eXpress™ Newsletter

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Considerations Regarding System / Subsystem Integration

This discussion focuses on the ability for the Prime System Integrator (PSI) or a Subsystem Integrator to accept diagnostic design data (specifically, in Microsoft Excel, as used in this example) from a sub contractor. This sub contractor is presumed to not being an ***eXpress*** user or a COTS supplier. Effectively, the Prime System Integrator may be left to work with a very limited and often design error-fraught, set of data (notice the use of the phase "set of data" in contrast to "information", because a prerequisite of having "information" is to know all of the interrelationships of each component(s) within the design).

One may ask why we can so positively make the assertion that the data set delivered by the sub would be "error fraught". Well, it is our experience that we are able to use ***eXpress*** in a manner that will (initially) force the functional design to be "verified" against itself for functional/design accuracies.

A spreadsheet has no way to perform this functional verification on a consistent basis, particularly when object or design states are involved, nor would it be in a position to welcome revisions and changes that it could reconcile for accuracy in a consistent and instantaneous manner. Secondly, we need to match the new data set supplied from the sub to the functional conformities of the specifications of the System Testability Architecture Plan (STAP) and/or any relevant and available (ICD) configuration control documents.

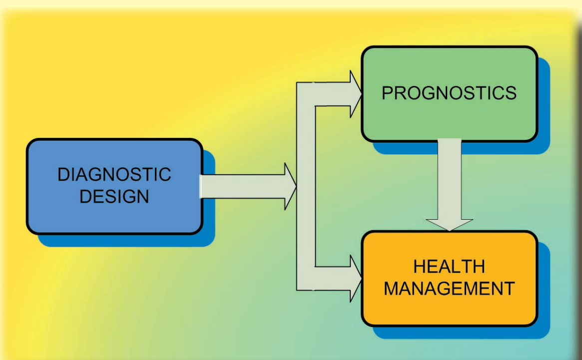
The STAP contains a listing of all of the specs as defined by the customer, and outlays a process and plan for achieving any of those integrated system testability requirements. It is unlikely that any supplier can attain such a level of conformity to those specs without the use of ***eXpress,*** either directly, or through the reliance of a Prime System Integrator /DSI to perform the effort with ***eXpress***.

As ***eXpress*** imports the data from a sub or supplier, it can create a graphical, topological model. In this activity, it may typically be learned that the data has to be greatly "cleaned up". The data may be discovered to be using "duplicate names" or may have omitted signals or I/O, or is unknowingly creating undesired and large "feedback loops" due to design errors. Our experience has proven these sort of maladies are virtually a given. Worse yet, the supplier would not have any other consistent process to manage these "subtle maladies" without examining their data in a defined process that can report back all of these areas of inconsistencies/inaccuracies.

Once in ***eXpress***, the design topology can be exported back into MS Excel and cross referenced validation/verification (V&V) with the original MS Excel or spreadsheet representation. This would allow the opportunity for a sub or supplier to be their own first diagnostic design V&V authority, and then permit their data to be of the form and fit that renders it relatively meaningful and ready to go for the Prime System Integrator. This would offer tremendous benefit in time savings (for design rework, future development/support, etc.) for the sub or supplier, in addition to saving the Prime System Integrator with the burden of making ill diagnostic assumptions of each delivered design with respect to the system diagnostic integration activities.

Using ***eXpress*** in a diagnostic V&V manner, avails a new capability for all involved in the design influence activities – Prime System Integrator, sub contractors, customers, etc. This allows for every contributing party to affectively "forecast" design omissions, inconsistencies, gaps, misrepresentations, errors, etc. in support of diagnostic design data functional inter-compliancy (V&V) in advance of discovering these anomalies through other means at more costly or critical times in the future.

Prologue to Prognostics - *The Prudent Planning of Prognostic Systems Integration*



Eventually, we all concede to the realization that Diagnostic Assessment and Trade-off Studies must occur before we invest in Prognostics. If the system doesn't see it, the investment in prognostics may not matter.

Prognostics, in and of itself, is recognized as a "specialized form of diagnostics". One can reduce the term to referring to the implementation of methodologies and specialized techniques to accomplish the object-specific forecasting (based on physics of failure characteristics, etc.) of a time-relevant expectation of a compromise in object performance verses a maintenance action.

Judging by the manner in which industry has latched onto Prognostics over the past few years, it hasn't allowed itself adequate time to consider or adopt a common practice or methodology to insure that the investment in Prognostics provides the expected value within the integrated system design.

Many people in industry who speak to Prognostics generally do not consider the impact on the integrated system design, either from a design-economic or an LSA (supportability-fit) perspective. Even the Prognostic Requirements inscribed in a few of the newer programs rather glaringly insinuate the same lack of clarity and lack of means to evaluate and implement integrated system Prognostics. We can all relate to the desire that one day we will always know before something will fail. We all are searching for answers from this "crystal ball". ***(cont pg 4)***

Inside this Issue...

Independent System Engineering vs. Programmatic System Engineering

The awarding of DoD Programs has continued to evolve over the recent decades toward a culture that exploits the concept of “Teaming” on the development of complex products or systems for many major programs. This concept appears to allow contractors to leverage each Team member’s particular strengths in their respective areas of expertise into a unified partnering environment. To facilitate this objective, the partnering environment must agree upon a mutual acceptable means and mechanism to integrate these individual products together into the developing of a superior end-product.

This is truly a noble concept and may have the potential to harvest many broad-based benefits. However, these benefits fail to be substantially realized due to converging design areas that must bear the burden of cross-partner product development gaps. These gaps are not easy to identify or manage without strong system-level product design resulting from specific diagnostic requirements flowed and tracked down to suppliers and across to team partners via a mechanism that can effectively “communicate” with this information exchange. We are not speaking of a simple mechanism that merely addresses the exchanging of data, but rather to a much more eloquent mechanism used for the exchanging of the knowledge of the interrelationships of the design and their interrelated diagnostic characteristics as they ultimately become grouped and buried within the various complexities of the system. Additionally, this mechanism must be able to respect the sensitivities and the proprieties of lower-level design contractors and suppliers while contemporaneously enriching the overall diagnostic capabilities of the integrated system. And further, this same mechanism must be able to perform this cross-partner diagnostic development and integration role while serving as an effective means in the assessing and accounting for each partners’ or suppliers’ individual product(s) to the overall integrated diagnostic performance within the end-product or system.

To date, such mechanisms that facilitate the cross-partnering development of the diagnostic or prognostic design, have not been recognized as a practice that extends beyond the boundaries of the individual diagnostic development within each independent Systems Engineering practices adopted by each Team partner on the end-product design or Systems Integration program.

Systems Engineering, with respect to the development of the diagnostics, has not been traditionally used, nor properly taught to consider the requirement to incorporate the concept of cross-partnering through the walls erected on either side of the individual Systems Engineering practices by each individual contractor or supplier on this partnering “Team”. Each Team partner may often maintain its own Systems Engineering practices (i.e. processes / procedures) that it shall employ in the development of its component that it designs for the Program. This challenging situation is illustrated in the diagram on the facing page.

The System Engineering practices may refer to policies, processes and/or procedures put in place to standardize how System Engineering activities are conducted within a company however these may not be common among various company locations and they are certainly not common across company boundaries. Some companies System Engineering practices go undocumented leaving the process open and fluid. This results in tremendous challenges when trying to work with such companies.

It is unlikely that any other Team partner will employ the same or an “open” and fully-interoperable Systems Engineering practice as any other partner on the Integration Program. This is obvious since it is known that many larger companies fail to share a unified Systems Engineering practice within their own divisions, sectors or activities. With so many variant and home-grown Systems Engineering practices, even within the same companies, why should we expect that any single Systems Engineering practice within one of these activities on the Program could effectively share all the Program knowledge of the diagnostics design with any other Team partner? This absolutely bolsters the reason for alarm that since industry is increasingly dabbling in so many individualized Systems Engineering practices, that the precision gained from the employment of each individual Systems Engineering practice, may be grossly compromised in the process of the honing of the information to fit the effective Systems Engineering practice institutionalized to serve the partners on the Program.

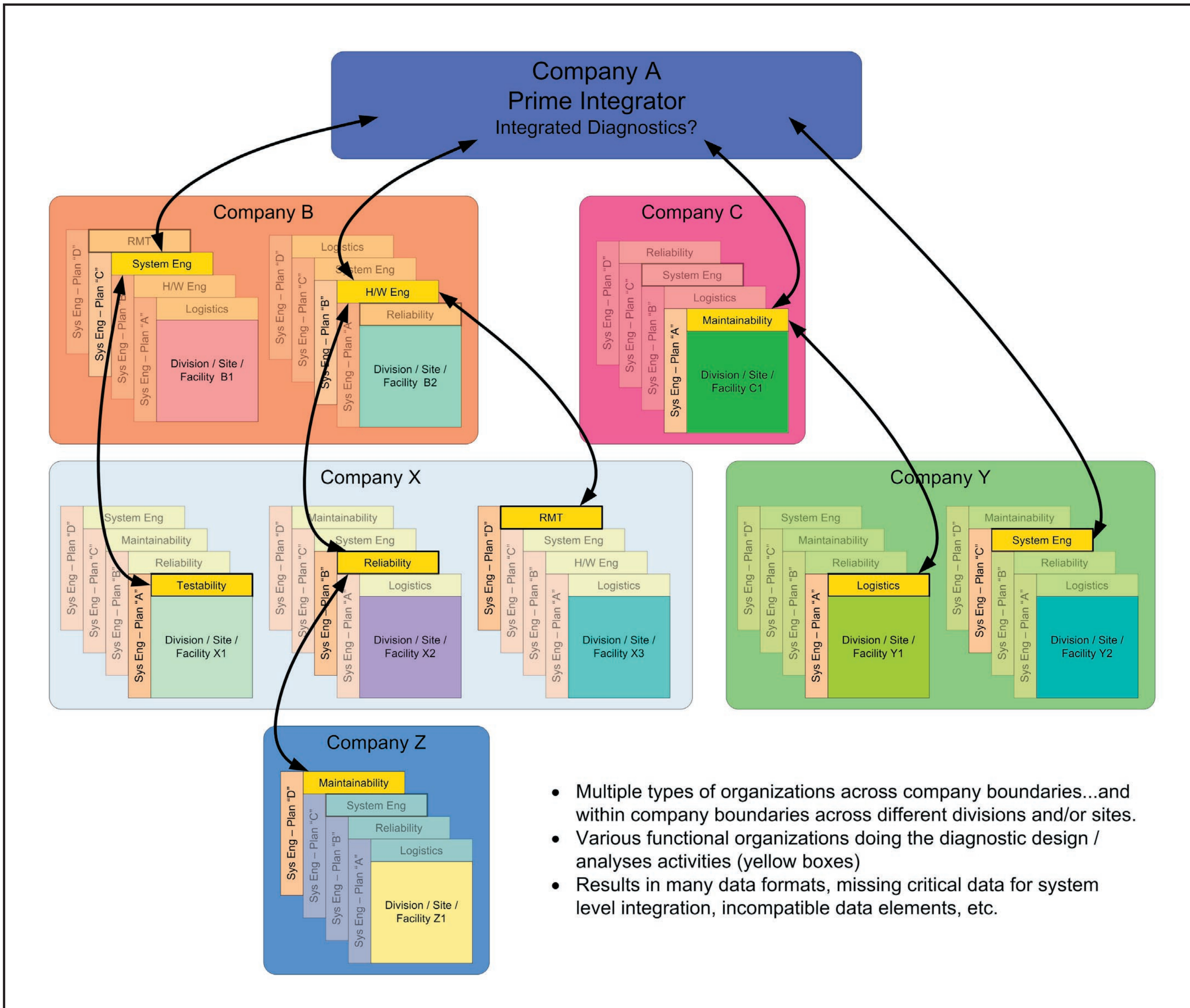
As a result, the DoD Programs that require the concept of Teaming or partnering shall inevitably fail to share a unified Program Systems Engineering practice that truly incorporates the interchangeability and compatibility of true diagnostic and/or prognostic knowledge exchange. This inadequacy can only increase uncertainty at the System Level and thereby inviting the opportunity for such relentless experiences as System Level False Alarms, inadequate sensor utility, ineffective and ambiguous isolation capabilities, lower system availability, and uncontrollable supportability costs, etc. Eventually, over time, the experiences will likely continue to grow as new components or substitute designs/suppliers are brought into the mix that are not compelled to adopt to a Programmatic Systems Engineering structure that can adequately and completely resolve the interchangeability of the diagnostic information throughout the design, development and support of the System or end-product.

Programmatic Systems Engineering across all Team partners is essential for diagnostic and prognostics (and/or notwithstanding, FMECA/Reliability, Maintainability, etc.) sanity at the System Level. Otherwise, the extensive investment of time, effort and funding to assure precision and accuracy at the lowest levels risk becoming vacuous and expensive endeavors throughout the life cycle of the System or end-product. The irony of prescribing to RAMT computational accuracies specified in the low-level Program Requirements in each independently engineered process, and then to avoid the practice of following through with fully integrating of the diagnostic development and interoperability between Team partners, is causing concern and suspicion to more and more Diagnosticians.

We have to ask ourselves if we are truly engaged in mitigating False Alarms and any of the prior mentioned maladies that are contagiously active in this environment. Else, we submit ourselves to accept the vaccine and preventative care of committing to a Program-wide Systems Engineering practice targeting the entire diagnostic engineering activity across and throughout the individual Systems Engineering practices within each contributing Team partner and any relevant COTS suppliers materially involved therein.

2007 eXpress User’s Group in Paris, France
Set for mid October, 2007
Details to be Available Soon!

Challenges Facing Diagnostic Integration



Training Schedule

Course Number	Pre-requisite	Course Description	Dates	Location	POC
100		System Diagnostics Concepts and Applications	16 Jul, 2007	Orange, CA	Denise Aguinaga , DSI
110	100	Basic Modeling & Introduction to Testing	16 Jul, 2007	Orange, CA	Denise Aguinaga , DSI
120	110	Introduction to Testing & Analysis	19 Jul, 2007	Orange, CA	Denise Aguinaga , DSI
200	120	Advanced Diagnostic Development & Assessment	6 Aug, 2007	Orange, CA	Denise Aguinaga , DSI
205	200	Advanced Test Development & Importing	8 Aug, 2007	Orange, CA	Denise Aguinaga , DSI
210	205	Advanced FMECA Development & Assessment	10 Aug, 2007	Orange, CA	Denise Aguinaga , DSI
100		System Diagnostics Concepts and Applications	15 Oct, 2007	Orange, CA	Denise Aguinaga , DSI
110	100	Basic Modeling & Introduction to Testing	15 Oct, 2007	Orange, CA	Denise Aguinaga , DSI
120	110	Introduction to Testing & Analysis	18 Oct, 2007	Orange, CA	Denise Aguinaga , DSI
200	120	Advanced Diagnostic Development & Assessment	5 Nov, 2007	Orange, CA	Denise Aguinaga , DSI
205	200	Advanced Test Development & Importing	7 Nov, 2007	Orange, CA	Denise Aguinaga , DSI
210	205	Advanced FMECA Development & Assessment	9 Nov, 2007	Orange, CA	Denise Aguinaga , DSI

Prologue to Prognostics (continued from page 1)

Prudence lies in the diligent preparedness of diagnostic design influence information ***before*** searching for lowest-level answers to system prognostic objectives. An effective system design is one that can preemptively learn, adapt, integrate and manage low-level supplier data in such a manner that the integration activity saliently doubles as a clutch validation and verification activity. Such a preemptive prologue can provide timely insight to diagnostic and prognostic needs at the system level far in advance of design development. This true Systems Engineering approach provides valuable opportunities for the system to obviate hurried and less system-cognizant low-level decision making.

Essentially, all integrated levels of the design can be influenced and benefit from an earlier form of, say, design "prognostics" – meaning, early insight into the possible latent effects of the disconnects within the integrated design. This early insight provides for assessment and rework within the earliest stages of the integrated system diagnostic design development process. This preemptive activity provides a structure and means to identify and forecast effects of integrated design flaws, and is a sort of "integrated design *prognostics*". This can be understood to serve as an imperative evaluation and validation activity and a prologue to selected Prognostics.

eXpress allows the diagnostic designer to "forecast" design integration errors/gaps through the use of rapid analysis that senses (functional design and or design integration) information through a host of "internal checking" mechanisms. These mechanisms are ubiquitously inherent within the ***eXpress*** model construct. One of these mechanisms that is frequently used in the initial rapid capturing of design data from any of the set of suppliers, would be the ***eXpress*** import/export mechanism. In this process, ***eXpress*** can graphically capture, identify, cross-match, and then communicate these areas of "disconnect" to all involved parties in advance of more critical system diagnostic integration test or evaluation. An outcome of this critical Systems Diagnostics is the recommended candidates for Prognostics assessment.

Discovering these areas of disconnect early in the design development process allow the opportunity to address some very fundamental concerns that may often arise when attempting to integrate design data into an overall system, design, or configuration. Many more deviant concerns have not been addressed in this discussion (design Gaps, False Alarms, etc.) that are ubiquitous and troublesome side-effects resulting from lesser attention to system organization and lack of thorough integrated diagnostic engineering practices.

The reality is that Prognostics isn't a crystal ball and it isn't an island. The technology and the expectations of the technology are real but still need to be allowed to mature. The Prognostics technology must work within its means, and Contractors and Customers alike, need to better understand those means. Prognostics does have a role that it can ultimately fulfill on projects and the expectation needs to be tempered to understand that role. In the mean time, diagnostics continues to serve as an excellent prologue to a successful systems design and a prologue to prognostics.

Publish Your Article

If you would like to publish a short article in the DSI's Newsletter, please let us know. The article should be relevant to Diagnostics, less than two pages and shows a solution to a challenge.

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