

Challenges in Working with a Consultant or System Integrator

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Introduction

A person who never worked with either a T&M technical consultant or a System Integrator company may think that these types of engagements are the silver bullet for test and measurements project success.

The client organization is certainly much better off by engaging a technical consultant or System Integrator to implement the T&M system needed than attempting to use internal resources. As the old business saying goes; focus on the core and outsource the shore. Unless the company has on staff a multitude of Engineers who are experienced in putting these systems together as their main job, a System Integrator can certainly help in reducing the overall implementation time as well as the overall project risk.

These companies have as their main business exactly the implementation of T&M systems. They usually have Engineers with different backgrounds on staff, who can be pulled together to form a very strong project team. They also should have Project Managers that are used to managing T&M projects, which are experienced with the pitfalls of integrating these solutions.

However, even though this is usually the case, there are still several T&M projects that end up failing, even when being executed by a competent and reputable System Integrator or by having involved technical consultants. There are challenges in working with both consultants and integration organizations that will be the focal point of this article. The chapter will present five challenges that are the most common ones when engaging an Integrator to execute T&M projects that can actually drive the project to failure. It will also present the main typical problem when engaging a technical test and measurement consultant.

Client trust initial requirements definition to Integrators

The most important driver of failure on T&M systems is lack of well established requirements. System Integrators, as experienced organizations in the business of implementing T&M systems, certainly know that. Integrator's profits stem from their ability to deliver a well determined scope of work within the original budget that was estimated and presented to the client in the form of a contract.

It is important to define the term scope of work. Many people automatically equate scope of work with system requirements; whereas this is not the case. Scope of work is the actual set of deliverables the Integrator will be contractually obligated to provide in exchange for the moneys spelled out in the contract. For example, a given contract might call out for two systems to be delivered at the end of the project. Therefore, one of the items that are part of the scope of work for such contract is to deliver these two systems, duplicates of one another. The system requirements document will call out the specifications that both systems will perform. If the contract would be for a single system to be delivered instead, the system requirements document would be the same, however the scope of work, and consequently the price, included in the contract would be extremely different than the one where two systems are to be delivered.

Since the Integrator's profit margin is directly proportional to their ability to complete a contract scope of work within the estimated budget, they are extremely risk adverse when creating technical proposals to deliver such systems. This is actually a good thing for the client, since, a thorough risk analysis is an extremely important exercise that needs to be executed when implementing T&M systems and one of the first steps towards a successful implementation.

Furthermore, Integrators are domain experts in the field of T&M; therefore it is natural that some clients would feel they should trust the initial requirements definition to them, completely. This, however, is in fact the first pitfall that will be detailed by this article.

Let's go through the usual process of engaging an Integrator to implement a T&M system and the reason why this can be a potential driver to project failure. A client defines it needs a T&M system, it shops around and invites three Integrators to participate in the procurement process.

Each Integrator, at this point, will be starting to look for ways to best bind the scope of work; in a manner they can actually put a price tag to the effort. Understandable, as their ability to make a profit is tied to their success in delivering the scope of work for the initial budget captured in the contract.

However, at the same time they are working in defining the requirements for the system that would allow them to define the scope of work and price for the effort, the activity of collecting these requirements is basically a risk for the Integrator. Integrators make their money by selling their staff's time. Every hour of staff time they invest in determining requirements for a system

they may not be awarded to build, is a risk. In our anecdotal example of three Integrators participating in the procurement process, all three are investing staff hours to collect the system requirements, but only one will be awarded the contract.

Therefore, they naturally have the focus of making an effort to spend the absolute minimum time they possibly can in order to extract the needed information that would allow them to provide the technical proposal with the scope of work and price. This is not to imply they are necessarily cutting corners, as it is also in their best interest, as they are providing a fix priced proposal to the client, to make sure they understand the system requirements enough in order to not underbid the effort.

However, they will probably focus only on the system features. The system features is what will determine their implementation cost; which will drive the contract price. They will most likely focus on questions like; how many analog inputs will this system need?; Is an analog switch needed? What about a DMM? Does the system need to push data to a database or a file system is enough?

Though these are absolutely questions that need answers as part of the requirements definition process, the requirements elicitation needs to also focus on capturing the business value the system will bring to the organization. It is almost certain Integrators won't drill as deep in the requirements gathering exercise as to uncover more subtle requirements that are not directly related to their activity of defining the scope of work and price to be included in the technical proposal. Not because they don't know what they are doing or are cutting corners, but as a basic risk mitigation activity on protecting their business. In the worse case, one can see an Integrator running out of business by investing too much of their staff time in requirements elicitation for T&M systems that end up not being awarded to them.

What this will create is a situation where a T&M system is being defined, a Integrator is being engaged to implement it, and the requirements gathering activity may have missed some key business value requirements or even some subtle technical requirements that would have been uncovered if a more thorough requirements gathering activity was executed.

A corollary case to what was presented above is the scenario where the client actually pays an Integrator to perform the requirements elicitation to kick off the project. This is in fact an excellent practice that should be more often adopted by clients looking to outsource. However, usually, this activity is seen by clients as an expense that is not necessarily adding value to the project. What ends up happening is that a small budget is allocated to this activity; which will force the Integrator to prioritize the types of requirements that it will be focused on.

As a rule of thumb, on successful T&M projects, about twenty five percent of the project's overall number of hours spent goes towards requirements elicitation and definition activities. If we take an example of a thousand-hour project; which is not that large in today's modern T&M

systems, something around two hundred and fifty hours should be allocated to requirements definition.

In reality though, I have never seen a client who would be willing to sign up for such an investment up front. Usually, funded requirements definition projects range between forty and eighty hours duration.

At this stage, the system implementation is already headed to a cliff, right off the gate. Usually the outcome for this type of situation is that “new” requirements will be uncovered throughout the project lifecycle, as the client is presented with intermediate deliverables. There will be frustrations on both sides; the Integrator and the client, as the Integrator will perceive the client as not knowing what she wants, and the client will perceive the Integrator as not being fully committed to the successful implementation of the system.

Every new requirement will have the potential of generating a change order to the contract, which will add cost to the Integrator and the client, and the implementation time will suffer. There will be frustration on both sides. The relationship will suffer and there will be opportunity costs incurred by the client by having the deployment of the system delayed.

One other point to be made is that, most of the time; Integrators will cover their proposal with what is called technical assumptions. Technical assumptions is a fancy way to say that they either don't know something well enough or didn't have the needed amount of time to fully define that something in order to put a price tag on the effort. In other words, the technical assumption defines the assumptions that were used by the Integrator in coming up with the scope of work, implementation schedule and price for the system. The proposals usually have verbiage stating that if one or more technical assumptions are not valid once the contract has been awarded and the implementation is underway, the Integrator has the right to modify price, schedule, scope of work, etc.

Obviously, the more gaps there are at the beginning of the project, the more technical assumptions will most likely be invalid. As the client learns more about what is being built by the Integrator via intermediate deliverables, these gaps usually start to come to light. Again, on this situation, change orders will be generated to cover such gaps. There is the risk for contractual battles between the client and the Integrator in regards to what was and what wasn't included as part of the original proposal. These battles don't add any value to the actual delivered system, most likely add schedule and costs overruns, and worse, degrades the relationship between client and Integrator.

Depending on how the budget for the contract was reserved, in case there isn't enough management reserve put aside to cover the gaps in the technical assumptions, the final system delivered may be close to what was originally proposed due to lack of funding to cover change orders. On this situation, the final system will most likely not capture the maximum business

value to the client and the Integrator may end up with a money loser project; a lose-lose relationship.

Client does back of napkin requirements definition

Even though this may sound like a step up from having the client fully trusting the Integrator to perform requirements elicitation, it can actually be as dangerous as the former scenario.

This scenario is defined when the client does have internal resources that can be devoted to an initial requirements gathering exercise. Though this may sound appealing as there is nobody better to understand the pain points and the areas of value that need to be captured by the T&M systems as the client herself, there are some underlying challenges that need to be addressed.

The first one is the fact that the client may not be as well versed in performing a thorough requirements analysis for T&M system as an expert from the field would be. This drives errors of omission, as described in the previous challenge. Errors of omission will in turn drive change orders by the Integrator, which will drive schedule and cost overruns, much like in the case of the previous challenge described in this chapter.

Also, it is usually extremely difficult to find resources who can execute a well balanced business and technical requirements gathering activity. It is important to recognize potential gaps in the organization's resource pool to make sure the company is not falling into the traps exposed in the previous chapter around the challenges in gathering well formed requirements.

One other fact that is usually present is that internal resources rarely can dedicate themselves full time to the requirements definition exercise. They usually have their day to day job they still need to perform, and are asked to execute this other activity on top of that job. As it was presented, planning and preparation for the T&M project is the most important driver for project success. Shouldn't such important activity deserve a full time resource(s) working on it?

Another fact that is fairly common is for internal resources not to have in depth knowledge of the type of information an Integrator usually needs from clients in order to keep headed in the right direction. Unless the internal resource has worked for a System Integrator in the past or has lots of experience engaging Integrators as part of her job, usually, the Integrator will most likely have to direct this internal resource on the type of information that it needs in order to successfully quote and execute the project.

This knowledge on how the Integration business works is extremely important when performing the initial risk analysis for the T&M project. If an internal resource doesn't necessarily know what drives risk for Integrators, it may not properly prioritize requirements that could have been dropped to reduce the overall proposal price with minimum impact to the final solution.

Sometimes, the execution of prototyping activities to further understand risk areas is another extremely valuable activity. The understanding on how risks impact not only the T&M project as a whole, but also the Integrator implementation is fundamental for the definition as to whether or not prototyping is needed and to define exactly what is to be prototype and how.

One may argue that the Integrator can potentially suggest this type of tradeoff and prototyping activities, but it is usually difficult for that to happen unless the integrator is very familiar with the project and client, and spent a considerable amount of time understanding the system to be built, how it will impact the client's business, pain points to the client, etc. As it was seen at the first challenge described in this article, Integrators don't usually have that time available.

When this is the case, the relationship falls back into the previous challenge described, as the Integrator's focus, as it was seen, is in making sure it is delivering the contracted scope of work, and not necessarily aligning the T&M implementation to maximize its business value to the client. The Integrator will most likely use several technical assumptions to cover the gray areas of knowledge in the requirements set as well as will probably provide a much higher proposed price for the system to cover the risks.

On this situation, one suggestion would be for the client to consider having an expert who can direct the internal available resources in the right direction and make sure the facts above don't push the planning and preparation towards failure. This expert would, ideally, have a thorough understanding of the System Integration business, deep technical skills in the technology available to implement the technical solution and, ultimately, have business savvy to understand the business value the system will bring to the client.

Over the Fence Mentality

This situation happens when the client believes that since an expert company is being hired to execute the T&M system, the Systems Integrator will take care of everything with absolute no or very minimum interaction with client internal resources until it is time to deploy the system.

On this described scenario, not only the requirements' gathering is given to the Integrator, but there is usually very minimum interaction throughout the project lifecycle. It is important to make the distinction here that when it is said that there is minimum interaction with the client throughout the project lifecycle, the intention is to say that there is minimum technical and business exchange between the client and the Integrator. Even though the Integrator's project management process may call out milestone meetings along the course of the project, on this scenario, the client either doesn't have technical resources to make sure the proposed solution by Integrator is in line with what is needed, or it doesn't have available resources that can devote the time to make sure the client's business value is being implemented.

On this situation, the client usually flies through the milestone checkpoints and raises a flag much later on the project lifecycle, usually at deployment time, when the delivered features “are not what they thought they would be”.

Another issue that is usually noticed in this scenario happens around the information flow between client and Integrator. Unless there is a main point of contact in the client’ side who understands what type of information need to be passed onto the Integrator and the potential impact of not passing that information will create, usually the communication between client and Integrator suffers. Once the communication suffers, the project is headed to failure.

As a trivial example to the paragraph above, consider a scenario where the Integrator is working on developing a T&M system to test a device under test that is under development. Assume now the common scenario where the DUT development team updates the DUT firmware. This obviously can cause an impact on the development of the T&M system depending on its design and how it is communicating with the DUT. If the point of contact in the client’ side doesn’t understand that this needs to be communicated to the Integrator, the project team will continue development of the T&M system as if nothing has happened to the DUT. This can lead to an unpleasant surprise at verification time when the Integrator can spin its wheels trying to debug the system, without knowing the DUT is actually different than the one the system was designed to interface to. This will lead to cost and schedule overruns.

It is the client’s best interest to make sure the final T&M system delivered by the Integrator is aligned to maximize its business value to the client. Good Integrators will make sure the contract is fulfilled and the T&M system that was originally contracted is delivered. However, it is sometimes very difficult to predict all features and interfaces a T&M system needs to implement at very early stages of its project lifecycle. As the system design and implementation is underway, and parameters from other areas that are related to how the system will be utilized by the organization become clearer, sometimes there is a need for tweaks and small redirections. The Integrator that is left at their own devices won’t have the needed visibility to make those adjustments and an opportunity to capture value may be missed.

T&M System Implemented in Parallel to DUT Design

One other scenario that is fairly common at the T&M industry is when, in support of a client’s NPI, a T&M system needs to be designed and built prior to the actual device under test to be designed and built.

One may question the feasibility of the approach; however, the fact of the matter is that the vast majority of the NPI schedules always assume the test system will be ready to be used as soon as

the product development is complete. This sound like an impossible task and a recipe for disaster as it violates the very root cause for T&M project failure; lack of well established requirements.

In fact, it can be an impossible task and a recipe for disaster, depending on how the project gets executed. As it will be seen at a later chapter presenting the T&MPM framework, there is a solution for this problem. However, this is usually not how the situation is tackled.

Historically, Integrators have been applying a typical Waterfall approach to managing T&M projects. As it was seen as part of the introduction, the concept of Waterfall Development lies in the idea that the overall project can be broken down into different phases and that work needs to be brought to completion in one phase in order for work on the next phase to be initiated. For instance, all requirements need to be fully defined before system design can start.

Waterfall Development thus emphasizes more time spent up front in the project lifecycle, highlighting the importance of requirements and design documentation. It is easy to see why Integrators favor this methodology. Since they are on the hook to provide clients with fix priced proposals for T&M systems, the only way for them to have a level of confidence that the risks are somewhat known and under control for them to have a shot at being profitable at the end of the project, is to make sure the requirements are known to a somewhat high level of certainty.

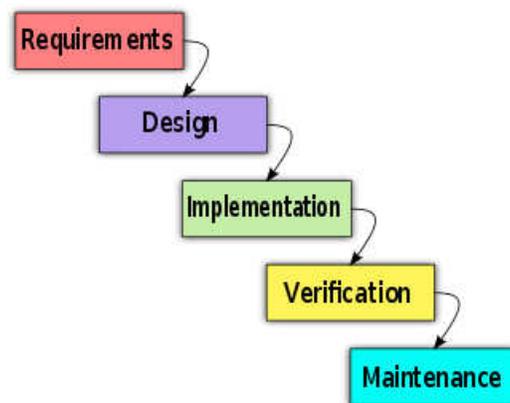


Figure 1 – Waterfall Development

One can see the conundrum of this scenario. How can the T&M system requirements be defined and well known if even the DUT requirements themselves are still in a high state of flux?

What ends up happening is that the Integrator will follow its usual waterfall model by using the information that is available about the DUT at the time of proposal generation. It will use technical assumptions to make sure it is contractually covered in the event of changes to the

DUT. The proposal budget is taken to whoever is the economical buyer at the client' side, a T&M budget is set aside and the contract put in place.

Well, changes to the DUT not only are expected, but are certain to occur as the product development process is still underway. A project being executed under this scenario needs to be managed extremely well, not only on the Integrator side, but also on the client side. However, one first issue that will most likely happen is the fact that the original budget that was put in place for the T&M system will most likely not be accurate due to the fluidity of development. Depending on the depth of the changes in the DUT, the T&M system may need to change significantly to match the new revision of the DUT. This always carries a cost and a schedule impact.

Using the last sentence as a hook to the next argument, the original implementation schedule that was included in the proposal will most likely not hold, for the very reasons that were presented above. Now the expectations need to be realigned, not only with the client main point of contact who is being managed the Integrator, but throughout several other departments in the client organization that were assuming the T&M system original schedule as Gospel. This communication needs to be very tactfully managed by both the Integrator and the client main point of contact who is managing the Integrator.

One other fact that is very often overlooked by both client and Integrator is that, usually, there is a lot of value in having the T&M system partially delivered to the client and in a configuration where the product development team can use it to execute characterization exercises. The T&M system has instrumentation that usually can be used by the client R&D department to collect data that will help in making design decisions about the DUT.

If a pure waterfall development methodology is used, the Integrator will most likely object to having these intermediate deliverables to the client as they can be very disturbing to the actual flow of development of the T&M system. They most likely will add to the Integrator's internal costs and will create an impact on the overall deployment schedule.

These issues are very difficult to be addressed by the existing frameworks and the typical way Integrators execute T&M systems. Future chapters show how the T&MPM framework proposes to address them.

T&M Budget Defined before Feature Set is Complete

This scenario is somewhat similar to the one presented above where the DUT design is done in parallel to the T&M implementation. However, it was included here in order to highlight the fact

that this situation where the client needs to define the budget for the T&M system prior to its functionality set to be fully defined is not a situation that is exclusive to client's NPI processes.

Several clients define the business need for a T&M system and need to come up with some dollar figure in order to justify that capital expense. Usually, a procurement process is started and Integrators invited to provide technical proposals for implementation. Very often, at that early stage, the full feature set for what the T&M system will implement is not necessarily flushed out. It is not uncommon for clients to request a ROM (rough order of magnitude) estimate in order for capital budget to be secured.

The Integrators will work with the information that is available at the time and come up with a fix price proposal or a ROM that covers the known features as well as include technical assumptions to cover risks and unknown features.

The best technical proposal/ROM approach is selected. At that point, the capital budget is reserved and maybe the project is started immediately by awarding an Integrator the contract, or it starts at a later date. Regardless of when the project starts, the fact of the matter is that now there is a fix budget set to implement a system where its feature set is not fully determined.

New requirements on these situations will always come to light once the project is underway. As it was seen previously, the Integrator will try, to the best of its ability, to stick to whatever scope of work was attached to that project budget. There will be an inherent disinterest from the Integrator's point of view to act and implement new requirements. Or it change orders will be put in place as a mechanism to make sure the new scope is properly funded. However, as it was seen, there usually isn't budget available in addition to the capital budget that was reserved for the project when the feature set was still undefined.

This causes all sorts of problems and one of the three following consequences: Integrator will offer to drop existing scope and use corresponding funding to the implementation of the new requirements, new requirements will not be implemented, or, there will be a contractual battle between client and Integrator in case the proposal verbiage is somewhat ambiguous in relation to requirements and scope of work.

Regardless of which of the three actually happen, there will be dissatisfaction and non value-add activities happening between the two organizations that will most likely cause cost and/or schedule overruns. Not only that, at this point, it is almost guaranteed the implemented system will fail to maximize its business value to the client.

Conclusion

Can all the issues presented in this article be pinned down as the Integrator's fault? Hardly. Is it the client's fault then? Also not true. Modern T&M systems have become much, much more complex than they were several years ago. The pace of technology advancements pushed end products to become true engineering marvels. As such, the corresponding T&M systems to support such products are also now exponentially more difficult to implement than the ones supporting much simpler devices under test.

Furthermore, technology advancements also reached data acquisition hardware devices that are now available as off the shelf components. What can be done now with off the shelf components used to require a product development project for a custom electronic device to be created, in a not so distant past. The breath of tools available to engineers and scientists today allow them to unleash their creativity in solving the most difficult problems. As a direct consequence, the requirements for T&M systems of today have transformed such projects in very complex projects. Complex projects need extra levels of planning and requirements elicitation processes in order to be successful.

The conventional model that used to work in the past where a client would engage an Integrator, as the domain expert in the T&M field, and simply hand the project off as a guarantee of success is no longer valid. The path to success when engaging an Integrator to execute a T&M system these days requires for the client to understand that a true partnership needs to be formed with the Integrator.

It is at the client's best interest that the Integrator has an uneventful project implementation, as that is the guarantee of an on time high quality system delivered. For that to be the case, the client needs to better prepare prior to engaging an Integrator to execute the T&M system as well as to support and monitor the Integrator throughout the entire project lifecycle to make sure the Integrator is marching in the right direction.

Conversely, the Integrator needs to make sure it fully understands and is aligned with the T&M system business value provided to the client. It is in the Integrator's best interest to raise a flag when/if it recognizes that the current contract as stated will prevent the organization to provide the most value to the client. As in the case of defects that cost much less to fix when uncovered early in the project lifecycle, it is much easier to deal with these types of contractual issues when the project is not going through critical path and everybody is scrambling to deliver on it.

Usually, at early stages of the project lifecycle, the Integrator has much more flexibility to move funds around and to reprioritize tasks, as those funds haven't been burnt as part of the project execution. One universal truth that needs to be understood by both client and Integrator together is that a risk won't just go away if it is ignored. Making sure risks are always being captured

doesn't mean the people involved in the project are being negative or pessimistic about its outcome. On the contrary, the project team, and when I say project team here I mean all project stakeholders from both Integrator and client, that is constantly bringing up risks to be captured as part of the risk registry is the one that usually see the best overall project outcome for both Integrator and client.

Opportunity costs for a delayed product launch is the highest cost an organization will bear on today's speed to market requirements; which can actually take companies out of business. Any perceived costs in proper planning and preparation for the T&M effort is money very well invested in the success of the NPI. As it was seen above, money spent up front is not necessarily an added cost to the overall T&M activity, but a redistribution of that cost and potentially a cost reducer. It is a known fact that defects found at earlier stages of a project lifecycle are much cheaper to address than the same defects uncovered at later stages. As such, it is easier to understand that every dollar invested on planning and preparation for the T&M project activity, even when engaging an Integrator to implement the system, it will save the client many dollars later in both saved change orders during project execution, but chiefly, in saved opportunity costs by speeding up the NPI.