

CASE STUDY  
NO. 23

AGVS PROCUREMENT AND THE BITTERSWEET  
STORY OF FICTIONAL CO., INC.

by

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## ACKNOWLEDGEMENT

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AGVS Procurement and the Bittersweet Story of Fictional Co., Inc. Bruce Boldrin

### ABSTRACT

The procurement phase of an Automatic Guided Vehicle System is critical to project success. It forms a bridge between the initial conceptualization/justification efforts and the contractual project. The continuity between concept and system operation is achieved with (1) the Requirements Document to obtain a focused proposal, and (2) a Functional Specification to assure detailed design. For a project to be successful, each document must be properly executed at the correct time. The timing and scope of customer/vendor communication is also critical to project success. This paper describes a proven procurement process, using a counter-example to point out details that have historically plagued otherwise-good AGVS projects. Backup information includes a Requirements Checklist and Vendor Evaluation Criteria.

### THE STORY

The bittersweet story of FICTIONAL CO., Inc. has been compiled from 15 years of experience and observation of the AGVS industry. The Fictional Co., Inc. story starts with a good beginning. Opportunity came in the form of a plant modernization program. AGVS was chosen over counterbalanced fork trucks for two key reasons: labor savings and inventory reduction. The inventory reduction was to be accomplished by the AGVS's ability to track unit loads of material, and feed this information in real time to the Shop Floor Control and Corporate MRP systems.

A project team was formed, consisting of a Manufacturing Engineer (the Project Leader), a Systems Engineer, a Plant Engineer, a Buyer, and the Assistant Manager of Operations, as a management champion with a vested interest.

The team worked with a local AGVS vendor through concept development, evaluation and feasibility analysis. It developed two concepts, one using Unit Load AGVS and one using Fork Lift AGVS. The Unit Load AGVS required one less vehicle, but needed a number of Pickup and Deposit stands. The Fork Lift AGV's were more expensive, but could pick up and deposit loads from the floor. Both alternatives would work. The costs were approximately the same, at \$720,000.

In a first-cut analysis, based on labor savings alone, the payback was 1.7 years before taxes and 2.4 years afterward. in rough numbers, four new Internal Combustion

Counterbalanced fork trucks were saved, at an initial cost of \$16,000 each. The plant worked two full shifts, requiring eight truck operators and two expeditors (one per shift). The average wage with fringe was \$35,000. Knowing that additional savings could be obtained from inventory reduction and reduced damage, management gave the go-ahead to obtain firm quote proposals, final justification figures, and a "12 month schedule - from today!"

Highly motivated, the team prepared a performance based Request For Quotation (RFQ). The RFQ included a requirements statement, design constraints, a 10-month schedule (to allow six weeks to procure the system), and a set of General Construction Terms and Conditions. Since a major plant modernization project was in process, the team decided to use the same contractual terms and conditions for the Building Contractors and Systems Vendors.

Simultaneously, with RFQ preparation, a Pre-Bid Conference was scheduled for two weeks after Management's go-ahead. From a list of 38 AGVS vendors, the buyer did a quick telephone screen. He was able to identify 25 vendors with 4000 Lb. capacity Unit Load and Fork Lift AGVS.

Vendors were invited to the conference via mailgram. The mailgram gave a one-paragraph description of the system. It requested three hours: for an overview by the team, a plant tour, and Q&A. RFQ documents would be passed out at the conference. Fifteen vendors attended.

The meeting started on schedule with introductions of the team and the vendors. After a briefing on the system requirements, project schedule was hit hard. The vendors were told that the total project duration would be 10 months, following a four-week bid time and two weeks for vendor selection and contract negotiations. There was some mumbling in the audience. Following the plant tour, there were very few questions from the assembled vendors. The team leader then delivered the benediction, encouraging all vendors to give the proposal their best effort. He advised the assembled vendors that answers to questions at the conference would be formalized and express-mailed to all attendees. He further stated that questions from any individual company would be formally answered and sent to all. The meeting ended early. It was the last time the project was on schedule.

After vendors returned to their offices, there was an early rash of questions, many of them redundant. The Project Team dutifully and quickly answered all written and phoned questions. In the third of the four scheduled weeks, four vendors requested schedule extensions of two to four weeks. A two-week extension was granted. One of the original four, plus two more vendors, requested extensions in Week Five on the basis of (1) a four-day weekend holiday in Week Six, and (2) the need for additional time to receive subcontractor quotations and prepare proposals. An additional one-week extension was granted.

In total, six proposals were received. Prices ranges form \$580,000 to \$875,000, after the lowest-priced quote was thrown out. The lowest-priced quote took exception to most requirements, and offered an alternative that would not provide the critical material tracking function. On the basis of non-compliance, it was disallowed.

The team immediately notified the next-lowest-priced vendor, who arrived the following week to consummate the agreement. The vendor appeared to have a good technical solution; however, its schedule was 11 months, vs. the requested 10, and a number of exceptions were taken to the General Construction Terms and Conditions. The exceptions included Lump Sum payments for equipment "delivered and set in place" on site - appropriate enough for bricks and mortar, but not for the design efforts that precede and parallel AGVS equipment manufacturing. The vendor requested progress payments. Another issue involved a "time-is-of-the-essence" clause and consequential damages, to which the vendor took vigorous exception. A third issue required the customer to have ownership of all vendor software, without any restrictions on its distribution to third parties. The vendor offered the application software to the customer, but required an on-site license for the proprietary software. Theses issues, and the necessity for both companies to consult their legal departments, required three weeks for resolution. There were coincidentally, a few scope-of-work changes, requiring the vendor to make minor revisions in its quotation. But the changes were made within the time required to iron out the T & C's. The vendor's proposal was included within the contract documents. Project schedule remained at 11 months after execution of contract.

The final contract documents were completed and signed by both parties within one week. At this point, the earliest System start-up date was 12 weeks later than original plan.

Following contract award, the customer heard nothing from the vendor for better than two months. Getting worried, the customer called for a status meeting, which took place in the vendor's facility 10 weeks after award. It was apparent that precious little work had been done, and that the vendor's project team had just been assembled. The customer was surprised at the relatively small size of the vendor's operations. The customer learned for the first time that the AGV's were substantially sub-contracted and, as of the meeting date, had not been released for production.

A revised schedule was presented by the vendor, indicating a one-month slip in Project completion. The slip was based on procurement of long-lead time components, now on the critical path; and engineering resources, which prior to the meeting had been committed to other work. The customer was upset. Heated discussions took place. But the vendor would not - actually, could not - commit to an improved schedule. Furthermore, vendor and customer agreed that communications would be improved through a monthly status report.

Progress was smooth through mid-contract. But conflicts arose during installation. The floor was not totally available for guidepath installation on the AGVS vendor's schedule. The vendor worked around the other subcontractors and trades, but arrived at a condition where its crew was blocked from further progress. The vendor pulled off-site, waiting two weeks for clearance to proceed. The customer demanded overtime, at the vendor's expense, to catch up. The vendor claimed the delays were beyond his control and, further, that (1) it had incurred unplanned work-around expenses, and (2) its quotation was premised on one-shift work, with no overtime. An accord was reached, the guidepath installation was completed, and three weeks were added to the project schedule.

Vehicles, computer, and software were expeditiously installed. System documentation was delivered. Operator and Maintenance training were completed. By then, the plant had commenced production, and the customer's need for the system was great. The customer began using the system. Premised on beneficial use, the vendor completed punch list items on the installation and submitted a final invoice.

With some system use, and coincidental with arrival of the final invoice, the customer discovered two operational problems. Problem 1 was that the system wouldn't handle

pallets with all the material removed from one side, causing an unbalanced condition. Unfortunately, this was the standard shop practice at process stations, and was normally not a problem, except at batch changeover. Problem 2 involved load overhang. In several aisles, vehicles carrying the overhung loads could not pass without the loads striking each other. The customer demanded that the vendor review and fix the problems.

The vendor visited the site and recommended a procedural change to handle the unbalanced loads. A quotation was submitted for widening the guidepaths to accommodate the overhung loads. The customer objected to paying for aisle widening, claiming the vendor should have foreseen the problem and designed accordingly. The vendor countered this position by saying that the problematic loads were not identified in the RFQ, and hence were not included in the proposal (which became part of the contract). Unfortunately, neither party had identified these load conditions early enough in the project to take pro-active action. The vendor was sorry for the situation, and was willing to work with the Customer, but legitimately believed the customer's final payment was due and payable. Needless to say, more time was lost in bringing the system up for full performance.

To recap, the customer finally had full operational use of the system six months after its targeted turn-on date. It lost half a year's payback in the process, and incurred some additional costs for manually moving the material in the interim. Most of the delays and additional costs could have been avoided with a proper procurement process. The customer and vendor teams worked harder than required, and received less than they needed. Let's review this case history and take some lessons.

### CASE STUDY CRITIQUE and RECOMMENDATIONS

- **Vendor Screening was Inadequate.** The quantity of vendors solicited did not make up for the quality required. A disproportionate amount of the team's time was taken by the vendors, for familiarization, answering of routine questions, and technical discussions. Since the customer did not qualify the vendors, the vendors spent time qualifying the application and the customer. Recall, there were 15 individual vendors at the pre-bid conference.

There wasn't enough time for visits to the vendor's facilities or customer sites.

RECOMMENDATION: Prescreen the potential vendors, first using formal request, then phone clarifications and site visits. Select three to five viable vendors.

- **The RFQ was Incomplete.** It did not specify all load parameters, and therefore missed the two problem load types that delayed final turnover. It did not specify the System acceptance parameters.

RECOMMENDATION: An AGVS contract requires five elements to be complete: (1) The Scope of Goods and Services to be provided, (2) Project Schedule, (3) Price, (4) Terms and Conditions, and (5) an Acceptance Criteria. Without an Acceptance Requirement, there is no clear point of completion; with it, there is an event that demonstrates the contracted work has been performed and final payment is due the vendor. The RFQ must include all information required to develop the scope of work, and a statement of the acceptance parameters. See Appendix 1 for a list of topics to be included in the RFQ.

- **Too Little Time for Vendor Preparation Before Pre-Bid Conference.** The vendors had no time to review the RFQ and prepare for the meeting. Consequently, they sent available people, and not necessarily the required specialist. Also the Q&A session was perfunctory. Little significant information was exchanged. The team more than made up for this inconvenience by talking to all vendors individually, often answering and re-answering the same questions. In reality, the time spent with potential vendors, after issuance of the RFQ, was time that would have been better spent in pre-qualifying the vendors.

There were significant vendor concerns after the bid conference. Certain beneficial questions and discussions were not held, because the customer promised to distribute information after the pre-bid conference. Throughout the proposal period, some vendors did not ask questions reflecting proprietary concepts, to avoid publicizing the answers to their competitors.

RECOMMENDATION: Schedule two weeks after receipt for the vendors to review the RFQ. This will allow vendors time to prepare specifically for the pre-bid meeting

and select the correct specialists. The design of AGVS is an iterative process, improving with each iteration. On this project, the first iteration occurred with the concept and initial justification. The proposal is an important second iteration. Its quality will depend on the quality of information exchanged at the pre-bid meeting. Don't neglect the opportunity.

To encourage discussion, advise vendors that their proprietary information will not be shopped. This discretion will pay dividends in designing a system to fit your needs.

- **Unrealistic Schedule.** Management's 12 month edict was unrealistic, and it significantly affected the project thereafter. The team heroically rushed to prepare the RFQ; it rushed to call vendors; it rushed to answer question; and then, it waited. The natural flow of information and sub-contractor quotations took time. The team did not know what its vendor response time would be, nor the typical duration of comparable projects.

RECOMMENDATIONS: Obtain estimates of project schedules and bid response time during the vendor qualification period. Use this information, and realistic time periods for in-house activities, to develop a comprehensive project schedule.

- **Vendor Evaluation was Inadequate.** This critique includes all aspects of the vendors offering, its track record, and its rapport with the customer's team. When Fictional Co., Inc.'s team selected the low priced offer, it made two mistakes: (1) it did not allow the other bona fide vendors to make their cases; and (2) it had inadequate knowledge of the selected vendor's resources and manufacturing capability. The selected vendor was so overloaded that the project couldn't start on schedule.

RECOMMENDATION: Schedule a formal presentation by each vendor. Do this after the team has reviewed all proposals in detail, and has prepared for the presentation. One to two weeks are normally required to evaluate the proposal's compliance to the RFQ, and to develop a preliminary evaluation of the vendor. The intent of this effort is to be well-prepared for the face-to-face meeting. The presentation and subsequent dialogue should enable the customer to evaluate the vendor's technical depth, problem-solving ability, and rapport with the customer's team. See the Appendix 2 listing of System and Vendor Evaluation Criteria.

Debriefing vendors is both a professional and practical practice. Each vendor expended substantial effort and money to prepare a quotation. On balance, each should be entitled to a debriefing on why it lost the order. The customer can often obtain a long-term advantage by providing this information, and allowing the vendor to improve its offering, its price, or both. Another benefit is to avoid the reputation of using some vendors for "checkbids", a practice that can discourage responses to subsequent RFQ's.

- **Terms and Conditions were not Applicable.** The customer attempted to use a convenient set of Terms and Conditions for the AGVS. There were several points of contention, due to requirement differences between General Construction and Automated Material Handling System. General Construction T&C's are premised on a Build contract commencing after completion of the architectural and engineering design. An AGVS includes design before manufacturing begins, and long before material can be purchased and delivered to site. Consequently, the AGVS supplier makes substantial expenditures before material and equipment are delivered to site. The use of progress payments or milestone payments normally results in greater equity for the vendor, and improved control of intermediate project milestones by the customer.

The overall performance of an AGVS is achieved with proprietary software. This software is applicable to the vendor's product line, and is not developed for the individual project. The project-specific software is typically a deliverable item, but the proprietary software is licensed, to protect the Vendor's product.

In this story, conflicts between on-site subcontractors interfered with timely installation. Certain delays were not the fault of the AGVS vendor. However, the contract assessed responsibility, requiring the AGVS vendor to make up schedule without a remedy for extra-effort compensation.

**RECOMMENDATION:** Discuss "hard issues" within the Terms and Conditions early, preferable offering a set of Term and Conditions that can be accepted without extensive negotiation. Use system equipment T&C's, not those for General Construction. Provide a contingency fund for special situation expenditures.

- **Project Controls were Missing.** The project got out of hand early because there was no requirement for status reporting, nor were there appropriate milestones. The Functional Specification document is an early and very important milestone. Functional Specification summarizes the total system content, operation and performance. It describes how the system, bounded by the Requirements Document, will work. Typically, the Functional Specification is completed before start of detailed engineering design. It is reviewed and agreed to by vendor and customer. It becomes the reference for design, and for final performance of the system. Its detail normally exceeds that of a proposal; hence, time must be allowed for preparation and review.

In addition to equipment delivery and installation events on the Project Schedule, add other milestones, including test of the first production vehicle, software demonstration at the vendor's facility, and specific items of documentation. Require identification of Critical Path items.

RECOMMENDATION: Include in the RFQ requirements for a Functional Specification document, and a specific reporting format and frequency. In the Project Schedule, include sufficient milestones to provide an early warning system for project progress.

### ALTERNATIVE FORMS OF AGVS PROCUREMENT

The story of Fictional Co., Inc.'s AGVS was premised on the traditional Competitive Bid approach, and pointed out a number of pitfalls. Two alternatives worthy of consideration are a Phased Negotiated Contract and a Sole Source Contract.

#### **Phased Negotiated Contract**

When Functional Specifications are completed after contract award, it is probable that changes to performance, cost, and schedule can arise. The phased, negotiated alternative proceeds as follows: First, pre-qualify your vendors. The request and evaluate Budgetary Quotations for the system and firm quotations for the design. Finally select the best vendor to design and price the AGVS. This results in a Phase 1 design contract.

At completion of the Phase 1 design, the vendor produces a complete Functional Specification, a firm schedule, a firm price, and an acceptance test description. The stage is then set to write an implementation contract, with all salient factors known and accounted for by both customer and vendor.

The Phased Negotiated Contract is often used to Fast-Track the system schedule. After the vendor is selected for Phase 1 design, the customer's team secures the appropriation, and uses it to go directly to the Phase 2 implementation.

Safeguards, for the owner to take advantage of this fast-track approach, include clauses that the final system design will meet the established justification criteria, and that the anticipated appropriation will be approved.

In summary, the customer maintains control of the procurement through a series of significant intermediate steps. He enters the implementation contract with a fully specified system. And project surprises are minimized.

### **Sole Source Contract**

After the initial vendor evaluation, the Project Team may find an AGVS system, a vendor, and a schedule that uniquely fit the customer's requirements. In this case, a Sole Source procurement is recommended. The use of "Open Book" pricing, with joint customer/vendor review of subcontractor bids, will assure that proper value is received.

### SUMMARY

Select a procurement method that best fits your company's situation and the vendor's offering. Fast-tracking with phased, negotiated contracts and sole-source contracts can often be practical.

Homework required for procurement of any AGVS has the common elements of (1) developing requirements, (2) qualifying vendors, and (3) allowing the iterative process to work.

The vendor selection criteria presented in this paper should be used throughout the qualification and procurement process, to focus on the attributes of a partner that will best meet your company's needs.

Use the leverage of time to your advantage. Prequalify vendors, assess realistic schedules for quotation and performance, and manage the project using milestones and reports developed in the procurement phase. These efforts will provide an early warning system to take corrective action, and will assure the best plans of customer and vendor are met.

## **APPENDIX 1**

### **REQUIREMENTS STATEMENT**

The core document of your Request-For-Quote is a Requirements Statement. The following list identifies the general categories and key specific items to be considered, and incorporated if applicable.

#### **Statement of Quantified System Objectives**

##### **Facility Characteristics**

- environment, temperature, humidity, dust level
- floor type, levelness, and quality
- location, accessibility
- aisle widths
- maintenance, battery charging, and parking space
- doorways, ramps, elevators

##### **Material Characteristics**

- load type, size, weight, stability, overhang, fragility
- quantity of loads to be stored, queued
- special positioning requirements; e.g., 0.030 inch
- required storage methodology; e.g., bulk, deep lane, pallet rack, etc.

##### **Material Flow**

- flow diagram
- from/to load movement table, by load type
- special response categories; e.g., immediate, 7 minutes, etc.

##### **Control System**

- load tracking requirements
- report requirements
- operator interface; e.g., push buttons, micro terminals, CRT's
- special operational considerations; e.g., recovery
- host computer interface, electrical and protocol

##### **Proving the Concept**

- simulation or calculation
- emulation through the production software

##### **Justification Criteria**

- space costs, new construction or leased
- direct and indirect labor costs
- unions, special union agreements

- staffing levels
- parts and service levels
- corporate financial parameters; e.g., payback, internal rate of return
- weighting of the criteria
- improved quality of the product
- reduced product damage

**Acceptance Tests**

- specify the static and dynamic tests that will constitute system acceptance
- typical sequence: inspection, functional performance, dynamic performance, and throughput performance

**Schedule**

- bid process
- contract date
- completion of functional specifications
- hardware ship date
- software demonstration (runoff)
- site installation window
- acceptance test(s)
- production start
- warranty period

**Applicable Standards:** e.g., NEC, ANSI, OSHA

## **APPENDIX 2**

### **AGVS SYSTEM AND VENDOR EVALUATION CRITERIA**

An AGVS Project Team should use the following guidelines for developing its own criteria. In the evaluation process, the criteria selected are typically weighted and vendors are compared. This technique has some subjectivity, but has the distinct benefit of providing a procedure to rate the vendors without overlooking key criteria.

#### **Business Considerations**

- vendor sales, solvency
- vendor systems history, longevity, uptime, performance
- vendor service and parts support
- vendor manufacturing capability
- vendor technical, support, and project management departments, headcount by discipline, persons per project
- vendor organizational structure, access to its management
- vendor documentation: project, service and parts manuals
- vendor historic ability to meet schedule
- teams rapport with vendor personnel

#### **System Performance**

- equipment performance; e.g. travel and lift speeds, cycle time, stopping accuracy, emergency stop distance
- safety equipment performance: sensor type and range, visual and acoustic devices, operational identification of a safety stop condition
- serviceability, including accessibility and diagnostics
- method of battery charging; e.g., change out, opportunity charging
- costs and performance for interface to other equipment
- controls complexity and maintainability (service contracts)
- ability to handle average and peak throughputs
- system expandability: equipment, inventory tracking, and throughput
- recovery: complexity and time for specific failure modes

#### **Services**

- training, initial and recurrent
- aftermarket service, including hardware PM, software maintenance, system modifications and improvements
- post installation audit

#### **Financial Justification**

- system price
- add-on and delete prices, e.g., for vehicle, batteries and charger, P & D's

- staffing and skill level required for the proposed AGVS, including operators and maintenance personnel
- reduced material damage
- payback, rate of return, etc., relative to best manual or mechanized alternative