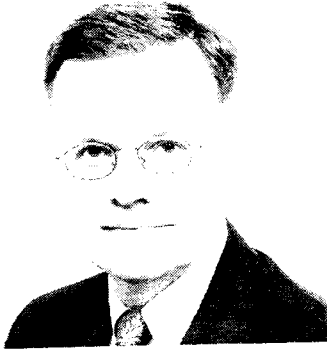


FOCUSING THE PROGRAM, PROJECTS AND TEAMS – PART C: REFINING AND CONTROLLING PROJECT AND WORKSHOP DIRECTION WITH FAST

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ABSTRACT

Based on the author's experiences in leading VM / VE workshops on several projects with very broad scope lines in 1998, this paper discusses the use of FAST to refine and control the direction of a VM workshop and, ultimately, the project under study. Three specific case studies are presented, ranging from FAST development by the VM team in the conventional manner to CVS development of a FAST diagram off-line, encompassing both program and project development. Use of the traditional FAST diagrams themselves as a focal point for the VE Team and project alike can yield a framework to shape and control programs and projects, particularly for matters of major policy and complex and/or controversial issues.

INTRODUCTION

FAST diagrams have often been a hot bed of contention between value practitioners. Some say if you do not use FAST, you are not following the value methodology. Fortunately, the prevalent conventional wisdom is that as long as you are performing function analysis in some meaningful way, then you are true to the value methodology. The discussion here is not intended to renew this controversy, but to explore how FAST can become the framework for deriving balanced solutions to complex and, perhaps, contentious problems.

1998 provided McClintock Value Professionals (MVP) with a full scale function analysis / FAST

laboratory, i.e. three VE study assignments on complex freeway projects for the same client, the Ministry of Transportation in Ontario, Canada (MTO). Two of these assignments entailed eight day combination Module I VE Training and project review workshops for over 25 personnel, which gave us extra time and personnel to explore different methods of looking at function. The result was a new appreciation of the power of FAST, and a field tested approach to make FAST, well, faster.

TRAINING IN FUNCTION ANALYSIS

Before getting into the specifics of each "laboratory", it is instructive to outline the general approach of MVP to training in function analysis in a Module I VE Training Workshop. Not that it is unique, but it will give a baseline for the "laboratory results".

Following an information phase, which often includes a site visit, the VE Team in training enters the function analysis phase, separated out of the information phase to reflect its importance to the VE process. The traditional Module I lecture material on function analysis is presented to the VE Team. MVP stresses that function analysis is the cornerstone of VE and that decisions based on function analysis is what separates VE from cost reduction and, often, standard design procedures. We explain that function analysis provides a clarity of thought which insures thorough understanding among members of the multi disciplined VM team members, avoids confusion, and allows the team to

break a complex project into well defined functions for which creative alternative solutions can be sought. We further state that "it all starts with the definition of function."

Then, we present verb-noun pairs and, in a magical moment which all VE trainers have probably seen, you see the eyes glaze over and the heads stop nodding. Clarity is the last thing with which the trainees think they have been provided. They now know they are not in Kansas anymore. They start to realize that VE is not "what we always do anyway". Now the fun really does begin.

The standard examples start to bring the trainees around, e.g. the pencil with graphite to MAKE MARKS, an eraser to REMOVE MARKS, wood to HOLD GRAPHITE and PROTECT FINGERS and paint to ATTRACT BUYER. The definitions of basic and secondary functions, required and unnecessary functions, and even higher order functions all make good sense. Then, just when they're all starting to feel comfortable again, you hit them with the best oxymoron in the VE world, the FAST diagram. It's a powerful tool when you know how to use it but, when faced with it for the first time, it does tend to give pause.

Starting with the much published Function Analysis System Technique (FAST) Diagram Ground Rules graphic, the rules of FAST are explained. We talk about the Scope Lines, which define the project under study, and the Critical Path of Functions, which must answer how to the right and why to the left. We show where design objectives and functions that happen "all the time" can go above the critical path. We also show where functions that happen "at the same time" and/or "are caused by some other function" can go below the critical path. It is a clear representation on a simple graphic. But as we will see, the real world is not usually that simple.

The next step in our educational journey is that most famous of FAST diagrams, the Mouse Trap. It is beautiful in its simplicity and very clear to the trainees. Although perhaps misleading in its simplicity, we often need to learn to walk before we run. It is when we turn to the live project that the real learning begins in both function analysis in general and FAST, specifically.

The common method we use, which greatly facilitates the completion of a FAST diagram, is to write identified functions on cards and tape them on a wall. Post-it notes work well in smaller workshops. The VE Team then rearranges the cards until satisfied that all

functions are represented, and are arranged for proper responses to the how - why questions.

The ultimate lesson is how important it is for the VE team to understand the functional relationships of the project as a whole before analyzing the functions of each specific target. The FAST diagram may be difficult and very time consuming to construct, but the discussing, questioning, compromising, and analyzing which the team goes through can be very fruitful. As will be shown, this is more important than the FAST diagram itself.

Our last instruction in the function analysis phase is on use of the standard forms we provide for function analysis. First, we have a two page form to IDENTIFY EXISTING FUNCTIONS, which asks the standard questions we see throughout the literature. Examples are "What does it do?"; "What must it do?"; and "How does its cost compare to its worth?". Second, we offer a FAST diagram form with a critical path, a HOW, and a WHY. Generally, only with the simplest projects can this form contain the FAST diagram. Third, we have the standard Function-Cost-Worth table. In our first laboratory, the first two forms took center stage.

LABORATORY ONE - TEAM GENERATES FAST

The first laboratory opportunity for MVP in 1998 was the eight day combination Module I VE Training and Project Review workshop for the Extension of Highway 410, Bovaird Drive to Existing Highway 10, in Brampton, Ontario. The VE Team included 19 personnel from MTO, six from prime Stantec Consulting Ltd., and one each from subconsultants John Emery Geotechnical Engineering Limited and GFE Consultants. The \$72 million project included 8.5 km of divided freeway, with five interchanges, three grade separations, and four major culverts. The project had first been planned ten years before and languished on the shelf due to a cost which was greater than political expediency could justify.

After an information phase which included an extensive field visit along the proposed Highway 410 route, we entered into the function analysis phase. Following the lecture on function analysis, as outlined above, the overall VE Team was broken up into three multi disciplined teams of seven and one of six. Each team then generated a list of functions that were provided by the project, in the standard verb-noun format. A spokesperson for each team then presented the respective lists to the whole group for discussion. Although many

functions were the same, each group came up with a few functions no other group had identified.

While still in the large group, we wrote each of the verb-noun functions with black marker on an 8 1/2 X 11 sheet of paper and started constructing a FAST diagram on the large front wall of the meeting room. Almost immediately the group fell into a common trap when building a FAST diagram on a complex project. They had identified functions which the overall project would provide, as well as the functions which deliver the finished highway. When the team tries to fit all these functions into the HOW and WHY structure of the FAST diagram, it can lead to much confusion.

It becomes similar to the chicken and the egg debate. Do you PROCURE PROPERTY first so you know how to DESIGN HIGHWAY, or do you DESIGN HIGHWAY first so you know the extent you must PROCURE PROPERTY? In reality, it's both, but when you try and force the functions into HOW / WHY with a group of 28, you get confusion. We got the group to agree that delivery of the project can be its own FAST diagram. If the sole purpose of the workshop was to build the perfect FAST diagram for the project, we could ultimately work the project delivery FAST diagram in as a subset of the overall project FAST diagram. This seemed to satisfy all, so we continued to build an overall project FAST diagram without each specific project delivery function. We continued on as a group until we had a good draft overall project FAST diagram. All significant functions were represented and the concepts of FAST had been learned.

A FORM TO FOLLOW FUNCTION OF TARGETS

At this point, we revisited, as a group, the list of potential targets for VE we had generated in our discussions on the cost model in the information phase. We discussed where the target components fit in on the FAST diagram, and whether the FAST diagram itself suggested any additional targets. A few more targets were added to our list. At this point, we gave specific instruction on use of the IDENTIFY EXISTING FUNCTIONS form and then broke down into the four teams. The assignment was to look at each target, define all its functions, classify its functions, and answer the standard function questions mentioned above, e.g. "How does its cost compare to its worth?"

When we reconvened the entire group to go over the results of the above assignment, we heard an interesting comment. Some members of our team felt

they understood function better through the form than from the FAST diagram. Others disagreed. We saw this as an opportunity to get some good feedback on the two methods of understanding function analysis, even though they really are not directly comparable. As an extra service to the client, we had just completed a lunch time seminar to the group on mind mapping. We decided to lead the group through a mind mapping exercise on the advantages and disadvantages of each method, to gauge the success of each method and provide first hand experience in mind mapping.

A MAP TO THE VE TEAM'S MIND

First, we'll discuss the advantages expressed for the IDENTIFY EXISTING FUNCTIONS form. The group generally agreed that this method was clearer and made more sense than the FAST diagram. Of course, with this method you are looking at a single component which in itself is a much easier proposition. The feeling was that you could more easily "weed out" functions that had poor value or were unnecessary. The group felt that this method accommodated discussion better in a small team setting. The form approach was compared to micro management as it considered specific components of the project. It was also noted that the relationship of functions at various levels could be shown by the use of higher order and secondary function classifications.

As for disadvantages, all agreed it sometimes was difficult to express a function in the Verb-Noun form, which is a problem common to both methods. Some felt the form was too linear, which is a testament to good mind mapping training. It was sometimes too easy to get a "runaway train" scenario going on the team, i.e. get something down without due consideration. Finally, some thought the form was too discrete, giving no clear picture of the project as a whole.

The advantages generated for the FAST diagram were enlightening to many in the group. With FAST, the group saw that you can define the scope of the VE study through the scope lines. Many expressed that the FAST diagram is clearer since it gives you the big picture, an overall sense of the project. FAST was compared to macro management. It also provides a path of logic, which helps the team to avoid jumping to the wrong solution. Many liked FAST because there are more than one right answer. All agreed that the more complex a project is, the more useful FAST will be. In addition, all agreed that FAST is a good prelude to the IDENTIFY EXISTING FUNCTIONS form and FAST helps a VE Team select targets.

The only disadvantage expressed for the FAST diagram was that it is slow. Still, the large number of advantages cited above implies that FAST is worth spending some time on. It appeared that only severe time constraints would dissuade this VE Team from preparing a FAST diagram in future workshops.

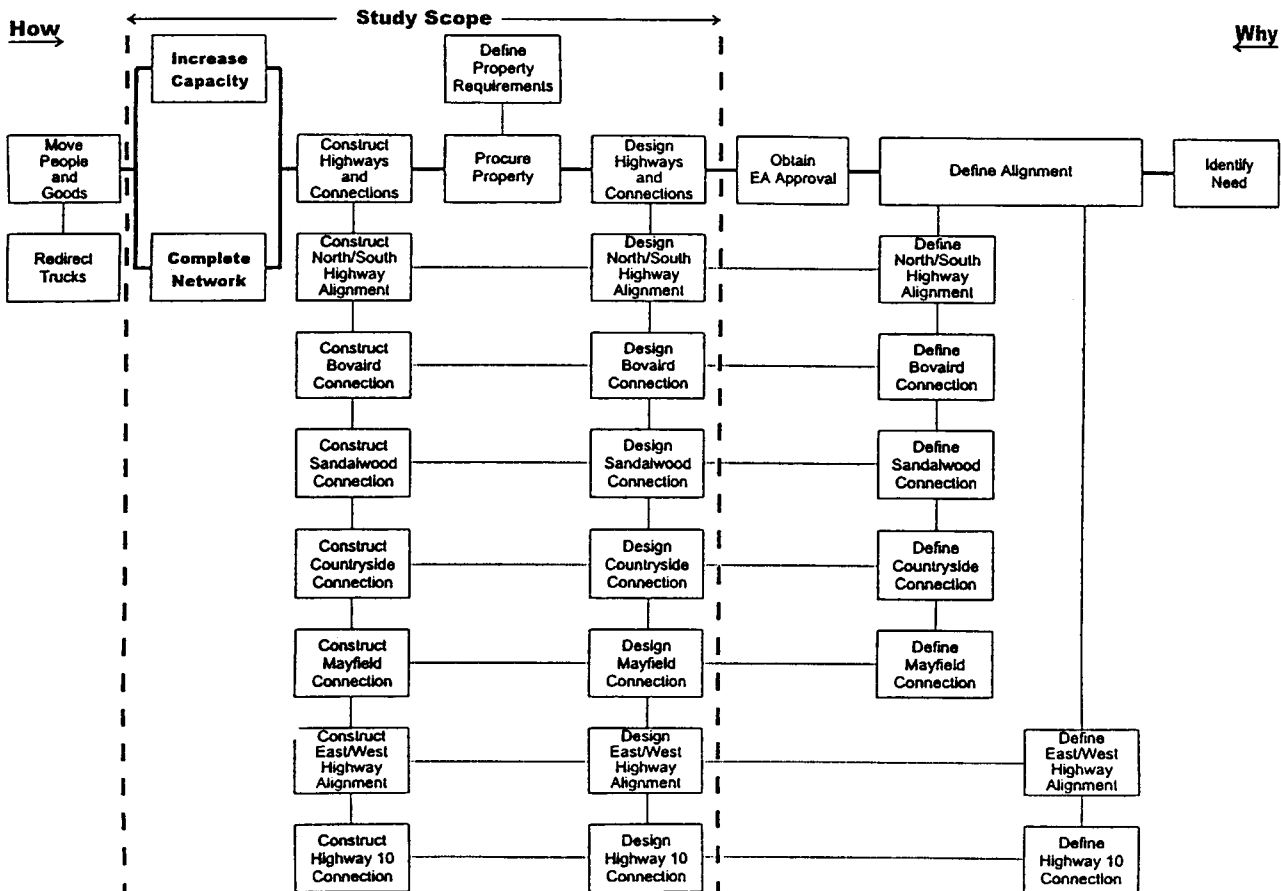
FAST diagram, but we also all knew we could further improve it if we spent the time. Of course, we all would change it in a different way. As it turned out, we didn't need to since, just as Mr. Bytheway also said, we got the creativity we needed from the VE Teams for a very successful workshop without "finishing" the FAST diagram.

REFINED, UNFINISHED, SUCCESSFUL

The workshop proceeded into the creative phase and beyond, but the FAST diagram lessons were not quite finished. One of the VE Teams decided to tweak the FAST diagram since it did not fit with some additional functions they had uncovered as the workshop continued. The discussions that followed led to further refinement and ultimately to a FAST diagram with which all could live, as presented below. This result reminded me of a comment made by FAST pioneer Charles Bytheway at a SAVE conference several years ago. He said he had never finished a FAST diagram. We all could live with our

Our "unfinished" FAST diagram did provide a very important benefit to the project. The VE Teams had many ideas on various ways to reroute the highway extension. However, these discussions were very uncomfortable for many in the room since it had taken ten years to obtain approval of the environmental assessment. The time required to obtain approval for a new route would likely use up any savings generated. The group agreed to locate the scope lines of the VE workshop to the left of OBTAIN EA APPROVAL, thereby focusing the VE Teams on development of VE recommendations within the same basic alignment. The FAST diagram also focused the VE Teams on one of

**F.A.S.T. Diagram
Highway 410 Extension, Bovaird Drive to Existing Highway 10**



the basic functions of the project provided by Ministry background documents, i.e. COMPLETE NETWORK. The extension had to reach all the way to existing Highway 10 to be acceptable to the Ministry. The result was implementable recommendations, which reduced project cost by approximately \$20 million and allowed the project to be taken from the shelf and moved into final design.

LABORATORY TWO - THE TRIAL FAST

The second laboratory opportunity for MVP in 1998 was a five day VE Project Review workshop on the Preliminary Design Report (PDR) for the Queen Elizabeth Way (QEW) Gap Freeway Traffic Management System (FTMS), from North Shore Boulevard to Winston Churchill Boulevard, in Oakville, Ontario. The VE Team included nine personnel from the Ministry, two from the prime IBI Group, and one each from Globe Network Integrators (communications) and Roper and Associates (operations). The "Gap" refers to a 23 km section of the QEW between the existing Burlington and Mississauga traffic management systems. The \$8.3 million project represents the Ministry's largest single deployment of FTMS in recent years.

In the Ministry presentation to begin the information phase, the Project Manager informed the VE Team that the VE recommendations for the Gap would most likely effect traffic management systems and operations throughout Ontario. This "challenge" was taken very seriously by the VE Team. As will be shown, this challenge was largely met through the use of a FAST diagram.

Based on the time it took to construct the FAST diagram for the Extension of Highway 410 with a similar mix of personnel, and the fact that we didn't have eight days, I decided to produce a "draft" FAST diagram for the VE Team's consideration. From several ministry reports and guidelines for freeway traffic management, and the PDR for the project, I developed the "draft" FAST diagram, with a very wide scope as reflected by the wide scope of the reports, prior to the workshop. I then placed scope lines on the diagram to designate the portion of this very broad scope which was under the influence of the QEW Gap project.

We began the function analysis phase with a quick but complete lecture on function analysis as many on the VE Team had not been VE trained. Immediately after the mouse trap FAST diagram was explained, I led the team through the construction of the "draft" FAST

diagram on the wall with markers and 8 1/2 X 11 sheets of paper. The team building aspect of this exercise alone was worth the effort as we fell over each other in semi-hysterics to place 40 some functions on the end wall of a too small conference room. If everyone knew how much fun VE is, it would be a much easier sell.

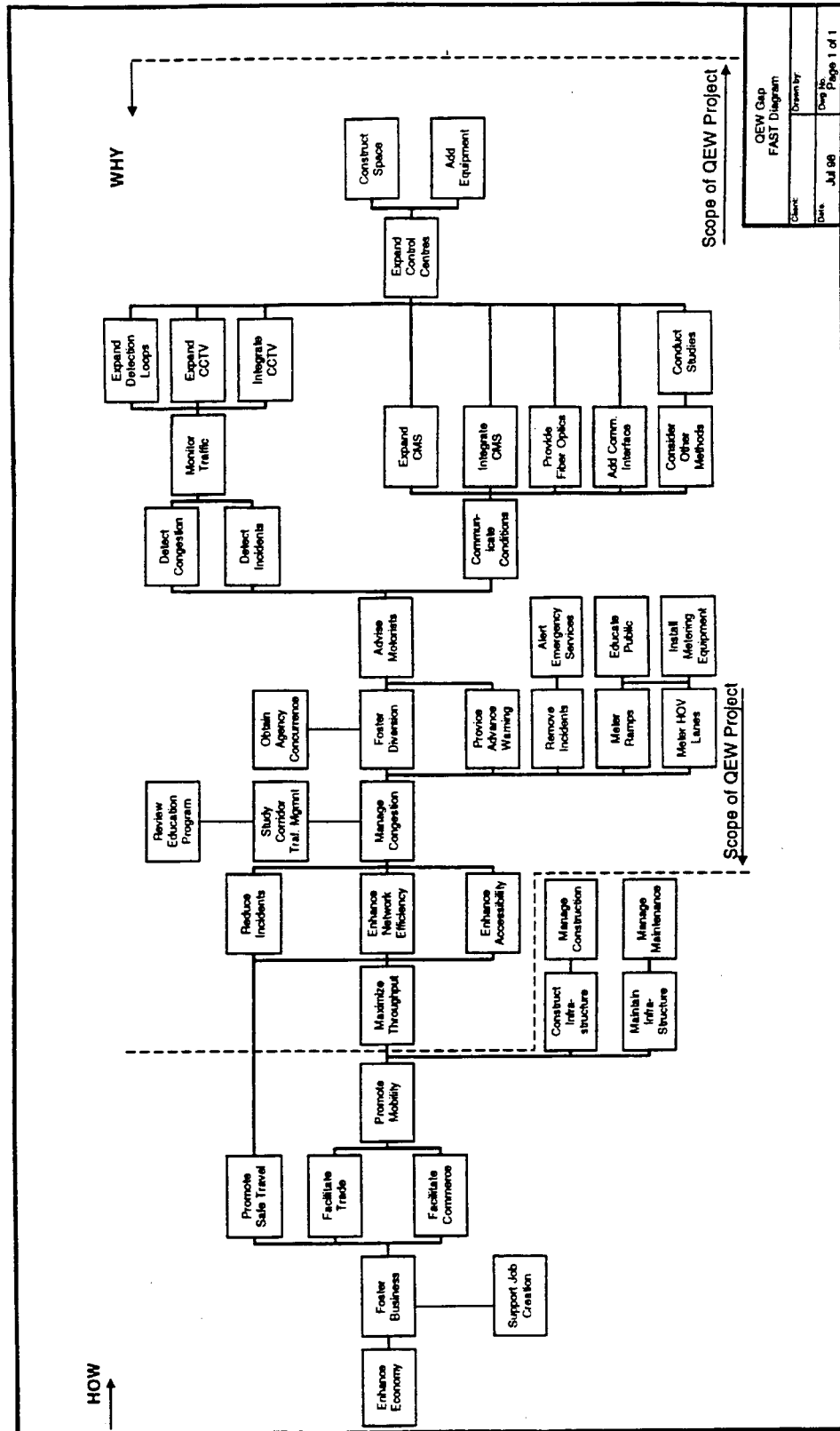
As soon as constructed, the "draft" FAST diagram began to generate discussion. I was asked where all the functions came from and shared their source with the Team. As the interaction continued, we added, subtracted, combined, broke down, and rearranged functions until we reached general agreement on the HOW / WHY relationships of the functions. With the entire VE Team totally focused on the issues surrounding freeway traffic management for the Gap and all of Ontario, we began an intense discussion on where the scope lines should be placed for this workshop. The "challenge" of the Project Manager would be met or not depending on the placement of the scope lines.

FOCUSED ON THE PROGRAM

The interaction that followed was as focused as any I have experienced in 17 years of leading workshops. All participated and all made excellent contributions. The main concern was how far to the left the scope line should go, with clear implications to freeway traffic management for all of Ontario. Systems selected for the Gap were expected to become a standard for future FTMS projects.

The resulting basic function for the QEW Gap project, and FTMS in general for Ontario freeways, was to MAXIMIZE THROUGHPUT. A required secondary function was to REDUCE INCIDENTS which had a link to a higher order function to PROMOTE SAFE TRAVEL. The FAST diagram for the Gap is presented on the following page. Although this was not necessarily a classic function arrangement, the VE Team understood what had to be accomplished and were well armed for the creative phase. It was clear the basic function of the FAST diagram itself had been met.

The FAST diagram was to have an additional significant role in the workshop. In the development phase, the VE team was struggling with the issue of individual VE proposals fitting in with the entire project. As a result, I initiated a discussion of what features individual VE team members thought should be in the QEW FTMS. This somewhat time consuming break in the flow of the workshop proved instrumental in development of several very beneficial VE proposals



which otherwise may not have been fully developed. The FAST diagram took center stage in the discussion, again focusing the VE Team on the important issues.

This VE workshop identified a maximum potential life-cycle cost savings to society of over \$180 million due to an improved approach to freeway traffic management. Although convened on a specific project, the workshop analyzed freeway traffic management throughout Ontario. Project specific maximum potential capital savings was estimated at \$2.5 million (30% savings), dropping to \$1.2 million if MTO opted to maximize savings to society. The VE study was instrumental in updating freeway traffic management in Ontario to the state of the art. As discussed above, the FAST diagram was instrumental in all of these benefits.

LABORATORY THREE - FAST RULES THE DAY

The third and final laboratory opportunity for MVP in 1998 was the eight day combination Module I VE Training and Project Review workshop on the preliminary design of the rehabilitation and upgrade of Highway 401, from Highway 3 to Provincial Road in Windsor, Ontario. The VE Team included 19 personnel from MTO, four from prime Stantec Consulting Ltd., and three from the project design consultant, Proctor and Redfern. This 40 year old, 4.1 km section of divided freeway is in need of rehabilitation and includes six substantial bridge structures and an appreciable amount of embankment.

Although this workshop offered us the eight day time frame of our first "laboratory", the overwhelming success of the "draft" FAST diagram approach on the QEW Gap workshop led me to use it again here. The function analysis "training" on the QEW Gap workshop was much less, since we had not been hired to train. Still, the Gap VE Team seemed to accept and understand the FAST diagram much easier than the Highway 410 VE Team. On 410, the struggle to build the FAST diagram from scratch had been viewed by some early on as not worth the effort. Fortunately, by the end of the 410 workshop, the worth of FAST was shown and changed their opinion. In the Gap workshop, this problem never occurred. Perhaps the mouse trap FAST is not as clear to highway professionals as a highway example, even if it is a much more complex diagram.

Similar to the Gap workshop, I led the team through the construction of a previously prepared "draft" FAST diagram on the wall with markers and 8 1/2 X 11

sheets of paper. The team building aspect of this exercise was again well worth the effort, this time with twice as many personnel. This was the point of the workshop when trainees realized we were doing something very different from their normal modus operandi.

This "draft" FAST diagram also began to generate discussion immediately. I once again was able to detail from whence all the functions came. As expected, we added, subtracted, combined, broke down, and rearranged functions until we reached general agreement on the HOW / WHY relationships of the functions. This agreement was not attained until we split the project into two distinct basic functions, each with its own branch of the FAST diagram. These basic functions were MAINTAIN PUBLIC INVESTMENT, which spoke to the dire need for pavement and structure rehabilitation, and REDUCE COLLISIONS, which addressed the minor, but too frequent accident rate, at the Provincial Road interchange. The FAST diagram for Highway 401 is presented on the following page.

Although the original design was technically sound and satisfied MTO's charge to the consultant, large costs were incurred by certain elements of the original design which provided minimal improvement to the driving public. Function analysis, and especially the FAST diagram, allowed the VE team to discover this inequity in the project's value. The FAST diagram made it clear to the VE Team that the basic functions of the project, and several high cost components of the design, were not consistent. The result of the team's focus on the function of the project, thanks to FAST, will be a well maintained, safe, and cost-effective Highway 401.

This VE study resulted in identifying potential savings of \$11 million on a project estimated at only \$22 million. The proposed scaled back design, which meets the basic functions of MAINTAIN PUBLIC INVESTMENT, as rehabilitation or replacement of all structures and surfaces is included, and REDUCE ACCIDENTS, since significant accident generators are corrected, should have a much higher chance of being funded.

LESSONS LEARNED

To say that the above FAST laboratories gave me a new appreciation of the power of FAST would be a severe understatement. I will admit to all that in over 17 years of project oriented VE experience in construction, I have not always been enamored with FAST. The IDENTIFY EXISTING FUNCTIONS form has always

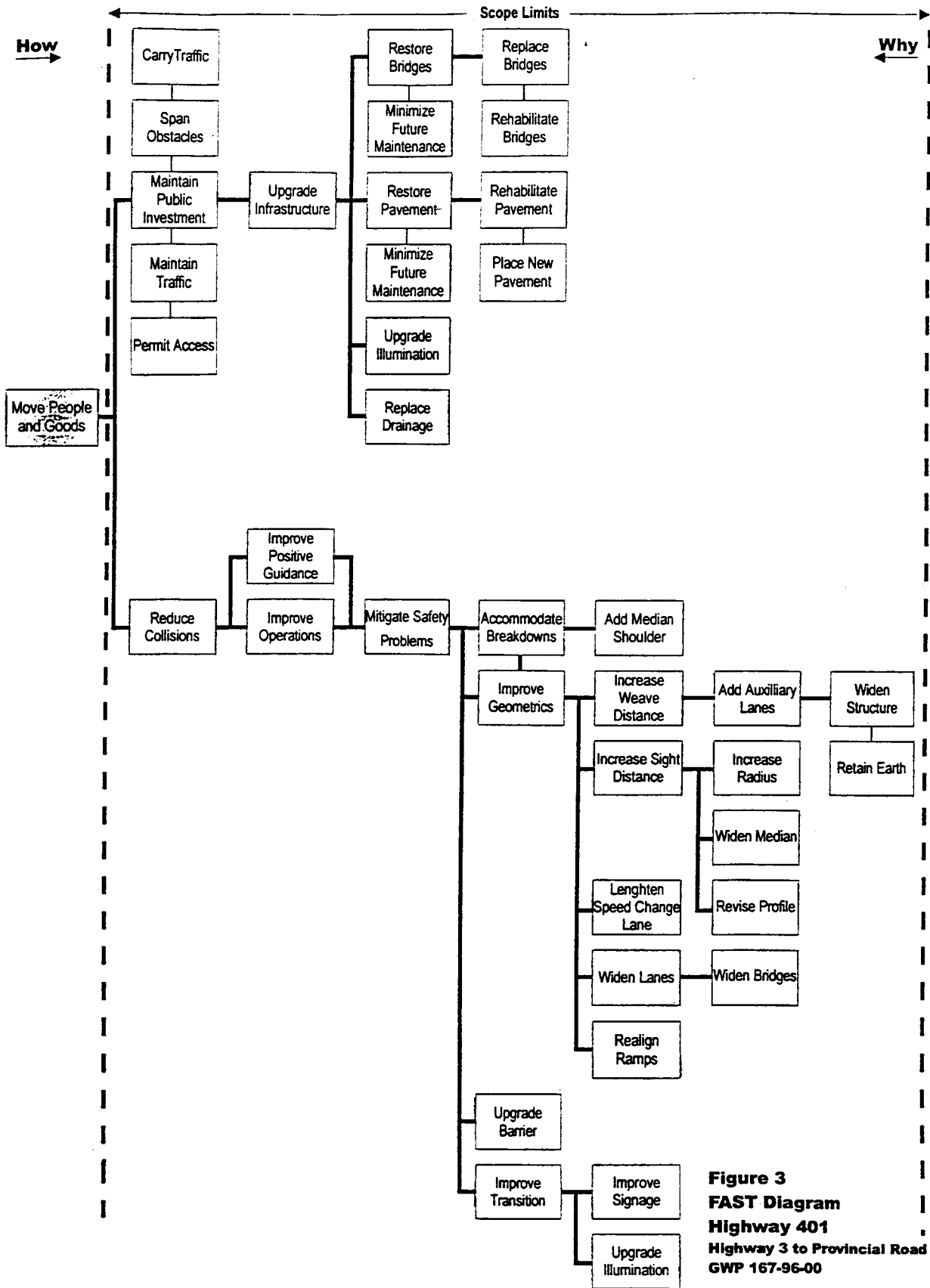


Figure 3
FAST Diagram
Highway 401
Highway 3 to Provincial Road
GWP 167-96-00

been my primary tool for function analysis. Exceptions have generally been for facilities with complex processes with which many on a multi-disciplined team would not be familiar. Prior to these laboratories, I had viewed FAST as too slow, taking away valuable time for proper VE proposal development. The "draft" FAST approach has given me a field tested approach speed up FAST. But it has also done so much more.

In all three laboratories, the FAST diagrams served as a focal point. Not just to focus the VE Team on the project itself, but to focus the project so it would fit in well with forces in the world around it. As an example, the Highway 410 Extension had constraints ranging from conforming to the hard fought environmental assessment to meeting the Provincial goal that the highway network be completed. The QEW Gap FTMS project, with the added pressure of having implications throughout Ontario, had to deal with some very controversial issues such as ramp metering, freeway to freeway metering, and service patrols. The Highway 401 project had to deal with complex issues of spending large sums of money to meet standards with little or no resulting improvement to safety or drivability.

In each case, the FAST diagram allowed the entire VE Team to focus on solutions which placed the project's focus where it belonged in the greater scheme of things. It gave us a framework to shape and control the projects, and in the case of the Gap, the future

FTMS program.

These "laboratories" also brought home to me the concepts in Martyn Phillips paper at the 1998 SAVE conference entitled "A Value Management Task Force Approach to Developing Strategic Direction", found on pages 323 to 332 of the 1998 Proceedings. Although the three FAST diagrams discussed above did give us strategic direction, Martyn develops Focus Diagrams, incorporating FAST in powerful and interesting ways and taking the concepts learned in our "laboratories" to a higher level. Martyn's presentation of these concepts at the conference led to formation of the Team Focus Group and, ultimately, to the trilogy of papers presented by our members, i.e. Martyn, Michael Thompson, and I, of which this is the third.

CONCLUSIONS

With the "draft" FAST diagram approach, FAST does not have to be slow. The time cost of the FAST diagram, which always translates to dollar cost, can be greatly reduced. In addition, the worth of the FAST diagram can be greatly increased when used not only to define the relationships of functions, but also to focus the VE Team and the project or program itself. As a result, the value of FAST diagrams has increased tremendously to this practitioner and to the participants in the three FAST "laboratories".