APPENDIX D: TRANSIT AGENCY PROCUREMENT AND BUS OPERATOR WORKSTATION CONSIDERATIONS: RESEARCH METHODS AND RESULTS

This appendix details the interview and survey process that led to the recommended steps for bus operator workstation procurement and for training, described in Chapters 2 and 3. It explains the research methods and summarizes the subjects' responses. The language used by interview respondents is included to illustrate the concrete experience of transit agency staff, bus operators and industry experts. The research protocol, including survey and interview question content, was reviewed and approved by the Virginia Tech Institutional Review Board.

Methods

Sampling

The research sample was designed to recruit input from transit agencies ranging in size and geographic location that addressed bus operator workstation health and safety in their procurement activities. The research target was to complete interviews with staff at ten transit agencies, and at least five union representatives at the participating agencies. Initial contacts consisted of the transit agency members of the American Public Transit Association's (APTA's) Bus Safety Committee, and three additional transit agencies that had been identified by industry experts as potential sources for good practice but which were not on the committee. Industry experts were identified from the research literature and via recommendations by other specialists in the field. Three international unions were asked to distribute a survey to their selection of local union affiliates. Based on the researcher's experience with union surveys, 25 responses were expected.

Recruitment

A total of 56 transit agencies were asked by email to describe their procurement practices in telephone interviews. Email or telephone contacts were made with twelve industry experts: three in bus cab ergonomics and manufacturing, two in transit procurement policy and practice, and seven in ergonomics and occupational health research. Some of these were made on referral by the initial targets.

The survey was distributed to local union representatives by an international union representing bus operators in the U.S. and Canada, and returned directly to the research team. One international union did not respond to the researchers' request to participate, and one was not able to distribute the survey. Email invitations to participate in a follow-up interview were sent directly to 13 local union presidents, who had either asked to be contacted on the union surveys or whose members worked at one of the interviewed transit agencies.

Data Collection and Processing

Each transit agency telephone interview was based on a set of 14 questions. The industry experts were asked six questions. Interviews typically took between 45 and 90 minutes, and were recorded using MP3 Skype Recorder software with the permission of the respondents. When recording was not possible for technical or time reasons, the interviewer made extensive manual notes during the interview using the questionnaire template. Interview data were transcribed and edited for clarity, and the content was coded using MaxQDA qualitative analysis software. Union survey data were entered into Excel, cleaned, and tabulated.

Responses

Management representatives from twelve transit agencies responded to the email recruitment. Three declined to participate in the interview, although they were all interested in the research and provided synopses of their procurement processes. Seventeen telephone interviews were held with respondents from ten transit agencies, lasting an average of one hour. In five locations, both union and management participated; in four, only management was interviewed, and in one only the union was interviewed.

Twenty-five union surveys were completed. Union leaders representing bus operators at six transit agencies were interviewed, five from locations where management was also interviewed and one from a union that had reported a procurement team on their survey response. One local union represented members in two of the agencies but provided responses about only one of those. One transit agency was not unionized.

The four industry experts who agreed to be interviewed were a governmental researcher involved in participatory ergonomics, a former bus operator with extensive experience in bus operator health and safety, a participatory design specialist, and an experienced transit agency manager who is involved in procurement training development and with national procurement policy. Despite initial interest, the manufacturing contacts declined to be interviewed.

Transit Agency Characteristics

Five of the responding transit agencies were large (more than 250 transit buses in regular service), two were medium (50 to 249 buses) and two small (less than 50 buses). Larger agencies represented a slightly greater proportion of those interviewed (78%) than those who were initially recruited (55%). Although the transit agencies were recruited from throughout the U.S., those agreeing to be interviewed were from the West (5), South (2), and East (2) of the United States; no Midwestern transit agencies responded. Each transit agency's respondents, procurement process, and bus operator's role are described in Appendix F: Description of Transit Agencies Interviewed.

As shown in Table D-1, the contacts made via the APTA Bus Safety Committee or directly represented operations, maintenance, safety, human resources, and executive teams. These contacts often referred the researchers to others in their agencies who they thought would be better able to contribute. Five of the interview respondents were in operations, four in engineering or technical services, four in maintenance, three in safety, and two in procurement.

Table D-1. Transit Agency Outreach and Respondent Areas

Area by Title	Contacted *N*=56	Participated in Interview *N*=17
Operations	27%	29%
Maintenance	4%	24%
Engineering/Technical	7%	24%
Safety	54%	12%
Procurement	0%	12%
Executive	7%	0%
Human Resources	2%	0%

Transit Union Surveys

The 26 union officers who returned surveys represented members at 36 transit agencies across Canada (four, or 15% of the respondents) and the U.S. (seven respondents in the East and five each in the Midwest, South, and West). The most of the survey response content referred to their members at larger agencies (14), with 10 medium and two small.

An employer bus procurement or design group was reported by union officers at 16 of the 36 transit agencies. In 17 agencies, the union officer reported there was no group. In three of the agencies, the union did not know if there was a group.

Only four union respondents reported that their members serve on the procurement committees. Two unions are involved in procurement, design, or retrofit activities but are not on the committee, and 17 stated that they are not involved at all.

Interview Responses

Note on language: Throughout this report the respondents' language follows the source as closely as practical. For example, while "bus operator" is the term used generally in this report, if a respondent said "driver" that is not corrected in a direct quotation. Where relevant, the source's title may be used. To preserve respondent anonymity, some details were elided and male pronouns were used throughout.

This appendix describes the responses to each interview question, with quotations illustrating the practices described. The examples of current transit agency activity included here are not necessarily best practice, but they illustrate how transit agencies describe their approaches to procurement and bus operator health and safety. The responses were culled from hundreds of useful observations and thoughts. The respondents' varied titles and backgrounds and their enthusiasm about the subject meant that respondents often discussed other areas of interest to

them, or details they felt were related but may have been tangential. The research also produced a lot of data about organizational concerns, group dynamics, and safety culture in the procurement process that are not reported here.

Not every respondent answered each question. In particular, the union respondents did not have as much to say about many of the areas in the interview, probably because they did not have as much access to information about the procurement process. Because all individuals self-selected to participate, and had a strong interest in describing their practice, the respondents may have been more satisfied with and comprehensive in their procurement and design practice compared with the industry as a whole.

Respondent Perspectives

Transit agency respondents tended to be more specific and detailed about their procurement structures and process, whereas union representatives focused on the areas they were most active in, such as safety concerns and the role of operators in the procurement process. Union respondents also had less time to spend on the interviews than the transit agency management. Thus, the lack of response on the union side about a particular area does not imply that it was not in place at the transit agency under discussion, except in cases where these gaps were specifically stated. Limited knowledge about the procurement process suggests that the union leadership, a major stakeholder often instrumental in identifying needs and communicating change, is not optimally involved.

Even more than agencies, union representatives wanted to talk about passengers. Problems with passenger interaction included issues ranging in complexity from farebox placement through assaults. But union representatives were also concerned about the whole bus. Two mentioned passenger seat layout, for example the side facing seats that are typically used by elderly passengers who can easily fall without a seat bar in front of them. This is a familiar problem in transit agencies, and echoes an example described by an industry expert, where bus operators mentored design students who worked on social and physical needs of the passengers as well as bus operators.

Many of the respondents were very practical people, used to solving problems based on their extensive knowledge of how vehicles work. They were also savvy about group dynamics and politics. However, the questions were at times removed from the way some did their procurement. As a result, the areas of the interview that focused on the mechanics and administration of the procurement process (for example, Question 3) did not provide as much insight as the more practical questions and those that asked about challenges and recommendations. The interview also failed to ask specifically about the kinds of ergonomics changes that were needed or contemplated. Although many discussed this anyway, it might have been better to carry out the interviews before completing the ergonomics recommendations covered in Task 2 and 3, using directed question that might to inform those earlier steps.

Although the safety representatives interviewed were able to describe their role in assessing the areas that affected vehicle and transit employee safety, they were frequently unaware of other steps involved in the broader procurement process. Bearing this in mind, the unscripted interview probes did continue to focus on the design and safety issues that are the purview of this project. Although the interviewer always included the phrase “for cab design especially as it affects bus operator health and safety,” the maintenance, engineering, and procurement staff interviewed at

times found it hard to restrict their answers to this area. Except as described below, the team meetings or committees the respondents described typically covered a wide range of issues, often within one meeting.

It is possible that sampling different titles in the transit agency could have produced different results. In particular, safety staff knew a lot more about how the procurement process served health and safety, while the maintenance and, of course, the procurement side understood the administration of the process better. However, in the one transit agency where two separate interviews took place, the reports from a safety staff person and a maintenance manager were quite similar. In the two cases where the whole team participated in one interview, representing a range of departments, they deferred to each other based on their expertise in the group but presented a cohesive view of the process.

Interview Section 1: Who Is Involved in the Bus Procurement and Retrofitting Processes

Responses to Question 1. Please describe your bus design/procurement group: who participates?

Who participates in procurement is shown in Table D-2. The core responsibilities were, as expected, held by fleet engineering and procurement managers; sometimes that was the same person. Managers from the maintenance department were reported to be involved by two-thirds of respondents, and operations staff by slightly fewer. Safety department involvement was mentioned at some point in two-thirds of the agencies, sometimes as active committee members but frequently being brought in for specific issues or asked to rate the final RFP for safety concerns.

Table D-2. Procurement Team Members Reported by Agencies

Who participates on the procurement team?	***N*=9**
Technical or engineering	56%
Procurement staff	56%
Management maintenance	67%
Management operations	56%
Safety (in some capacity)	67%
Bus operator as committee members	56%
Bus operator as end users	56%
Bus operator consulted as technical experts	22%
Maintainers as committee members	33%
Maintainers as end users	33%
Maintainers consulted as technical experts	22%
Other individuals	67%
Other committees (i.e., ADA, finance)	67%

Hourly maintainers were more frequently involved than bus operators, earlier in the process, and more often as active committee members. An active role for bus operators on the procurement team was described at five of the nine transit agencies described. Bus operators

contributed most commonly at the pilot bus test stage, but agencies and union respondents concurred that this is often too late to make significant changes. Plans to increase bus operator involvement and bring them in earlier in the process were in place at several transit agencies.

Practical details of how these various stakeholders contributed to bus operator health and safety and to procurement will be described in Question 4 below.

Responses to Question 2. Is there a separate team or committee for bus assessment, refitting or retrofitting? What departments or individuals contribute to this stage?

Two of the nine transit agencies reported well-defined maintenance or bus evaluation teams that do ongoing evaluation and retrofitting of buses, and three described a more informal but still systematic process. One affirmed that there was no such process, and the remaining three either did not answer this question directly or did not have anything beyond regular maintenance. Typically, maintenance or the fleet engineer gets input from both operations and safety about safety concerns in the current build:

> Like a mirror for example. If we're having a hard time seeing out of this mirror, my staff will look into it and go back to the builder and see what adjustments they can make and changes they can make during the warranty period to try to get what they paid for. Even after the warranty, if we start seeing things that are a problem we'll still work with the builder and we might come up with a resolution that we feel is an acceptable repair or a change…. We don't go back to them for everything, but it depends on the level of what the repair or the change is required.

Interview Section 2: How the Procurement Process Works to Enhance Operator Health and Safety.

Responses to Question 3. How does your group work?

The interview included probes about meeting frequency, chairs or other formal roles, reports prepared, and whether there are differences between procurement and retrofit. Several respondents described their committees as meeting informally or not at all as a committee. Others had scheduled meetings, held more frequent during critical decision times. Those with rolling or annual procurements met continually. A common concern was that at times meetings were so frequent that it was hard to fulfill other work obligations.

Typically, the procurement person acted as the chair or facilitator, if there was one at all. The procurement person set deadlines, took notes, and distributed summaries and task assignments to participants.

> Someone from the procurement team leads the meeting, while another distributes documents distributed amongst the group and keeps notes about the process and decision made. Then they collect it all the results, put the report together and send out the information to the prospective builders.

The NTI procurement workshop states that the procurement process should engage maintenance, operations, and marketing, and that the procurement department should coordinate. In the transit agencies sampled here, procurement staff did this in agencies with an extensive team, but such single-task staff people were not always present.

Subject area groups or technical teams often broke out from the core committee, with a team leader accountable to the committee. Roles were sometimes shared, depending on the issue being

reported on. Formal leads were either technical managers or procurement staff. Some were proud of their relaxed efficiency:

> This group works well together, and there is no formal chair. The procurement coordinator, who is very organized, competent, and knowledgeable, documents and schedules the meetings, and keeps the whole process moving along, so it is easy to focus on tasks.

Transit agencies found it hard to quantify how often they met, as this varied through the cycle. But for some, it was a big demand on their time. One transit agency respondent reported that the responsible team meets frequently, as they have annual procurement contracts, "probably too much sometimes." They also "constantly" meet to discuss bus retrofit and other improvements because the team is tasked to come up new products or ideas throughout the year. In another transit agency:

> The bus acquisition team hold typically 3–4 meetings: They review key items, then address questions on specified items after breakout meetings with operations, then with the feedback finalizes list. When reviewing the RFD, they go through every line, areas where manufacturer has questions about content or intent. They allow time to take back drawings, to meet with stake holders, for example transportation management, and ask for changes while still in the design stage. They hold monthly meetings at this point.

Safety teams were described as meeting frequently, but were often not invited into procurement until fairly late in the process.

Formal presentations were given usually only at the beginning of the cycle, or when a new product needed to be explained to another group. But using schematics, equipment prototypes, and images was useful:

> I [the technical manager] will attend an accessibility or a driver meeting with a notebook in my hand to take notes and hear what they have to say. I don't have a presentation presentation, but sometimes I will bring a seating schematic or something the drivers could review. It is somewhat informal.

Responses to Question 4. Can you summarize the practical steps your organization takes for new bus procurement and for retrofit?

These comments substantially directed the outline of the Bus Operator Workstation Procurement Process. This was the most open-ended of the interview questions. Not surprisingly, it was difficult to get the respondents to focus on these areas only as they affect bus operator health and safety.

Responses to Question 4.a. Practical steps for new bus procurement

Most transit agencies used the past procurement document as a template for the next. Sometimes only the engineers did the initial review, and in other agencies, the entire procurement team looked over it, together or in breakout groups. In some cases, the safety person reviewed all relevant areas in the proposed specifications but was not involved at this initial phase.

One fairly typical example shows how safety concerns can be addressed, although bus operators themselves are not actively involved:

> The bus engineering group start to design. And at each iteration, the engineering group sends it out to the stakeholders to review: the safety department, operations, training, maybe even infrastructure, all at the management level. The safety department makes sure that it's compliant with all the pertinent safety and health regulations, and... the engineers have incorporated anything that seen in past designs that need to be

> improved upon. Engineering decide whether or not it is possible or feasible to do those changes. . . .They bring [the prototype] on to the property and everybody gets the chance to touch it and feel it and sit in it. That is where the bus operators themselves come in, and their union representation would start to get involved. If the prototype is drivable, the instructor staff, the supervisors, put it through its paces, and discuss safety concerns.

In contrast, this small transit agency engaged bus operators throughout the process:

> There is a procurement panel, including three drivers who poll the other drivers. The panel reviews the options and results. At employee meetings, they go over the outcomes of the tests and surveys, to ensure that everybody is aware of what choices were made and why.

In the transit agencies interviewed, outreach about desired changes, past problems with equipment, and potential solutions was made through surveys (open-ended and fixed response) or meetings with stakeholders. In about half the transit agencies, this initial query attempted to include bus operators. Most transit agencies reported an iteration of information collection:

> Emails are sent throughout the company requesting input but not many line-level employees respond. The procurement and engineering leaders meet with bus operators and mechanics from each operating division, to get their input of what works, what doesn't work, what they would like to see changed…. They incorporate any problems experienced with a particular component or area of the vehicle, determine which of those things they can address, and work with the manufacturers to come up with a solution to that problem. The final decision on requests and recommendations are tabulated and explained in a summary document.

Some tried to involve bus operators systematically:

> We put potential new products into current vehicles so the drivers can test them out. We do training on the proposed product then leave them on the vehicles for 6 months-to a year. We survey the drivers for their preferences. We usually pick a dozen options that affect the driver and overall safety for the next purchase. Operators are provided with the results of the survey and the purchase decision.

The input from bus operators was limited at times, even when they were involved:

> The operators really do not know what specifically is in the bus specs and might not understand the budget. We tried to focus on a couple of different areas. We asked them to list the specific things they liked about certain models. And then we asked them to list what they dislike.

The transit agencies typically target some but not all health and safety concerns based on bus operator input:

> If it does not get more than one or two or three people complaining about the thing it does not generally end up on the list. The list had 85 items on it before the last procurement went out.

Some transit agencies visited others to find out about new equipment and the current available configurations:

> The maintenance director there gave us a tour and pointed out the new features … [on] their most recent [procurement]…. We did spend a fair amount of time … when the buses were just arriving, talking to their maintenance director about the additional safety features that they had built in, the rationale for them, and maintenance convenience factor…. They agreed to bring one of their new buses over to our facility…. They let us do a test drive as well. It made [the decision process lot easier]. As we went through the spec writing, we did adopt quite a few of their safety features as well.

Transit agencies with larger committees had a system to make sure that the right stakeholder addressed each question. For example,

> [Manufacturers'] requests for deviations are divided up to those separate areas to approve or disapprove or ask for more information.… The bus operator group will look at ergonomics issues, as well as safety. When the initial proposals come in each team evaluates the proposal separately and scores them as they see appropriate. They then have technical discussions with the builders. Often safety, operations and vehicle maintenance will participate.

In about half the transit agencies, bus operators participated in manufacturer preliminary and build factory visits.

> Two senior operators went to the manufacturer to see the pilot bus, spent a week reviewing ergonomics, mirrors, controls, seats, reach, ride dynamics, and successfully negotiated with the steering committee for big design changes that affected cost and time of delivery.

Most transit agencies called on bus operators at some point to comment on equipment that was previewed or tested at the facility

> Through the years, we have had manufacturers bring in securement devices. At the beginning of this procurement we had a couple of different securement devices come in so that [bus operators] could look at it. We have always had different seats that we put out for them to test and comment on.

This input was not always requested soon enough to make significant changes. For example, in one transit agency two bus operators spent a week at the manufacturer reviewing the pilot bus operator workstation ergonomics, mirrors, controls, seats, reach, and ride dynamics. The engineer felt that this timely evaluation allowed bus operator feedback to be rolled into the final bus purchase. The union respondent reported that the senior bus operators do not normally participate until these missions, when major decisions have already been made. Overall, he viewed the bus operator role to be limited to driving the pilot buses.

> The problem is that looking at [pilot] buses in parking lots is not enough.

Additional changes were sometimes made after the team had analyzed the safety concern and specified solutions. The question of who decides what will change is discussed further in the Question 10 summary.

Responses to Question 4.b. Practical steps for refit/retrofit of existing vehicles or when problems develop?

Predictably, the process of assessing the safety impact of buses that were in use was based in the maintenance or technical services department as a rule. It made use of existing maintenance reporting formats and decision teams, rather than special steps, in general.

> This is an ongoing process, separate from the steering committee. The process resides in the technical services team. Typically they arrange weekly conference calls with manufacturer. Especially in the multi-year procurement contracts they have vehicles being delivered, and may see issues before the delivery is complete, including fleet defects.

Depending on the timing and level of change, the retrofit may be tied to procurement:

> Formal retrofits go through the procurement committee. The Component Supply Center, which can fabricate just about anything, is also brought to the table to confirm what they can't and can do. They usually come up with the best plans on how to accomplish the task.

The process relies on bus operator input, especially for safety issues:

> There is a hazard report operators can write up and submit. This has led to changes in where the flash signals were. We are working on changing the emergency button. In the old buses it used to be right up on by our left finger, but they put them a little bit further back, which is complicated if somebody's starting with you or getting ready to assault you. The problem is all the money that's involved in the initial selection and purchase, and then needing move it back. Because you just have to ask somebody who drives a bus.

Safety committees have ongoing input and channel bus operators' concerns:

> They have a reporting system, and the safety committee of operators, supervisors and safety/training department will follow up on any reported issues. Drivers do daily pre-post trip inspections, and the committee looks for patterns. If a product has several failures, that may be a fleet defect.

Bus operators may be given a more formal role in retrofit:

> We have had a couple of other issues where we convened a committee of drivers to help address a specific problem brought up by a driver. We have collaborated with maintenance and operations and this representative group and the unions usually get involved.

Responses to Question 5. What are the strengths of your process and your group – what makes them effective?

The transit agency interview subjects were enthusiastic about the way they did procurement. Stakeholder involvement was most important to them, followed by the details of the process that were honed through experience, and how well the team worked together. Most described the value of long experience in the transit field, as discussed in Question 9. Two agencies felt that upper management support helped them do a good job.

This positive experience did not make them blind to the limitations and barriers they faced, as will be seen in the responses to Question 10, "Is there anything that limits the effectiveness of your procurement, refit or retrofit processes?" and Question 11, "What could be done to improve the bus operator workstation procurement processes in your agency?"

The most common strength, reported at seven of the transit agencies, was how they involved multiple stakeholders throughout the process:

> This team was composed half from operations and half from maintenance. So for the technical maintenance aspects, that side were respectful in explaining it in a layman's term so that [operations] could understand. We deferred to their judgment in most of these instances and they deferred to our judgment when it came down to the operator and the customer amenities. We tried to understand exactly what they were looking at, what the advantages and disadvantages of different ways were that we were interested in.

Many transit agency respondents described how they had honed and improved the process through practice and even mistakes. All had made choices they later regretted, but learned from. Some worked harder to get along, or to get external partners onboard. Some tightened up technical steps related to testing:

> We do our planning up front. Success is with finalizing decision points in advance of production. The group needs to honor a design freeze so can build according to configuration.

In several of the agencies, success was attributed to the efforts of an effective individual, as will be discussed further in Question 9, "Are there members with specific qualifications, skills or knowledge that make your group more effective?" This was often a good administrator who kept the process on track, but was especially true for ergonomics activity:

> He's one of those pioneers to get them to make a better cab for the operators. Buses have come a long way. And a lot of that's because of guys like him who push the manufacturers to make a lot of changes over the years.

Personal relationships mattered a lot, within the group and between individuals. Agencies and some unions described the value of a good rapport. And the freedom to make good decisions was important:

> It helped that everybody involved was fairly new to this process, and from different transportation modes and even industries. People play different roles, and nobody was insulted if somebody brought in something from the outside. There was a lot of advantage in not having to do it the same way.

Responses to Question 6. What external documents or sources have you used in procurement and retrofitting?

Seven out of the nine agencies referred to the APTA procurement guidelines in drafting their procurement documents, and several relied on it as the main template:

> That is our bible, for example if we're looking at the appropriate hip to knee room for passenger seats. We always use that as a resource. It's an excellent tool. If we did all the technical specs, it's based on a lot of the information in the Standard Bus Procurement Guide.

Four referred to TCRP Report 25 at some point; most did not even know of it. One actively used TCRP Report 25:

> Report 25 recommendations are factored into ergonomics thoughts especially hand and reaction time, line of sight - it helped demonstrate compliance with ergonomics requirements.

Some mentioned other APTA reports generically. Overall, agencies and unions described a need for better and more up-to-date resources. They call for a shared database of technologies, research reports, and review—a kind of "Travel Advisor" as one transit agency described it.

Interview Section 3: What Is Involved in the Training and Preparation of the Procurement Group

Responses to Question 7. Do group members receive any training to help them do their jobs better? If yes, please describe.

Two-thirds of transit agencies reported specific training provided to the procurement team. This predominantly addressed the administrative mechanics of procurement. Summary training was provided mostly to the procurement team, but in-depth training was mostly limited to the procurement department staff. There were good examples of internal training:

> They had a presentation by the maintenance manager on the procurement process. The trip to the manufacturer was educational. They had explanations of new equipment, how it works, where it is installed, his research and from other agencies.

Department-specific training and practical skills helped in the procurement process.

> Each person or group may go to a training course to improve their skills in their field, and then they just bring that back to the team.

A safety department respondent wanted to help the team be more effective:

> I worked with technical training to put together print reading class for the safety department. They don't need to know how to build, just to read. I also brought in the TSI design review course. The important thing

> is that we are not teaching how to do, build, but how to read it. I look for this kind of opportunity all the time.

Most respondents did not initially consider that additional formal training was needed:

> I saw my own weakness in starting, but I didn't in fact need to read blueprints. When handed prints, I was able to be trained by others.

This opinion was grounded in the answer to Question 9, "Are there members with specific qualifications, skills or knowledge that make your group more effective?" But they were more open to the idea of additional training when answering Question 12, "What training would be helpful for your group?" More details are described in those sections.

Responses to Question 8. Could you provide examples of any training plans or materials that you use?

The only procurement-focused training material made available to the research team was the NTI procurement courses, provided by an industry expert. These are in-depth and effective, described by many respondents as helpful, but they do not address procurement for bus operator health and safety concerns. In addition, they are quite time-consuming.

One safety manager had developed a basic blueprint-reading training for the safety department and sent the course outline. The objectives were that participants be able to read mechanical blueprints, identify materials and revisions as presented in blueprints, and have a basic understanding of electrical schematics. Participants learned to interpret blueprint title blocks, interpret views, understand parts dimensions and features in drawings, and interpret scale information.

One transit agency respondent sent example of training checklists confirming bus operator evaluation in pre-trip inspection, bus operation, and passenger interaction.

The bus operator safety and ergonomics training-related materials will be discussed further in Task 8, as will the NTI and union bus operator training examples and materials collected in previous research.

Responses to Question 9. Are there members with specific qualifications, skills or knowledge that make your group more effective?

Transit agency respondents were confident of the skills in their own departments, and admiring of that in others. They consistently highlighted the value of time spent in the transit industry:

> The biggest asset are some staff members who have grown up through the ranks of the maintenance department. So they have a very good mechanical aptitude. They understand the nuts and bolts and seating and engines and transmissions and mirrors. I think the second best thing that you could have is someone that has good writing and communication skills, to hear what people have to say and communicate that to the bus vendors.

Some acknowledged the need to bring in outside expertise to support internal capacity:

> We have some, but the majority of the time we'll bring in an expert, or a consultant, to do the analysis and that kind of thing. We will bring in a young engineer for something that's their specialty and get the report and the feedback.

Ergonomics skills are important. One respondent felt that having ergonomics training and experience in another industry contributed to the success of the team. Others described an older cohort of generalists with these skills:

> The previous procurement head wasn't an educated ergonomist. But he knew a lot about ergonomics. And he worked very hard, he pushed the bus manufacturers to get them where they are.

Ergonomics knowledge was sometimes available but not applied when needed:

> The maintenance people understand ergonomics, but I don't know that there is concern about it. For example, a driver says, "This seat is bad." So a mechanic gets out there and he sits in it and takes it out and looks at it and does a road test. And he's in the seat for 20 minutes or a half an hour and says, "Well, there's nothing wrong with this seat" and puts it back in…. But that driver's in there for eight hours. That's the part of the ergonomics that some of the technicians don't think about.

Interview Section 4: Barriers and Needs Encountered in the Bus Procurement or Refit Processes

Responses to Question 10. Is there anything that limits the effectiveness of your procurement, refit or retrofit processes?

The areas of concern included interactions with manufacturers, time constraints, loss of institutional skill and knowledge, and cooperation across the organization. Only one respondent felt that there were no known problems with the process. Although the overall level of satisfaction was high within each transit agency, the responses about what could be improved, described in Section 5, hint at additional barriers.

Frustration with manufacturers was reported here and elsewhere. Respondents reported that despite requests from the transit agencies, few options were provided by the manufacturer and that suppliers made it hard to get needed changes in equipment. Some manufacturers responded well, others did not:

> We are somewhat limited by the bus manufacturers themselves. It is not possible to fit a very large person in a bus because they have pretty much dedicated all the room of the bus, limiting how far the seat could go back, and how close it can come to the steering wheel.

On occasion, the change orders process limited effective improvement.

Although several transit agencies stated that they are not constrained by budget in safety-related procurement, the related concerns of time and budget were frequently described in these responses.

> There is a lot involved in interviewing all these bus operators and trying to check into all these different things. An example: we just made a decision to change our window manufacturer. The proper way to do that would have been to make additional calls to other properties that are running that window to make sure that they have not had problems with it. But you just do not have time to do all the things that you need to do.

Most agencies felt that the procurement team worked well together; however, limited coordination across the organization was a significant barrier:

> In my safety perspective there are some faults in the process. And the real crux of the matter, the root cause is who has more power? Who has more authority? Who has right of refusal? Because every group has their own vested interest; so how do you look at it? Of course, I look at things from a risk management standpoint. The most important thing is to manage risk. So if it comes to a high level of risk then I think that

should trump other concerns as long as there's another reasonable alternative. But that is the biggest barrier and stumbling block that I see with our process: everybody has their own vested interests. Sometimes you have group think instead of a real clear, concise process of what should trump the other.

Union representatives reported similar concerns about how decisions are made:

Between the procurement and the purchase of the bus … they pretty much make their decision. The pyramid is in the headquarters and we're out here in the field. We don't get a chance to make that decision. And they may get some input, but we don't, we union officers, and most of us are bus drivers and mechanics. And so if they don't come back to us, they had already purchased that thing when we get to input.

As is described in other transit research and practice literature, the actual or potential loss of institutional memory was a major concern. This problem can arise when workers retire or simply move on, and is exacerbated when the effective procurement process depends on individuals with critical personal or technical skills and, often, dedication.

A third of the agencies voiced concerns about the procurement process as a whole, not just as it relates to cab design or bus operator involvement. As seen in the next section, they also had ideas about how to improve it.

Interview Section 5: Recommendations

Responses to Question 11. What could be done to improve the bus operator workstation procurement processes in your agency?

Transit agencies most frequently described ways to improve communication and trust in the procurement process:

We have not done a very good job of communicating to the operators what we've adopted and what we haven't and why. When there are 85 things that they came up with that might be things that we were going to pursue. Out of those 85 we might end up with 35 or 40 that make it on the bus. The rest of them are not there for one reason or another, whether it be cost, or no manufacturer would do that, or whatever. I'm sure that that bothers them so they go, "I'm never going to tell them again because they didn't implement my process." This document that I have in front of me [a summary of the points, their resolution and the rationale], it was our first attempt to do that. That's why we have this written document. We put it out there for people, but I would imagine that about 10% of the people in the company see it. We have an Intranet here and that's attached to our Internet site for anybody to go view, but I doubt many people do. It has some rationale, although it doesn't go into great detail.

They wanted better information, earlier in the decision process, and time to analyze it:

Let's say Operations brings us 25 issues they'd like to see changed on a future purchase. If we had the time to sit down and, like you said, is this one driver that doesn't like it and wants it changed? Is this 10% of the operators or is it 90%? To have that information ahead of time to filter out the issues that aren't pertinent, and then decide, "These are the ones that we need to deal with," and see what alternatives are out there.

This might require a more sophisticated approach to data that is beyond some small agencies:

Internally you have to be able to evaluate your failure rates, and have good follow though and reporting. This requires good software. A small place can remember the details but as you get bigger, you need software to track for failure analysis. Places may be shorthanded, and some management software is not so user friendly.

Transit agencies wanted time to make good decisions, and they wanted dedicated staff:

> Something that has been identified and we are working on: When we were going through the bus procurement, we were all tasked with several different, concurrent significant projects. If we the procurement committee were to have one lead, one project manager, as a liaison for the coordination, to ask the questions, even to just have their heard buried in it. That would be helpful.

Respondents called for an increased role for bus operators in the procurement process:

> Operators could give better suggestions. That is really tough because the attitude amongst 70% to 75% of the operators is, "Why would I fill this out because they won't listen to me anyway?" It would be wonderful for them to report back on the survey. But they don't. [The manager interviewed acknowledged independently that the report is not seen by most employees.]

One highlighted the need for a deeper analysis of the buses:

> Operators need to operate the bus to test it and tell the procurement team what is wrong. There is no way to figure out ahead of time what could go wrong, or just by asking the mechanics. It is important to see if the operator can fit in the seat, and what the conditions are like over the course of the driving day: accidental door opening, bus interlock, physical position, pedal pressure, steering pressure.

This would work best with union involvement:

> The first thing that should be done is a survey of the buses. Then, it would be best if they took two or three serious people from our board or some of our shop stewards with them [through the build process] and let us be serious about picking out this bus, and picking out the safety issues, …. If they are going to take somebody with them they take somebody likeable. And probably somebody that will come back and make a speech, "These are the greatest buses in the world." And we already know that's not true as soon as we get in them. If you want somebody serious I would suggest that we select a person from labor who is driving the bus every day and somebody that we know who is not scared to give them a real answer. Some people are scared to give a real answer because they don't want to be on the wrong side of the fence.

Responses to Question 12. In particular, what training would be helpful for your group?

Few respondents independently suggested that training was needed for those who participated in the procurement process. Most described what they saw as a diverse set of people with the needed skills that could be called on as required.

> Each group brings their own area of expertise. Team members teach each other what they need as they go along. It would be too much to ask an average person to be able to read blueprints and understand the design and the reconfigurations. They can bring [resource people] in as needed.

The most common interest was in training to provide orientation and background for all team members, to set the terms and bring new participants up to speed. This could be in the form of a prepared training module, or less formally. Although the NTI procurement process training is widely recommended, agencies thought a more tailored approached would be helpful:

> As some of the older groups have retired and moved on newer people are now at the helm, or at least in the trenches. And they don't necessarily understand what the process is. It would be very beneficial to have some kind of a training platform for every new member of the procurement team, so that they understand the process, so that they understand the different elements, and they understand the priorities, at least be familiar with Standard Guidelines for Bus Procurement and TCRP Report 25. So for the new person, if they walk in there; what do I expect from all this? What is my role? What am I going to do? So they have an idea of to expect as they go through this process. It's not going to be one meeting to say I want this engine in the bus as opposed to the other one

> However, if you offer [procurement training for new team members] and you only have three people that are new to the group, the trainer to student ratio is not very good. But if it was opened up to other people in your organization, it would be beneficial to others even if they weren't team participants. "I know I've heard a lot of comments that, I don't know about this bus, because I don't like it. Well, if you knew what the process was, even if you were never a part of the team, at least you would know what that team was doing, what the input was, how the decisions are made.

Any training offered should be practical:

> Ideally: a compilation of fundamental real life bus procurement acquisition planning. Starting with, a presentation. All of us probably could relate to "walk me through the process." I want to see it graphically or visually, I'll give you an outline or something to tell me about it. I want to start with "you have to build this specification." Okay, what's involved with those specifications?

Opportunities to learn occur throughout the procurement process, what one transit agency called "training by exposure to the industry":

> Not sure if this is a training issue, but a trip to the manufacturer to understand time and constraint issues FOR THEM in procuring from OEMs. The team members need to understand what is in the manufacturer's control, the specifications process, how things need to be vetted, and the impact of budgeting process for example in a suggested retrofit.

Professional events provided the opportunity to learn outside of a job title's limits:

> [A woman I met at a meeting from the APTA Bus Safety Committee] taught me a lot too. I know how to look at buses and tell certain things, but she told me how to look at a lot of different safety things. I have blinders, because I'm maintenance and a mechanic and now I'm starting to learn to think like a safety officer, I look for pinch points, or sharp edges.

Training for new team members could be done more informally at the workplace or during meetings. This kind of active mentoring is also recommended by the industry experts:

> You have new people coming in and you can send them to class, but they really need to spend time with somebody who has been doing it for the past 14 years, or ten years, to learn the job.

When asked about specific topics, some transit agency respondents felt that additional design and ergonomics training would be useful. (As described in Question 7, one has already developed this for the safety team.)

> I think [design concepts would help], definitely. Because you're trying to do so much. For example, you're trying to take a low flow bus and get as many seats as possible in there. Being able to look at the design phase would help too. And to get ahead of the game, [practical areas] like the flip up seats.

Using practical content in this training would be effective:

> To cover the ergonomics and human factors, one strategy would be to identify your key configuration item, not necessarily the seat specifically, but start with the interior, the exterior, the dynamic envelope. Basically it's the driver's station, the passenger seating layout, the range of the vehicle, the climate control. ADA compliance in the workstation and what kind of equipment you're going to need. And then walk from that side, so what do you do with this? Well, we need to get a new interior.

Not all areas of procurement are needed, and some could be avoided:

> Ergonomics training is always good, and it is needed for members on the team. Costing not a useful training as it is not a good approach to safety issues.

Experience with and information about new equipment and options would be welcomed, before and after purchase:

> Our biggest challenge in that area is just being aware of what's available in the marketplace. There are only so many bus manufacturers and they are basically packagers. They don't build everything in that bus, and they outsource things. So a lot of our work is to meet with various suppliers of seats, lights, mirrors, to see what's out there and make the best choice.

Responses to Question 13. How can or could transit agencies assist each other in improving the procurement process?

Transit agency staff communicate formally and informally about maintenance, procurement, and bus cab concerns. They take advantage of APTA and other industry meetings, and use industry listservs. Setting up regular exchanges of information was a consistent goal of respondents:

> I think a lot of transit agencies are starting to [share more information]. I hope they do before a lot of these guys retire. They're trying to get regional committees back together, to meet and brainstorm, so they are not all out but just working on the same problem by themselves. The manufacturer is always telling them, well, it's only your buses and only your transit agency having this problem. I think that's a key. Put them all together in some kind of forum, to just talk about this kind of stuff.

Time was, as always, a constraint:

> As far as inter-agencies, it's difficult. I like to share with people but it is a time-consuming process, time that I personally just don't have, and I'm sure that most other agencies are in the same boat as I am, to try to share at depth that is just a time restrictive process. Not only regional meetings, although that would be good, but even, you know, information sent back and forth through emails, documents like you requested, or ergonomic stuff, it's a very time-consuming process.

All but one transit agency described how this exchange could be improved, and bus procurement enhanced. Pooling technical information was particularly important:

> It would be good to pool all available information on equipment testing, especially for optional items. The transit agencies could look at this and review for products, for example failures on wheelchair restraints. This suggestion was voted down in the regional buying process.

Transit agency respondents raised the idea of coordinated procurement that could increase the leverage of smaller agencies and reduce the administrative demands in all organizations. Two reported participating in group procurement. Some regions are developing similar programs:

> The transit authorities in this State are working in close collaboration with the State Department of Transportation on developing one state contract for all agencies for procuring all the buses, including working with the OEMs

Union representatives reported reaching out to other local unions and networking at international union conventions. One transit agency encourages this exchange:

> The executive board officer representing the local union here was asked to contact his counterpart at a nearby large agency and to hear about their recent procurement from the union's perspective.

One union representative would like more access to the results of management contacts:

> Although management are networking, they don't necessarily share with union, and don't make safety and health a priority. Their focus is on service delivery, even for safety staff sometimes.

Responses to Question 14. What could be done to improve the processes across the transit industry?

Transit agencies and union representatives reported working with academic research groups, APTA, FTA and manufacturers. Important state and regional resources include the Florida University Transportation Center (UTC) resources and discussion groups [http://www.cutr.usf.edu/outreach/listservs/]. Many can be accessed by transit agencies in other regions:

> The state has a maintenance committee, for example, and there is a lot of exchange there. There are a lot of ways that we have to ask questions and get responses other transit agencies quickly. You can send in a question to the state DOT [department of transportation], and they will send out the survey for you and post the answers.

Several respondents felt that this TCRP project could help:

> It would be useful to incorporate ergonomic elements into the APTA guidelines, as an addendum annotated graphically with legend in layman's terms so everyone, including sales staff and manufacturers, can understand: What does visibility mean? What are demonstrable tests?

They recommended that ergonomics considerations be supported at a national level:

> Best Practices for the design of operator workstations should include integration of those design standards into the APTA Transit Bus Baseline specifications. Following that would be inclusion of those requirements into the FTA's Bus Testing program.

APTA was a respected partner, and the meetings were considered an important place for information sharing. Transit agencies also felt that APTA could play a more active role in ergonomics concerns, and coordinate resource and information sharing.

> I would like to see us as an industry, through APTA, able to consolidate our findings and to try to encourage manufacturers to make certain design changes, depending upon the needs of transit in general.

Academic partners are excellent resources for design and testing of equipment:

> Agencies can work with their local universities. We've tapped into the university engineering group on several occasions to get their assistance. A lot of times they don't charge anything, sometimes they do. We used them when we switched over to LED headlights and when having our bike racks on the front of the coach. We are continuing to use them for our air cushion seats to see if there are mitigations for lower back injuries that could be developed.

Transit agencies understand the value of research partners, but do not make use of them extensively:

> We've done some work with academic researchers, but we don't do a lot of it. The organization in general does a lot of work with academic researchers, for planning, but not as much for bus procurement or maintenance.

There was some experience and a lot of concern about how to get the manufacturers' attention and support in improving bus cab design for operator health and safety.

> Manufacturers need to be more responsive, to have operators in the factory, to sit in bus to see what their visuals are etc. This approach could set milestones throughout industry.

Agencies called for more oversight and information from the FTA (or thought it was already in place; one union representative assumed that the FTA already set regulations for ergonomic seating):

> I would like to see the FTA get much more involved and start sending some regulations to the manufacturers.

Some are frustrated with the FTA's current safety profile:

> There used to be a good exchange on safety with the FTA, haven't had so much involvement recently. [Past leaders at FTA Safety] would send advisories. FTA gets reports of incidents, hazard reports, and it would be great to pass this information along to agencies as it occurs, not just in annual reports.

APPENDIX E: INDUSTRY EXPERTS' PERSPECTIVES ON IMPROVING BUS OPERATOR WORKSTATION DESIGN

Twelve industry experts were identified from the research literature and via recommendations by other specialists in the field. Emails were sent to request a telephone interview. Four agreed to be interviewed.

Responses to Question 1. Please describe your experience with the workplace design and procurement process. Have you worked with vehicle design? With transit agencies?

As described in Table E-1, subjects had experience in academic research, in transportation ergonomics, in bus operator health and workstation ergonomics, in participatory ergonomics, and in procurement practice, policy, and training.

Table E-1. Industry Expert Background

Industry Expert 1 was an expert in bus cab ergonomics assessment and design. He was a bus operator for several decades, pursued a scientific field at the doctoral level, and now works as a transit safety specialist. He has participated in the evaluation of seat design considerations, contributors to pedestrian fatalities, and the functional design of pedals.
Industry Expert 2 has carried out health and safety research and policy projects related to transit worker health and safety, including overall health and musculoskeletal health. He worked with an ergonomist on seat concerns, and with manufacturers who were interested in increased standardization of bus procurement. He runs international projects involving workers in design and procurement of work equipment.
Industry Expert 3 works at an occupational health agency where he carries out research projects designed to improve workstations to reduce musculoskeletal problems through participatory methods. He has evaluated and redesigned an industrial vehicle, carrying out an evaluation of the cab structure concept and the arrangement of the seat, joysticks, and steering wheel. He has worked in a series of projects focusing on improving subway cab design. These projects were carried out in close collaboration with a transit agency and the union representing vehicle operators.
Industry Expert 4 has been working in public transit for several decades. He was a transit manager in a medium-sized agency. Since then he has worked on transit policy and training at a national level. He is currently involved with the FTA mandate to develop a strong and consistent specifications process, including Standard Bus Procurement Guidelines, supported by procurement training courses. The working group has involved transit agencies, bus manufacturers and other OEM companies, APTA, and others.

Despite initial interest, the manufacturing contacts declined to be interviewed. The industry experts answered seven questions about their experience with practices for designing the bus operator workstation to enhance health and safety, and gave their recommendations.

Responses to Question 2. Can you describe a project exemplifying an effective design and procurement process that enhances employee health, safety and wellness?

The industry experts had experience with diverse projects, as transit agency employees, research ergonomics, trainers, and product design facilitators. Most of these project examples called on the equipment users in analyzing and addressing health and safety concerns. To two of the experts, the equipment users were essential partners at every step, as illustrated in detail below. In one case, users were trained to be the product designers and testers, and had a long-lasting impact:

> The project involved frontline equipment users in the design and selection of safety devices. We did a course in design for the users. They have had an impact on the industry, which over the course of years has come to these users in early stages of design.

The projects agencies described called on skilled internal partners and outside resources as needed. In one case, a transit employee worked with a physics researcher to resolve a problem of mirror placement and bus body design on mud deposition, which had interfered with rear and side views. In another project, graduate students in product design were mentored by senior bus operators who proposed cab design changes to the agency:

> We put them on the buses cold and then four students met for three hours with senior drivers who had experience working on ergonomics issues. The design groups came up with innovative ideas on where the passengers were sitting, passenger access and communication, and on the lack of clarity on the signage, which puts more pressure on the bus driver.

The solutions generated in these projects were sometimes complex and not always practical. One expert worked in a transit agency that tried many different seats to improve health and ergonomics for bus operators, in part driven by a need to reduce compensation claims. Decisions were influenced by the existing cab details, such as the placement of the fare box or controls. Desirable improvements would sometimes conflict with the Americans with Disabilities Act (ADA) and maneuverability requirements. The expert felt that the changes that are limited by the overall ergonomics of the cab will not be achieved, as he put it,

> Until that dies. The biggest current challenge now is the assault barrier. But the seat and steering wheel placement are the limiting factors.

In another case:

> [Based on a long participatory ergonomics process,] changes were made to the cab and a seat prototype was developed. The results arising from trials conducted in real conditions were positive and promising to help preserve musculoskeletal health of operators and increase their comfort. However, long term the research team could not perform evaluation to see if the changes reduced the operators' discomfort or musculoskeletal problems.

Responses to Question 3. Who have the experts observed participating in procurement?

Experts described both limited and more inclusive models of participation. The policy expert observed that procurement is done mostly by supervisors from operations and maintenance, along with procurement staff. Rarely, mechanics from smaller properties attend procurement training. One had experience with an extensive and integrated procurement:

> There is a company-wide group that oversees the process, aggregating data and opinions. It includes fleet engineering, operations, service planning and instruction. Vehicle maintenance is the loudest. Financial may be represented, but not sure it drives procurement decisions.

Bus operators' input was not always requested in a timely way, as confirmed by the agencies and unions:

> Many years ago the union negotiated for having bus operators involved in procurement that affected musculoskeletal health. Unfortunately, they had gotten involved towards the end, after a large specification, so not everything could be done. But some horrendous mistakes were caught, as the ergonomist who went up with them said. And he said he felt that if we had those on, drivers would be out with ankle problems within two weeks.

Manufacturers contributed to procurement when new equipment was needed:

> The presence of the representative of the company chosen to build the seat prototype has facilitated and accelerated the design process. He took note of the requirements and design constraints imposed by each department and was able to quickly offer alternatives to try to get as close as possible to the desired criteria.

The industry experts who did not work directly for the company were able to define the terms of stakeholder involvement:

> In the frontline user project, we created a joint labor-management committee chaired jointly by frontline workers [and management]. It was negotiated that the committee have the authority to choose the devices. That has been the model for many of the better organizations in this industry. We were not sure how that is implemented nationally. They were frontline workers, union representatives, people from procurement, and other management people.

The structure a researcher established is useful throughout the procurement process, not just new product design:

> We demanded operator involvement at three different levels: 1) decision/support for the project (monitoring committee); 2) practical realization of the project (working group); 3) participation in different trials (employees-users).

One industry expert observed that contributions from the safety department or bus operators were not well integrated into procurement:

> Safety has been sidelined, only seeing the RFP just prior to finalizing. However, the Safety Department has been given veto power because [Agency] had to return fleet vehicles for safety concerns…. The depot safety committees hold quarterly contractually mandated meetings, which raise issues to the GM and designees. Many are reported to the safety committee by drivers. In recent years, drivers can't photograph problems as easily because they can't carry their phones.

Similarly, bus operator involvement is not always ideally influential or effectively organized:

> Operators on the driver evaluation team were told about the legal issues related to procurement, shown written manufacturer proposals, then sat in a room and asked for comments…. A dozen or maybe 20 operators look at the pilot bus and drive it around. Mechanics do similar. They all fill out evaluation form developed by procurement – mostly about whether the vehicle meets specs for angle of approach and room for open-ended comments. The bus is borrowed from another agency so it is not exactly the proposed specs. Responses are aggregated then ignored. Some operators have raised post purchase issues, which are still ignored.

Responses to Question 4. What is the ideal role of employees?

The industry experts had thought a lot about this, and felt that a wide range of stakeholders should be involved. As described earlier, this was observed in some of the agencies:

> Engineering departments, maintenance, operations and occupational health and safety should participate in the working group. The departments should delegate a person who has very good technical knowledge in the area but also has some policy influence. The designated staff of these departments should attend all meetings.

As in product design generally, engineers and other technical experts should be close to the end users; in this case that is the bus operators:

> The people who design the equipment specs [at the company or in industry] should be involved [with the whole ergonomics process at the company].

In their experience, bus operators can provide valuable contributions from the beginning:

> Drivers should have a role in defining functional goals. Input needs to be solicited earlier, and feedback provided to those who comment and contribute. At the same time operators and others have to listen to engineers for valid reasons why a thing might not be possible.

One industry expert had experience with a more limited role for bus operators, but was open to change:

> Some things can be adjusted with the input of the users. For example, the placement of transfer cutters, fareboxes have some flexibility. The labor-management committee would be the best place to do work these things out. [In his agency], once the new bus came in they would ask operators what they thought about e.g., farebox angle. Operators could be involved more than they are. Some places have mechanics on specifications and proposal evaluation teams.

Other bus operators should be recruited for testing, and as naïve users throughout the process:

> A large number of other users should be involved in the stages of testing and validation. Their selection will depend on the type of important variables to be considered, e.g., age, experience, height, build, training.

Some industry experts recommended that there should be union team representatives to transmit information on the project's progress more widely and point out if any planned changes conflict with the collective bargaining agreement. Management is also a conduit for information to other agency employees.

> An employer representative and a union representative are also the contacts for the relay of information and coordination of the project. These [union contacts and management team members] must be sufficiently aware of the project to avoid generating unrealistic expectations among workers.

Responses to Question 5. What skills do you observe or recommend in design and procurement teams?

Like the agencies and unions, industry experts on the whole felt that some technical competence was required of all team members, but that detailed skills and knowledge in many areas could be contributed as needed. One, in contrast, felt strongly that transit agencies limit their own effectiveness by not understanding the background of the equipment they need:

> It is essential to have someone who understands product development. Every agency is doing procurement, but without anyone having any experience in design.

The best process calls on a range of backgrounds and skills:

> What works best is that you have people who bring different knowledge to the table…. The most successful is a team that represents the various interests, with a fair balance. To have range of disciplines, maybe even marketing at a certain point, e.g. color, look. More specific skills like blueprint reading are not needed by everyone although all should have a general understanding of what the vehicle is about, including mechanics, rules and regulations including ADA, FMCSA, EPA.

To be most effective, the team should have access to advanced knowledge and skills:

> The team needs engineers, human factors people, competent safety people with skills in human factors, accident analysis skills - as experts who can evaluate and combine their insight with that of operations and maintenance concerns.

Refining the process and expectations is an important step, and this requires someone with group management skills:

> You have an agreement on roles and perspectives. You may need to discuss relative influence and power in the decision process, as some participants will and probably should have more.

Working together enhances the group dynamics:

> Allow some time for discussion "off topic" when you see that this is conducive to building a stronger social ties among participants or when it is used to set points that could not be settled by other means (the Working Group an opportunity to meet people from other departments when it is not possible at other times - it brings satisfaction to members). Overall, we noted an increase in listening and mutual respect of participants in the working group.

Skills are connected to and supplemented by access to information:

> Provide an information storehouse for all players to educate themselves (including industry resources, TCRP reports, etc.)

Respondents did see expertise in areas that might on the face of it seem unrelated:

> At [Agency], mechanics and fleet engineers can draw on many backgrounds e.g. racing, how cameras are assembled.

Agencies need to seek expertise out, internally and externally, accessing intellectual resources across research, industry, evaluation tools, and specialists. They need to move beyond existing products and ways of thinking:

> In transit because of the scale and complexity of problems, a conscious focus is needed on getting generalists to integrate ideas from other areas rather than off-the-shelf from manufacturers.

Overall, the industry experts felt, "The best process involves people who have knowledge of the area." They see a wide range of skills being exercised, but not as effectively as they might be. Sometimes the needed skills, as well as products or design ideas, can be transferred from other modes or industries. Transit agencies needs to recruit the essential skills among their employees, and provide training to support or develop it. They echoed the common concern of transit agency respondents:

> Agencies need to invest in time for education, and for communication with others.

Responses to Question 6. What training have you observed that supports effective groups? If not maximal, what additional skills and training do you recommend?

Training to support bus operator health and safety via the procurement process was not often seen:

> The NTI course attempts to communicate a basic understanding of the FTA's procurement rules. There is flexibility in how agencies manage specifications, and another purpose of the course is to develop support for standard specifications that are being developed by the industry. This is a good program, designed to make industry responsive to the current regulations and the guidelines as they are developed, in a reiterative and rolling fashion. However, in terms of safety there is nothing other than the issues covered in the APTA Standard Bus Procurement Guidelines. The issue is, not to say ignored, but there have been a lot of issues that agencies need to cover. The one that comes to mind is the operator seat.

The industry experts diverged strongly on whether training was needed to improve bus operator health and safety. One was explicit:

> It is critical that there be a course for the frontline workers [involved in design and procurement] because there are technical things that need to be understood, so that they can ask the right questions. There should be a design course. Not all the people on the device user committee have taken the design course, but I could see the ones who did were much more astute about looking at the design, the new technology, taking it apart, and look for errors. The course also should look at what could go wrong, and identify all the different maneuvers that may impact the technology. It should cover prototypes, with an understanding that these are not the final product.

This contrasted with:

> The meeting of experts of different skills (engineering, maintenance, operation, operators, health and safety, expert vibration, ergonomists) in the same working group reduces the need for training. The explanation provided by each member, as and when a concrete situation arises, was enough to understand several key concepts which are nevertheless sometimes difficult to convey. Training would be required only if an important part of expertise was missing around the table.

Agreeing with some agencies' expressed need for an orientation course for new participants, one suggested that past minutes can be a good way to integrate a new employee within the working group. Industry experts emphasized that the whole team should start with a shared perspective on the process:

> Training will probably work best when delivered to a team of people working together on procurement. It provides an overview and defines a partnering model. It is also useful in dispelling some of the myths about the process – what people believe FTA said.

General and technical training areas were recommended in some cases:

> If a full installation of cab was possible (ex. if designing a new vehicle), a short training on the principles of physical adaptation of the workplace (postures), design of a management dashboard and visibility could be useful. In any case, learning should be concrete in action rather than in theoretical forms.

Good training takes place in practical settings:

> Where possible, the team learns by going to the manufacturers, especially new participants and those with critical roles. As for ergonomics training, that team should include operators, maintainers, engineers. In smaller agencies those roles will overlap. This team approach is needed because a rule or training content may lead to, for example, specifying where to put a thing, but that might not be always available. So in this process of achieving desired ergonomics improvements, the manufacturers need to be in the loop.

Training should include how to assess one's own work and equipment using systematic tools.

> Something that should be in a design course, is how do you assess your work? To interview people is important, to tap their expertise, but a systemic tool is also powerful. It doesn't mean that you go and interview people, but that you give them the tools to look at their own job.

Training can be practical and supported by experienced committee members:

> I always like group mentoring. The design students were mentored by senior drivers, very much at [union leader]'s recommendation, because these people know what's going on. [This applies to new committee members.]

Responses to Question 7. What kind of communication and decision-making processes have you observed that enhance effective design and procurement within companies, and what would you recommend?

Industry experts described how the procurement and design could be improved. At the outset, the individuals who participate should be selected with some intention. Ideally, people are recruited who understand project management, product development and what it takes to operate and repair vehicles. These might be criteria in hiring as well. Some respondents recommended the team members self-select, to make sure they wanted to contribute maximally.

> Team building by product development person is needed. Not us and them, but look at the problem in teams. They should define the roles, [and how they are] integrated. Goals and priorities should be shared.

But not everyone needs to be at every meeting:

> The process should be iterative rather than all at table together. A global view needs everybody there but not all together.

The team's work needs to be supported by the organization:

> The people involved in the working group have a workload that hardly seems compatible with the assumption of these responsibilities. We must make time for meaningful stakeholder involvement. The stability of members of the working group is important, it eliminates the need to re-explain the entire journey and why certain decisions were made.

Communication is at the heart of effective design and procurement. The industry experts' responses echoed those of the agencies and unions reported earlier:

> Allow me to stress the importance of transparency in communications: both worker representatives and members representing employers have the same information. The minutes approved by all members of the working group at each meeting are also a basis on which we can build. This avoids disagreements and backtracking. We also note the important role played by the Monitoring Committee, which was informed and consulted during the project milestones, and gave its support before the next steps were pursued.

Time is needed for the development of mutual respect and effective communication:

> The most important is open dialogue, to get beyond "Here it is, bid," or "Here it is, buy it." Reasoned thinkers see we are in this together. And there has been a vast improvement. The industry is learning that more successful operations are working with labor-management partnerships. Adversarial roles will continue in some areas, but where all could get along and work together, they should find commonalities.

Important content may still be missing even when communication takes place:

> This kind of teamwork could be effective but usually the teams have not defined all their targets. [For example, you say], "We need a mirror" but forget that operator still needs to see forward.

The lines need to stay open:

> It should be transparent to the committee when there are changes that are going on, and what implications that has, because I think the big troubles happen in the work changes.

Communication extends to outside stakeholders and partners:

> [Agencies should] do long-range outreach to industry and manufacturers, in an organized process of discussion. [This could also work to] develop market interest.

Industry experts reported problems with how decisions were made and changes incorporated to improve the bus operators' workstations:

> I do know that we're getting buses that are not optimal.… You put in your specs, and then they get changed along the line. What keeps changing them I don't know. I would suspect that it's economics.

Paying attention to the role of all the participants could improve matters:

> An important outcome of this experiment is that the company has chosen to adopt a participatory approach in its future vehicle purchases.

Experts agreed with agencies and unions that the process of improving bus cabs requires more testing, earlier, with more extensive and more educated stakeholder input, and with more flexibility about the outcome:

> During the whole process have [bus operators and maintainers] periodically testing the proposed equipment. There should be a systematic testing strategy for evaluating the devices, whether it be in mockups or in first trials. It needs to be spelled out and it needs to be involving, with workers actually doing what they do, or simulating it as close as possible. I would bring senior drivers on different routes. When you're testing the buses you need to test them on the most difficult routes. The protocol also should include those external factors that can be stressors, such as passenger loading, passenger actions. Not all these things have to be done in actuality, but they need to be simulated.… I don't think driving [buses] around the yard recreates those issues.

There is a role for naïve users as well as experienced ones in testing:

> You do want to know what the experience is for new drivers, because they don't know how to make the accommodations [senior bus operators do]. Maybe you have to have a two level kind of strategy, for both training and testing. At what point do you bring naïve drivers? Because you want your design to be so apparent that it's not an issue for anybody.

As discussed in Chapter 2 [of *TCRP Report 185*], these combined insights led to the development of recommended practices.

APPENDIX F: DESCRIPTION OF TRANSIT AGENCIES INTERVIEWED

Information about procurement practices at 10 agencies was collected in 15 interviews, 10 with transit agency staff and 5 with union representatives. One-third of agencies reported that there was no real committee, and that the work was being done by one or two people. This occurred in small and large locations. Others described well-established teams either made up of representatives from all stakeholder groups or involving them as needed. The agency sizes, types of procurement, and committee or team activities are described below.

Three agencies responded by email to explain that they did not have a formal committee. Because of the restriction of our Institutional Review Board (IRB) protocol, we were not in a position to continue recruitment with these agencies in the absence of positive assent; although, judging from their comments, they were not very different from the agencies we did interview. One stated that they take bus operators' input when going out for procurements. Another does not change much in their specification from procurement to procurement. The third recommended that we include bus operator and customer comfort, maintainability, functionality and cost, as well as impacts to work place injuries.

Agency 1 is a large county-wide multimodal agency.

Who was interviewed: Technical services manager.

Procurement team details: The technical services manager has primary responsibility for specifications, with a team of managers he directs in the process. The chief operating officer (COO) wrote that Agency 1 "does not have a formal team; however, our technical services team has worked with our accessibility advisory committee and our driver's committee to obtain input on needs requirements for disabled passengers and our operators on our new bus fleets."

Role of safety: The safety department does not review procurement specifications.

Role of bus operators: The bus operators' committee provides input on bus design concerns.

Agency 2 is a large state-wide multimodal agency.

Who was interviewed: Director of bus maintenance.

Procurement team details: The chief executive officer (CEO) explained that they do not have a group that focuses on bus operator workstation design specifically. The procurement process is run by the director of bus maintenance, who had started out as a mechanic. He supervises a team of four managers who coordinate concerns for their own areas.

Role of safety, role of bus operators: A joint labor/management systems safety group has final say on safety-related procurement questions.

Agency 3 is a large multimodal county-wide agency.

Who was interviewed: The fleet engineering superintendent, a safety and health administrator, and the union president, separately.

Procurement team details: A large procurement team formally integrates input from procurement subcommittees, some including hourly and management representatives. The process is detailed in protocols and documentation, including requests for vehicle specifications changes at all stages of the bus lifecycle.

Role of safety: A safety subcommittee reviews specifications concerning ergonomics and safety.

Role of bus operators: Bus operators are involved in evaluating manufacturer proposals, although there was disagreement between union and agency respondents about the extent of the input.

Agency 4 is a medium-sized county bus transit agency.

Who was interviewed: Management procurement team representatives, two each from maintenance and operations, and one from procurement, in one interview, and the local union president, separately.

Procurement team details: The team consists of the management staff interviewed, plus a finance person. The members of this team work closely and well together, and were proud of the method and rapport they have built over the course of the recent procurement cycles.

Role of safety: The senior manager of safety reviewed and commented on the specifications in the recent procurement.

Role of bus operators: Bus operators are surveyed before and during procurement, and union leaders and senior bus operators visit neighboring transit agencies with management to evaluate possible changes. Bus operator trainers are consulted when concerns arise that affect bus operators.

Agency 5 is a large multimodal metropolitan transit agency.

Who was interviewed: A safety specialist and the local union president, separately.

Procurement team details: The procurement plan is developed by the General Manager and department executive directors. The procurement process is also supported by a technical review team that includes upper management representatives from safety and security, operations, maintenance, facilities, operators, projects, capital projects and representatives of other modes.

Role of safety: The safety director has been active in procurement, and a safety staff person chairs the new bus operator team, involving bus operators, the safety manager, and operations and bus maintenance department managers. In the recent cycle, the joint labor/management safety team visited the manufacturer during procurement and build.

Role of bus operators: The agency sent bus operators to the manufacturer, with a bus operator trainer and mechanics.

Agency 6 is a large state-wide transit agency.

Who was interviewed: Procurement and fleet engineering administrators, jointly, and local union president separately.

Procurement team details: There is no formal committee. The procurement and engineering managers coordinate procurement, with the fleet engineering manager responsible for specifications and the procurement manager otherwise taking the lead. The agency recently initiated an implementation committee to prepare for and follow the new buses.

Role of safety: There is no formal role in procurement, but the safety committee refers concerns from time to time. The previous fleet engineer had extensive ergonomics knowledge that influenced procurement.

Role of bus operators: Bus operators are surveyed for their opinions on proposed changes but are not partners in the process.

Agency 7 is a large multimodal urban transit agency.

Who was interviewed: The system safety director.

Procurement team details: There is no formal procurement team that engages all stakeholders.

Role of safety: The bus engineering group calls in the safety department, operations, maintenance, training, infrastructure, and others at various stages of planning.

Role of bus operators: Bus operators are not involved until the prototype stage. The agency is discussing the opportunity to bring in bus operators earlier in the process, and the safety director felt strongly that the team must be willing to include all stakeholders.

Agency 8 is a large multimodal regional agency.

Who was interviewed: Fleet systems engineer and local union president, separately.

Procurement team details: The procurement steering committee team includes maintenance, technical engineering, senior transportation, the administrative procurement team, and safety department representatives. Subgroups cover their own areas, and then reconvene.

Role of safety: The safety committee identifies and evaluates the salient areas of the procurement.

Role of bus operators: According to the engineer, survey information and input from key senior bus operators is collected, and two operators spent a week at the manufacturer reviewing the pilot bus operator workstation ergonomics. The union reported that bus operators do not normally participate until build and pilot manufacturer visits, when major decisions have already been made.

Agency 9 is a small, non-union bus transit agency.

Who was interviewed: Maintenance manager.

Procurement team details: Procurement takes place in a regional contract, but individual agencies are free to modify hundreds of elements, which this transit agency does via a procurement panel. Agency 9 tests pilot configurations and surveys bus operators and maintainers. The panel reviews the options, internal suggestions, and survey results.

Role of safety: Safety issues with the bus operator workstation are vetted by the purchasing consortium. Agency 9's safety committee of operators, supervisors, and safety/training department follows up on any issues reported by bus operators.

Role of bus operators: The panel includes three bus operators who poll the others. At employee meetings, they go over the outcomes of the tests and surveys to ensure that everybody is aware of what choices were made and why.

Agency 10 is a medium-sized metropolitan transportation agency**.**

Who was interviewed: Local union president.

Procurement team details: The union president was not familiar with the current process. After responding to the union survey, the president requested a place on the procurement team and was accepted.

Role of safety: Although in the past a union member of the safety committee served on the procurement team, this had not happened for the last procurements.

Role of bus operators: Bus operators had gone out to the bus build, with maintainers, to make recommendations. Other equipment selection teams have continued to include bus operators and maintainers. Earlier and more thorough involvement of the bus operators in testing was recommended.