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Control Systems

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KEYWORDS

- **Systems intergration**
- **Control system design**
- **Project management**
- **Standards compliance**

The latest initiative by the Control System Integrator Association (Exton, Pa.; CSIA at www.controlsys.org) offers help to end-users who lack adequate in-house resources for designing and implementing automation and control projects themselves.

The CSIA's new "Guide for Selecting & Working with a Control System Integrator" (the Guide) helps them find a CSI with the knowledge, expertise, and experience required for specific industries and applications. It includes sections on evaluating and selecting a CSI, developing a "request for proposal," selecting the best proposal, and managing the project.

(*Control Engineering* also offers help—see sidebar on enhanced searches.)

Selection criteria

The Guide's suggested method for evaluating a CSI begins with a decision analysis tool based on the Kepner-Tregoe methodology. It establishes the appropriate selection criteria and classifies them by relative importance. It also outlines a simple and logical procedure for reaching a conclusion based on the selected criteria.

The specific selection criteria proposed in the Guide were derived from the CSIA's own research into the characteristics that define sound and successful CSI businesses. The resulting list of best practices and benchmarks was put before a panel of end-users, product manufacturers, equipment distributors, and integrators to determine which are most important in selecting the best CSI for a job. Not all apply to every

situation, but end-users looking for a place to start their evaluation will find this list quite comprehensive.

The general management of a CSI's business is the first criteria addressed in the Guide. Long-term management issues such as the CSI's purpose, long-range plans, objectives, and goals may not be particularly important when selecting a CSI for a particular project, but could affect the decision of an end-user seeking a long-term partnering arrangement (commonly called "in-sourcing"). More immediate management issues include the company's organizational structure, facilities and equipment, computer system management policies and insurance coverage.

A CSI's recruitment process, employee development, and other human resource issues can also bear on the end-user's decision. Employee retention can be particularly important. Substituting new personnel on a long-term project can be very costly to both parties in terms of efficiency, project familiarity, and even employee competence. The end-user may also want to ascertain if the CSI will be executing the project with the experts presented during the selling phase or if different personnel will be assigned after the deal is signed.

Project management issues include clarity of scope, thoroughness of work planning, project team structure, practices and standards, project execution methodologies, documentation, quality procedures, testing, and commissioning. Prospective clients may not need to judge the CSI's actual methodologies during the evaluation stage, but they will want to ensure that the methodologies will be documented and followed per the project scope.

Proposals

The Guide also covers the automation project itself, starting with guidelines for developing a request for proposal (RFP) and evaluating the proposals submitted.

An RFP should include an overview of the project, the environment in which it will operate, the scope of work, details of who will supply what, performance criteria, a list of applicable standards and policies, and documentation requirements.

The project overview is particularly critical to the success of the project. It should provide the overall intent of the project and contain a brief description of items such as project objectives, operational overview, project schedule milestones, and system performance requirements.

The scope of work covers the details of the work required, assuming that the preliminary budgetary work and field research have already taken place. The materials or products to be handled by the automation system must be fully defined.

All existing documentation, such as plant layout drawings, hazardous area classification plans, equipment lists, P&IDs, one-line diagrams, motor lists, input/output lists, and interfaces to external systems, are of utmost importance in defining the scope of the project. The impact on existing plant equipment must be clearly defined, including power, steam, and water capacity; instrument and plant air capacity; network capacity; rack and cabinet space; and UPS capacity.

Third-party issues

All hardware, third-party software, and services to be provided by the CSI must be clearly defined in the RFP. These could include consulting, project management, specifications, design and documentation, software development and documentation, software testing, procurement, panel fabrication, construction, installation, commissioning, training, and on-going support.

Most projects also require interfacing to existing equipment or to new equipment provided by other suppliers through the client. This client-supplied equipment, as well as the CSI's access to it, must be specified. Modifications required for existing equipment, a shutdown schedule, and a list of who is responsible for each modification must also be detailed.

Multi-vendor control systems also involve support and warranty issues that should be addressed as part of the original contract. A mutual understanding is required as to what support services are included in the project and who will be responsible for it.

Additional job assignments should include a roster of the client's project team and the labor to be provided by the client for installation and start-up. The RFP should also specify who is to provide the development hardware and software and whether or not it is to remain with the project.

Performance criteria and the client's acceptance criteria must be fully defined and realistically stated. Performance criteria could include production rates, consistency and tolerance specifications, and reliability measures. It is also important to define the appropriate acceptance testing methods such as software simulation, hardwired simulation, or actual process trials.

The control system's environment, including hazardous materials, seismic activity, site geography, and altitude, is equally important. Temperature and humidity requirements must be specified for both indoor and outdoor locations, where applicable.

Standards compliance

All applicable standards and government regulations affecting the system should be stated. Client policies, such as safety, work conditions, refuse disposal, labor relations, confidentiality, and exclusivity, should be included in the RFP where applicable. Any special equipment or training required by or from the CSI should also be clearly defined.

The client may establish standards or preferred manufacturers for the project's equipment, but where the CSI has latitude, the RFP should indicate where equivalent products would be acceptable. The level

of redundancy required must be stated along with spare capacity, such as extra rack space.

Connectivity requirements for hardware should be specified if standards have been established or if the system must interface with existing systems. Certification and labeling requirements such as UL, FM, CSA, CE, etc., should be stated where applicable.

The client may also establish software development standards such as IEEE, FM, NFPA, or BLRBAC. If commercial software is required, the CSI should specify the number and size of the runtime software packages to be included in the project. The RFP should also address the transfer of third-party software licenses.

Good documentation can go a long way towards assuring the success of follow-up projects. Drawing requirements should be specified, including CAD packages or preferred drawing formats, title block and symbol library requirements, numbering sequences, layering, etc. Final format should be specified as hardcopy or disk. Software documentation addressing code annotation, source code vs. compiled runtime code, etc., should be stated. Requirements for operator and maintenance manuals should be specified as to the number required, format and content. The training requirements for operators, maintenance personnel, and technical staff must also be defined.

Once the RFP has been published and answered, the client is faced with the daunting challenge of evaluating the competing proposals. The selection process that the Guide suggests involves the same decision analysis tool used to evaluate and select a CSI, albeit with different criteria.

Project management

The management of the project begins once the CSI and the proposal have been approved. Every project involves constraints that dictate that certain activities be completed before others. The Guide provides an overview of proven principles for managing the workflow, as well as a means to assure that critical steps do not get overlooked.

However, every project is unique and must be planned and implemented according to its specific elements and constraints. The client should designate a project manager (PM) to develop an action plan tailored to meet the particular needs of the project.

The PM is the key to completing a successful project according to the project plan. The PM assures delivery of all purchased deliverables, while meeting a defined schedule and budget. The project plan, the execution plan, communication details, work breakdown, the schedule and budgets all come under the responsibility of the PM.

Because the scope of a project tends to change between the time a proposal was approved and the time of the actual purchase, the PM should review the purchase order to determine that the client has purchased what was proposed and what, if anything, has changed. Changes should be documented and clarified between the client and the CSI at the very beginning of the project.

Planning and scheduling

A successful project will also have a well-documented plan for how the work will be accomplished. This project plan should be developed jointly with the PM and the CSI's technical project leader. The plan should detail the project schedule, the project team, required resources, and training as well as project implementation, testing, installation, and start-up. Since changes are inevitable, the plan should be reviewed, revised and reissued to the project team as necessary.

The project schedule is a key measurement tool for the PM to gauge the team's progress towards a defined end date. It also serves as a communication tool to keep the client apprised of the CSI's progress. Commercial scheduling tools such as Microsoft Project or Entivity Automation ProjectNet are preferred for this.

Major milestones for the project schedule could include award, kickoff, functional specification, approval of the functional specification, detailed design, fabrication submittal, fabrication approval, equipment purchase, detailed programming, unit testing, integrated testing, factory acceptance testing (FAT), approval of the FAT, shipment, installation, checkout, and start-up.

Once the project schedule is complete, a detailed work breakdown structure can be prepared to take work assignments to the detailed activity level. It breaks the project down into measurable, manageable bits of work that can be defined by an action verb. This level of detail is imperative, as it will determine the scheduling, tracking, reporting and communications efforts throughout the project. It is advisable to use critical path management techniques to determine possible scheduling constraints.

Implementation

With all of the preliminary planning complete, the project can begin with a kick-off meeting and continue with periodic review meetings held between the CSI and the client. The CSI's PM should prepare and distribute minutes of all meetings detailing information presented, assignments made, agreements made, and details affecting commercial issues.

During the course of the project, the PM is in charge of maintaining "official" communication between the CSI and the client. This may include issuing and receiving approvals for any submittal and the schedule impact of missed submittal dates.

Meanwhile, the client typically takes responsibility for timely response on commercial issues, resolution of all scope changes prior to implementation, review and agreement/disagreement of all project documentation, timely notification of schedule changes, support of the CSI while in the field, and overall review at the end of the project.

Once all the panels and software are complete, the FAT can be performed. The entire system is wired together and tested to simulate inputs and the resulting outputs. The tester fills out a pre-approved written test plan in detail. This test is usually at the CSI's facility and should be witnessed by the client.

Start-up follows the FAT. The start-up plan is usually the responsibility of the CSI. The CSI must complete and retest any open action items agreed to during the FAT. A site acceptance test (SAT) can then be run on site to prove the system tested with the FAT operates correctly with the actual equipment in the field.

Sign-off

All tests are either classified as "acceptable," "failed," or "good, but modifications needed." Obviously, failed items have to be corrected and retested until acceptable. Any changes identified during the start-up tests must be reviewed for implementation, then tested until acceptable.

The completion of the SAT is normally considered the point of client acceptance. At that point, the CSI must prepare and present an acceptance or sign-off document to the client to complete the project. This document will signify that the control system is complete and fully functional (except where noted) and that all deliverables have been met or provided to the satisfaction of both parties.

The "Guide for Selecting & Working with a Control System Integrator" covers all of the foregoing issues in general terms that may or may not be applicable to all control systems. Nonetheless, users looking for a place to start an automation project may well find the CSIA's guidance helpful.

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Sidebar

Acronyms used in this article are:

BLRBAC - Black Liquor Recovery Boiler Advisory Committee

CE - Conformité Européene (European Conformity)

CSA - Canadian Standards Association

CSI - Control system integrator

CSIA - Control System Integrator Association

FAT - Factory acceptance test

FM - Factory Mutual (Research)

HMI - Human-machine interface

IEEE - The Institute of Electrical and Electronics Engineers

NFPA - National Fire Protection Association

P&ID - Piping and instrumentation diagram

PM - Project manager

RFP - Request for proposal

SAT - Site acceptance test

UL - Underwriter's Laboratory

Since its inception in 1994, the Control System Integrator Association (Exton, Pa.; CSIA at www.controlsys.org) has served to promote the interests of independent control system integrators (CSIs) and help them establish a presence in the industrial automation industry. Through the CSIA, member firms work in a collaborative environment to improve their effectiveness and educate their clientele.

Today, the CSIA includes over 160 member firms, headquartered in more than 30 states and four countries.

Members provide products and system integration services for automation projects involving process, discrete, and batch control; robotics; supervisory control and data acquisition; and manufacturing execution systems. The average member has well over 10 years of successful automation installations and a staff with thousands of man-years of actual system experience.

For more information, go to www.controlsys.org or contact Executive Director Norm O'Leary at execdir@controlsys.org or 800/661-4914.

Control Engineering enhances system integrator searches

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