

Your company just decided to add a new product to the lineup and you're up to bat on purchasing a new manufacturing line. It's just like buying a USB charger on Amazon, you make sure the product is at least 4/5 stars and you browse a couple of the reviews, click, click you're all set. Dream on-not even close. This purchase may very well be the largest purchase you have been involved with and it will consume the balance of your thoughts for the next year and don't forget that everybody's watching.

With any new significant endeavor, the best course of action is to plan well, build on the experience of others and work with a solid team. Let's first go over the functions of the team.

Project Manager-the organized one. Tracking of the tasks, documents, project charging, etc. to keep everyone on the same page and aware of their tasks.

Supply Chain-this is your buddy in the foxhole if things get bumpy with the supplier. They cover contracts, negotiations, and change orders.

Technical Lead/Champion-the go-to for all technical information. If they don't have it, they know who does.

Quality-source of quality standards, reviewer of documents, evaluation of supplier.

ES&H-source of standards, best practices, design reviewer.

Marketing/Product Manager-the voice of the customer. Knows in detail what is to be produced and why.



Facilities-homeowner. Does the machine fit? do we have enough power? Source of many of questions that need to be answered in the specification.

Process Engineering-the most invested person in the details. Will be responsible for the development and qualification of the process.

Equipment Engineering – Owner of Specification, controls and systems engineering. The source of company standard practices and preferred equipment suppliers.

R&D/Product Development – Key resource for the products' function and specifications. It's likely there's some new custom feature included that hasn't been mass produced so keep them on the hook until production is up and running.

Operations-the customer. They are not the final customer, but they will be the most vigorous advocate for making sure the new production line works.

Of course, the team should be scaled up or down to match the complexity and size of the project. Small projects may require people

taking on multiple roles but be sure not to neglect a role just because it seems small. You may also have other functions such as compliance, permitting or certification that require special attention.

To break the project down into manageable pieces, a set of 12 phases are suggested here as a foundation. These phases will ultimately be shaped to match your organization's style and project management system.

1. Requirements – Document detailing the product to be produced along with the capacity and cost requirements.
2. Specification – Document that translates the product requirements into functional details of the new equipment.
3. FMEA – Performing a Process Failure Modes Effect Analysis on the proposed equipment design is the best way to reduce project technical and schedule risk.
4. Proposal – Submission of the specification to suppliers, answer their inquiries and iterate specification if necessary.
5. Supplier Selection – Evaluate the supplier proposal, supplier capability, and efficacy of the original specification.
6. Test Plan – Determine materials, and resources needed to test and accept the equipment at the supplier and on-site in your factory.
7. Design Reviews – Reviews of the specification, conceptual design, and detailed design before the build starts.
8. Build – Supplier fabrication and further definition of the details of the equipment's operation that were not

included during the proposal or design reviews.

9. Factory Acceptance – Evaluation of the completed equipment relative to the specification using observation and execution of the test plan.
10. Site Preparation – Physical preparation of your site's facilities including supporting equipment and procedures. Installation and startup on the factory floor.
11. Site Acceptance Testing – Execution of the test plans and evaluation of machine compared to the specification.
12. Process Qualification – Full capacity evaluation of yield and quality. This step may be included in 11 if the supplier is completely responsible for product quality and throughput.

Now that we have a picture of the team and the project's phases, let's dive into the inner workings of the project.



Fully automatic line with 8 robots for a medical device. Courtesy of CAID Automation

Project Management

What is planning? It's preparation for actions you know of and anticipation of the things that could likely go wrong. Project management is the methodology to organize tasks and keep the project on track. There are plenty of ways to manage this function, and if your organization has a system in place you should definitely use it, even if it's not ideal. Reducing the friction related to getting tasks done is a critical and ongoing endeavor. Using a system that people are already familiar with improves acceptance of the tasks. Adding 'features' to the existing project management system may be helpful, such as personalized task summaries and 1-1 discussions.

A good project plan should start with a project charter that defines the purpose, scope, costs, and makes the business case for the new equipment and capacity. The team should brainstorm all the significant tasks needed for the project and generate the initial timeline.

When determining the budget, if you are planning on custom equipment, you're usually in a no-win situation. If your estimate's low and the supplier's quotes come in high, no one's happy, if your estimate is high, you'll have to spend too much time defending the project before it gets started. It's best to use the experience of the team, and a similar quote if you have it to come up with a base cost with a list of incremental cost estimates so that there is some built-in justification for each line item. Remember to include materials, travel, consulting, testing, installation, shipping and support equipment.

Agreement on the charter and approval by management may not be available or advisable until after the Requirements and Specification phases are complete but remember the game clock may be stopped

but the project clock is still ticking even though there isn't agreement on the project.

Meetings

The team should have regularly scheduled meetings to stay informed and keep things on track, but you want to avoid it feeling like a chore so pick a schedule that matches the requirements. Meeting a couple of days in a row might be ok for the kick-off with a change to weekly or bi-weekly as the situation merits-bring cookies. The team will start out as a working group to determine the project charter and tasks then move into more oversight and review activities. One of the goals of the initial meetings should be to build the team and project ownership. Engaging all of the participants can help this process, a useful exercise is to go around the table and ask if they have worked on a similar project and if they have any stories or advice. If they are concerned about the success of the project, try to use the team to address the concerns.

As far as the primary work product of the meeting, the tasks and schedule should be updated which naturally brings up any issues. Look for opportunities to save meeting time by researching items offline before the meeting such as spending and order status.

Don't expect 100% attendance. Only if things aren't getting done or going well will it be an issue. Have the big boss sit in occasionally for weight if it's needed to improve attendance and help with decisions that the group is delaying.

Many of the accomplishments and decisions will be made by individuals or smaller groups working as a satellite to the project team. A couple of key examples are the specification development meetings or the meetings with the supplier during the proposal review and build. These topical meetings will likely change over time but need to have delegates that drive the tasks and provided feedback to

the project team. The expectation should be regular status reports with assigned action items. If there is a reporting issue assign a team member or the project manager to these meetings for support if necessary.

Progress Reports

Long projects will inevitably have ups and downs that you can't control. Knowing there will be trouble, what are you going to do about it? You're probably thinking "How I'm I supposed to fix a theoretical question about a non-existent project from an unknown author." Well, you don't, but since you know that there *will be* problems you need to prepare the team and management by putting together a program that looks for problems and communicates their status regularly. I suspect you were assigned this role because a primary function of your job is to solve problems and make decisions. So, since those activities are going to happen anyway, don't completely hide them behind the scenes.

Progress reports, whether asked for or not, are an excellent way to keep everyone up-to-date on the good and the bad. If you build a weekly report that discloses issues and shows a track record of fixing them, you are banking credibility so that every issue overheard in the hallway doesn't get you a trip to the principal's office.

The progress report should be as simple as possible, 1 page if possible, so it's read by management and the people working on the project. Unless the project is sensitive, broadcasting the report should be as wide as possible. Include schedule and budget status, significant issues and positive progress. It's not obvious to highlight the achievement of scheduled progress so make sure optimism comes through when appropriate. When reporting problems, I suggest adding possible solutions and include the last couple of problems that were solved to show progress. Including major decisions is also a

good way to keep everyone up-to-date on the direction of the project. Add a picture to the report if you have something cool to show.

It's best to use the same format every time so it's easy to read and you can also have the report generated mostly in the course of the team meeting. It saves time, minimizes the gap between reporting and reality, and adds weight since you have buy-in from the team.



Automated line, based on a rotary table, for a medical diagnostic product. Courtesy of CAID Automation

Schedule

The schedule is going so well that you need to move the dates up in MS Project but you're having trouble with the software for some reason. So, you're on a chat with Microsoft customer support describing your problem and they say, "We don't understand, there is no function to shorten the schedule, are you sure you didn't make a mistake?"

Even if things are tracking early who wants to report it and give it back again down the road? I would bet that your supplier won't. The sunny side is nice to contemplate, but the reality is you'll be putting most of your effort into holding the schedule you put together months ago. The biggest schedule change you should anticipate is when you adopt the first schedule from the supplier. This will likely disagree with the original

schedule estimate so keep that in mind when the team makes the original plans.

The good news is that the supplier wants to ship the new equipment as much or more than you, so you have the same goal. The trouble is that depending on who you are dealing with, they might be biased to portray a more or less optimistic view of the schedule. Getting a handle on this is helpful and asking a couple of people at the supplier early on about their philosophy and record may be helpful down the road.

Since you're pretty much obligated to use the supplier's schedule during the build phase and can't realistically keep two schedules, you'll need to be more conservative about the schedule for the tasks you can control. You can't plan for a supplier's schedule slip but planning your response ahead of time and managing expectations can help when the time comes. Be generous about the time of the acceptance, shipping, and installation. Padding these can be justified because there are many unknowns when offsite and your company doesn't have complete control of the resources.

You can reduce technical and schedule risk by determining if you have development efforts that have an unrealistic schedule or a high probability of failure. Keep an eye on the efforts to address the high priority items from the FMEA to manage the technical risk. A similar exercise to the process FMEA on the overall project schedule would help identify what tasks are likely to need backup plans or additional resources. Learning about schedule recovery techniques is also a good exercise before they are needed—they also help with supplier discussions.

A good project schedule is one that you can work on live with the team and easily maintain. I suggest detailing supplier subtasks that have a resolution of about 2-weeks, so you can respond before it's too late. The build schedule is owned by the

supplier, but it's only a subset of the overall project so it needs to be well integrated. If it's a complicated project, also track the BoM deliveries for several long lead parts and randomly check on others or get the entire parts list status.

Change Orders

Death, taxes and change orders. Just like problems, you should expect changes and even go as far as supporting positive changes. Remember that progress through positive change is in the spirit of the new equipment, but change orders are not your friend. It's \$ and time. It comes across as poor planning even if it's driven by a late-stage product change. Use of the team is critical here since changing the specification and/or the purchase order will be a distraction and takes up valuable time. The team approach can help with reviewing the change and deciding on the path so it's handled only once. Always get changes documented by the supplier so there is no confusion.

Also, it's a good idea to get changes signed off by the same management that approved the initial project, so everyone is aware of the change in scope. No one wants to be in the boss's office discussing a change order from three months ago.



Robotic line for aerospace product. Courtesy of CAID Automation

Be Prepared

A successful new equipment project requires the accomplishment of numerous tasks by people that don't necessarily have all the information they need to align with the project's goals. Dealing efficiently with the inevitable shortcomings and problems that arise requires that the team is made aware of the problems and can solve them promptly. Therefore, building a project system with tools so you can detect problem's as soon as possible is critical. Anticipating missteps by looking for failure modes is the best way to lower technical and schedule risk. Solving problems can then be accomplished by a team that works well together and invested in the successful outcome.

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