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A requirements measurement method of organizational units strategic projection

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ABSTRACT

Requirements measurement of organizational units' strategic projection is graveness but again huge task. Currently, the methods of requirements measurement of strategic projection lack standardization and unification. The paper introduces a method for measuring requirements of strategic projection. Firstly, a framework of it is shown how to work. Then, the task model and the requirement model, which are the two parts of task-requirement match method, are respectively analyzed and built. A case study of train requirement measurement, including requisite trains for personnel and equipments, is finally given to demonstrate the applicability of the method. The method will provide design reference to research of scheme, capability evaluation, technique& equipment and standard of organizational units' strategic projection. And also, it will provide decision-making consultation to the capability construction of organizational units' strategic projection.

KEYWORDS

Strategic projection; Transportation; Requirement measurement; Model.

INTRODUCTION

With the accelerated pace of combat and operation space expansion, strategic projection increasingly become spread all over the troops disposition, rapid mobility, to defeat the enemy and achieve key strategic intent[1,2]. To improve the PLA core military capabilities, we must attach great importance to the building of strategic projection capability, in addition to strengthen capability of information perception and precision strike. Scientific and reasonable measure to the strategic projection requirement, especially from a quantitative point of view to reveal the number of relationships between organizational units fighting forces and their projection needs is an important foundation for the development and improvement of strategic projection scheme. It is the core preparation for prewar contingency operations quickly, but also a reference to strengthen the building of strategic projection capability[3]. The organizational units' requirements measurement of strategic projection (RMSP) means that, based on certain strategic projection task token by forces, to achieve delivery support capability goals, a series of requirement to the transport capacity are proposed. The basic connotation includes two aspects: First, to ensure the completion of the projection task to determine the species of demand delivery tools, namely "What do I need" question; Second, to figure out the number of each specific demand delivery tools, namely "how much" question. Currently, research on methods of calculation of total transport demand are not too much, more complex, lacks theoretical and systematic[4, 5]. To make the RMSP be estimated very accurately especially wartime transportation security needs is a rather difficult project.

This paper presents a strategic projection task-requirement matching calculation method, establishing strategic projection tasks model and requirements model, through the task-requirement estimation algorithm derived RMSP, including various ways of transportation. The RMSP will provide design reference to research of scheme, capability evaluation, technique& equipment and standard of organizational units' strategic projection. And also, it will provide decision-making consultation to the capability construction of organizational units' strategic projection.

MATERIALS AND METHODOLOGY

Framework of rmsp method

Measurement here contains two meanings: First, under the existing conditions of transportation capabilities to maximize the strategic needs that can support the delivery tasks; second, under the strategic projection of targeted tasks and situations, in order to achieve this goal may be beyond the capacity of existing transport security; the future demand of security ability needs to calculate on. Therefore, the RMSP of organizational units is closely related to strategic projection tasks and existing transportation security capacity. So organizational units' strategic projection requirements measurement models are established by connecting projection tasks with security demand.

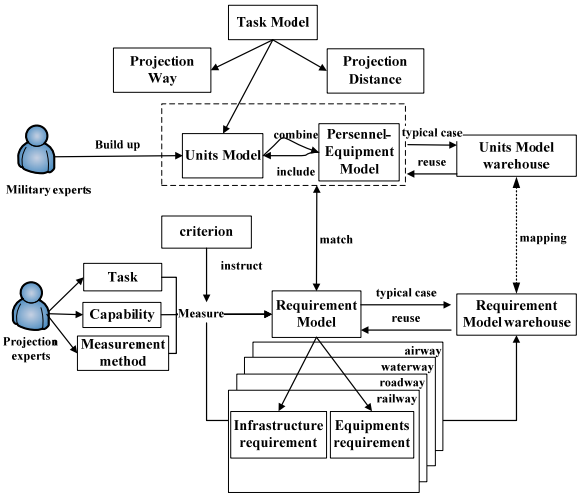

Figure 1 : Task-requirement measure framework

The RMSP is to establish the mapping between strategic projection tasks model and requirements model, shown in Figure 1, gives the organizational units' strategic projection requirement measurement framework.

According to strategic projection task, military domain experts analyze the whole force components, which are mainly equipments, including the type and quantity of equipment. In the decomposition process, we can directly reuse existing models in the organizational units *Unit* warehouse. If the library does not, then all of the equipment information of a regiment that is the basic unit is filled in the Table 1. Eventually, a projection task list $\{task_i = (unit_i, way_i, time_i, start_i, end_i)\}$ is formed, which units model is $unit_i = \{(name_j, size_j, weigh_t, number_j, [guard])\}$. Task List clearly shows that delivery personnel and equipment in detail the situation from $start_i$ area to end_i by manner way_i.

TABLE 1 : Equipment model data sheet

Name	(kind, type)	Size	(length \ width \ height, unit: mm)
Weight	(unit: ton)	Number	
Projection Platform	(kinds, types of transport tool)	Platform Requirements	(transportation requirements of single equipment)
Reinforcement Requirements	(standard reinforcement device, etc.)	Other Conditions	(oversize, hoisting, cross-load, ban humping etc.)

According to the task list formed above and the actual ability of the loading area, projection experts use appropriate calculation methods to measure security requirement, referring to the relevant security, loading/unloading, etc. standards of Military Transportation. For a typical organizational unit, such as armored regiment, artillery regiment, etc., can refer to an existing *Requirement* model library, which direct reuse. If the library does not, according to the principles of demand measure, we can calculate the task requirement gradually with comprehensive after the first decompose and bottom-up method. The following: $requirement_i = \{way_i, infrastructure_i, requipment_i\}$, as shown in the sec3. After experts to examine and confirmation, $requirement_i$ can be added to the *Requirement* model library for reuse. After the list of tasks through all delivery tasks traverse calculations, eventually forming projection support requirements list, which give a detailed list of requirements to complete the delivery mission $task_i$.

Tasks model of organizational units

Before the RMSP, the projection support task has been divided into several ones by delivery ways. That is, we know exactly the traffic volume of each mode of transport, including railway, highway, waterway & airway. Each mode of transport based on the delivery of support tasks undertaken by the amount, or the ability to measure the number of required support conditions. Therefore, we must first establish task models of strategic projection [6-8].

Strategic projection is usually described as organizational units will be transported to certain destination from somewhere by which certain delivery time and in certain ways. For example, Communications Regiment of XX Army (total L people, M equips) will be transported by rail from Henan to the somewhere in N days (about X km away). So, we establish strategic projection task model as follows:

Task :: = (*Unit*, Way, *Time*, *Start*, *End*), where:

Unit represents a finite set of projection troops, usually expressed as the number of personnel and equipments. Personnel *Persons* :: = (*Level*, *Number*, *SubNumber*), which *Level*, *Number*, *SubNumber* respectively represent level of units, the number of staff directly under and the number of staff subordinate to forces. The equipments here refer to all the hardware material except personnel, including a variety of tanks, artillery, guns, vehicles and other military equipments, as well as fuel, ammunition, et.al supplies. Equipments can be expressed as *UEquipment* :: = (*Name*, *Size*, *Weight*, *Number*, [*Guard*]), in which the *Name*, *Size*, *Weight*, *Number* denote the name, size, weight and quantity of the equipment, *Guard* said constraints conditions when loading equipment;

Way said that the use of delivery ways, including railway, highway, waterway, and airway four kinds;

Time represents time of delivery, generally denoted by date or time;

Start represents the starting location delivery;

End represents delivery destination, by starting and ending location delivery can calculate the delivery distance.

For RMSP, core of strategic projection tasks model is to build the units model. According to the strategic projection task and actual establishment of armed force, firstly strategic projection typical units of the model library *Unit* are established. Strategic projection of troops generally refers to the regiment level and above, and a regiment troop generally is in the same place. So the regiment model is the smallest group in library *Unit*. Figure 2 shows the Group Army model described in UML class diagram, in which the regiment level as the basic unit of troops, including a number of personnel and equipments. And equipments further are subdivided into different equipment model trees by different types of troops, until tree leaves are some specific types of equipment.

The needs measurement of staff is relatively simple, but the needs measurement of the equipment is more important and difficult. With the model data shown in Table 1, we can establish an equipment model library of typical armed forces, such as mechanized infantry group, artillery regiment, armored regiment, etc. Depending on the type, size, weight, quantity, and delivery constraints of an equipment parameters, choose different equipment performance parameters at different delivery ways to measure the support requirements of the respective ways.

On the basis of personnel and equipment model library, then tasks model library of strategic projection is built.

Requirements model of transportation

As Mentioned earlier, now we should answer the first question "What do I need". In order to better describe the condition of protection or capacity needed, a triple model of strategic projection needs is proposed, expressed as follows:

Requirement :: = (Way, Infrastructure, REquipment), where:

Way said that the use of delivery ways, including railway, highway, waterway, and airway;

Infrastructure represents a finite set of required delivery infrastructure, depending on the delivery ways, the required type and quantity of infrastructure will be different. For example, railway transport facilities including military dedicated lines, top platform, etc. We describe it as *Infrastructure* :: = (*Name*, *Type*, *Number*), in which the *Name*, *Type*, *Number* denote the name, the type and quantity of facilities;

REquipment represents a finite set of equipment necessary for the transport, depending on the delivery ways, the type and quantity of equipment needed is different. For example, railway transportation equipments, including passenger trains, flat cars, etc. It can be expressed as *REquipment* :: = (*Name*, *Type*, *Number*), in which the *Name*, *Type*, *Number* denote the name, the type and quantity of support facilities. There is a certain relationship between the facilities and equipments.

Figure 3 shows requirement architecture diagram of support equipments and facilities of organizational units' strategic projection, the requirement models of *Infrastructure* and *Requipment* are based on tree leaves in the chart, and are the main measure data also. Due to the train station, airport or port restricted areas or conditions, the strategic projection facilities and transport equipments are fixed and there is limited support capacity. Therefore, the support requirement models of strategic projection *Infrastructure* and *Requipment* are finite sets. By comparing protection needs with the actual support capabilities, we can get the actual projection capability gaps, thus providing the basis and reference for the next support capability building.

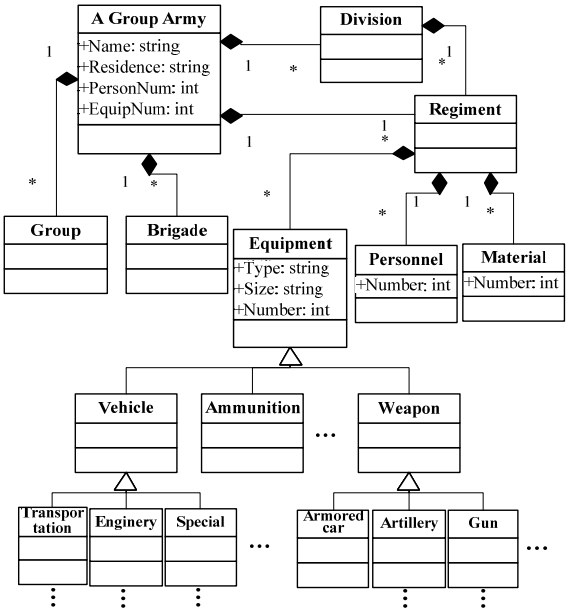

Figure 2 : Unit Model of Group Army

Measure of strategic projection task-requirement

As shown in Figure 3, the various elements of four transport ways are so many and complexity. And also each demand measure when the equipment performance parameters are not the same. So we take the railway train requirement for example, and describe the requirement measure models according to the task – requirement measure methods. According delivery objects, requirements measure of railway trains includes personnel demand measure and equipments demand measure.

Measure train requirement for personnel

There are four kinds of railway train for transport people, including soft sleeper carriage RW, hard sleeper carriage YW, hard seat carriage YZ and substitution passenger carriage DK. The kind and the number of train requirement for personnel are measured by the flow chart shown in Figure 4. According to the established tasks model, traversing personnel models in the *Unit* model, the number of different kinds of train is calculated in accordance with the different criteria by judging the *Level*. For example, the number of the Group Army headquarters and directly under it is $Number_i$, the soft sleeper carriage is needed and the required number of carriage is calculated as: $NRw_i = Number_i$ / fixed number of carriage. The number of Subordinate units is $SubNumber_i$, which is subdivided into Divisions, Brigades, or Regiments, also composed of the same level and sub-level persons with a nested loop. Calculating the number of the needs of various models by top-down decomposition, then collect and summarize total number from the bottom to up. After traversing the organizational units all, we can get the number of railway train delivery requirements for people.

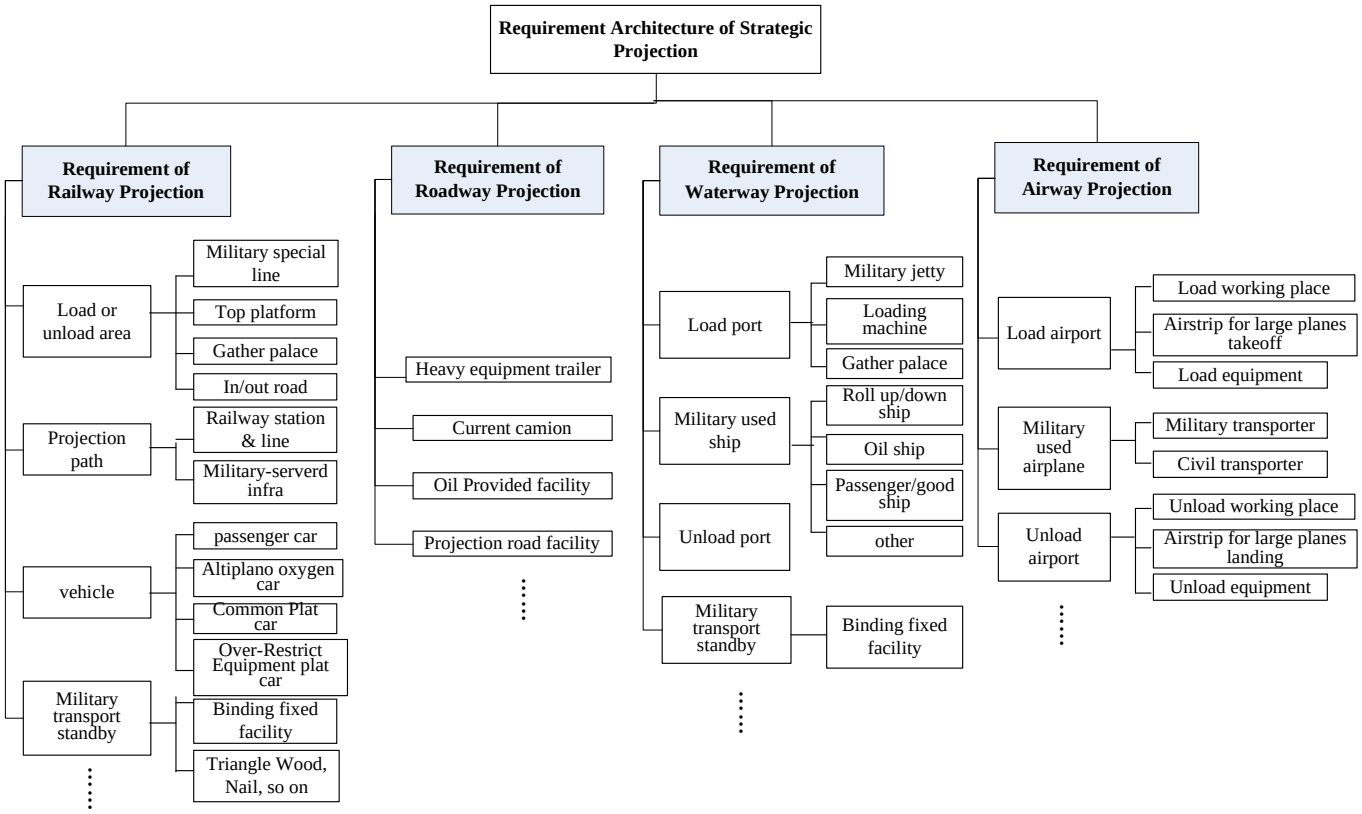

Figure 3 : Requirement architecture of support equipments and facilities

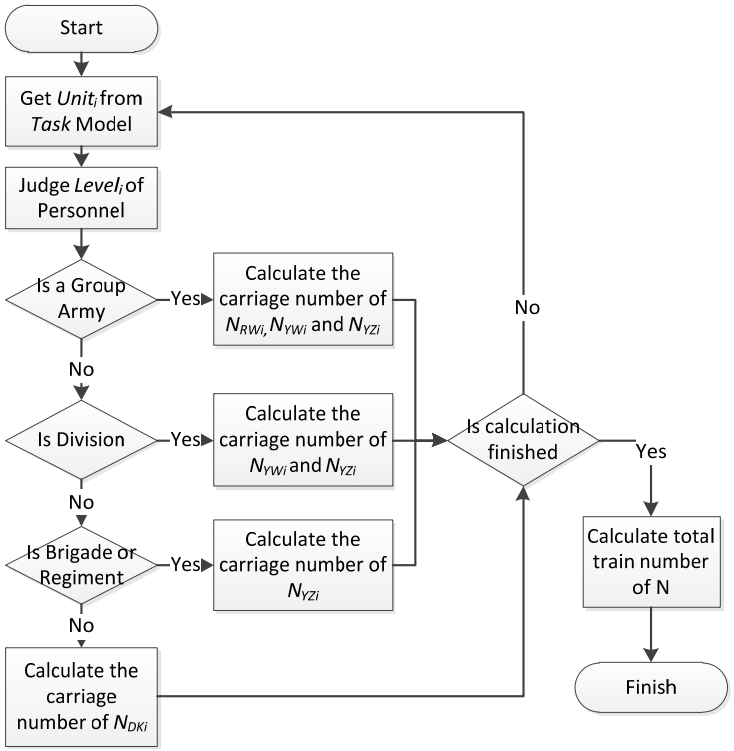

Figure 4 : Flowchart of train requirement measure for personnel

From the flow chart and analysis, we can get the train needs measure model for personnel, as follows:

$$N = \min(N_{RW} + N_{YW} + N_{YZ} + N_{DK})$$

$$st.\begin{cases} N_{RW} = \sum_{i=1}^{n} N_{RWi} \\ N_{YW} = \sum_{i=1}^{n} N_{YWi} \\ N_{YZ} = \sum_{i=1}^{n} N_{YZi} \\ N_{DK} = \sum_{i=1}^{n} N_{DKi} \\ P = \sum_{i}^{n} P_i \\ P_i \le A \bullet N_{RWi} + B \bullet N_{YWi} + C \bullet N_{YZi} + D \bullet N_{DKi} \end{cases} \quad (1)$$

In the formula (1) where:
N represents the total number of carriages for people delivery needs;
N_{RW}, N_{YW}, N_{YZ}, N_{DK}, respectively, the total number of required delivery soft sleeper carriage, hard sleeper carriage, hard seat carriage and substitution passenger carriage;
N_{RWi}, N_{YWi}, N_{YZi}, N_{Dki} denote the number of soft sleeper carriage, hard sleeper carriage, hard seat carriage and substitution passenger carriage that Regiment i needs;
P represents the total number of a unit;
P_i represents the number of Regiment i;
A, B, C, D, respectively, represents the fixed number of members in soft sleeper carriage, hard sleeper carriage, hard seat carriage and substitution passenger carriage.
According to criteria, under normal conditions, $A = 20$, $B = 40$, $C = 70$, $D = 40$. So an army headquarters usually needs two soft sleep carriages and four hard sleep carriages. A division needs $B = 2$, $C = 2$, and others. The relationship between these forces and support resources can be placed as a typical model to the library. And they can be used to actual requirement measure as a reference later. However, there are special circumstances recalculated using the above model.

Measure train requirement for equipments

Flat car or boxcar is usually used to delivery equipments in the railway. The main factors considered in loading equipments include the length, width and weight. Considering the dimensions of military equipments and the performance of cars, load of cars can meet the weight requirement of equipments. Width of equipments is mostly in the range of train boundary, part of the excess load is delivered through over-boundary transportation. So the most important factor affecting train demand is the length of equipments[9].

The flow chart shown in Figure 5 gives a measure process of wagons needs for equipments support. According to decompose troops and equipments to get all the equipment data sheets as shown in Table 1, traversing all the equipment data, we can calculate the cumulative number of the wagons requirement for delivering equipments of the unit.

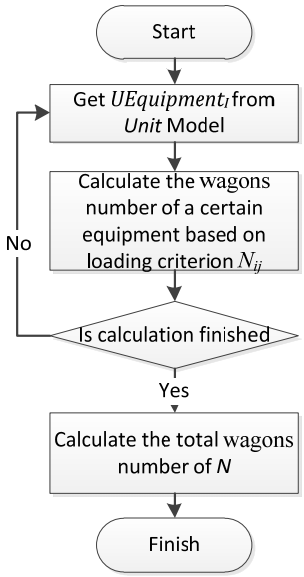

Figure 5 : Flowchart of train requirement measure for equipment

From the flow chart and analysis, we can get the wagons needs measure model for equipment, as follows:

$$N = \min(\sum_{i=1}^{n}\sum_{j=1}^{m} N_{ij} M_{ij})$$

$$st.\begin{cases} Len(E_{ij}) \le N_{ij} \bullet L \\ \min(L - \sum Len(E_{ij})) \\ \sum Wt(E_{ij}) \le W \\ \min(N \bullet L - \sum_{i=1}^{n}\sum_{j=1}^{m} Len(E_{ij})) \end{cases} \quad \textbf{(2)}$$

In the formula (2), where:
N indicates that the total number of flat car needed in projection;
N_{ij} represents the number of flatcar needed to deliver the kind of equipment j of Regiment i;
M_{ij} indicates the number of the kind of equipment j of Regiment i;
E_{ij} represents equipment j of Regiment i;
$Len\ (E_{ij})_j$ denotes the length of the equipment j;
L represents the length of flat cars;
$Wt\ (E_{ij})_j$ represents the weight of the equipment j;
W represents load of flat car.

RESULTS

According to the measure process and calculation model, the equipment support needs of typical units can be calculated, as shown in Table 2. They would then be added to the model library after experts have checked and confirmed.

TABLE 2: Railway requirements reference for equipments of partial typical troops

Units	Type & Number of vehicles						
	YW	YZ	DK	P	N	No. of Carriages	No. of Trains
directly under Group Army	4	4	38	2	152	200	6
Infantry Division	2	9	307	22	989	1329	35
Artillery Brigade	1	1	39	6	190	237	7
Communications Regiment	1	1	13	2	49	66	2

From the projection tasks, we know the starting station $Start_i$ should support the delivery. If the needs calculated by the above calculation model are out of $Start_i$ ability limit, then we should do as follows:
1. If it takes some time, we can transport in batches and cycle;
2. Or by way of change or share other transport ways, to complete the projection task.

CONCLUSION

To accelerate capacity-building of our military strategy projection, we should plan scientifically and design in top level, but scientific requirement measure of strategic projection is the basic precondition. The paper firstly analyzes our tasks of organized units strategic projection and support requirements architecture. Then a matching method of task-requirement is proposed and requirement measurement models of strategic projection are also established. Lastly, taking railway transport for example, the measure model of train projection support needs is given to analyze capabilities and support requirements bottlenecks of strategic projection. So we can optimize the allocation of resources to support strategic projection, and provide a theoretical basis for capacity-building and decision-making guidance to strengthen our military strategy capability.

CONFLICT OF INTEREST

This article content has no conflict of interest.

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