

Report No. UT- 11.11

STREAMLINED RESEARCH PROJECT SELECTION AND REPORTING

Prepared For:

Utah Department of Transportation
Research Division

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This report was prepared by T. Y. Lin International for the Utah Department of Transportation Division of Research. Contributions were received from the UDOT Research Staff.

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1 INTRODUCTION

This report outlines processes for the UDOT Research Division to be used to develop smaller research projects and initiatives, and streamline the delivery of the findings. Fast-track, short-term projects can be very cost-effective in delivering useful products to the transportation community with a limited expenditure of funding, manpower and time.

Not every research undertaking can be fast-tracked or streamlined to achieve cost-effectiveness. Many topics and project types require a more deliberate traditional approach. Concepts are included in this document to aid in the decision-making related to using a fast-track process or more traditional methods to deliver the most successful and efficient research outcome for each project.

These processes include general criteria to determine which type of project deliverable is appropriate and useful. The criteria are based on the scope of the initiative, the champions, end-users of the products, how the deliverables align with the Department's Final Four, and the urgency of the project.

Also, practical processes for the management of fast-track research projects have been developed for use by UDOT Research Division managers. These processes contain sufficient detail for managers to identify topics, prioritize initiatives, prepare budgets, determine what deliverables are needed to meet the objectives and select experts to conduct the research.

A fast-track process can be more easily applied to specific types of projects including the following research initiatives:

- 1- Literature searches
- 2- Literature summaries
- 3- State-of-the-practice studies
- 4- Policy research
- 5- Experimental projects
- 6- Executive summaries
- 7- Scanning tours and Technology Implementation Group (TIG) initiatives
- 8- Research projects with limited scope
- 9- Research based on historical data
- 10- National and regional transportation pooled-fund projects

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2 TASKS

The following tasks were completed by the T Y Lin International project team:

- 1- Brainstorm with the UDOT Research Division staff on small project needs and concepts.
- 2- Conduct a literature search to identify processes used by other agencies.
- 3- Develop and outline a process for identifying and prioritizing smaller projects and how they differ from the larger project selection process.
- 4- Develop criteria for the process related to project size, scope, budgets, schedules, and complexity.
- 5- Outline a process for selecting the principal investigator for the project. This could be UDOT Research staff members, region or division experts, university personnel, LTAP staff, or consultants.
- 6- Define and produce a template for simplified reports for smaller UDOT research projects, including literature searches, state-of-the-practice, experimental projects, and scanning tours.
- 7- Describe the needed deliverables related to each type of project.
- 8- Work with UDOT Research Division to implement the process to the Regions.

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3 CRITERIA FOR USING A STREAMLINED PROCESS

Certain types of research projects and initiatives are more conducive to streamlining than others. The major types that should be considered as candidates for fast-track work plans are described in the following paragraphs. Report templates for each type are included in Appendix B to aid in the preparation of deliverables.

3.1 Literature Searches

This is a collection of the most pertinent literature related to a topic. Literature searches are a very valuable service provided to transportation experts. Upon request, a literature search can be delivered on most transportation topics through the Transportation Research Information Service (TRIS), and the Transportation Research International Documentation (TRID). Related topics can also be reviewed through other information web sites, such as environmental, property, and legal issues.

3.2 Literature Summaries

These studies provide an in-depth product from a literature search that can be used by transportation managers to understand and implement new concepts into their business areas. Literature summaries are the compilation of information on a topic intended to allow the expert to quickly become knowledgeable on the issue.

3.3 State-of-the-Practice Studies

These studies produce an overview of how a technology or process is being used in the transportation community. They are much more complete than a literature search or literature summary, and provide detailed examples of solutions to the problem. They also identify agencies that have successfully utilized the concepts. A great deal of time, manpower and funding can be saved where State-of-the-Practice studies can be employed in the place of a full research project.

A significant portion of the problem statements submitted at the UTRAC Workshop each year can be accomplished by initiating a State-of-the-Practice study. The implementation of the proposed concept may also be enhanced by employing this information. Policies, specifications, and methods may exist in other states that can be directly used by UDOT. These types of reports also lead to scanning tours, videoconferencing sessions, and other activities leading to early technology transfer. The abridged scope and problem-solving nature of these undertakings is efficient and effective. Details on state-of-the-practice studies are included on Page 18.

3.4 Policy Research

When the target deliverable of a research project is a new policy or standard, the chance for fast-tracking the work is improved. Often a new policy or standard is needed based on an identified problem related to current operations. Modifying guidelines as soon as possible can prevent substandard designs, construction practices, or safety issues on subsequent highway projects.

3.5 Experimental Projects

The use of Experimental Projects has been very successful in Utah for many years. These projects are directed at the evaluation of the effectiveness of specific products or processes. Products such as the temporary pavement marker that is now being used around the world were first installed in Utah. Many concepts and products developed in other states were introduced to UDOT through the Experimental Features Program.

It is important to verify that a product can perform adequately under Utah's extreme weather and freeze-thaw cycles before approval for use. Also these projects are used to introduce engineers and managers to various handling and installation procedures that are required for these innovative products to succeed.

The use of Experimental Projects is a very resourceful and successful way to conduct research. The design, installation, and performance of a concept all tend to overlap and occur in a short period of time. Also these activities prove to be valuable in the implementation of the concept through an on-the-job training experience.

3.6 Executive Summaries

It is often useful to publish a short summary intended for managers and key leaders. Executive Summaries are aimed at the issues facing the organization, how the study findings can solve the problem and what actions are needed by these decision-makers to implement the deliverables of the project.

3.7 Scanning Tours and Technology Implementation Group (TIG) Initiatives

In recent years the use of scanning tours has increased. UDOT has successfully used these out-of-state sessions as a powerful technology transfer tool both as the lead state and by visiting demonstrations in other states.

Scanning tours provide direct exposure of innovative concepts to experts in multiple agencies. These on-site demonstrations often can be used to bypass more extensive research projects, while still delivering the needed design methods, construction practices, and other standards needed for successful implementation.

Technology Implementation Group (TIG) initiatives are a valuable asset to any transportation agency. The main goal of TIG is the accelerated deployment of key focus areas. These ready-to-use topics are based on proven technologies and have been shown to have a high benefit-cost ratio. The UDOT Research Division may get involved in promoting TIG visits where appropriate and initiate scanning tours to TIG demonstrations for key UDOT experts.

3.8 Research Based on Historical Data

Projects that rely heavily on the use of historical data can often be completed on a shorter schedule. These include studies based on the following:

- Pavement performance records
- Bridge performance data
- Material property data
- Construction quality information
- Crash data
- Highway geometrics
- Traffic volume and loading data
- Maintenance inventories
- Planning records
- ITS inventories and performance
- Commercial vehicle operations information

3.9 National and Regional Transportation Pooled-Fund Projects

The use of pooled-fund projects can be an effective way to participate in a project without a significant commitment of UDOT funding. Implementable deliverables can be obtained for UDOT through the careful and selective involvement in these projects.

3.10 Utah as a Participating State

When UDOT is considering committing funding and other resources to another state, it is important to investigate issues beyond the project topic. In general, participation in a pooled-fund proposal should be contingent on the following critical factors:

- The topic of the project should be of high interest to one of UDOT's key business areas, and usually align with one or more of UDOT's Final Four strategic drivers.

- The project deliverables should be directly implemented into UDOT operations without significant revisions to the products.
- A UDOT expert should be allowed to serve on the project TAC, and have direct input to the project scope of work and work plan.
- If test sections are part of the study plan, it is preferable that some of the test sections be placed within Utah to provide direct applicability of the findings. This improves the changes for the findings to be more useful in UDOT's designs, materials, and environmental conditions.
- When laboratory testing is included in the project, samples from Utah facilities are sent to the project testing facility for inclusion in the project. In the past successful findings have occurred when cores or other samples from Utah have been tested. This ensures applicability of any specifications, standards, or policies developed to Utah's conditions and environment.

3.11 Utah as the Lead State

Soliciting pooled funds from other agencies has been an effective way to reduce the cost to any single agency.

When one or more of the following criteria are met, the use of a pooled-fund concept should be considered as feasible:

- The topic relates to a national or regional issue.
- The project is a high-cost undertaking.
- Data gathered in many environmental climates is desirable.
- Information related to numerous material sources is needed.
- A very broad level of expertise would benefit the project.

A topic for a national or regional pooled-fund project may come from a number of sources. A few are listed below as examples:

- A highly valued UTRAC problem statement meeting some of the criteria above.
- Unselected UTRAC problem statement, but with high UDOT need.
- High profile project mandated by key UDOT leaders or managers.
- Topic proposed by a UDOT committee.
- Research that leads to addressing a national problem.

4 CRITERIA FOR AVOIDING THE USE OF STREAMLINED WORK PLANS

Certain types of projects tend to require a more traditional research approach. These project types are as follows:

- Projects requiring the placement of test sections
- Studies requiring new field data gathering
- Data gathering efforts with long performance cycles
- Studies needing significant laboratory testing

The traditional approach is the UTRAC process, which found in the UDOT Research Manual of Instruction.

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5 SMALL VS. LARGE PROJECTS

Project size is not always an indication that the project work plan, schedule or deliverables can be streamlined. The complexity of the project is a better indication of how intricate and time-consuming the execution and management of the project will be.

For example, large budget projects may have only a few objectives, funding sources and stakeholders. The deliverables may be very straight-forward and aimed at a limited audience. Small projects, like some unique experimental projects, may have all of the elements of complex research projects but with a small budget. Small projects with test sections, laboratory testing, several products and vendors, and multiple funding sources, often result in more complex deliverables and expanded management needs.

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6 CRITERIA FOR REPORT TEMPLATE SELECTION

The decision to use the full report template (*Guidelines for Preparing Utah Department or Transportation Research Reports, UT-07.10*) or a small report template must be based on project complexity and made early by the project manager. Templates for abridged reports are included in Appendix B.

Approval from the Research Director (or designee) should be required for use of any of the abbreviated report templates. This approval can be given during the work plan approval stage or at the end of the project once the findings have been compiled.

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7 CRITERIA FOR PROJECT TYPE SELECTION

Research managers should not automatically approve and fund a project from the UTRAC Workshop as proposed simply because the topic was voted high in the balloting process. Care should be taken to analyze various ways to deliver the intended products of the project in the quickest way and with the best value for the resources expended.

It can be counterproductive to approve a work plan with an excessively long schedule when the deliverables are needed in a more-timely manner. The following issues should be considered when selecting the project type, management processes, and schedule length:

- Final Four relevance
- Urgency to the transportation community
- Benefits to transportation users and stakeholders
- Cost to UDOT
- Availability of information from other agencies
- Chance of success
- Outside resource contributions (hard and soft match)

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8 SELECTION OF PRINCIPAL INVESTIGATOR (PI)

The selection of a principal investigator for a project can greatly delay the start date of the study. Under certain circumstances a Request for Qualifications (RFQ) is useful, but selecting the performing PI by sole source results in less delay in getting the study underway.

8.1 Sole Source Criteria

The use of sole source contracting for research projects is very common due to a number of factors. In many cases the number of experts qualified to carry-out the project is limited. If the concept is proposed by an expert, the work often can represent intellectual property for the expert. The budget of many research projects is not at a sufficient level to justify using the RFQ process to select a PI. The cost of the RFQ process can actually be more costly than the project budget itself.

For these reasons the following criteria are recommended to determine if sole source or RFQ should be used to select the PI:

- Only one expert is available
- Intellectual property is part of the concept or deliverable
- Consultant pool would reduce the schedule and administrative costs
- Use of RFQ to Select PI

Using an RFQ process has been successful in the past when certain factors exist for a project scope. Introducing competition into a project can be beneficial when the project budget is quite large or an innovative research approach to an issue is desirable.

The project stakeholders may be able to obtain the deliverables at a lower cost using an RFQ using procurement processes. RFQ submittals from multiple consultants are beneficial for projects that are somewhat complex with tasks and work plan strategies that are not well defined. When an innovative research approach is needed, the information supplied in the RFQ process can greatly enhance the successful outcome of the project.

The following criteria are recommended to use an RFQ to select the PI:

- Complex tasks and work plan
- Innovative research approach needed
- High cost project

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9 URGENCY OF THE FINDINGS AND DELIVERABLES

A research project or other initiative should be placed on a fast-track process when it has been given a high priority status by key UDOT managers. The use of contingency funding can aid in getting the project budget allocated and underway quickly.

The availability of highly qualified experts in the research on-call consultant pool is invaluable when a short schedule is desired. Care should be given to check the workload of the expert to show that his/her team is available to perform the work as described in the work plan.

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10 SEASONAL CONSIDERATIONS TO SHORTEN SCHEDULE

There are seasonal and weather related factors that should be considered when preparing the work plan and schedule. Delaying the project at a crucial time of year can result in a significant wait to obtain deliverables.

- Projects requiring test sections or data gathering during construction seasons are best started during the winter or spring months. This allows for planning and preparation of field activities required during favorable weather conditions. The UTRAC Workshop timing can result in a problem for these types of projects. Holding the workshop as early as possible will allow urgent projects with construction season aspects to be started in a timely manner.
- Similarly, winter related projects, such as snow removal studies, projects with freeze-thaw factors, avalanche related studies, etc. should be started in the summer or fall.

These staggered starting times are also good for project managers who can be challenged to get multiple studies underway in a short period of time.

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11 USE OF EXISTING COMMITTEES AS TECHNICAL ADVISORY COMMITTEES (TACS)

It can be time-consuming to form and organize a TAC to provide project oversight. Delays in developing and approving the work plan can occur when the project manager is responsible to seek potential TAC members, communicate the project goals and coordinate the schedules of potential contributing experts.

One way to reduce the time and expense of forming a TAC for a project is to utilize existing committees to provide the needed responsibilities of the TAC. Examples of this concept are shown in Table 1 on page 15.

In this way sub-research programs within the main Research Program can be created and managed very effectively. A Materials Research Program, a Maintenance Research Program, a Safety Research Program, etc may be organized. The TAC meetings for each project may be combined with TAC meetings for other similar projects. This can save man-hours and travel time when compared with holding meetings individually for each project. This approach should not be used for large, complex projects where the TAC membership will include experts from a wide scope of agencies and interests.

Typically when this strategy was used in the past, the TAC agenda items were scheduled at the end of the committee meeting so that any non-participating members could be excused. For example, projects only relating to urban areas may not be of interest to rural region personnel.

Another advantage of utilizing existing committees as TACs is that a research project manager will be in attendance at the committee meeting and can monitor activity by the group for other research issues. These could include literature searches, experimental features, special projects or future problem statements for the UTRAC process. This dual purpose for attending the committee meeting can save time and manpower.

Table 1- Examples of Potential Committees used as TACs

Region Materials Engineer Committee	Materials related projects producing specifications, policies, pavement designs, laboratory testing, etc.
Construction Enhancement Team	Projects related to construction field operations, project inspection, testing, efficiencies, training, etc.
Structures Committee	Projects related to bridge rehabilitation, retrofit, inspection, seismic issues, structural designs, etc.
Maintenance Committee	Maintenance related projects delivering rehabilitation methods, preventive maintenance concepts, etc.
Traffic Policy Committee	Traffic and safety related research projects
Pavement Management Committee	Projects related to pavement design, rehabilitation strategies, pavement data gathering, or congestion
Motor Carrier Advisory Committee	Trucking related research projects
UDOT Executive Committee	Projects implementing new UDOT programs, Divisions, or high profile policies
Legislative Committees	Projects recommending new laws, programs requiring legislative funding, or state level policies

12 PROJECT MANAGEMENT SCHEDULING AND EFFICIENCIES

The management of research projects and other activities can be a very overwhelming responsibility. Typically a project manager is responsible to manage ten to twenty research projects at once. This requires juggling tasks ranging from work plan approval through implementation of the study deliverables.

Historically the management of research projects has been part of nearly every staff member of the UDOT Research Division. Some project managers have few other assignments and spend more than 90% of their time on project oversight. In contrast, program managers may contribute 20% to 40% of their time managing projects that correspond to their program duties. Division directors have traditionally managed projects of a high priority, those with significant political implications, or projects that fit with their specific area of expertise.

12.1 Project Scheduling

As the work progresses in the UDOT Research Division, a number of critical path decisions and corresponding dates occur on an on-going basis. Managing these critical decisions and dates can result in a more efficient and timely delivery of research products into UDOT's key business areas and systems.

When project and program managers fail to track and react to critical dates, schedules and quality of these activities can be compromised. The complex nature of the job duties assigned to project managers requires formalized planning techniques to ensure project scheduling efficiencies.

The work schedule of a research project is often complex and dependant on many factors such as the following:

- Work plan preparation
- Funding availability and cash flow
- Selection of the principal investigator (PI)
- Available schedule of the PI and others assigned to the project
- Selection of the Technical Advisory Committee (TAC)
- Scheduling the tasks within required seasonal time periods
- Establishing test site conditions and approval
- Availability of laboratory personnel or equipment
- Scheduling technicians to gather field data

Many of these issues are beyond the control of the project manager. It is crucial however, to understand the impact that these factors will have on the project scope,

schedule and budget. Failure to understand and react to these factors can lead to loss of project funding, expertise and crucial data.

12.2 Division Timelines Document, Critical Path Analysis, and Calendar

A Division Timeline Document and Calendar can be used to identify and emphasize critical dates and tasks to optimize the flow of work in the division. This document is similar to the critical path concepts used in large construction project management.

Each project and program manager within the UDOT Research Division should submit a Timeline Document for their workload. This document would include a calendar of events that defines the key schedule of tasks for their projects and programs. The Division Director can use this documentation to plan the budget for the research program. This is especially useful when preparing the Annual Work Program for the division. This document aids in identifying when a project manager may exceed a full schedule and require help in completing their duties. Many of the concepts outlined in this document may aid in dealing with these peak-load times.

Critical Path analysis can be useful for complex projects to obtain an understanding of which tasks are the controlling aspects of the schedule. Documents and training should be available for project managers. A description of critical path analysis and examples of charts and graphs used in the process are provided in Appendix C.

13 PHASING PROJECTS TO REDUCE SCHEDULES

The utilization of project phasing may be another useful project management strategy. The use of phases to control a project schedule can shorten the process under certain circumstances. The following are criteria are indicators that phasing may be appropriate in the project work plan.

13.1 “Chance of Success” Rating

Phasing the tasks of a project to control a project schedule can shorten the process. This is especially true for topics with a low or moderate “chance of success” rating.

For example, if a project success relies on the completion of the first four tasks, before further action can proceed, the early tasks could be funded under Phase 1 of the project. This retains the funding for later tasks until Phase 1 work is shown to be successful. Where the “chance of success” is moderate or low this eliminates the second phase if the project is unsuccessful, saving time and money. For these projects, a final report is usually sufficient to document the project and other expensive tasks and deliverables can be eliminated.

Care should be given to begin the approval of the Phase 2 work plan as soon as it is determined that the Phase 1 tasks are successful. The use of phasing is intended to streamline the process, but could back-fire causing delays if approvals to the work plans are not handled in a timely manner. The contract for phase 1 should reference a possible phase 2.

To facilitate the use of project phasing, it is recommended that the Research selection process include separate ratings for “project need”, “value for proposed budget” and “chance of success”. If this is not possible, the TAC could provide a rating and determine if the use of multiple phases is needed.

13.2 Phasing to Produce Early Deliverables

Projects with multiple deliverables can also benefit from using project phases. If usable deliverables can be developed after the completion of the early tasks, the use of a formal Phase 1 budget can ensure that early deliverables are produced prior to further work being carried out.

This is usually true for a more complicated, expanded schedule, or high budget project. It is recommended that project phasing be considered when one or more of these conditions exist in a project work plan.

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14 STATE-OF-THE-PRACTICE STUDIES

Projects aimed at compiling the best practices on transportation issues can be very useful in modifying policy, revising specifications, enhancing design methods, acquiring software, etc. When this type of undertaking meets the goals of a proposed study, the funding, manpower and schedule required to obtain results is significantly reduced.

15 TOPIC SELECTION

Criteria for selecting topics for state-of-the-practice studies are similar to the selection process for other types of research projects. The exception is that the decision may also be made at the division level, by a consensus of the TAC members if available or by a vote of the UTRAC Council.

Topics for consideration can come from any source. An evaluation should be made of the urgency, alignment with the Final Four, estimate of benefit/cost, and chance for a successful outcome.

The most common submitting sources are:

- Topics from the UTRAC Workshop (often unfunded projects)
- Key managers mandating studies
- Problems identified at region visits
- Division staff submittals
- Issues raised in UDOT committee meetings
- Spinoff recommendations from completed research projects
- Expanded new product evaluations
- Concepts presented by private sector partners
- Other credible sources

15.1 Budgeting

A complete best practice study can vary depending on the complexity of the issue and the number of agencies currently utilizing the concept. Some topics are still in their infancy while others are widely used by a number of agencies.

A typical State-of-the-Practice study cost may range from a few thousand dollars for straightforward topics, to tens of thousands of dollars for complex topics. Some of these studies can be identified following the UTRAC process in the spring and can be included as line items in the Work Program. Others, however, will come up during the year and should be funded from the Special Projects line item, division budgets, or region funding.

15.2 National Surveys

National or international surveys are often utilized to acquire the most accurate and current information on how other agencies use specific technology. These surveys are more successful when generated through the Research Advisory Committee (RAC) member from each state. A web delivery tool is available that incorporates a protected email system for RAC members. The survey is forwarded through the RAC member in each state to the best qualified expert(s) in that agency for submittal of the survey.

15.3 Deliverables of State-of-the-Practices Studies

The deliverables of a state-of-the-practice study should be focused meeting the goals outlined in the proposal. Reference materials provided should be restricted to an appendix or additional volumes related to the report. The main body of the report should be a summary of the findings that can be used by the end-user to implement any of the recommendations included by the principal investigator.

A template for state-of-the-practice reports is included in Appendix B. The deliverables should include highly useable products such as:

- New or enhanced policies and procedures
- New or improved specifications
- Design methods for the technology
- Training sessions & materials
- Software acquisition
- User's manual
- Workshops
- Demonstrations
- Performance measures

16 IMPLEMENTATION STRATEGIES TO REDUCE SCOPE, SCHEDULE, AND BUDGET

Implementation of new and innovative concepts is one of the most crucial but often less successful initiatives in transportation agencies. This is usually not from a lack of effort but due to the great number of barriers existing in the path of complete implementation. Typically implementation efforts require commitment, funding, manpower, planning, technical adjustments and completion of the feedback loop through performance measures. Many require training, equipment purchases, new policies, specification changes and formal procedural modifications.

These tasks are not trivial and cannot be routinely conveyed to personnel who have not been part of the original research. The implementation of the project products should be planned early in the project, even during the problem statement phase. How the deliverables will be implemented (or if they can be) should be considered when making the decision to fund the project. If the barriers to implementation are too great, the funding agency should consider delaying or canceling the project until these issues are resolved. The following concepts outline potential tools to enhance the chance for successful adoption of research products.

16.1 Implementation Throughout the Project

The chance for the successful implementation of research deliverables can be improved by taking several key steps before, during and after the project. The implementation phase of any project can expand the schedule, and exceed the programmed budget for the project. Effective project streamlining may be better achieved by planning and monitoring the implementation activities associated with a research initiative. These implementation activities should overlap with the completion of the tasks as the project progresses. This is a “Design-Build” philosophy for research projects.

Effective implementation is enhanced when certain tasks are completed during the project rather than waiting until the final deliverables are produced. Implementing as the project proceeds has many advantages:

- Early implementation
- Reduced schedule
- Lower budget
- Improved project management

All four entities (the project manager, the champion, the TAC and the principal investigator) are crucial to the management of continued implementation during the

project schedule. The key end users and supporters should be members of the TAC to enhance the completion of the products. Each TAC meeting should have agenda items dedicated to the implementation of project findings in a timely manner.

16.2 Problem Statement

During concept development a research initiative must consider the potential for implementing the project findings. The following questions must be successfully answered before the project is funded:

1. What implementable deliverables will be created?
2. How will the findings be implemented?
3. Who will be the key personnel during the implementation activities?
4. What funding and other resources will be needed for implementation?
5. Will training be needed?

16.3 Scope of Work & Contract

The typical research initiative begins with the customer's question, problem or needed improvement and then leads to a solution. This is not always conducive to the implementation aspect of the research. A more successful approach entails addressing the customer's issue through a Scope-of-Work that helps he/she answer his/her own question. This approach fosters the type of ownership in each phase of the research project that naturally leads to more complete implementation.

The Scope-of-Work should not only describe how the project will be conducted, but it should answer each of the questions above in detail about how the findings will be incorporated into UDOT practice. Commitments from key personnel should be obtained and a plan drafted to achieve a useable technology.

Funding for implementation tasks may be included in the original contract or conceived as part of activities in a phase 2 plan. The higher the chance for a successful project, the more likely the funding will be included as part of one contract.

16.4 Deliverables

Too often the sponsoring agency fails to require the proper deliverables to facilitate implementation of the research findings. A final report alone is often insufficient in providing the needed tools for implementation. Early planning for implementation requires detailed discussions concerning what deliverables and products are to be required of the PI and other partners. The following deliverables should be considered in addition to a final report as part of the contract to aid decision-makers and end users to market the innovative aspect:

- Executive Summary
- User's Manual
- Training Sessions & Materials

- Policy & Procedures
- Specifications
- Software
- Workshop
- Demonstration
- Web page
- Experimental Features
- Demonstration Projects
- Laboratory Test Methods
- Performance Measures

16.5 Champion of the Project

An active and committed champion is crucial to the successful implementation of project deliverables. This advocate of the project must be in a position to aid in promoting and implementing the results but could be related to the subject area in any of a number of ways. The project champion may be asked to campaign in favor for the initiative during crucial times during the beginning of the study or when problems arise throughout the study.

16.6 Technical Advisory Committee (TAC)

Each project must have a functioning TAC to provide oversight to the principal investigator and aid the project manager. The advisors are crucial to the success of the project. The end users of the project deliverables should be the key members of the TAC with implementation in mind. This promotes commitment early in the project and fosters an environment of ownership by the users. This is an effective way to accentuate implementation during the planning phase of the study. The practical aspects of the work will be emphasized, more useful products can be proposed and funding can be allocated for tasks aiding the end user.

If the project addresses the decentralized aspects of UDOT's operations, UDOT regions should be represented on the TAC. If the issue is intended for a central set of users, stakeholders from multiple divisions may have representation on the TAC. Care should be given to ensure that all divisions, sections and region personnel who will be impacted are represented and informed on the project.

Secondary impacts can sometimes be overlooked. For example, if a new safety device is recommended in the project and Traffic & Safety Division agrees with the findings, the Maintenance Division should have input into the decision. Maintenance personnel must be able to replace the apparatus if it is damaged or worn out. They will be required to have replacement parts in their inventory for the device.

Most TAC membership should include a representative from the Federal Highway Administration (FHWA). This will help the TAC avoid conflicts during the project with federal rules and guidelines. Further, where federal rules are no longer appropriate, the project can be useful in changing or helping to obtain UDOT exemptions from federal

requirements. The FHWA staff member can be very beneficial in facilitating these actions.

Progress reviews by the TAC are crucial in keeping the work on schedule, and guide the effort toward practical findings. A thorough review of the end products is important to enhance the implementation effort. Much of the implementation will be immediate since the users are involved throughout the study. Also, they will have a better understanding of the technology and more buy-in is achieved due to the ownership generated through the TAC. An exit survey of TAC members is important to obtain feedback about the process, as well as the value of the research project.

16.7 Reports, Newsletters & Research Briefs

Reporting the findings of research is a required step in the implementation process. This is important not only to the agency conducting the research but to those from other transportation agencies. It is important to report negative findings as well as successful findings. Too often researchers undertake a nonproductive project because an agency that has performed a similar study is unwilling to publicize unsuccessful work. Reporting why a project was not successful may lead to improvements in the concept that generate a productive technology.

All written deliverables should address the implementation tasks required, who is responsible for completing these tasks, and how the work will be funded. A complete implementation plan is a very important step in the research process. A feedback step is usually needed once the plan is completed.

At some point (six to twelve months after completion) the project manager should verify that barriers to implementation have not occurred. Unfortunately, many valuable technologies have been abandoned due to a few minor problems that could have been easily corrected. Communication between all parties over a period of time is sometimes needed to remove obstacles and make minor improvements.

16.8 Training

A good working relationship with training personnel in the Department is very important. The training program is a valuable asset to the implementation effort. Funding and manpower can be utilized from the training budget to enhance the effectiveness of the implementation program.

16.9 Specifications & Standards

The adoption of sound specifications and standards is a formal method used to enhance the application of research results. These measures do not always ensure the adoption of the technology. However, it is important to convey the reasons why the change has been made through training, reporting or other methods. If they are not convinced that the change is appropriate, staff members often find ways around specifications such as the use of special provisions. A routine telephone or E-mail survey should be scheduled several months after the specification has been adopted to ensure that it is still being used.

16.10 Experimental Projects & Demonstrations

Often the best way to show that a technology is an improvement over existing methods is to place it in the field as part of an Experimental Project. This demonstrates that the technique is constructable, the product or material can be transported and handled and the installation can survive the harsh environment.

16.11 Conferences & Meetings

Opportunities to market new ideas are often available at conferences and other meetings. The research staff should constantly seek to take advantage of these occasions. Presentations should be given at meetings conducted by groups such as the Materials Engineers, Maintenance Engineers, Construction Engineers, Motor Carrier staff, Administrators, Aeronautics experts, Community Relations personnel, Environmental Engineers, Geotechnical Engineers, Computer Experts, Planners, Structural Engineers, and Traffic & Safety Personnel. Taking time on these group's agendas is an excellent way to inform staff members of new technology and receive input concerning the implementation of these products and processes.

16.12 Videoconferencing Programs

Use of the Department's videoconferencing system should be utilized when appropriate. Delivering technology over the State's EdNet System is a valuable tool for UDOT personnel. Programs with neighboring states are also useful in the technology transfer initiative. The WASHTO-X Program is a topic specific peer exchange program that could be used to distribute findings and obtain input by a larger group of experts.

16.13 Agency Emphasis on Implementation

Successful implementation of research products into practice is crucial to the long-term success of a research program. This leads to innovation in the industry, and continued support from funding sources. Producing useable products and implementing them into operation should be a basic underlying philosophy in any transportation agency.

The entire UDOT research staff should be aware of the need to move useable findings to the operating level. In some instances there is a tendency to separate the phases of the study too much and keep implementation personnel out of the loop until the research is completed. Once the products of the study are available, implementation personnel should be given the task to market the work to the users. This is often a difficult or impossible task. Getting both the implementation staff and the end users involved throughout the study is an important process.

Various tools are available to enhance the implementation of research findings. Often combinations of implementation actions are needed to influence all of the needed levels of users and decision-makers in the loop. UDOT managers often set goals for personnel to spend a portion of their time implementing new and innovative technologies and processes into their operations such as:

Implementation Staff	100%
Research Director	25%
Project Managers	10%
UDOT Managers	1 to 3%

These commitments represent a significant investment in resources but should help the organization to work smarter. The cost and time savings of these improvements have been shown to be passed on the traveling public.

16.14 Communication and Interaction

Effective and continual communication is crucial between all of the key personnel associated with a project or other research initiatives. All forms of communication are needed to ensure that everyone understands their role, project tasks are completed effectively and main milestones are established and attained.

An excellent guidebook is available to aid in improving and enhancing communication in transportation research organizations, entitled “Communicating the Value of Transportation Research”, NCHRP 610. This guidebook provides signs that

indicate that good communication is occurring in an agency, a strategy to make improvements, various channels for communication and the ways to evaluate progress through feedback processes. The guidebook also discusses how to communicate with key customers and stakeholders, such as program managers, politicians, policy makers, the media, and the public. Case studies are included to demonstrate how agencies have successfully promoted certain transportation issues in their agency or state.

17 CONCLUSIONS AND RECOMMENDATIONS

1. The criteria outlined in this report should be reviewed when making a decision to utilize streamlined concepts to deliver a research project. A research project should be considered for a fast-track schedule if it is a topic of critical importance to the department, a project delivering a new or modified policy, a State-of-the-Practice study or a project based on existing historical data. A flow chart for use in selecting the proper project type is included in Appendix A.
2. The project is usually not a candidate for streamlining when the project requires the gathering of new data, the establishment of new test sections or requires significant laboratory testing.
3. Project Managers and TAC members should sole source the Principal Investigator (PI) when one or more of the following criteria exists:
 - A. Only one expert is available
 - B. The concept represents the intellectual property of an expert
 - C. A consultant pool PI would reduce the schedule and administrative costs
4. Using an RFQ to select the PI is advisable when
 - A. The project has complex tasks and work plan
 - B. An innovative research approach is needed
 - C. The project has a high-cost budget and the project budget may be reduced
5. The process of project approval, funding decisions and work plan preparation can be crucial in completing a project in a timely manner. UDOT Research Division administrators and project managers should be sensitive to the seasonal constraints of multiple research projects. Delays of more than a year can occur due to construction seasons, winter operations timeframes, or workforce availability.
6. Formal project timelines and critical path analysis may be used to aid in the scheduling processes associated with research projects. Staff training or contracting with experts can be used to acquire this information as needed.
7. The continued use of champions for each project and major initiative is very important to sustain the success of the research program.
8. The use of existing committees as project TACs can get a project underway faster and may involve fewer man-hours during project oversight.
9. Scanning tours and Technology Implementation Group (TIG) demonstrations have been highly successful in the past. The UDOT Research Division should utilize these

programs to promote the accelerated deployment of these technologies within UDOT operations.

10. The use of phases in project scheduling can be beneficial under certain circumstances. When projects have a questionable “chance for success” rating or early deliverables are desired, funding the project under more than one contract may be appropriate.
11. The UDOT Research Division should utilize national and international surveys to acquire information on topics of interest. These surveys greatly enhance State-of-the-Practice studies, Policy Research, and Scanning Tours. The results provide the most current and accurate information on transportation related ready-to-use technologies, products, or processes.
12. The UDOT Research Division may choose to allow the use of an abbreviated report template when deemed appropriate. Templates for abridged reports from Literature Summaries, Policy Research, State-of-the-Practice Studies, Executive Summaries, Scanning Tours, and TIG Demonstrations are included in Appendix B.
13. Funding a project through a national or regional pooled-fund program can be a good way to reduce the UDOT cost commitment and produce findings for multiple states. Criteria for participating in a pooled-fund project are:
 - A. The topic should be of high interest to one of UDOT’s key business areas and usually aligned with one or more of UDOT’s Final Four
 - B. The project deliverables can be directly implemented by UDOT
 - C. A UDOT expert would be allowed to serve on the project TAC
 - D. Some test sections would be placed in Utah if possible
 - E. Samples from Utah facilities would be included in laboratory testing

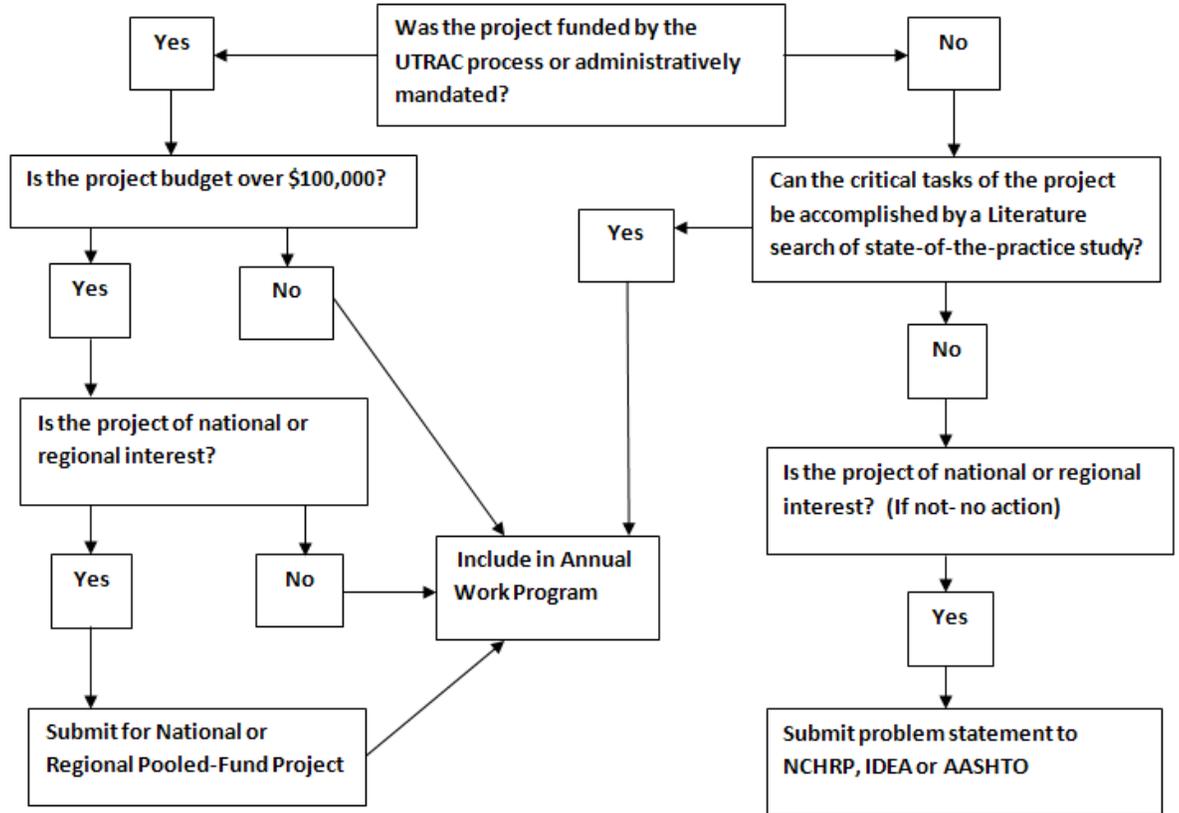
18 IMPLEMENTATION

1. A formal presentation should be given to the UDOT Research staff to fully explain the concepts described in this report and foster an open discussion about their use.
2. A PowerPoint presentation will be prepared and delivered to research managers for future use in implementing these concepts.

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APPENDIX A

Project Type Selection Flowchart



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APPENDIX B - REPORT TEMPLATES

-Literature Summary Template-

TITLE (14 pt, Arial, Bold)

Author(s) (12 pt, Arial)

Organization (12 pt, Arial)

Date (12 pt, Arial)

Introduction (12 pt, Arial, Bold)

Describe the issue/problem/improvement under investigation. (11 pt, Arial)

(The author may choose to revise the title of this section to be more descriptive of the issue.)

Findings (12 pt, Arial, Bold)

Describe the project findings in sufficient detail to meet the needs of the intended reader. This will be a summary of the information compiled during the literature search. (11 pt, Arial)

(The author may choose to revise the title of this section to be more descriptive of the issue.)

Conclusions and Recommendations (12 pt, Arial, Bold)

List the main conclusions of the investigation, along with any recommendations made by the author(s). (11 pt, Arial)

Implementation Activities (12 pt, Arial, Bold)

Describe the implementation strategy. Implementation tools may include: User's Manuals, Training Sessions, Policy & Procedures, Specifications, Software, Workshops, Demonstrations, Executive Summary, Experimental Feature, Demonstration Projects, etc. (11 pt, Arial)

Appendix (12 pt, Arial, Bold)

Attach the results of the literature search for backup information. This will supply the reader with the contacts and experts described in the topic summary.

-State-of-the-Practice Report Template-

TITLE (14 pt, Arial, Bold)

Author(s) (12 pt, Arial)

Organization (12 pt, Arial)

Date (12 pt, Arial)

Introduction (12 pt, Arial, Bold)

Describe the issue/problem/improvement proposed. (11 pt, Arial)

(The author may choose to revise the title of this section to be more descriptive of the issue.)

Summary of National/Global Use (12 pt, Arial, Bold)

Describe the key findings of the literature search in sufficient detail to meet the needs of the intended reader. (11 pt, Arial)

(The author may choose to revise the title of this section to be more descriptive of the issue.)

Organizations Using the Concept (12 pt, Arial, Bold)

List the organizations that are currently using the concept (11 pt, Arial)

Examples of Successful and Unsuccessful Applications (12 pt, Arial, Bold)

Summarize the projects or other applications used by other organizations (11 pt, Arial)

Conclusions and Recommendations (12 pt, Arial, Bold)

List the main conclusions of the investigation, along with any recommendations made by the author(s). (11 pt, Arial)

Implementation Activities (12 pt, Arial, Bold)

Describe the implementation strategy. Implementation tools may include: User's Manuals, Training Sessions, Policy & Procedures, Specifications, Software, Workshops, Demonstrations, Executive Summary, Experimental Feature, Demonstration Projects, etc. (11 pt, Arial)

Appendix (12 pt, Arial, Bold)

Attach any specifications, standards, policies, procedures, design methods, etc.

-Policy Research Report Template-

TITLE (14 pt, Arial, Bold)

Author(s) (12 pt, Arial)

Organization (12 pt, Arial)

Date (12 pt, Arial)

Introduction (12 pt, Arial, Bold)

Describe the issue/problem/improvement desired under the new policy. (11 pt, Arial)

(The author may choose to revise the title of this section to be more descriptive of the issue.)

Summary of National/Global Use (12 pt, Arial, Bold)

Describe the basis of the new policy on a national or global scale, and how it will solve the problems or issues listed above. (11 pt, Arial)

(The author may choose to revise the title of this section to be more descriptive of the issue.)

Summary of the Desired Results of the Policy (12 pt, Arial, Bold)

Describe the key reasons for the new policy in sufficient detail to meet the needs of the intended reader. (11 pt, Arial)

Conclusions and Recommendations (12 pt, Arial, Bold)

List the main conclusions of the study, along with any recommendations made by the author(s). (11 pt, Arial)

Implementation Activities (12 pt, Arial, Bold)

Describe the implementation strategy, along with the approving body for the new policy and a schedule for achieving approval. Implementation tools may include: User's Manuals, Training Sessions, Policy & Procedures, Specifications, Software, Workshops, Demonstrations, Executive Summary, Experimental Feature, Demonstration Projects, etc. (11 pt, Arial)

Appendix (12 pt, Arial, Bold)

Attach a copy of the proposed policy along with any specifications, standards, procedures, design methods, etc. related to the new concept.

-Executive Summary Report Template-

TITLE (14 pt, Arial, Bold)

Author(s) (12 pt, Arial)

Organization (12 pt, Arial)

Date (12 pt, Arial)

Introduction (12 pt, Arial, Bold)

Describe the issue/problem/improvement. (11 pt, Arial)

(The author may choose to revise the title of this section to be more descriptive of the issue.)

Findings (12 pt, Arial, Bold)

Describe the project findings in sufficient detail to meet the needs of the manager or key leader.
(11 pt, Arial)

(The author may choose to revise the title of this section to be more descriptive of the issue.)

Conclusions and Recommendations (12 pt, Arial, Bold)

List the main conclusions of the project, along with any recommendations made by the author(s).
(11 pt, Arial)

Implementation Activities (12 pt, Arial, Bold)

Describe the implementation strategy with emphasis on how key leaders should proceed on the issue. Any implementation tools that will be produced as part of the project should be listed and described. Implementation tools may include: User's Manuals, Training Sessions, Policy & Procedures, Specifications, Software, Workshops, Demonstrations, Executive Summary, Experimental Feature, Demonstration Projects, etc. (11 pt, Arial)

-Scanning Tour and TIG Report Template-

TITLE (14 pt, Arial, Bold)

Author(s) (12 pt, Arial)

Organization (12 pt, Arial)

Date (12 pt, Arial)

Introduction (12 pt, Arial, Bold)

Describe the issue/problem/improvement observed. (11 pt, Arial)

(The author may choose to revise the title of this section to be more descriptive of the issue.)

Summary of National/Global Use (12 pt, Arial, Bold)

Describe the use of the concept on a national or global scale in sufficient detail to meet the needs of the intended reader. (11 pt, Arial)

(The author may choose to revise the title of this section to be more descriptive of the issue.)

Organization Demonstrating the Concept (12 pt, Arial, Bold)

List the organization that hosted the sessions demonstrating the concept (11 pt, Arial)

Summary of the Sessions and Photos of the Operation (12 pt, Arial, Bold)

Describe the key findings of the visit in sufficient detail to meet the needs of the intended reader. Attach photos of the process, construction methods, and other activities. (11 pt, Arial)

Conclusions and Recommendations (12 pt, Arial, Bold)

List the main conclusions of the scanning tour, along with any recommendations made by the author(s). (11 pt, Arial)

Implementation Activities (12 pt, Arial, Bold)

Describe the implementation strategy. Implementation tools may include: User's Manuals, Training Sessions, Policy & Procedures, Specifications, Software, Workshops, Demonstrations, Executive Summary, Experimental Feature, Demonstration Projects, etc. (11 pt, Arial)

Appendix (12 pt, Arial, Bold)

Attach any specifications, standards, policies, procedures, design methods, etc. obtained during the scanning tour.

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APPENDIX C- CRITICAL PATH METHOD (CPM)

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Introduction to Network Analysis of Projects and CPM

The Critical Path Method (CPM) is one of several related techniques for doing project planning. CPM is for projects that are made up of a number of individual "activities." If some of the activities require other activities to finish before they can start, then the project becomes a complex web of activities.

CPM can help you figure out:

- how long your complex project will take to complete
- which activities are "critical," meaning that they have to be done on time or else the whole project will take longer

If you put in information about the cost of each activity, and how much it costs to speed up each activity, CPM can help you figure out:

- whether you should try to speed up the project, and, if so,
- What is the least costly way to speed up the project?

Activities

An activity is a specific task. It gets something done. An activity can have these properties:

- names of any other activities that have to be completed before this one can start
- a projected normal time duration

If you want to do a speedup cost analysis, you also have to know these things about each activity:

- a cost to complete
- a shorter time to complete on a crash basis
- the higher cost of completing it on a crash basis

CPM analysis starts after you have figured out all the individual activities in your project.

Example: Activities, precedence, and times

This example involves activities, their precedence (which activities come before other activities), and the times the activities take. The objective is to identify the critical path and figure out how much time the whole project will take.

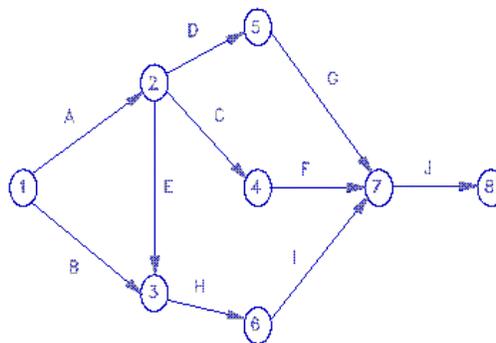
Step 1: List the activities

CPM analysis starts when you have a table showing each activity in your project. For each activity, you need to know which other activities must be done before it starts, and how long the activity takes. Here's the example:

<i>Activity</i>	<i>Description</i>	<i>Required Predecessor</i>	<i>Duration</i>
A	Product design	(None)	5 months
B	Market research	(None)	1
C	Production analysis	A	2
D	Product model	A	3
E	Sales brochure	A	2
F	Cost analysis	C	3
G	Product testing	D	4
H	Sales training	B, E	2
I	Pricing	H	1
J	Project report	F, G, I	1

Step 2: Draw the diagram

Draw by hand a network diagram of the project that shows which activities follow which other ones. This can be tricky. The analysis method we'll be using requires an "activity-on-arc" (AOA) diagram. An AOA diagram has numbered "nodes" that represent stages of project completion. You make up the nodes' numbers as you construct the diagram. You connect the nodes with arrows or "arcs" that represent the activities that are listed in the above table.



Some conventions about how to draw these diagrams:

- All activities with no predecessor come off of node 1.

- All activities with no successor point to the last node, which has to have highest node number.

In this example, A and B are the two activities that have no predecessor. They are represented as arrows leading away from node 1.

J is the one activity that has no successor, in this example. It therefore points to the last node, which is node 8. If there were more than one activity with successor, all of those activities' arrows point to the highest number node.

Project managers sometimes make the mistake of creating a diagram with several starting or ending nodes. *Don't* do this.

The trickiest part of building the above diagram was figuring what to do with activity H. I had drawn an arrow for activity B coming off node 1 and going to mode 3. I had later drawn an arrow for activity E coming off node 2 and going to node 6. Since H requires both B and E, I had to erase my first E arrow and redraw it so it pointed to the same node 3 that B did. H then comes off of node 3 and goes to node 6.

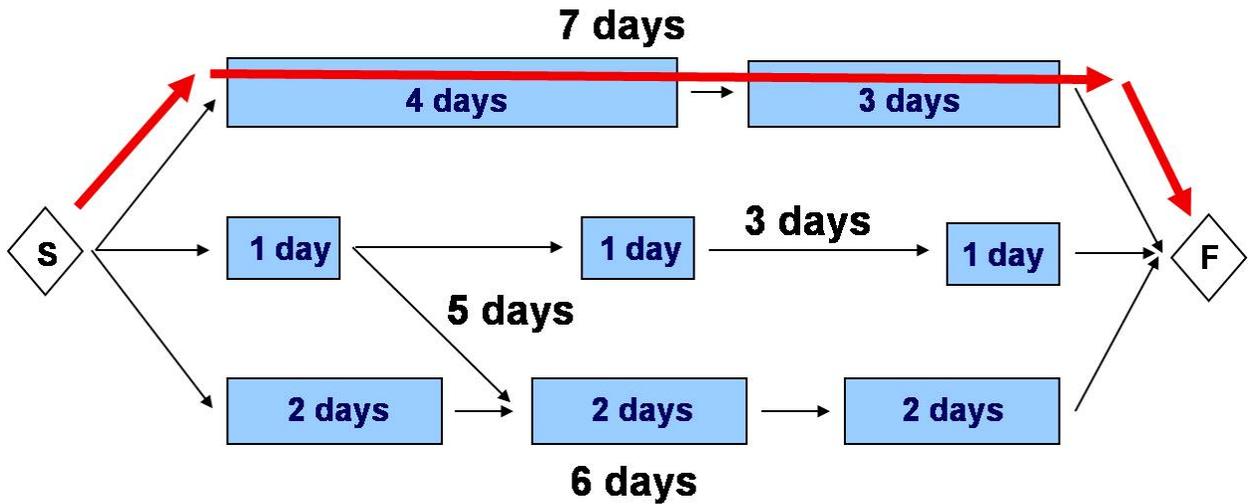
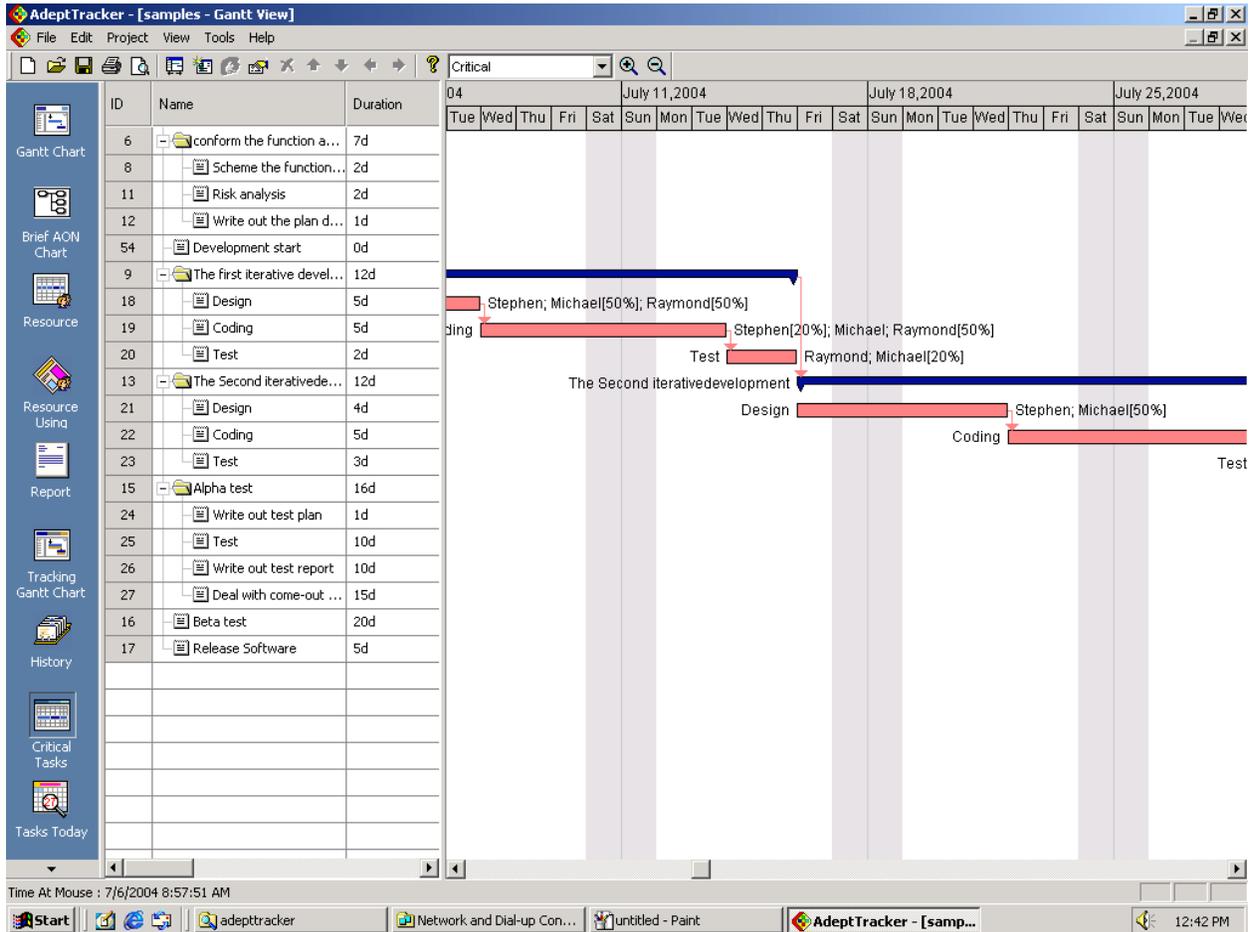
When designing these diagrams, work in pencil.

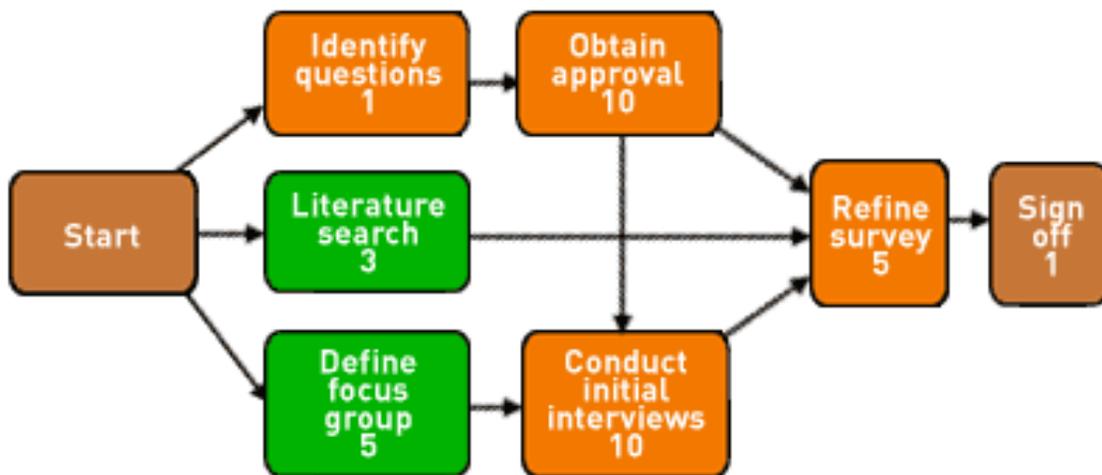
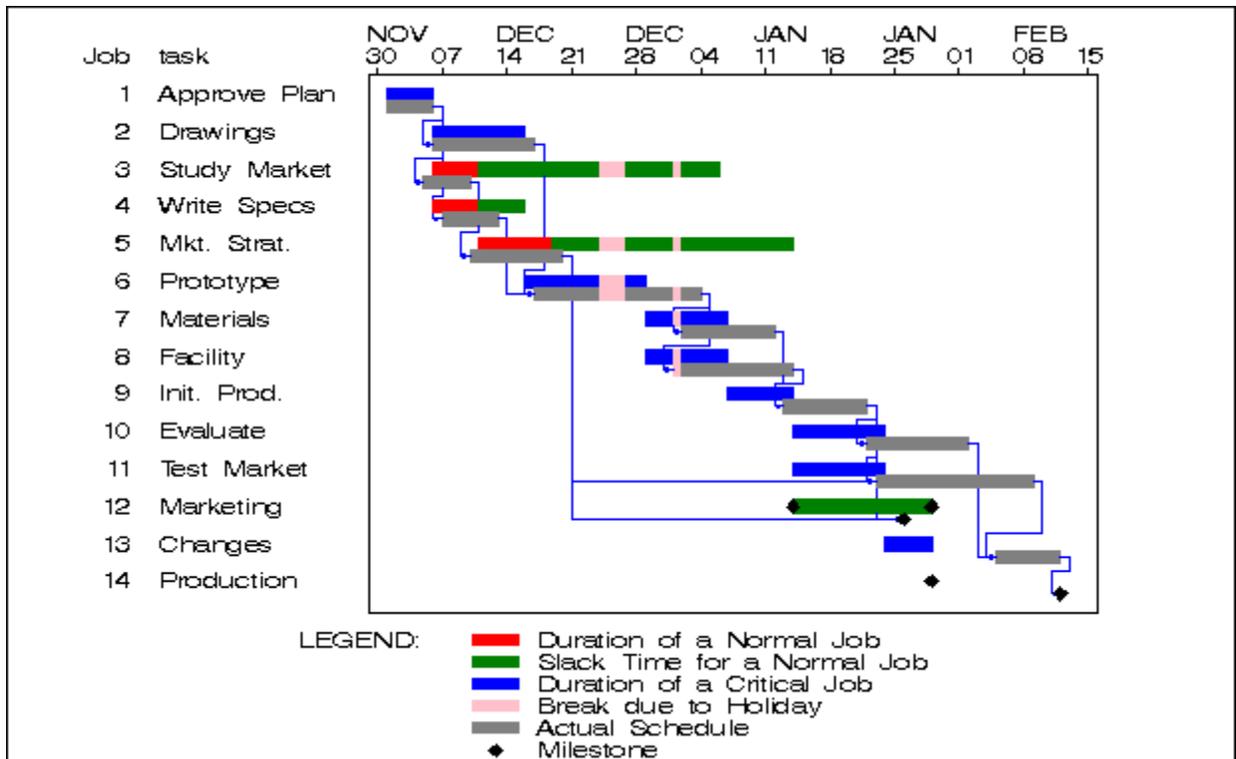
Step 3: Set up the CPM spreadsheet

There are specialized commercial programs for doing CPM analysis. Rather than purchase and learn one of those, we'll leverage the spreadsheet knowledge we already have. We will use one freeware program written for this course and made available to you through the Internet.

	A	B	C	D	E	F	G	H	I	J	K
1	Activities										
2	A	B	C	D	E	F	G	H	I	J	
3	Nodes										
4	1	1	2	2	2	4	5	3	6	7	Start
5	2	3	4	5	3	7	7	6	7	8	End
6	Times										
7	5	1	2	3	2	3	4	2	1	1	
8	Paths										
9	1	0	1	0	0	1	0	0	0	1	11
10	1	0	0	1	0	0	1	0	0	1	13
11	0	1	0	0	0	0	0	1	1	1	5
12	1	0	0	0	1	0	0	1	1	1	11

Examples of Charts and Graphs Used in Critical Path Analysis





Critical Path Method



[HELP](#)

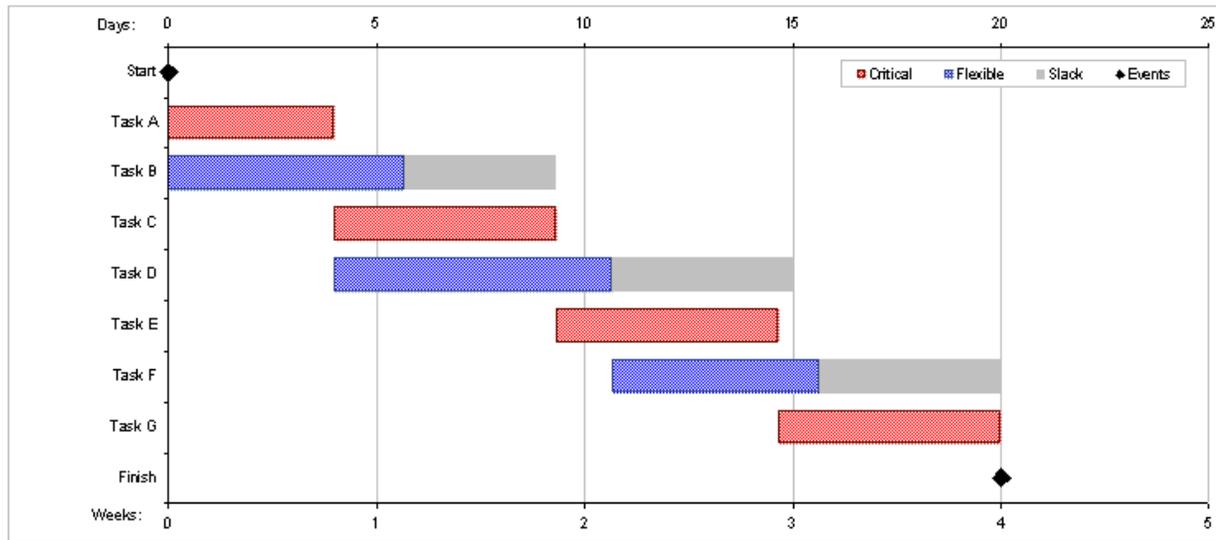
Start Date
1/11/2010
Finish Date
2/5/2010

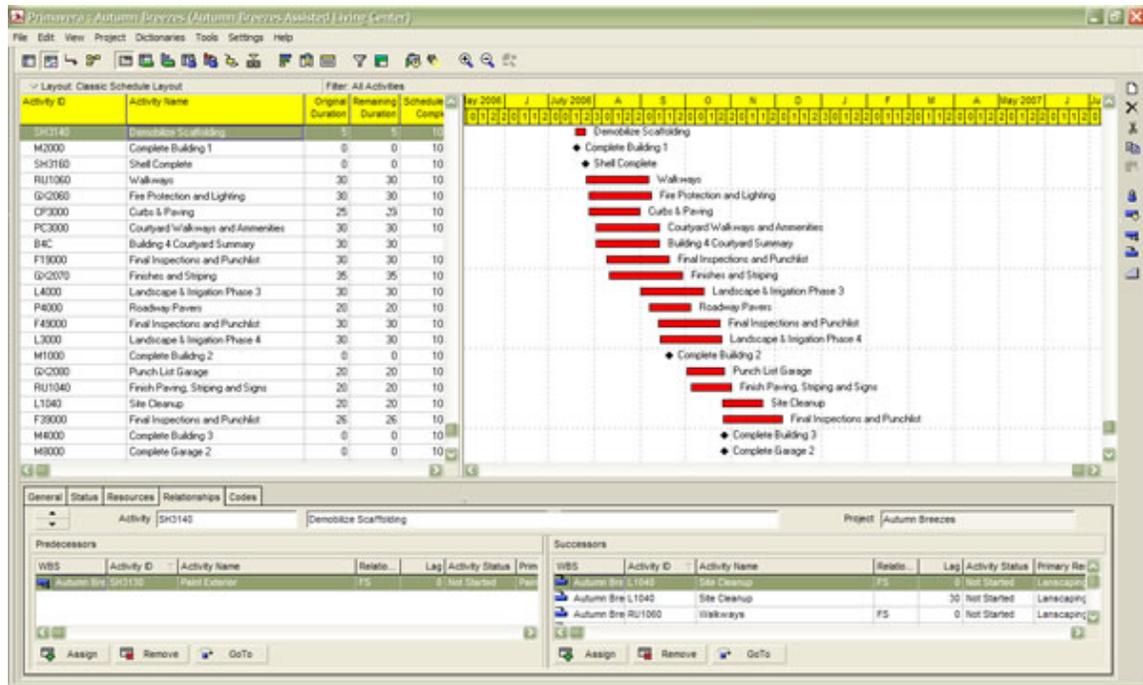
Days to Completion
20.00

Times (in Days)

Time Distribution: Triangular

ID	Task Name	Predecessors (Enter one ID per cell)	O (min)	M (most likely)	P (max)	Duration (exp. time)	ES	EF	LS	LF	Slack
10	Start					0.00	0.00	0.00	0.00	0.00	0.00
20	Task A	10	2	4	6	4.00	0.00	4.00	0.00	4.00	0.00
30	Task B	10	3	5	9	5.67	0.00	5.67	3.67	9.33	3.67
40	Task C	20	4	5	7	5.33	4.00	9.33	4.00	9.33	0.00
50	Task D	20	4	6	10	6.67	4.00	10.67	8.33	15.00	4.33
60	Task E	30 40	4	5	7	5.33	9.33	14.67	9.33	14.67	0.00
70	Task F	50	3	4	8	5.00	10.67	15.67	15.00	20.00	4.33
80	Task G	60	3	5	8	5.33	14.67	20.00	14.67	20.00	0.00
90	Finish	70 80				0.00	20.00	20.00	20.00	20.00	0.00





Time Management (16:08 / 82:41) ATTACHMENTS EXIT




CPM Building Blocks

Activities

ACTIVITY = VERB + NOUN + LOCATION

Verb – Action

Example:

- » Procure
- » Build
- » Install

+

Noun – What

Example:

- » Bridge No. 1234, Pier 1
- » Building A, Floor 3
- » Concourse C

+

Location - Where:

- » Where is the activity taking place

SLIDE 23 OF 82 FLYVIEW 06/23 / 10:41

		Project Ideal				
		Highest Satisfaction	Highest Quality	Shortest Time	Lowest Cost	Lowest Risk
Project Constraint	Knowledge					
	Time					
	Cost					
	Resource					
	Risk					