

Peer reviewed article

Guidance for the application of a dynamic purchasing portfolio model for defence procurement – A Swedish perspective

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Abstract

Purpose: The purpose of this paper is to develop guidance, including tactical levers, for the application of a dynamic purchasing portfolio model (PPM) for defence procurement.

Design/methodology/approach: The study uses a workshop and a literature review to identify suitable tactical levers for the application of a dynamic PPM for defence procurement. Based on application rules proposed in previous research (Ekström et al., 2021), the study then formulates guidance for application and validates the methodology in two desktop exercises.

Findings: The study identifies tactical levers and proposes guidance for the application of a dynamic PPM for defence procurement.

Research limitations/implications: The proposed guidance includes tactical levers, which will enable defence authorities to dynamically reposition in the segmentation model proposed by Ekström et al. (2021) and find an enhanced position to optimise. The presented results build on a study in the Swedish defence context. To determine generalisability, additional studies are required.

Originality/value: The paper develops guidance, including tactical levers, for the application of a dynamic PPM for defence procurement, which is original in several aspects. The guidance addresses public procurement, which is a novelty. In contrast to most extant PPMs, the model is dynamic, which enables practitioners to reposition in the model.

Keywords: Purchasing portfolio model, tactical levers, guidance for application, defence procurement, military logistics.

Paper type: Research paper.

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1. INTRODUCTION

The caution that "one size does not fit all" (Shewchuk, 1998) is now so recurrent in the supply chain management (SCM) literature that it has passed the status of postulate. It is progressively established in supply chain design (SCD) and supply chain strategy (SCS) development as a premise, which has implications for sourcing, operations and distribution (Christopher, Peck and Towill, 2006; Hilletofth, 2009). There is a similar premise in the purchasing and supply management (PSM) literature, regarding purchasing portfolio models (PPMs), where "formulating a single overall strategy for the purchasing function is a difficult task", and a varied set of strategies and tactics may be required (Hesping and Schiele, 2015). In both PSM and SCM, researchers frequently address these premises through segmentation and differentiation. In their seminal contributions, Kraljic (1983) and Fisher (1997) introduce segmentation and differentiation into PSM and SCM, respectively, using two-by-two-matrices, or typologies. These seminal contributions have since their inception been modified, extended and contested. In PSM, authors such as Olsen and Ellram (1997), Bensaou (1999), van Weele (2006), Drake, Lee and Hussain (2013) and Rezaei, Wang and Tavasszy (2015) modify and extend Kraljic's PPM. In SCM, authors such as Naylor, Naim and Berry (1999), Mason-Jones, Naylor and Towill (2000), Lee (2002), Christopher et al. (2006) and Vonderembsea, Uppalb, Huangc and Dismukes (2006) modify and extend Fisher's strategy typology.

Two-by-two-matrices have been criticised in both the PSM and SCM literature. In PSM, authors criticise Kraljic's PPM and its derivations for being too simplistic (Dubois and Pedersen, 2002; Hesping and Schiele, 2015, 2016; Lovell, Saw and Stimson, 2005; Rezaei et al., 2015). Similarly, in SCM, authors criticise SCS typologies for being too simplistic (Basnet and Seuring, 2016; Godsell, Harrison, Emberson and Storey, 2006; Hilletofth, 2012). As a response to the critique, researchers have proposed alternative approaches. In PSM, authors such as Cox (2015) develop significantly more complex models and methodologies. In SCM, authors such as Sharman (1984) and Yang, Burns and Backhouse (2004) develop strategy continuums, based on customer order decoupling point (CODP) positioning.

To avoid sub-optimisation in the supply chain (SC), Christopher et al. (2006) request holistic SCM, in which companies' overarching objectives drive supplier selection, facility localisation and distribution decisions. This presupposes an all-embracing perspective, including both inbound and outbound logistics. However, with Drake et al. (2013) as a noteworthy exception, few authors merge contributions from PSM and SCM into a holistic SCM approach in response to the cautions by Shewchuk (1998), Christopher et al. (2006) and Hesping and Schiele (2015). Consequently, extant segmentation models and differentiation strategies predominantly address part of a SC, from a buyer's or a supplier's perspective, at the risk of sub-optimisation. PPMs that are more comprehensive are required (Rezaei and Ortt, 2012) and a combination of commercial and operational analyses is a step in this direction (Cox, 2015). Ekström, Hilletofth and Skoglund (2021) summarise the academic debate on PPMs in the PSM literature and identify open design and application issues. Building on a Delphi study in the Swedish defence context, Ekström et al. (2021) also establish design and application rules in the public defence context, and propose a two-stage segmentation model for defence

procurement. Ekström, Hilletofth and Skoglund (2020) summarise the academic debate on differentiation strategies in the SCM literature and propose eight SCSs that are acceptable, applicable and sufficient in defence SCD.

Building on Gelderman (2003, p. 21), Ekström et al. (2021) define a PPM as a tool that combines two or more dimensions into a set of heterogeneous segments and recommends different tactics and strategies for these segments. Accordingly, a PPM consists of a segmentation model, tactical levers, differentiation strategies and guidance for application of the model. While authors have developed several segmentation models and differentiation strategies (Hilletofth, 2009), comprehensive methodologies for complete PPMs are less frequent in the literature. Existing complete PPMs, including Kraljic (1983), Olsen and Ellram (1997) and Svensson (2004), focus on companies in the private sector. In contrast to the private sector, the public sector is not profit-maximising (Wilhite, Burns, Patnayakuni and Tseng, 2014) and defence authorities must achieve operational outcomes, not financial outcomes (Yoho, Rietjens and Tatham, 2013). Researchers have yet to understand the consequences of operational outcomes for SCD and Melnyk, Narasimhan and DeCampos (2014) call for more research to identify the unique SCD issues in military/defence.

In line with a methodology proposed by Hilletofth (2012), Ekström et al. (2020, 2021) take the first steps towards a PPM for defence procurement and propose a segmentation model and differentiation strategies suitable for defence SCD. Ekström et al. (2021) suggest that the application of a PPM for defence procurement should be dynamic, which requires dynamic tactical levers. However, extant PPMs are predominantly static (Persson and Håkansson, 2007), with static tactical levers, and researchers rarely address dynamic tactical levers in the literature (Cox, 2015). To propose a complete PPM for defence procurement, researchers have yet to develop dynamic tactical levers and guidance for application. This paper addresses these gaps in the literature. The purpose is to develop guidance, including tactical levers, for the application of a dynamic PPM for defence procurement. This paper operationalises the purpose through two research questions:

> RQ1: Which tactical levers are suitable for repositioning in a dynamic PPM for defence procurement?
>
> RQ2: Which guidance for application is required in a PPM for defence procurement to ensure practical relevance?

This paper takes the final steps towards a complete PPM for defence procurement. It contributes to PSM, SCM and military logistics theory and practise as follows. First, based on a workshop, open-discussion desktop exercises and the combination of contributions from the PSM and SCM literature, it proposes a set of tactical levers, which will be useful in defence procurement practise. Second, it proposes a dynamic methodology that will assist procurement managers to select appropriate SCSs based on operational requirements, the market's ability to deliver supplies on time and the limitations in the Armed Forces operational capability if the market does not deliver supplies on time. Third, it provides defence authorities and defence industry with an instrument that will enable holistic SCM and thus be

useful for defence SCD that aspires to begin with the customer's requirements and move backwards, in line with the suggestion by Christopher et al. (2006).

The paper is organised as follows. In the next section, it reviews the related literature on PPMs, segmentation models and differentiation strategies. Thereafter, it presents the research methodology. Next, it presents and discusses the results of the study. Finally, it explicates theoretical contributions, practical implications and limitations and proposes further research.

2. LITERATURE REVIEW

2.1 Purchasing portfolio models

PPMs trace their origins to the portfolio models introduced in finance by Markowitz (1952). This pioneering portfolio theory for the management of equity investments has since been influential for applications in other fields and disciplines (Turnbull, 1990). Kraljic (1983) took PPMs into PSM with the purchasing portfolio matrix. Since then, a key focus in the purchasing literature has been on finding ways to classify purchases to assist buyers manage portfolios (Terpend, Krause and Dooley, 2011) and scholars have proposed a number of models as guidance (Hilletofth, 2012). Prior to PPMs, ABC analysis (or Pareto analysis) was the only tool for differentiating between important and less important purchases (Gelderman and van Weele, 2005). The advent of the PPM thus presented the purchasing community with a powerful alternative. Researchers and practitioners frequently describe PPMs as appreciated instruments for developing differentiated purchasing and supplier strategies (Gelderman and van Weele, 2005).

By the definition employed in this paper, a PPM consists of a segmentation model, differentiation strategies and guidance for application. Based on this definition, most contributions in the PSM and SCM literature are segmentation models, differentiation strategies or a combination, whereas few contributions are complete PPMs (Luzzini, Caniato, Ronchi, Spina and Sousa, 2012). In the latter category, Kraljic (1983) proposes a complete methodology in four phases, classification, market analysis, strategic positioning and action plans. Olsen and Ellram (1997) propose a similar three-step approach, analysis of the company's purchases, analyse the supplier relationships and develop action plans. Svensson (2004) proposes a managerial process in four phases, analysis of business environment, analysis of relationship criteria, selection of relationship strategy and managerial decision of relationship strategy. Based on severe critique of extant models, regarding rigour, robustness and application, Cox (2015) advocate a more complex, dynamic approach, the sourcing portfolio analysis (SPA). In SPA, the methodology includes criticality analysis, static power positioning and sourcing strategies, dynamic power positioning and sourcing strategies.

2.2 Segmentation models

There is a longstanding academic debate on the topics of segmentation model design and application. Regarding design, traditional models have been criticised for having only two dimensions (Dubois and Pedersen, 2002; Hesping and Schiele,

2016; Lovell et al., 2005; Rezaei et al., 2015) selection of dimensions (Nellore and Söderquist, 2000) and for values of dimensions (Gelderman and van Weele, 2005; Olsen and Ellram, 1997; Ramsay, 1996). Regarding application, researchers have discussed if segmentation models should be prescriptive, or serve as catalysts for discussions among stakeholders (Gelderman and van Weele, 2003; Jarzabkowski and Kaplan, 2008) and if they should have segment-generic or purchase-specific strategies (Hesping and Schiele, 2015). The discussion also include strict or pragmatic application (Gelderman and van Weele, 2003; Hesping and Schiele, 2015) and static or dynamic application (Cox, 2015; Hesping and Schiele, 2015; Persson and Håkansson, 2007).

In a study in the Swedish defence context, Ekström et al. (2021) investigate practitioners' perspectives on these open design and application issues, establish suitable design and application rules and propose a two-stage segmentation model for defence procurement, which satisfies the operational requirements (Figure 1). The two-stage segmentation model builds on three dimensions and consists of a precursor and a two-dimensional model. To reduce complexity, the two-dimensional model merges sixteen elements into four segments, routine, delivery risk, operational risk and strategic supplies, which users should treat differently (Ekström et al., 2021).

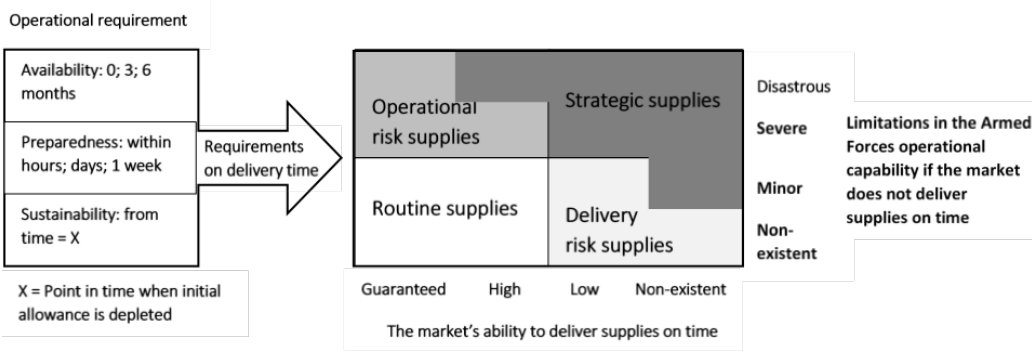

Figure 1: A two-stage segmentation model for defence procurement (Ekström et al., 2021).

Regarding application, Ekström et al. (2021) conclude that to satisfy the requirements of Swedish defence procurement practitioners, the two-stage segmentation model should be prescriptive for routine supplies and serve as a catalyst for discussions for all other segments, strategies should be segment-generic, whereas application should be pragmatic and dynamic. Of these application rules, dynamic application presents a particular challenge, since there are few detailed strategies and/or tactics identified in the literature to explain how practitioners can move to a more favourable position in a segmentation model (Cox, 2015). In addition, there are relatively few empirical investigations on which tactical levers that practitioners use for different segments (Hesping and Schiele, 2016).

2.3 Strategies and tactics

The concepts of strategy and tactics are central parts of PPMs, but there is no consensus in the literature regarding their application (Hesping and Schiele, 2016). Hesping and Schiele (2015) propose a hierarchical distinction, firm strategy, purchasing strategy (as one functional strategy), category strategy (for specific supply market), tactics (sourcing lever applied for specific category strategy) and supplier strategy (for specific supplier in a sourcing category). Using terminology from SCM, this paper discusses SCSs, which correspond to supplier strategies in the hierarchy proposed by Hesping and Schiele (2015). In addition, this paper discusses tactics in the context of static and dynamic leverage (Cox, 2015), which has overlap with tactics in the hierarchy, but which is not identical.

After segmentation, traditional, static PPMs, allow optimisation of a given purchasing situation, whereas empirical arguments support the idea of developing dynamic PPMs, which could offer improved situations to optimise (Persson and Håkansson, 2007). As a result, using extant models, managers frequently believe that they have accomplished their decision-making once they have performed the initial segmentation and are unaware of any repositioning possibilities (Cox, 2015). In contrast to traditional, static PPMs, dynamic tactical levers enables repositioning in the segmentation model in dynamic PPMs.

This paper equates tactics with dynamic and static tactical levers, corresponding to the first and second principle of leverage (Cox, 2015), which practitioners should apply immediately after the initial segmentation. Using dynamic tactical levers, practitioners can move to a more favourable segment in the model. The paper defines two types of dynamic tactical levers, reducing operational dependency and increasing market capability, which corresponds to moving down and left, respectively, in the two-dimensional model in Figure 1. The paper also defines one type of static tactical lever, risk analysis, which practitioners must perform when all opportunities for movement are exhausted.

When practitioners have exhausted all repositioning opportunities in the segmentation model, they must differentiate treatment by selecting a suitable SCS. A SC consists of all activities that manufacturers and distributors perform to create value, including purchasing, manufacturing and distribution (Chen and Paulraj, 2004; Hilletofth, 2009). SCs must service a wide range of products and markets and a recurrent caution is that "one size does not fit all" (Christopher et al., 2006; Lee, 2002; Lovell et al., 2005). A SCS specifies how a company enhances performance through competitive priorities, such as quality, flexibility, innovation, speed, time and dependability (Chen and Paulraj, 2004). SCSs must match the specific requirements of a product or a market (Christopher et al., 2006; Fisher, 1997; Melnyk et al., 2014) and customers' requirements (Godsell et al., 2006).

Researchers have proposed SCS typologies, such as efficient/responsive (Fisher, 1997), postponement/speculation (Pagh and Cooper, 1998) and lean/agile (Naylor et al., 1999), which others have criticised for being too simplistic (Basnet and Seuring, 2016; Godsell et al., 2006; Hilletofth, 2012). In another stream of research, authors such as Sharman (1984) and Yang et al. (2004) have suggested SCS continuums, using the customer order decoupling point (CODP) position as a demarcation between different SCSs.

In the Swedish defence context, Ekström et al. (2020) find that commercial SCD-constructs, such as contingency variables, competitive priorities and SCSs, are acceptable and applicable, but not sufficient, in defence. Ekström et al. (2020) propose a set of eight SCSs, which satisfy the Swedish defence authorities' operational requirements (Table 1).

Table 1: Supply chain strategies for defence supply chain design (Adopted from Ekström et al., 2020).

SCS	CODP-position	Push-pull boundary	Postponement-Speculation	Agile-leagile-lean	Customisation-standardisation
Engineer-to-order (ETO)	Before design	Engineering (pull-only)	Pure (full) postponement	Agile (responsive)	Pure customisation
Buy-to-order (BTO)	Before purchasing	Purchasing	Purchasing postponement	Leagile	Tailored customisation
Make-to-order (MTO)	Before manufacturing	Manufacturing	Manufacturing postponement	Leagile	Tailored customisation
Assemble-to-order (ATO)	Before assembly	Assembly	Assembly postponement	Leagile	Customised standardisation
Package-to-order (PTO)	Before packaging	Packaging	Packaging postponement	Leagile	Customised standardisation
Ship-to-order (STO)	Before distribution	Distribution	Logistics postponement	Leagile	Segmented standardisation
Make-to-stock (MTS)	After distribution	Storage (push-only)	Pure (full) speculation	Lean (efficient)	Pure standardisation
Procure-to-stock (PTS)	At customer	Prestorage	Pure (full) speculation	Lean (efficient)	Pure standardisation

The first seven SCSs in Table 1 use names from the literature, from a supplier's perspective. However, engineer-to-order (ETO), buy-to-order (BTO), make-to-order (MTO), assemble-to-order (ATO), package-to-order (PTO), ship-to-order (STO) and make-to-stock (MTS) work equally well from a buyer's perspective, since buyers can contract suppliers to differentiate SCSs to satisfy their requirements. ETO is applicable for capability development (CAPDEV), which involves development of new, technically advanced systems, but not for operational requirements.

Depending on lead-time, BTO, MTO, ATO, PTO, STO and MTS may be expedient to satisfy some operational requirements, but not all. The complementary SCS, Procure-to-stock (PTS), is applicable for all operational requirements and may be necessary to satisfy requirements on availability and preparedness and to ensure sustainability until industry commences delivering replacement supplies. However, in addition to costs for procurement, operations, maintenance, infrastructure, distribution and personnel, PTS involves risk-taking regarding depreciation and obsolescence and should be used restrictively.

Table 2: Operational requirements versus supply chain strategies (Ekström et al., 2020).

Operational requirements	Proposed supply chain strategies							
	ETO	BTO	MTO	ATO	PTO	STO	MTS	PTS
CAPDEV	Match	Match	Match	Match	Match	Match	Match	Match
Availability immediately	Mismatch	Mismatch	Mismatch	Mismatch	Potential match	Potential match	Potential match	Match
Availability within three months	Mismatch	Potential match	Potential match	Match	Match	Match	Match	Match
Availability within six months	Mismatch	Potential match	Potential match	Match	Match	Match	Match	Match
Preparedness (mobilisation within hours)	Mismatch	Mismatch	Mismatch	Mismatch	Potential match	Potential match	Potential match	Match
Preparedness (mobilisation within days)	Mismatch	Mismatch	Mismatch	Mismatch	Potential match	Potential match	Potential match	Match
Preparedness (mobilisation within one week)	Mismatch	Mismatch	Potential match	Potential match	Potential match	Potential match	Potential match	Match
Sustainability	Mismatch	Potential match	Potential match	Potential match	Match	Match	Match	Match

Table 2 matches CAPDEV and the Swedish Armed Forces (SwAF) operational requirements with the proposed SCSs. The lead-time from order to delivery for military-specific supplies ranges from hours to years, depending on supply class and SCS. When the SwAF require replacement supplies depends on consumption patterns, which depend on time, activity, chance, or a combination. Consequently, Table 2 is illustrative, not prescriptive. It is not a decision-making tool, but serves as an illustration of which SCS that may be applicable. Prior to any decisions, defence authorities must analyse the different supply classes and, in some cases, individual supply items, to determine applicable SCSs, for each operational requirement. For a specific supply item, a combination of SCSs will probably be required to satisfy all requirements. In addition to matches and mismatches, which are certainties, Table 2 includes potential matches, which are uncertainties. Potential matches illustrate that a certain combination of operational requirement and SCS may be a match, depending on lead-time and consumption pattern.

3. RESEARCH METHODOLOGY

Ekström et al. (2021) propose a two-stage segmentation model for defence procurement and Ekström et al. (2020) propose a set of differentiation strategies for defence SCD. Ekström et al. (2021) also provide a set of rules for the application of a PPM for defence procurement. According to these rules, the PPM should be prescriptive for routine supplies and serve as a catalyst for discussions for all other segments, strategies should be segment-generic, whereas application should be pragmatic and dynamic. Based on these contributions, this paper develops guidance for the application of a dynamic purchasing portfolio model for defence procurement, to complete a PPM for defence procurement.

The application rule "dynamic application", which includes analysis of repositioning opportunities in the segmentation model, requires elaboration. There are two directions in which to move to a more favourable position in the two-dimensional model, down and left, which corresponds to reducing operational dependency and increasing market capability. However, the application rules established by Ekström et al. (2021), offers no guidance regarding how to move in the model.

3.1 Workshop and literature review

As a first step, this study used a workshop, to review and extend the application rules established by Ekström et al. (2021). Of the fifteen workshop participants, seven represented the Swedish Armed Forces (SwAF), five the Swedish Defence Materiel Administration (FMV), one the Swedish Defence Research Agency (FOI) and two the Swedish Defence University (SEDU). The experts from the SwAF include the strategic, operational and tactical perspectives on military logistics. The experts from FMV represent the military, technical and commercial/legal perspectives on defence procurement. The researcher from FOI has long experience of research on logistics and procurement. The researchers from SEDU are officers, combining practical experience with a research perspective.

Using operational and commercial analysis, the workshop participants identified suitable dynamic tactical levers, which are different ways of moving in the segmentation model. The participants also identified appropriate static tactical levers, which are the remaining options when moving in the model is not possible. The study then conducted a literature review, to establish to what extent the literature can corroborate these findings and/or contribute with additional dynamic and static tactical levers.

3.2 Methodology development and testing

As the next step, the study combined the segmentation model and the application rules (Ekström et al., 2021) with the differentiation strategies (Ekström et al., 2020) and the identified tactical levers, to propose guidance for the application of a dynamic purchasing portfolio model for defence procurement. To test the resulting methodology, the study conducted two open-discussion, desktop exercises with two representatives of the SwAF and four from FMV.

The scenario involved the procurement of a particular, advanced type of ammunition. The study selected this ammunition since it represents current, complex defence procurement, with few suppliers and long lead-times, which means that the market's ability to satisfy all operational requirements is low or non-existent. In addition, the limitations in the Armed Forces operational capability if the market does not deliver on time is likely to be disastrous or severe. Consequently, users are likely to segment this advanced ammunition as strategic supplies, which is the segment that provides most challenges as well as opportunities for repositioning in the two-dimensional segmentation model.

During and after the first desktop exercise, the exercise participants evaluated the methodology in plenary, which resulted in minor revisions. No further revisions were required after the second desktop exercise. The researchers distributed the final methodology to twelve logistics and procurement experts in the SwAF and six procurement experts within FMV for evaluation and comments. There were no comments from the experts that necessitated any further revision.

4. RESEARCH RESULTS

4.1 Tactical levers

During the workshop, the operational analysis identified tactics 1a-e (Table 3) as potential dynamic tactical levers for reducing operational dependency. The commercial analysis identified tactics 2a-e (Table 3) as potential dynamic tactical levers for increasing market capabilities. Table 3 presents these tactics in the order in which the workshop participants discussed them during the workshop.

In cases when there are substitute supplies on the market, such as lower-grade commercial fuels, tactic 1a is a possibility. Tactic 1b is an option if there are two similar capabilities. If the actual capability is greater than the required, tactic 1c is an alternative. In some cases, it may be possible to modify the operational planning, to enable tactic 1d. When possible, armed forces strive for standardisation of, asan example, spare parts for different vehicles, which allows tactic 1e.

Occasionally, it is possible to find alternative suppliers, which permits tactic 2a. To contract suppliers to use buffer stocks of raw materials, sub-components, etc. and to position these stocks as close to the user as possible is an avenue that defence authorities can explore in tactic 2b. Tactic 2c involves contracting suppliers to decentralise production in order to reduce lead-times. Similarly, tactic 2d entails contracting suppliers to localise sourcing, storage and/or distribution. In tactic 2e, defence authorities can contract suppliers to increase production and/or distribution capacities.

When defence authorities have exhausted all opportunities to reduce operational dependency or increase market capabilities, it only remains to decide if the residual risk is acceptable, or not. In some cases, operational risk-taking, tactic 3a, may be motivated. When it is not, the only alternative left is tactic 3b, prestorage (procure-to-stock, PTS).

The ensuing literature review did not identify any corresponding tactics to tactics 1b-d, which is not surprising, since they have a distinctly military perspective. However, several authors discuss substitution and standardisation of

supplies, tactics 1a and 1e. As demonstrated in Table 3, the literature review also corroborated tactics 2a-e. Once topics for potential dynamic tactical levers were exhausted, the workshop participants identified tactics 3a-b as suitable static tactical levers. In line with Hesping and Schiele (2016), Table 3 refers to these static tactical levers as risk analysis.

Hesping and Schiele (2016) provide a comprehensive list of tactics that the literature on purchasing portfolio models recommend. However, with the exception of the tactics already suggested by the workshop participants, the literature review did not identify any further tactics that are suitable as dynamic tactical levers. Using terminology from the supply chain risk management (SCRM) literature, tactic 3a is risk acceptance and tactic 3b is risk avoidance. Similarly, tactics 1a-e and 2a-e are either risk avoidance or risk mitigation tactics.

Table 3: Tactics for dynamic and static leverage after initial segmentation.

Tactical levers	Tactics for dynamic and static leverage				
Dynamic	a	b	c	d	e
1. Reduce operational dependency	1a Identify substitute supplies[1]	1b Identify overlapping capabilities	1c Identify redundancy in capabilities	1d Modify operational planning	1e Standardisation of supplies[1,4]
2. Increase market capabilities	2a Supply base extension[1,2,3]	2b Inventory buffer stock[3,4] and position4	2c Decentralise production[4]	2d Localise sourcing[4], storage[3,4] and/or distribution[4]	2e Increase production capacities[3,4] and/or distribution capacities[4]
Static	a	b	c	d	e
3. Risk analysis[1]	3a Operational risk-taking[5]	3b Prestorage (Procure-to-stock, PTS)[5]			

[1] Hesping and Schiele (2016); [2] Cox (2015); [3] Basnet and Seuring (2016); [4] MacCarthy, Blome, Olhager, Srai and Zhao (2016); [5] Ekström et al. (2020)

4.2 Step 1: Selection of operational requirement to satisfy

Step 1 uses the precursor (Figure 1), which involves selection of which operational requirement that is to be satisfied. There are three types of requirements, availability, preparedness and sustainability. The Swedish government differentiates requirements on availability and preparedness between military units. They have three values each, immediately, within three months and within six months and mobilisation within hours, days, or within one week, respectively.

Requirements on sustainability follows once the armed forces has depleted supplies stored for availability and preparedness and involves a flow of replacement supplies for the duration of, for example, an operation. Sustainability requires a flow of supplies from external suppliers. The point in time from which this is required depends on consumption patterns, which differs between supply classes. The point in time when this flow can start varies between different supplies and depends on lead-times for production and distribution. To address the potential gap in time between depletion of supplies stored for availability and preparedness and delivery of replacement supplies from external suppliers, defence SCs must store sufficient replacement supplies. For each supply item, the output of Step 1 are answers to the questions "how much" and "when" for availability and preparedness and to the questions "how much", "from when" and "for how long" for sustainability.

4.3 Step 2: Market and impact analysis

Based on the input from the precursor and an estimated consumption pattern, the market analysis addresses the market's ability to deliver supplies on time. Staff in the SwAF and/or FMV with adequate market knowledge for a particular supply item perform the analysis, which results in one of four values, guaranteed, high, low or non-existent. The impact analysis clarifies the limitations in the SwAF operational capability if the market does not deliver supplies on time. Staff in the SwAF with requisite insights regarding the interrelatedness of logistics and operational capabilities perform the analysis, which results in one of four values, non-existent, minor, severe and disastrous. Market and impact analysis are independent activities, which the SwAF and/or FMV can perform as separate activities. However, they must combine the results as input to Step 3.

4.4 Step 3: Segmentation of supplies

Given the market and impact analyses, the SwAF and/or FMV positions the supply item in the two-dimensional segmentation model (Figure 1), which places the supply item in one of the four segments routine, delivery risk, operational risk or strategic supplies. It is advantageous if the staff who performed market and impact analysis execute the positioning in the model jointly.

4.5 Step 4a: Selection of supply chain strategies for routine supplies

For routine supplies, the PPM is prescriptive. No further cooperation between the staff responsible for segmentation, market and impact analysis is required. No in-depth discussions among other stakeholders is required. The responsible authority, FMV for advanced systems and the SwAF for all other supplies, procures supply items in accordance with the matching, or potentially matching SCSs (Table 2). PTS is a match and ETO is a mismatch for all operational requirements. The potential matches for requirements on availability and preparedness depend on lead-times for different supplies. The potential matches for requirements on sustainability depend on lead-times and consumption patterns for different supplies and on duration and stage of an operation.

4.6 Step 4b: Selection of supply chain strategies for delivery risk supplies

For delivery risk supplies, the PPM is a catalyst for in-depth discussions among all stakeholders prior to any decisions. In addition to staff responsible for segmentation, market and impact analysis, other stakeholders from the SwAF and FMV are required to join a cross-functional team, or an integrated project team (IPT), to resolve legal, commercial, technical and operational issues regarding the interrelatedness of logistics and operational capabilities, including operational, commercial and risk analysis. From the SwAF this includes staff from the operational level, the Training and Procurement Staff (TPS) and the Joint Forces Command (JFC). From FMV, this includes the Logistics Division, the Commercial Affairs Division and the Legal Affairs and Security Office.

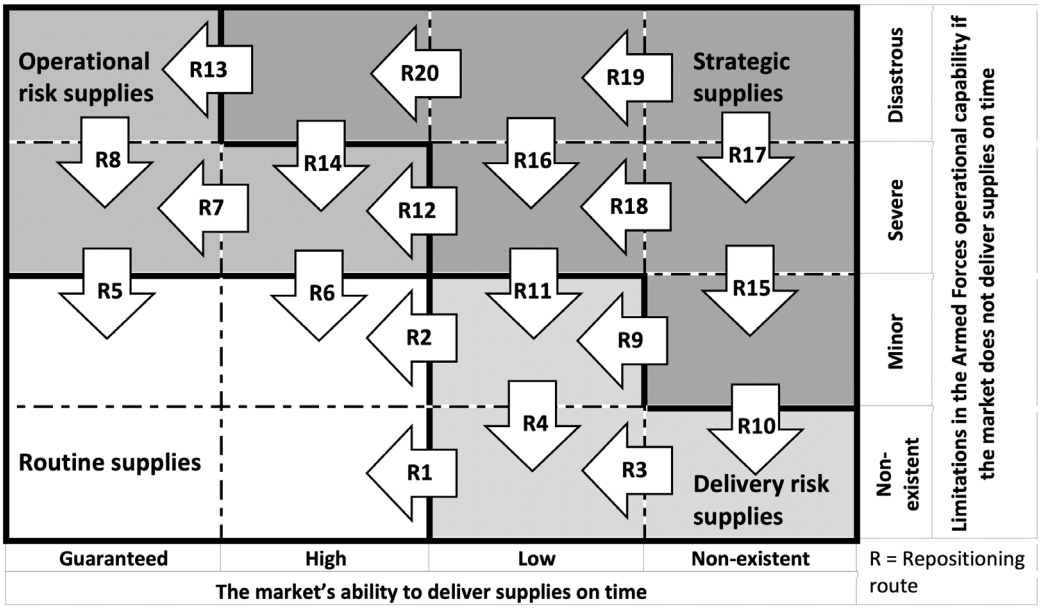

Figure 2: Repositioning routes in the two-dimensional segmentation model.

Immediately after segmentation, the IPT analyses opportunities to reposition the supply item to routine supplies by increasing the probability of delivery on time (Tactics 2a-e, Table 3). If possible, the IPT repositions the supply item to routine supplies (R1 or R2, Figure 2) and procurement follows in accordance with Step 4a. If repositioning is impossible, the IPT analyses if operational risk-taking is an option (Tactic 3a, Table 3). As part of this analysis, the IPT analyses if they can reduce the level of operational risk-taking by increasing the probability of delivery on time (Tactics 2a-e, Table 3) or by reducing the impact of failure to deliver on time (Tactics 1a-e, Table 3). If possible, the IPT repositions the supply item within the segment (R3 or R4, Figure 2).

If the remaining level of operational risk-taking is acceptable, the responsible authority procures supply items in accordance with the matching, or potentially matching SCSs (Table 2). PTS is a match and ETO is a mismatch for all operational requirements. The potential matches for requirements on availability and preparedness depend on lead-times for different supplies. The potential matches for requirements on sustainability depend on lead-times and consumption patterns for different supplies and on duration and stage of an operation. For each of the potential SC solutions, BTO, MTO, ATO, PTO, STO and MTS, the risk that the market fails to deliver on time is high. However, the limitations in operational capability if it fails are minor, or non-existent, which could justify operational risk-taking.

If increasing market capabilities and reducing operational dependency is unfeasible or unaffordable and operational risk-taking is at an unacceptable level, defence authorities must utilise PTS (Tactic 3b, Table 3). However, PTS is associated with extra costs and commercial risk-taking and defence authorities must use it restrictively.

4.7 Step 4c: Selection of supply chain strategies for operational risk supplies

For operational risk supplies, the PPM is a catalyst for in-depth discussions among all stakeholders prior to any decisions. In addition to staff responsible for segmentation, market and impact analysis, other stakeholders from the SwAF and FMV are required to join an IPT, to resolve legal, commercial, technical and operational issues regarding the interrelatedness of logistics and operational capabilities, including operational, commercial and risk analysis. From the SwAF this includes staff from the operational level, TPS and JFC. From FMV, this includes the Logistics Division, the Commercial Affairs Division and the Legal Affairs and Security Office.

Immediately after segmentation, the IPT analyses opportunities to reposition the supply item to routine supplies, by reducing the impact of failure to deliver on time (Tactics 1a-e, Table 3). If possible, the IPT repositions the supply item to routine supplies (R5 or R6, Figure 2) and procurement follows in accordance with Step 4a. If repositioning is impossible, the IPT analyses if operational risk-taking is an option (Tactic 3a, Table 3). As part of this analysis, the IPT analyses if they can reduce the level of operational risk-taking by increasing the probability of delivery on time (Tactics 2a-e, Table 3) or by reducing the impact of failure to deliver on time (Tactics 1a-e, Table 3). If possible, the IPT repositions the supply item within the segment (R7 or R8, Figure 2).

If the remaining level of operational risk-taking is acceptable, the responsible authority procures supply items in accordance with the matching, or potentially matching SCSs (Table 2). PTS is a match and ETO is a mismatch for all operational requirements. The potential matches for requirements on availability and preparedness depend on lead-times for different supplies. The potential matches for requirements on sustainability depend on lead-times and consumption patterns for different supplies and on duration and stage of an operation. For each of the potential SC solutions, BTO, MTO, ATO, PTO, STO and MTS, the risk that the market fails to deliver on time is low. However, the limitations in operational

capability if it fails are disastrous, or severe. Nevertheless, the IPT may find that operational risk-taking is acceptable and/or necessary, given the costs and commercial risks associated with PTS. The IPT may also find it judicious to use a combination of PTS and operational risk-taking, where a certain percentage of the required supplies are pre-stored to reduce the operational risk.

If increasing market capabilities and reducing operational dependency is unfeasible or unaffordable and operational risk-taking is at an unacceptable level, defence authorities must utilise PTS (Tactic lever 3b, Table 3). However, PTS is associated with extra costs and commercial risk-taking and defence authorities must use it restrictively.

4.8 Step 4d: Selection of supply chain strategies for strategic supplies

For strategic supplies, the PPM is a catalyst for in-depth discussions among all stakeholders prior to any decisions. In addition to staff responsible for segmentation, market and impact analysis, other stakeholders from the SwAF and FMV are required to join an IPT, to resolve legal, commercial, technical and operational issues regarding the interrelatedness of logistics and operational capabilities, including operational, commercial and risk analysis. From the SwAF this includes staff from the operational and military strategic levels, TPS, JFC and Defence Staff. From FMV, this includes the Logistics Division, the Commercial Affairs Division, the Legal Affairs and Security Office and the Governance, Policies and Plans Office.

Immediately after segmentation, the IPT analyses opportunities to reposition the supply item to delivery risk or operational risk supplies, by reducing the impact of failure to deliver on time (Tactics 1a-e, Table 3) or by increasing the probability of delivery on time (Tactics 2a-e, Table 3). If possible, the IPT repositions the supply item to delivery risk supplies (R9, R10 or R11, Figure 2) or operational risk supplies (R12, R13 or R14, Figure 2) and procurement follows in accordance with Step 4b or 4c. If repositioning is impossible, the IPT analyses if operational risk-taking is an option (Tactic lever 3a, Table 3). As part of this analysis, the IPT analyses if they can reduce the level of operational risk-taking by increasing the probability of delivery on time (Tactics 2a-e, Table 3) or by reducing the impact of failure to deliver on time (Tactics 1a-e, Table 3). If possible, the IPT repositions the supply item within the segment (R15, R16, R17, R18, R19 or R20, Figure 2).

If the remaining level of operational risk-taking is acceptable, the responsible authority procures supply items in accordance with the matching, or potentially matching SCSs (Table 2). PTS is a match and ETO is a mismatch for all operational requirements. The potential matches for requirements on availability and preparedness depend on lead-times for different supplies. The potential matches for requirements on sustainability depend on lead-times and consumption patterns for different supplies and on duration and stage of an operation. For each of the potential SC solutions, BTO, MTO, ATO, PTO, STO and MTS, the risk that the market fails to deliver on time ranges from relatively low to high. The limitations in operational capability if it fails ranges from minor to disastrous.

For strategic supplies operational risk-taking is less likely to be acceptable than for other supply segments. If it is at an unacceptable level, defence authorities must utilise PTS (Tactic3b, Table 3). Even if PTS is associated with extra costs

and commercial risk-taking and defence authorities must use it restrictively, for strategic supplies, it may be the only feasible solution.

4.9 Step 5: Repositioning due to changes in the external environment

The staff within the SwAF and FMV who are responsible for the application of the PPM are also responsible for monitoring the development of factors in the external environment, corresponding to the three dimensions in the segmentation model (Figure 1). This responsibility entails conducting operational and commercial analysis, respectively, which may require repositioning in the model. The SwAF and FMV should use existing frameworks from the commercial and military sector to structure the analyses and ensure that all aspects of development are included in the analyses. This means using frameworks such as STEEPLE (social/demographic, technological, economic, environmental, political, legal, ethical), PESTLIED (political, economic, social, technological, legal, international, environmental, demographic), PMESII (political, military, economic, social, infrastructure, information systems) and/or DIME (diplomatic, informational, military, economic), or other of their several derivatives, to assist the analyses. The analysis should include trend analysis, scenario development and sensitivity analysis.

- If the operational requirements change, the responsible staff within the SwAF and FMV must repeat the segmentation from Step 1. The operational requirements may change due to new directives from the political level. Capability development or capability termination may also have effects on the operational requirements.
- If the market's ability to deliver supplies on time changes, the responsible staff within the SwAF and FMV must repeat the segmentation from Step 2. Developments, which may change the market's ability to deliver supplies on time, include new entries into the marketplace, as well as mergers, acquisitions and closures. Changes in production and distribution capacities and localisation may also have an impact on the lead-time and consequently affect the market's ability to deliver supplies on time. Some of these changes may increase the lead-time, whereas others may reduce it.
- If the limitations in the SwAF operational capability if the market does not deliver supplies on time changes, the responsible staff within the SwAF and FMV must repeat the segmentation from Step 2. Changes in operational planning, capability development or capability termination are examples of developments, which may affect the limitations in the operational capability.

If the repetition of the segmentation results in repositioning of a supply item in the model, a new SCS may be the most suitable one. This means that volatility in operational requirements, market capabilities and operational consequences has implications for the length and content of contracts with suppliers. The importance of step 5 must not be underestimated. As an example, a minor change in the marketplace, such as the termination of a localised storage facility, may

turn operational risk supplies into strategic supplies, which could have major operational implications. In addition, simultaneous changes in the dimensions in the two-dimensional model (Figure 1) may transform routine supplies into strategic supplies. The SwAF and FMV must accordingly conduct continuous monitoring and regularly communicate the results of the operational and commercial analyses, so that all stakeholders fully understand the implications of any changes.

5. DISCUSSION

The purpose of this paper is to develop guidance, including tactical levers, for the application of a dynamic PPM for defence procurement. The first research question asks which tactical levers that are suitable for repositioning in a dynamic PPM for defence procurement. Using a workshop with experts in military logistics and defence procurement, the study establishes ten dynamic and two static tactical levers. The dynamic tactical levers are an operationalisation of the application rule "dynamic application", established by Ekström et al. (2021). To some extent, the findings are in line with previous research, such as Cox (2015), Basnet and Seuring (2016), Hesping and Schiele (2016) and MacCarthy et al. (2016). However, with the exception of Cox (2015), most contributions in the literature do not discuss tactical levers intended for repositioning in a dynamic PPM. Nevertheless, the study finds agreement for the five dynamic tactical levers intended for increasing market capabilities. Regarding dynamic tactical levers for reducing operational dependency, the study finds conformity for two out of five. Since previous research has focused more on the commercial goals of an organisation than the operational goals (Cox, 2015), this lack of confirmation is to be expected. The static tactical lever is labelled risk analysis in this paper, which is in line with Hesping and Schiele (2016). In combination, the proposed dynamic and static tactical levers proposed in this paper demonstrate similarities with elements in the supply chain risk management (SCRM) process, as summarised by Fan and Stevenson (2018). The ten tactics in the dynamic tactical levers correspond to risk mitigation, whereas the two tactics in the static tactical lever correspond to risk acceptance and risk avoidance, respectively.

The second research question asks which guidance for application is required in a PPM for defence procurement to ensure practical relevance. Building on the segmentation model proposed by Ekström et al. (2021), the differentiation strategies proposed by Ekström et al. (2020) and an operationalisation of the application rules established by Ekström et al. (2021), this paper develops such guidance. In general, previous research has contributed with inbound-focused, static PPMs. The proposed guidance answers calls for more comprehensive PPMs (Rezaei and Ortt, 2012) and dynamic PPMs (Cox, 2015). In contrast to previously proposed methodologies, such as the ones proposed by Kraljic (1983), Olsen and Ellram (1997) and Svensson (2004), a significant aspect of this guidance is the repositioning. Similar to the sourcing portfolio analysis (SPA), as described by Cox (2015), this guidance allows users to find a more advantageous position in which to optimise decisions. However, where defence procurement practitioners consider the SPA to be too complex for use in practise (Ekström et al. ,2021), this guidance is based on a PPM that occupies the middle ground between the

simplistic two-by-twos and the more complex SPA. Another important difference between this guidance and existing methodologies is that the ultimate objective is quite different. Extant models, such as Kraljic (1983) and Cox (2015), strive to exploit power positions between the buyer and the supplier, whereas the PPM for defence procurement aim to satisfy the operational requirements of armed forces. This difference is in line with the underlying differences between the private and the public sector. Where the private sector uses production and marketing of goods and services to achieve financial targets, the public sector uses its financial resources to produce public goods and services.

6. CONCLUSIONS, IMPLICATIONS AND FURTHER RESEARCH

6.1 Conclusions and implications

This paper contributes to the PSM and SCM literature in several ways. With the exception of Cox (2015), previous research has mainly contributed with static PPMs. This paper contributes with tactical levers for a dynamic PPM, which enables practitioners to optimise an improved situation (Persson and Håkansson, 2007). This paper also provides guidance for the application of a model developed for the public sector, which is a novelty. Following an initiative taken by Drake et al. (2013) and reinforced by Ekström et al. (2021), this paper integrates theory from PSM and SCM. The paper thus contributes to the literature by providing a PPM that enables holistic SCM (Christopher et al., 2006), in which buyers and suppliers can make SCD decisions based on the operational requirements of the buyers.

In some areas, for example performance-based logistics (PBL), researchers, such as Glas, Hofmann and Eßig (2013), have made significant contributions to the academic knowledge in military logistics and defence procurement in recent years. However, in many other areas, such as sourcing, resiliency and defence SCM, there is an absence of published research in academic journals (Yoho et al., 2013). This paper contributes to the academic knowledge in military logistics and defence procurement by introducing theory from PSM and SCM, to develop tactical levers and guidance for the application of a dynamic PPM for defence procurement.

The paper has implications for managers in both the private and public defence sectors. For managers in the defence industry, it extends the insights provided by Ekström et al. (2020) and further enables them to understand the operational requirements of their military customers. For managers in defence authorities, the paper provides them with guidance regarding how to combine the segmentation model proposed by Ekström et al. (2021) with the differentiation strategies proposed by Ekström et al. (2020). In particular, the guidance includes tactical levers, which will enable defence authorities to dynamically reposition in the segmentation model and find an enhanced position to optimise. The guidance provides the defence industry and defence authorities with an instrument that enables holistic SCM, which will allow SCD beginning with the customer's requirements and moving backwards.

6.2 Future research

Ekström et al. (2021) propose a two-stage segmentation model for defence procurement and Ekström et al. (2020) propose eight SCSs that are acceptable, applicable and sufficient in defence SCD. This paper contributes with the remaining parts of a complete dynamic PPM for defence procurement, tactical levers and guidance for application. As a next step, researchers should combine these contributions to propose a dynamic PPM for defence procurement.

The dynamic and static tactical levers identified in this paper share characteristics with the SCRM process. In future research, it would be interesting to use SCRM theory to develop a framework of dynamic and static tactical levers and test it empirically in the context of dynamic PPMs.

The issues of logistics values and utilities (Mentzer, Rutner and Matsuno, 1997; Rutner and Langley, 2000), value creation (Prahalad and Ramaswamy, 2004) and value co-creation (Vargo, Maglio and Akaka, 2008) relate to the results presented in this paper. It would be interesting to explore these topics further in the public defence context. How can, for example, a military buyer define the value of a safety stock at a supplier and consequently motivate the expense and how can the buyer and the supplier co-create such values? A related issue that would be interesting to investigate is how PBL relates to the PPM for defence procurement. Perhaps researchers should expand the framework to integrate performance-based contracts. This also relates to the wider issue of buyer-supplier relationships. In its present form, the guidance for the application of a dynamic PPM for defence procurement does not include such relationships. As a logical next step, researchers should develop the methodology to include recommendations regarding buyer-supplier relationships.

Industry 4.0 and emerging technologies, such as additive manufacturing (AM), or 3D printing, will inevitably have consequences for defence SCD. Industry 4.0 marks the fourth industrial revolution, enabled by the introduction of the Internet-of-things (IoT) into manufacturing (Tjahjono, Esplugues, Ares and Pelaez, 2017). AM enables manufacturing all around the world (den Boer, Lambrechts and Krikke, 2020) and positioning manufacturing closer to the end-user will potentially reduce lead-times and logistics costs (Durão, Christ, Zancul anderl and Schützer, 2017). It would be interesting to investigate the applicability and consequences for defence SCs. How can, for instance, lead-times in defence SCs be reduced by the introduction of IoT and 3D printing? A pertinent question is also, to what extent is implementation possible, given the classified nature of information in the military sphere?

This paper derives its results from a study in the Swedish defence context. To determine generalisability, additional studies are required. This paper suggests that researchers conduct studies with other methods and stakeholders, in other contexts, including different national perspectives. In particular, this paper invites researchers to test the PPM for defence procurement in other defence settings.

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