boxes" or technically compatible equipment.

Yet another factor affecting NATO tactical ground C^3 is the fact that the capability to interoperate functionally must be Alliance-wide and not restricted to those units which share corps boundaries with other nations in peacetime or at the initiation of hostilities. In attempting to get the right forces to the right place at the right time, the NATO commander, according to Eric Rider, "will need not only be able to fight alongside other allied forces, but also to pass through, and sometimes fight under command of, units of other nationalities."[50] In the words of William Stoney, Assistant to SACEUR for Command and Control: "anyone can find himself next to or in the corps of almost any other nation."[51] Thus praiseworthy efforts like the Central Army Group Interoperability Program (CIP),[52] which limits its efforts to the integration of Central Army Group

forces, can be counterproductive in the sense that they tend to ignore interface problems at Army Group boundaries. Theoretically, all levels of command in all national forces would have to possess organic liaison or "black box" capabilities, or tactical ground C^3 equipment that is technically interoperable throughout NATO, to ensure interoperability in all possible circumstances. However, even if such a degree of inter-operability were achieved (doubtful in light of Alliance budgetary and manpower constraints[53]), there is no guarantee that information flow will have been optimized, since differences in procedures, tactics, and doctrine could distort that flow.

THE ROLE OF DOCTRINE

The problem of diverse doctrines and procedures would thus seem to be a serious one -- an obstacle not to interoperability, that is, technical interoperability, but to total rationalization of tactical ground C^3, an ideal best approximated by the pursuit of functional interoperability. In fact, this problem has received quite a bit of attention within NATO. For example, U.S. Army doctrine has emphasized that:

> An important consideration is that there will be
> differences between the various forces which encompass
> more than the easily recognized variation in language.
> They will include variations in doctrine, organization,
> training...and customs as well... Some of these
> differences are being eliminated. Standardization
> Agreements (STANAGs) establish procedures and
> guidelines for the employment and coordination of all
> arms in land combat... As STANAGS are adopted, they
> become a part of the various nations' unilateral
> procedures. Allied Publications (APs) provide NATO
> allies information pertaining to tactics, intelligence,
> training, doctrine....[54]

However, an examination of relevant STANAGs (Figure 3) demonstrates how

piecemeal such highly commendable efforts have been. Reporting procedures

and formats seem to receive the most emphasis, while NATO efforts seldom

touch upon doctrinal issues. Consequently, as Dov S. Zakheim has written,

"The Allies have continued to foster independent military programs based on

conceptions of doctrine, strategy and tactics that are hardly uniform

throughout the alliance."[55]

The effect that doctrine has on tactical C^3 planning is substantial.

In fact, NATO recognizes doctrine as an integral part of C^3. According to

Mallorie:

> $[C^3]$...is defined as an integrated system of doctrine,
> procedures, organization, personnel, equipment,
> facilities, and communications to provide authorities
> with timely and accurate data to plan, direct,
> coordinate and control their operations. Note people
> and doctrine are part of the system.[56]

People (commanders) and doctrine are emphasized here for good reason: They

are quite often overlooked. Furthermore, these two elements interact;

doctrine is the product of commanders' perceptions accumulated over time,

and doctine, in turn, influences those perceptions. This interaction, in

turn, influences the formulation of functional military requirements which

drive the tactical C^3 planning process.[57] The relative strength of

military requirements in comparison to the influences of national

particularism as determinants of tactical C^3 planning and associated

management approaches has already been examined. In light of these

considerations, the doctrinal/perceptual dimension of tactical C^3 planning

assumes greater importance.

An examination of two different tactical ground C^3 systems can

illustrate how doctrines and perceptions drive military requirements and

affect tactical C^3 planning: WAVELL, already operational with British

STANAG 2003   Patrol Reports by Army Forces.

STANAG 2008   Bombing, Shelling and Mortaring Reports.

STANAG 2014   Operation Orders, Annexes to Operation Orders,
               Administrative and Logistics Orders.

STANAG 2017   Orders to the Demolition Guard Commander and Demolition
               Firing Party Commander.

STANAG 2020   Operational Situation Reports.

STANAG 2022   Intelligence Reports.

STANAG 2036   Doctrine and Procedures in the Technique of Land Minefield
               Laying and Recording.

STANAG 2041   Operation Orders for Road Movement.

STANAG 2077   Order of Battle.

STANAG 2082   Relief of Combat Troops.

STANAG 2096   Reporting Engineer Information in the Field.

STANAG 2099   Fire Coordination in Support of Land Forces.

STANAG 2101   Principles and Procedures for Establishing Liaison.

STANAG 2103   Reporting Nuclear Detonations, Radioactive Fallout and
               Biological and Chemical Attacks.

STANAG 2104   Friendly Nuclear Strike Warning to Armed Forces Operating
               on Land.

Figure 3.   Relevant Standardization Agreements (STANAGs)

forces, and the U.S. Tactical Operations System (TOS), which is still in its planning stages. The primary difference between these two systems is that WAVELL has an "all-informed" distributed data base and a distributed data processing capability,[58] while the TOS concept foresees the centralization of its tactical data base and processing capability in a Division Computer Center (DCC).[59] One reason for WAVELL's adoption of a decentralized scheme was a change in doctrine: In 1974 the British Army was restructured. This restructuring, P.G. Pengelley has written, "...entailed the removal of the brigade level of command, and significantly increased the responsibilities of individual staff cells within divisional headquarters and with it the volume of operations data to be handled by each."[60] Therefore, giving Task Forces (battalions) a data processing capability and data bases of their own would reduce the operational load at the division level. Since the U.S. Army has retained its brigade-level commands, the U.S. TOS concept was not motivated by similar concerns. Another reason for WAVELL's decentralized configuration is the British concept of how to ensure system survivability. The British meet this objective by giving each level of command its own data base and an ADP capability which, in turn, are linked with those of all other commands. Thus if one headquarters is knocked out, the entire data base is not lost and another headquarters can readily assume command. The U.S. concept of ensuring survivability is quite different. The TOS will satisfy the survivability requirement by isolating the Division Computer Center (DCC) from the Division Tactical Operations Center (DTOC), creating in effect an alternate DTOC.

Another example of how doctrine and perceptions yield military requirements that influence tactical C^3 planning can be drawn from NATO

experience with tactical communications systems. The U.S. tactical

communications system, TRI-TAC, differs significantly in structure from

those of European NATO nations. Most European nations have adopted area

communications systems with highly survivable grid networks. Current

national examples of this type system are AUTOKO (West Germany), RITA

(France), and PTARMIGAN (U.K.).[61] In contrast, the U.S. TRI-TAC system is

a hierarchical, point-to-point system that parallels the chain of

command.[62] The primary reason for this structural difference between U.S.

and European tactical communications systems is a divergence of doctrine

and, hence, perceived military requirements. Indeed, the U.S. withdrew

from the multinational MALLARD tactical communications program for this

very reason.

Until recently, U.S. Army doctrine maintained that "the Army's primary

objective is to win the land battle - to fight and win battles, large or

small, against whatever foe, wherever we may be sent to war."[63] Conse-

quently, the overriding U.S. tactical communications systems requirement

became deployment flexibility, a quality found lacking in extensive,

complex grid systems. The Army therefore adopted a more versatile point-

to-point system to fulfill its requirement for flexibility and mobility.

The fact that TRI-TAC, unlike European systems, is a joint communications

system that must meet the needs of all services also influenced the U.S.

choice, since point-to-point systems are readily adapted to all types of

missions. On the other hand, the operations of European armies are

virtually confined to Central Europe, and to NATO's Northern and Central

Army Groups in particular. These armies will be operating on familiar

terrain (most likely in their assigned corps sectors) in a forward defense

that probably will not require wholesale displacement of tactical communi-

cations systems. Accordingly, survivability rather than flexibility was the primary concern of European tactical communications planners.[64] The meshed area network best fulfilled this requirement.

Carrying the tactical communications example one step further will demonstrate how the influence of doctrine can have a cumulative effect. For instance, since the German AUTOKO tactical communications system is a grid network that extends throughout the entire corps area of operations, the German corps has responsibility for providing multichannel communications between divisions. Consequently, as Edward R. Baldwin stated, "The German division does not have the capability of providing a multichannel tie of its own to the adjacent division on the right [as required by NATO agreements]... Under German doctrine, such a link would be available only through the corps provided network."[65] In contrast, the U.S. division, because of the U.S. point-to-point communications setup, is not designed to be "plugged" into a corps communications grid, but rather possesses the organic capability to establish multichannel communications with the division on its right.[66] Obviously, then, a German division attached to a U.S. corps and placed on line to the left of a U.S. division would be left with no multichannel communication with that division. Such a situation could be catastrophic were the enemy to attack along the boundary between the two divisions.

Hence, it is easy to see how different doctrines and perceptions can generate functional military requirements that yield different tactical ground C^3 systems. To be sure, national economic influences played a part in shaping these systems, but it is important to note that in the absence of such influences, divergent doctrines and perceptions would have inevitably left their imprints. From the viewpoint of NATO, tactical

ground c^3 planning is, as a result, reduced to interface management by ad
hoc methods. Some additional observations: WAVELL and TOS are planned to
be interoperable although functionally they would be incompatible. Like-
wise, U.S. and European tactical communication systems are designed to be
technically interoperable; yet, as the TRI-TAC/AUTOKO case demonstrates,
they may be functionally incompatible. Such situations clearly demand more
than simple interoperability if NATO is to have effective tactical ground c^3.

Finally, one should consider not only the effects that existing
differences in doctrine have had on tactical ground c^3 development, but
also the effects that ongoing doctrinal change will have. As Mallorie has
observed: "In an Alliance...it is important to look at the whole system
and to be aware how changes in one element have repercussions elsewhere."[67]
A case in point is the U.S. Army's recent adoption of the so-called
"AirLand Battle" doctrine. This new concept emphasizes aggressive,
violently executed offensive action that exploits the speed and mobility of
maneuver forces rapidly to concentrate maximum combat power against enemy
forces at the critical place and time, both in the "close-in" battle and in
the "deep" or interdiction battle.[68] Although the U.S. holds that its new
operational concept "is consistent with NATO doctrine and strategy,"[69] the
AirLand Battle doctrine is radically different in terms of the requirements
for increased responsiveness and flexibility which it will impose on U.S.
and NATO tactical ground c^3 systems. In fact, the new U.S. doctrine cannot
be supported by currently deployed U.S. tactical ground c^3 systems, and is
based on tactical ground c^3 capabilities associated with systems that have
not yet been fielded.[70]

How does the U.S. plan to integrate its new tactical ground c^3 systems
with those currently fielded by its NATO allies? As advanced as the

AirLand Battle concept might be, its proposed solution for integration of U.S. and other NATO tactical ground c^3 systems is hardly innovative: exchange of liaison parties and equipment,[71] and use of the NATO interface unit[72] (a type of "black box") are the only provisions made for tactical ground c^3 in a combined operations environment. Unless credible alternatives to these traditional "paste ons" can be developed, the U.S. Army's gain in implementing its new doctrine may very well become NATO's loss, as far as integration of NATO tactical ground c^3 is concerned.

STANDARDIZATION OF DOCTRINE

The foregoing discussion suggests that standardization of doctrine within NATO could alleviate NATO tactical ground c^3 problems. This is not a new notion. According to Mallorie:

> Before a command and control system suitable for the electronic age is defined there must be some concept of command which is agreed and understood by the Allies.[73]

In fact some limited progress has been realized in this regard through the conclusion of STANAGs; yet "legislating" doctrinal change is bound to meet with resistance. First of all, as is the case in any multinational environment, it is difficult to reach agreement on meaningful change; compromises yielding vague doctrinal formulas are inevitable. Moreover, doctrine is the product of an evolutionary process[74] and therefore cannot be changed by decree.

Perhaps, therefore, the human element, the source of perceptions and concepts that over time become doctrine, might be a better focus for efforts at standardizing doctrine. In fact, it is for this reason that NATO has, in addition to the implementation of STANAGs, pursued an

educational approach to doctrinal change -- the exchange of ideas through

Allied Publications (See page 25). Unfortunately, even this method has its

limitations. As Mallorie wrote:

> ...well established organizations and methods of work
> become set; there is a psychological resistance to any
> change which disturbs relationships within an existing
> structure.[75]

This last phrase, "within an existing structure," is a telling one. It

suggests that changes in command structure could reduce psychological

resistance to new concepts and thus facilitate the modification of

perceptions and with them, doctrine.

In the past, calls for revamping NATO's command structure have derived

from the perceived need to have a command structure that conforms with C^3

technological capabilities. In Mallorie's words:

> ...new developments combining information and
> communications cut across these traditional boundaries
> and will probably require modernization of the
> structure of headquarters and change in boundaries...[76]

However, this concept, as do attempts to dictate doctrinal change, seeks

too much, too soon. Command structure cannot be changed significantly

overnight.

MULTINATIONAL COMMAND STRUCTURE

The changes in command structure mentioned previously, having as their

objective the modification and eventual standardization of doctrine, need

not be so sudden or drastic. The NICS experience suggests that a more

subtle, evolutionary change might be pursued. The progress made by NICS

was due in part to the fact that the system encompasses only NATO/multi-

national commands, thus precluding the adverse effects of national

particularism. NATO commanders consequently were able to formulate clear-cut functional military requirements which NICSMA then used to design and implement NICS. It would therefore seem that movement toward a multinational command structure at the tactical level (starting with Corps) could facilitate tactical ground C^3 planning and development.

A shift to a multinational command structure can be a gradual, evolutionary one. A starting point would be to extend partially NATO control over national forces in peacetime. According to Bowman:

> It should be possible to give NATO commanders some carefully limited peacetime command and control functions over all units they would command in war. This would provide daily exercise and improvement of command and control capabilities.[77]

Likewise, those commanders who wear two hats -- one as a peacetime national commander and the other as a wartime NATO commander -- could be required to spend more time preparing for their wartime roles. Too often such preparation is limited to annual NATO exercises.[78] Once commanders find themselves working more and more closely with their allied counterparts, a more complete changeover to a multinational command would most likely be seen as a natural, logical next step.

The whole idea of moving in the direction of a multinational tactical command structure is to place commanders of different nations in an environment that would facilitate the direct exchange of ideas (in contrast to the vehicle of Allied Publications) and, hopefully, eventually result in shared perspectives and the development of a common mind set -- in sum, a common doctrine. After all, the exchange of liaison parties, which seems to be the preferred method of addressing interoperability problems within the Alliance, is in essence nothing more than the formation of multinational staffs on a temporary basis. The notion of multinational

tactical commands only seeks to make such productive relationships permanent. This concept of a multinational tactical command structure has been implemented with great success in NATO's Northern Army Group, where a multinational corps, Allied Forces Schleswig-Holstein and Jutland (LANDJUT), was created in 1962.[79] The LANDJUT command headquarters is truly multinational and includes officers from Germany, Denmark, Canada, the United Kingdom, and the United States. W. Gerhardt has described the success of the LANDJUT concept:

> While other commands still question the word
> "interoperability," we in the LANDJUT area have
> practiced it for years and not only in the
> headquarters, but all the way down to the brigade and
> sometimes right down to the company.[80]

Thus the LANDJUT experience indicates that a move to a multinational command structure can greatly enhance interoperability, foster closer cooperation and, through joint training, gradually develop the common procedures and doctrine required to fight effectively a coalition war.[81] Further, as new generations of commanders are trained in the multinational command environment, the tendency toward doctrinal convergence would most likely be accentuated.

CONCLUSIONS

In relation to tactical ground c^3, a convergence of doctrine would most likely be reflected in a convergence of functional military requirement specifications for tactical ground c^3 systems. Given the force of these requirements as determinants of tactical c^3 planning and systems development, one could expect to see movement toward development of a common tactical ground c^3 system or, at least, a series of systems that are

not only technically interoperable, but also functionally interoperable. Such optimistic expectations, however, should be tempered by the realization that the disruptive influences of national particularism will inevitably make their presence felt.

A transition to a multinational command structure and a consequential convergence of doctrine and perceptions could also have a salutary effect in the area of NATO tactical C^3 management. Such developments would certainly accelerate the current trend toward a controlled insular/interface management approach in NATO tactical C^3 planning. The hope for a management authority to coordinate interoperability efforts could become a reality. Furthermore, the establishment of multinational tactical commands would make possible a downward extension of the NICS concept, and possibly the NICS program itself, to the tactical level. Theoretically, therefore, NICSMA could become the management authority for all NATO C^3 systems.

Upon closer examination, the notion of extending the NICS program to the tactical level, although desirable in theory, seems questionable. Total systems management of the entire NATO C^3 system would be an undertaking of such magnitude that NICSMA would quickly become overloaded.[82] On the other hand, as Baroni has stated, "The concept applied for the NICS should be seen and considered as material development and expansion for tactical systems."[83] In other words, the NICS management approach could be adopted for tactical ground C^3 alone. This would give tactical C^3 planning the total systems approach that it must have to address the long-term goal of tactical ground C^3 functional interoperability, which has been grossly neglected in the quest for tactical C^3 technical interoperability. This is not to say that the ongoing drive for interoperability should be abandoned. On the contrary, in accordance with

the NICS management model described earlier, technical interoperability would continue to be pursued, under a controlled insular approach, as a short-term, temporary goal that would yield a technically interoperable baseline system upon which to build a functionally integrated tactical ground C^3 system.

Nevertheless, a total systems approach to tactical ground C^3 planning could encounter some of the same difficulties experienced by NICSMA. In addition to the aforementioned problem of possibly overloading the management system, there is the potential problem presented by long development times. Although the total systems approach has the advantage of optimizing the entire tactical ground C^3 sector of NATO communications, the need for centralized, detailed analysis could delay development so long that the final system is obsolete before it is deployed.[84] Likewise, long development times could cause the tactical C^3 system program to be disrupted by the turnover of key personnel, the introduction of new technologies, or changes in system requirements.

As already noted, effective tactical ground C^3 demands optimal information flow and thus cannot be achieved through pursuit of mere technical interoperability. The concept of "rationalization" is too vague and ambiguous to serve as a goal in tactical C^3 planning. Instead, functional interoperability of all tactical ground C^3 systems at all levels throughout the Alliance should be the object of NATO tactical C^3 efforts. This goal must be met if NATO is to increase the effectiveness of its forces in order to counter the Soviet/Warsaw Pact threat. Simply because functional interoperability of tactical ground C^3 is such an important long-term goal, it deserves immediate attention. Technical interoperability should continue to receive emphasis, but only with the understanding

that it is a limited, short-term goal -- a first step toward functional
interoperability.

There are obviously no quick solutions to NATO's tactical C^3 problems.
The divisive forces of national particularism, especially the pressures of
domestic economic realities, can be expected to continue to drive national
tactical ground C^3 systems down different paths. NATO can do little
directly to affect this trend, other than offer economic incentives to
cooperative development and joint production -- an unlikely eventuality
given NATO's already strained resources and the politico-military nature of
the Alliance. However, the situation should not be written off as
hopeless. NATO can do something to counter the disruptive effects of
national particularism by broadening and redirecting the type of thinking,
the perceptual consensus that has made technical interoperability the
priority goal of NATO tactical ground C^3 efforts. Military thinking --
doctrine -- must focus on overall functional interoperability of tactical
ground C^3, not simple technical interoperability, as the overriding goal of
NATO tactical ground C^3 planning and development.

Influencing and redirecting thought is a gradual, evolutionary and
difficult process, and that is why it is absolutely essential that the
process begin now. Meanwhile, efforts at achieving interoperability will
most likely continue to be managed in ad hoc fashion. Existing methods of
interface management/attaining interoperability -- STANAGs, liaison
arrangements, "black boxes" -- should be exploited to their fullest,
keeping the establishment of a baseline tactical ground C^3 system as their
ultimate goal. Concurrently, NATO should work toward standardization of
tactical doctrine. STANAGs and Allied Publications are useful in this
regard and should continue to be pursued. However, NATO could also move

toward a multinational tactical command structure that would encourage a convergence of tactical doctrine and, in turn, perceptions of functional military requirements for tactical ground C^3 systems which drive the tactical ground C^3 planning and development process. Likewise, such developments would make possible a unification of the tactical C^3 management structure with the constitution of a centralized management authority, similar to NICSMA, that would guide two parallel tactical ground C^3 efforts: the short-term quest for technical interoperability and the long-term drive for functional interoperability.

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