

# Top 10 Rules for Contract Type Teams to Establish Spare Parts Supply Line Source[s] Routines

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We describe all possible limiting behaviour principles for contract type “Bucket Brigades” support supply line schedule series by multiple teams of dispatchers routing defined levels of work orders.

The results of this report suggest caution should be taken in interpretation of equipment repair/upgrade simulations at installations under review by dispatch teams. Results also indicate sourcing ticket strategies should be established for partitioning dispatcher tasks into effective teams to establish new supply line connections.

In “Bucket Brigade” contract grouping for every supply line connection team, dispatchers move between schedule series stations in defined sequences where each dispatch team follows simple rules about what sourcing ticket to write next.

Results confirm that dispatcher sequence organisation independent from schedule series station of origin establish stable work order routes automatically. Supply line connection rates converge to maximum possible value over all techniques of organising dispatch teams & schedule series stations utilised in equipment repair/upgrade simulations.

Most DoD installation business processes have special requirements & logistics characteristics derived from the reasons they got tasked for Fleet Maintenance/Modernisation operations in the first place. One example is a Repair Shop utilising Work order Reminder Sets with temporal equipment parts delivery guarantees.

To really make this happen without losing supply line deployment capacity, all kinds of operational factors have to be taken into account, such as estimates for purchase order-taking lead times & delivery constraints to meet localisation parameters for Fleet Equipment Part deployments.

To be sure, some business logistics underlying DoD operations cannot be completely automated because the success of missions relies upon personnel skill sets drivers/limitations, but certainly many parts of the purchase order process could be automated, such as ordering from contract quote interface configurations, automatically triggering the delivery of new supplies to installations in need of equipment spare part components required for Fleet Maintenance/Modernisation operations.

Automated techniques are used to prepare the purchase orders required to move the supply logistics lines forward. Ideally, DoD should be able to introduce as many successful operations/missions as possible with minimal cost to the fiscal constraints present in design of the equipment part supply systems involved. Specific work order instructive infrastructure based on Repair reminder sets can help.

## *RULE #1: Contract Order Logistics*

Sourcing strategy can be characterised by three key interrelated decisions 1) criteria for establishing supplier base; 2) criteria for selecting subset of the supplier base who will receive an order from DoD; and 3) the quantity of goods to order from each supplier selected. Short-term contracts provide more flexibility and avoid fixed investments, but also forgo improvement and price certainty benefits afforded from long term contracts. Benefits of single-sourcing include quantity discounts from order consolidation, reduced order lead times, and logistics cost reductions as a result of a scaled down supplier base.

Supplier selection is concerned with identifying the subset of qualified suppliers who will be considered for order placement, and allocation focuses on splitting the required quantity between the selected suppliers. These decisions are interdependent and are also driven by the total delivered costs to DoD of an order quantity from each supplier.

## *RULE #2: Schedule & Unit Cost*

In the presence of low ordering costs and highly variable lead-times, dual sourcing can be cost preferable. Key differences between an all-unit discount and incremental schedule is that in the former, all units ordered are supplied at the unit price, while in the latter; only the number of units in a specific break point are supplied at the unit price. Suppliers offer these types of schedules to encourage buyers to procure larger quantities and to reap the operating advantages associated with these larger quantities. While DoD may utilise a single supplier for a particular item, it may also address differences in contract type supply risk by sourcing from multiple suppliers. In particular, DoD allocation decisions determining an appropriate supplier set and order allotment impacts on all competitive dimensions for deployment of defence equipment- including cost, quality, reliability and flexibility.

## *RULE #3: Orders & Demand*

When all suppliers have different cost and reliability functions for contract types, one of our key recommendations is for DoD not to rely one dominant sourcing strategy. That is, under certain circumstances, it will be optimal to place a single order with the lowest cost supplier & under other circumstances, an order is placed with a subset of the suppliers. There are some interesting interactions between the uncertainty in demand & uncertainty in supply. When

the uncertainty in demand is low, then it is optimal for DoD to address the uncertainty in supply by including different contract types in total orders amongst several suppliers. Conversely, when the uncertainty in demand is high, then DoD limits its fiscal risk and optimally relies only on the single lowest cost supplier.

## RULE #4: Cost Structure

When suppliers have cost structures from different contract types & identical reliability distributions, then there is no one dominant supplier sourcing strategy. For supplier settings with uniform demand, our recommendations indicate that, in the absence of capacity constraints, there are circumstances under which it is never optimal to order from more than one supplier when reliability distributions of suppliers are identical. When suppliers have identical cost & identical reliability distributions, then it is optimal to order the same amount from all suppliers. Single sourcing strategies could be optimal only when there are differences in costs across suppliers.

On the other hand, if costs across suppliers are identical then multiple sourcing strategies are an optimal choice regardless of supplier reliability distributions. With homogeneous suppliers, the optimal number of suppliers remains the same but the total order quantity increases in response to either an increase in the mean demand or an increase in demand variability. To summarise, we recommend that DoD decrease the number of suppliers receiving a positive order and increase the total order quantity in response to higher levels of demand uncertainty.

## RULE #5: Order Quantity

Supplier cost & reliability are the key factors to weigh for contracts coming into play when DoD is deciding whether or not to place an order with supplier in this sourcing case. Consequently, the lowest cost supplier in the prequalified pool will always receive a positive order. An exception to this rule can be shown in examples when the lowest cost supplier has a restrictively high minimum order quantity. It follows that if all pre-qualified suppliers have similar costs, then it's optimal to place an order with all suppliers in the pool. Single supplier strategy is favourable when the mean demand is low. However, if DoD anticipates a significant increase in demand, our recommendations propose the consideration of enlarging the supplier base even when the low cost supplier could provide the full order quantity. Surprisingly, an increase in the variability in demand also favors a single sourcing strategy.

## *RULE #6: Reliability Criteria*

When several suppliers are very close in cost, our recommendations propose that DoD consider qualifying them all such that they meet specific reliability criteria. Indeed, our recommendations indicate that sourcing cases with homogeneous suppliers are fairly robust with respect to changes in demand and supplier reliability. Specifically, when all suppliers in the pre-qualified pool have similar costs and reliability, then the total quantity ordered and the total DoD Fleet Component deployment efficacy is fairly constant even when demand and supplier reliability factors change.

Suppliers often offer discount schedules to induce larger purchases by offering progressively lower unit prices for progressively larger purchase quantities. Even for a single product purchasing decision, if it is available from many suppliers, each with various qualifying order sizes, identifying the optimal selected supplier set and corresponding quantity allocations is a difficult decision. Further complicating matters is that decisions must often be made quickly and with limited information due to time pressures.

## RULE #7: Cost & Reliability

Our recommendations illustrate how the optimal sourcing policy changes with alterations in the first suppliers cost and reliability. While small increases in the first suppliers cost does not change the optimal number of suppliers, it does decrease the total quantity ordered and the total profit. Similarly, an increase in the first supplier reliability decreases the total number of units ordered and increases deployment efficacy. In general, DoD simply compensates for small changes in reliability by ordering proportionately more items since it does not pay for undeployable units.

Our recommendations provide several insights, including that DoD consider the situation where supplier minimum order quantities are not assessed and when DoD does not obtain any explicit benefits by expanding its supplier base. First, DoD single sourcing practise is only optimal when supplier capacities are relatively large as compared to product demand. In such a case, DoDs optimal choice is to source all its requirements from the least cost supplier.

## RULE #8: Capacity Ratios

When supplier capacities are relevant, our recommendations propose a good strategy for DoD is to source from multiple suppliers. Under this scenario, DoD total order quantity across all suppliers & expected deployment efficacy are both lower than that compared to the scenario where suppliers are uncapacitated. The difference in deployment efficacy could be regarded as the value to DoD realised if the lowest cost supplier could be motivated to increase capacity for convenient evaluation of the DoD decision to select suppliers, a ratio determines whether or not a single supplier strategy is appropriate. This ratio reflects a trade-off between the first supplier reliability and its cost advantage relative to other suppliers. Essentially, if the lowest cost supplier has a reliability distribution with a high mean and a low standard deviation, and has a large cost advantage, then a single supplier strategy is warranted.

## RULE #9: Cost & Demand Certainty

Another key factor influencing supplier selection decision is DoD anticipated demand. Our recommendations include that a single supplier strategy is favorable when the mean demand is low. However, if DoD anticipates a significant increase in demand, it should consider enlarging its supplier base even when the low cost supplier could provide the full order quantity. Surprisingly, an increase in the variability in demand also favors a single sourcing strategy. In this case, DoD limits fiscal risk by sourcing only with the single lowest cost supplier when DoD anticipates great uncertainty in demand.

## *RULE #10: Capacity & Contract Type*

Our recommendations indicate that when supplier capacities are relevant, the optimal strategy for DoD is to source from multiple suppliers. Under this scenario, DoD total order quantity across all suppliers and expected deployment efficacy are both lower than that compared to the scenario where suppliers are uncapacitated. The difference in deployment efficacy could be regarded as the value to DoD which could be realised if the lowest cost supplier could be motivated to increase capacity.

When benefits of taking contract type into account are incorporated without supplier minimum order quantities, our key recommendations indicate that if suppliers are uncapacitated, multiple supplier sourcing strategies are always optimal where the number of suppliers is determined by contract type function. This recommendation implies that DoD should determine the total order quantity based on the least cost supplier. However, in placing orders, DoD should order the required amount from the least cost supplier and order marginal quantities from all the other selected suppliers. When suppliers are capacitated, DoD can use a similar simple decision rule when the number of suppliers which optimise contract type is larger than the number selected without contract type considerations.