Support Engineering and the Supplier Network

There is a tendency when writing about defence procurement and support issues to focus on the end users and the prime contractor, the original equipment manufacturer [OEM].

This is natural but rather short sighted. There are thousands of organisations, tier 2 and tier 3 suppliers (many of them small to medium enterprises [SMEs]) that support defence programmes, both during development and during the in-service phase.

On a single major acquisition programme the number of tier 2 & 3 suppliers may number in the hundreds and each will have to implement some form of Support Engineering activity. Collectively they have a significant impact on the operational capability, availability and through Life Cost [TLC] of the system they are contributing to.

It makes sense therefore to examine the issues that such suppliers face when called upon to perform Support Engineering for a large programme.

What could we achieve in an ideal world – what happens in the real world, what issues do such suppliers face - and what we can do about them ?

It seems that little consideration is given to the issues associated with managing the Support Engineering efforts of the many suppliers that support major procurement programmes. Such supplier networks can consist of several hundred organisations including large multinationals, micro SMEs and all sizes in between. This supplier network provides equipment ranging from very complex, high value systems which may require a major support engineering programme in their own right, (e.g. propulsion system), through to simpler items such as video cameras, heating systems and pumps.

In this piece I aim to examine the challenges that the smaller and more specialist suppliers face when a large programme demands not only their products but a potentially wide range of esoteric Support Engineering deliverables as well.

I am going to address three questions, 1) what happens today? 2) What should happen? 3) What can we do about it – how do we can address the gap between these two positions?

Question 1 - What Happens Today ?

Many of the issues facing tier 2 & 3 suppliers stem from the inappropriate requirements which are all too often imposed on them.

A few examples will provide a framework for discussion. It is common for such suppliers to be asked to provide reliability and maintainability data, and this seems reasonable enough on first sight but a closer examination reveals some fundamental issues.

Whilst it is perfectly rational to ask a supplier to provide reliability assurance, it is not rational to ask the supplier to provide reliability measures such as Mean Time Between Failure [MTBF]. A system designer and manufacturer can inform a client as to the quality of the materials they have used, the development testing that they have carried out, how they have designed a system or equipment so as to improve reliability, and what manufacturing processes they have used or developed in order to improve product quality; they can provide information that will inform a Reliability Case. Reliability metrics such as MTBF are statistical measures however and as such they are wholly dependent on the availability of historical data. (*Noting that there is an ongoing debate as to the validity of MTBF as a metric that I will not enter into here*).

In its simplest form that historical data has to include both arisings (how often did the item fail) **and** usage data, i.e,

how many hours run, how many cycles of use, were associated with that number of failures. With the technology readily available today we should be looking to collect additional information; great benefits could be derived if details of the failure process, of the stresses experienced, of the usage, maintenance and failure history of individual items were available. This data is rarely available to the equipment manufacturer, it is the responsibility of the end user to collect and to collate such data, but the present reality is that they are struggling to collect and to collate basic failure data.

Reliability prediction databases are readily available, these are databases of generic, historical data. They will tell you the average reliability of the generic items, not the reliability of the specific items that the prime contractor and the end user are interested in.

Such tools do provide metrics that can be used to predict the volume of support resources that will be required, but given the nature of such predictions, they could be performed by any organisation involved in the Support Programme. Does it make sense for 100+ organisations to acquire or to gain access to the tools (reliability prediction databases and reliability modelling tools) required to conduct such predictions, a proportion of which cost has to be transferred to the prime and ultimately to the end user?

Consider the situation where the reliability target is set by utilising a reliability prediction database.

Consider also the supplier who is providing a relatively simple and mature product, a fuel pump for example.

It is very unlikely that this product will be subjected to any extensive reliability testing.

The supplier is unlikely to have historical reliability data, nothing sufficient to make a meaningful estimate of the pump's MTBF.

If the supplier has to provide reliability data for that pump to the prime contractor, they are likely to use a reliability prediction database.

There is a strong possibility that the requirements, and the "proof" that those requirements can be met, are both derived from the same set of generic historical data.

…and the point of the exercise would be … ?

The reliability, or more usefully the arising rate, that will be achieved when the system is in service, is affected by a significant number of factors, many of which are beyond the control of the supplier. Examples of such factors include:

1. The local environment in which the equipment is installed
2. The actual stress experienced by the equipment during the in-service phase of its life cycle
3. Operating times and operating cycles
4. The applied maintenance regime
5. The competence of the operators and maintainers
6. No Fault Found [NFF] rates (determined in part by the quality of the training and the technical publications provided)
7. End user storage conditions, packaging quality, how the item was handled whilst in transit
8. etc

Including any reliability metric in any contract requires a great deal of care.

The nature of reliability requirements which have been imposed on suppliers exposes the lack of understanding that is evident in some requiring organisations, and unfortunately this lack of understanding often goes beyond simply asking for MTBF data. In the recent past a supplier was asked to provide a reliability model including MTBF's for oils, greases, seals and bolts and perfectly correct reliability figures were repeatedly questioned. This was all due to an individual in the requiring organisation who didn't understanding basic reliability theory. Similarly, an individual in a supplier organisation made a fundamental error in calculating the predicted reliability of an equipment, again because they didn't understand basic theory, and this caused many problems in the downstream programme.

These are classic examples of "A little learning is a dangerous thing"* and it is a far from trivial matter, responding to such issues consumes considerable amounts of time and effort and the supplier can only do so if they have access to appropriate skills, knowledge and experience. The alternative is to accept the situation, to try and satisfy the requirements, and this can quickly lead to a situation where lip service is applied to the Support Engineering process.

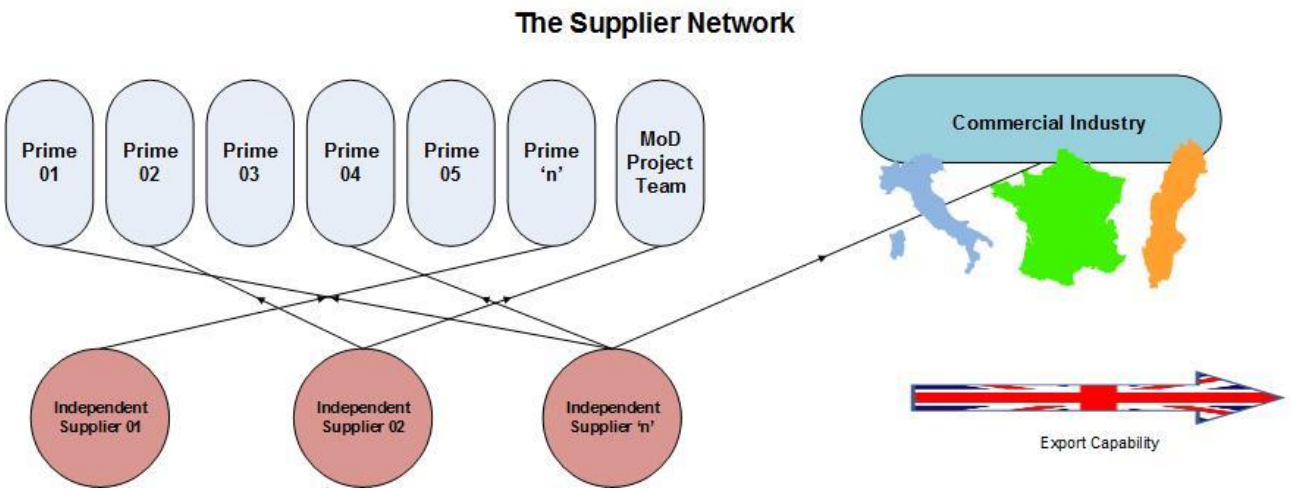
In a similar way suppliers are often asked to supply Through Life Cost [TLC] information. TLC is driven, in part, by reliability hence for the reasons given above, the suppliers will struggle to provide meaningful TLC predictions. As for reliability, there are many factors that impact TLC which are outside of the control of the suppliers. Given also that different suppliers will use different TLC models and different models will deliver different results even if the same data and assumptions are used as inputs, the value of such an exercise is questionable and so we have to question the value of this type of requirement.

In summary, the fundamental issue is a low level of understanding of Support Engineering, which leads inevitably to:

1. An inappropriate division of responsibilities and activities between the end user, the prime contractor and the

supplier network

2. Inappropriate requirements
3. Errors, misinterpretations, potential conflict, escalating cost.
4. Lip service being applied in many instances and hence lost opportunity to improve system availability and to reduce TLC



Question 2 – What should happen?

This question is not an easy one to answer, but there are some tenets that we can establish to guide us, tenets that are based on fundamental Support Engineering principles, and we can apply some basic management common sense.

In the ideal world:

1. Support Engineering activities will be based on a profound understanding of Support Engineering principles, an understanding shared by the end user, the prime contractor and the supplier network.

   We would decide what meaningful analyses the supplier can undertake, what meaningful information they can provide, and which analyses are best consolidated and undertaken by the prime contractor, and what role the end user has in this process (the provision of an accurate context for the analyses and historical data being the obvious example). Then we would determine what processes, skills and tools, (i.e. what capability) are required in each of these three types of organisation, and we can do so in a logical manner. Support Engineering activities and responsibilities will then be distributed in a rational and optimal manner between the end user, the prime contractor and the supplier network.

2. The supply network will have access to a cost effective and optimal, Support Engineering capability (an optimal methodology, tools, skills and experience).
3. We would apply a quantum of common sense to this issue. Support Engineering covers a wide range engineering disciplines, so organisations who have an irregular need to implement Support Engineering programmes will struggle to maintain the necessary capability. Note that such a capability may include reliability, maintainability, Reliability Centred Maintenance [RCM], spares optimisation, authoring, database management, xml and a range of analytical skills, to name just a selection. It may require access to logistics databases, mathematical models, simulators, etc, it will require robust processes and procedures.

   If a hundred plus suppliers have to provide a Support Engineering capability, but only on an irregular basis, then the costs of meeting any Support Engineering requirement will be very significant. Particularly so if each supplier develops and tries to maintain their own capability; an approach that is also likely to lead to significant incoherence in the outputs which are provided to a prime contractor. As an alternative, the suppliers may hire in external expertise in order to meet the demand, but this is an expensive option, the magnitude of these Support Engineering costs are often placed in stark relief when they are compared with the expected revenue from the equipment sales. Good support is expensive – read that list of capabilities again - poor support, even more so.

   We would therefore optimise and standardise methodologies and tools and apply these across the supply network.

The term "Spend to Save" is often bandied about when people talk about Support Engineering, but if we transition from the present approach to something akin to what I have described above, we will find that this is a "Save to Save" approach. Support Engineering, done 'properly' is a highly structured, pragmatic and optimal methodology, it will put more capable systems in the hands of the end user, it will also reduce programme costs and it will shorten programme schedules.

We don't live in an ideal world however, so in the meantime…

Question 3 - What can we (the supplier network) do about it ?

Suppliers have to live with and to manage the present challenging situation.

Let's summarise the issues:

1. Inappropriate requirements, as per the reliability and TLC examples
2. A prime contractor, or more accurately individual points of contact in a prime's organisation, that have an imperfect understanding of Support Engineering. (Leading to poor requirements, differing interpretations of the requirements by different individuals, incorrect interpretation of results, etc)
3. An irregular demand for their Support Engineering capability and hence difficulty in funding, establishing and maintaining such a capability
4. Support Engineering costs which are disproportionate to the value of the equipment supply contracts.

The supplier therefore has two key challenges:

1. To do a good job, cost effectively
2. To manage the relationships with their prime contractors

Both require access to skills and knowledge, you can't argue your case with the prime if you don't understand the basic principles on which to found your arguments. Some of these skills and this knowledge can be bought in, but it is essential that the suppliers have, as a minimum, a basic internal capability, a foundation level of knowledge and understanding. How else can they engage effective external suppliers and how can they communicate effectively with such a supplier once they have engaged them?

The first step is to educate the supplier network. This is the key to establishing an effective and affordable Support Engineering capability.

And the supplier network does need a Support Engineering capability, they need an effective methodology, applied by skilled and experienced people, facilitated by a set of effective tools. It is unlikely that any but the largest organisation can afford to establish and to maintain such a capability and even very large defence contractors struggle with this.

So how do we square this circle?

Consider first the need for a methodology and the supporting tools, reflect on the following:

1. **Any such methodology and the associated tools would have to work, not only for a specific project, but for multiple projects**
   Prime contractors often ask for different Support Engineering outputs for each of their programmes, even if those programmes are very similar. The typical supplier will also have to meet the requirements of more than one prime contractor. Designing such a methodology presents some challenges therefore.
2. **The Methodology should be based on fundamental Support Engineering principles**
   If the methodology is based on robust Support Engineering principles it is more likely that it will be capable of satisfying any future requirement.
3. **Design and field modern, affordable and flexible tools**
   If the tools (software tools such as models, product and logistic databases) are well designed and if they capitalise on modern technologies, they **can** be flexible, adaptable and affordable.
4. **Share elements of the capability across the Supplier Network**
   Suppliers could share such assets, there is no logic in every organisation developing their own methodology, their own tools, these can be developed and shared, spreading not only the cost, but they also provide a mechanism for capturing shared experience.
5. **Facilitate Coherence**

If suppliers share a methodology and the associated tools, this will drive in coherence on behalf of their clients.

6. **Facilitate Reusability**
   If an optimal methodology is applied, supported by robust software tools, then there will be a high level of reusability and therefore reduced costs in the longer term.

So what this boils down to is:

1. An effective methodology needs to be developed, agreed, documented and deployed by the supplier network (or a reasonable sub section of it)
2. Tools to facilitate the implementation of the agreed methodology need to be developed and deployed. To be utilised collectively by the supplier community (i.e. a cloud based, software as a service [SaaS] approach).
3. Tier 2 & 3 suppliers need some form of training / mentoring to establish and to maintain a basic level of internal capability. This could be comprised of a blend of formal classroom training, mentoring (via a helpline perhaps) and online training materials. But it has to be affordable.
4. This training should be provided collectively to both reduce costs and to facilitate coherence.
5. Consultancy support needs to be minimised, but available if and when required.

And that raises even more issues, such as:

1. Who should, could or will lead on this?
2. Achieving this is step in the direction of the "Ideal World" discussed above, how much progress to this goal is feasible?
3. Why hasn't this been addressed already? What are the blockers?

Which all need addressing, but let's stop and leave it there, for now…

* One of the most misquoted quotes, from a poem by Alexander Pope 1688-1744. The poems goes:-

A little learning is a dang'rous thing
Drink deep, or taste not the Pierian spring:
There shallow draughts intoxicate the brain
And drinking largely sobers us again

The Pierian spring is associated with the Greek Muses, drinking from the spring endows the drinker with great knowledge and inspiration.

In the world of Support Engineering, if you think you know enough, then you know very little at all. The more you know, the greater your horizon and the alarming realisation of just how much there is still to learn.

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