

Construction Scheduling for Urban Freeway Renewal Projects: A Case Study

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ABSTRACT

The reconstruction of Interstate 235 (I-235) is the largest and the most expensive project in the history of the Iowa Department of Transportation. In order to accomplish this urban freeway renewal project, the Iowa Department of Transportation personnel need to know corridor-level information, such as durations, predecessors, and successors of construction projects, as they manage the design and construction process. They also need to know project-level information when communicating with the contractors, utility companies, and governmental agencies that are using detailed construction schedules. An appropriately customized corridor schedule, when updated consistently and distributed regularly, provides the necessary information. This customized schedule facilitates management decisions and helps the corridor project keep within budget while keeping it on schedule. This paper discusses the corridor schedule development, how it has been customized, updated, and distributed, as well as the research results and recommendations. The reconstruction of I-235 corridor is used as a case project in this research to better develop a corridor scheduling system that can be used elsewhere for other urban freeway renewal projects.

Key words: corridor schedule—heavy/highway construction—Interstate 235—scheduling—urban freeway renewal project

INTRODUCTION

The reconstruction of Interstate 235 (I-235) is a budgeted \$426 million project managed by the Iowa Department of Transportation (Iowa DOT). As one of the largest and most expensive road projects in the Iowa DOT's history, construction began in 2002 and is scheduled to be completed in 2007. The I-235 project is located near downtown Des Moines, Iowa (see Figure 1). The 14-mile corridor will either be rehabilitated with hot-mix asphalt or totally reconstructed and paved with portland cement concrete (PCC). Seventy-one bridges and 21 interchanges on this corridor need to be rebuilt, which involves about 175 separate construction contracts. During the 2003 construction season, approximately 10 concurrent projects are under construction.

The general construction timeline for the reconstruction is as follows:

- 2002 ~ 2004: Utility relocation, overpass bridge replacements, temporary paving, interchange reconstruction.
- 2005 ~ 2007: Mainline paving, mainline bridge widening (except Des Moines River Bridge, which is constructed in 2003).

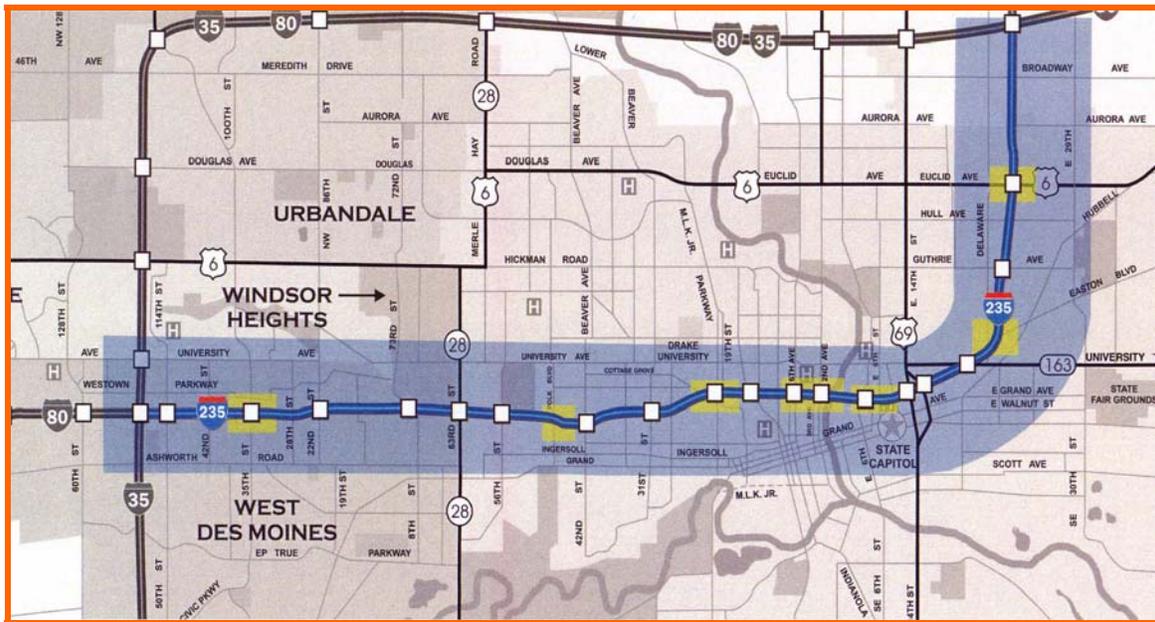


FIGURE 1. Map of I-235 Corridor (Des Moines Downtown Area)

The reconstruction of I-235 is a comprehensive project with multiple contractors and multiple tasks. The entire project needs to be accomplished in limited working spaces, within tight deadlines and budget. In order to accomplish this urban freeway renewal project, project participants need to know corridor-level information, such as durations, predecessors, and successors of proposed construction contracts, as they develop detailed plans and manage construction. They also need to know project-level information when communicating with the contractors, utility companies, and government officials who are using detailed construction schedules. An appropriately customized corridor schedule, updated consistently and distributed regularly, provides necessary information. This customized schedule facilitates management decisions and helps the corridor project keep within budget while keeping it on schedule. Therefore, the objective of this research is to better develop a corridor schedule system that can be generally applied to other urban freeway construction projects that are administered in way similar to the I-235 project.

RESEARCH METHODOLOGY

In order to accomplish the I-235 project, the development of a schedule that is able to provide an appropriate level of detail for the entire corridor is an important part of the research (1). Not only can this corridor schedule be used by the Iowa DOT and contractors for making decisions and controlling the work, but it can also potentially be used to help resolve conflicts when multiple resources and jobs (e.g., personnel, materials, and administrative effort) may be required at a given time. The working flow of the research is shown in Figure 2.

Since August 1999, Iowa State University (ISU) researchers have been working on the developing, updating, customizing, and distributing the I-235 corridor schedule. Researchers developed a conceptual schedule for I-235 based on input from Iowa DOT personnel. Then the schedule was further developed by adding logical relationships (see Figure 3). Since January 2002, the schedule has been refined to the extent that it can be updated and published regularly, which is an important part of the system in order to make it useful.

Developing the Corridor Schedule

In order to simplify and standardize the scheduling process, scheduling templates were developed for each major work category, including asphalt cement concrete/PCC paving, concrete/steel girder bridge, retaining walls, concrete box culverts, and utility work (2). When fully developed, the templates provide the following:

- identification of critical work activities that involve each major work category in determining construction duration
- identification of construction sequences between work activities and other considerations such as the lag time between the activities

A great time savings can be achieved as the templates are customized to any project and, in the case of a larger project, inserted into the larger project's overall schedule.

With the experiences built upon 55 field visits, the knowledge of the staging plan of each section, as well as the information obtained from the Iowa DOT regarding available state and federal budgets for upcoming fiscal years, logical relationships among separate projects (e.g., 35th Street Bridge construction and 35th Street Interchange construction) can be developed. Integrating these 175 projects, their durations, and relationships leads to the I-235 corridor schedule.

I-235 Corridor Schedule

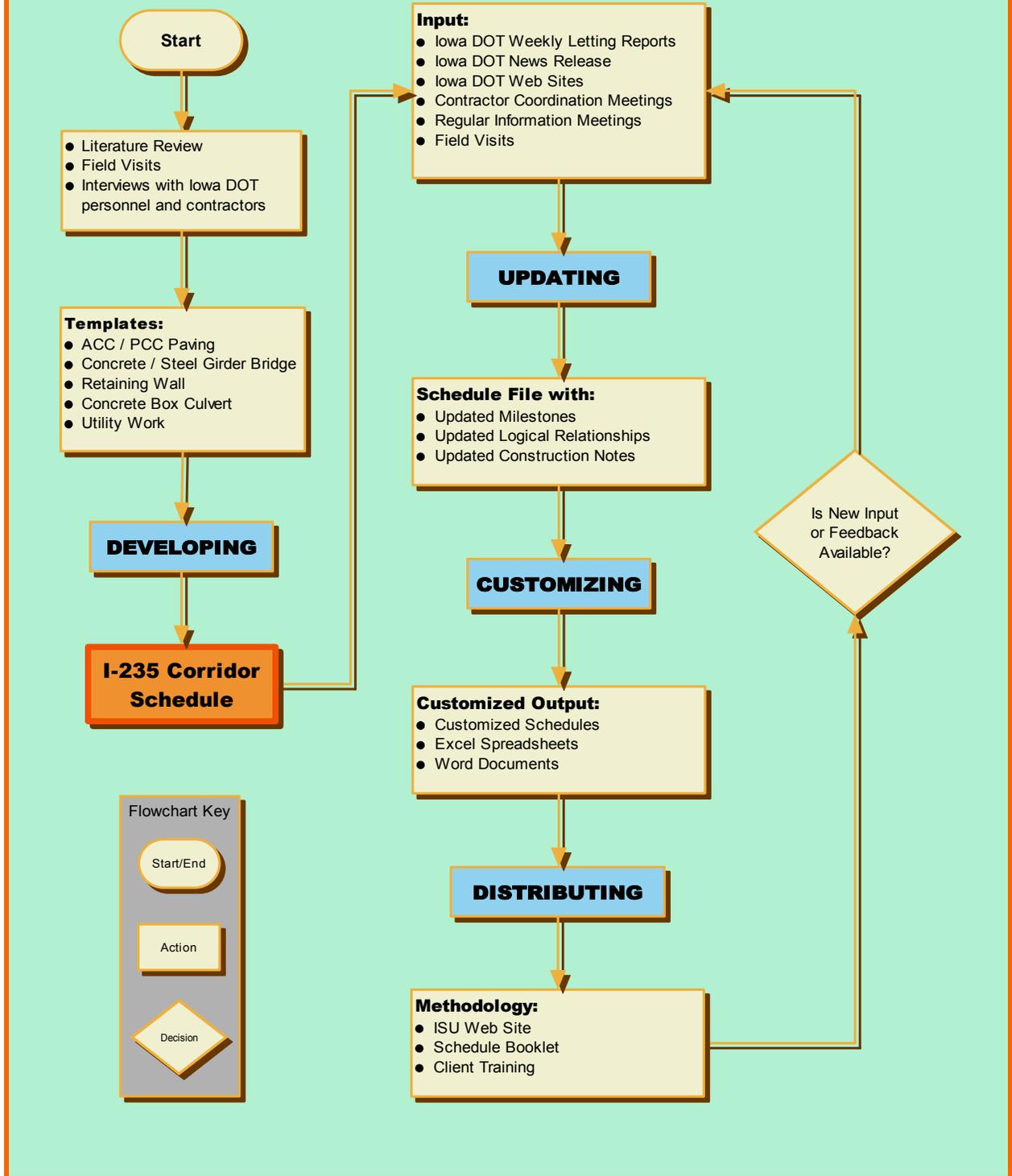


FIGURE 2. Flow Chart of I-235 Corridor Scheduling Work

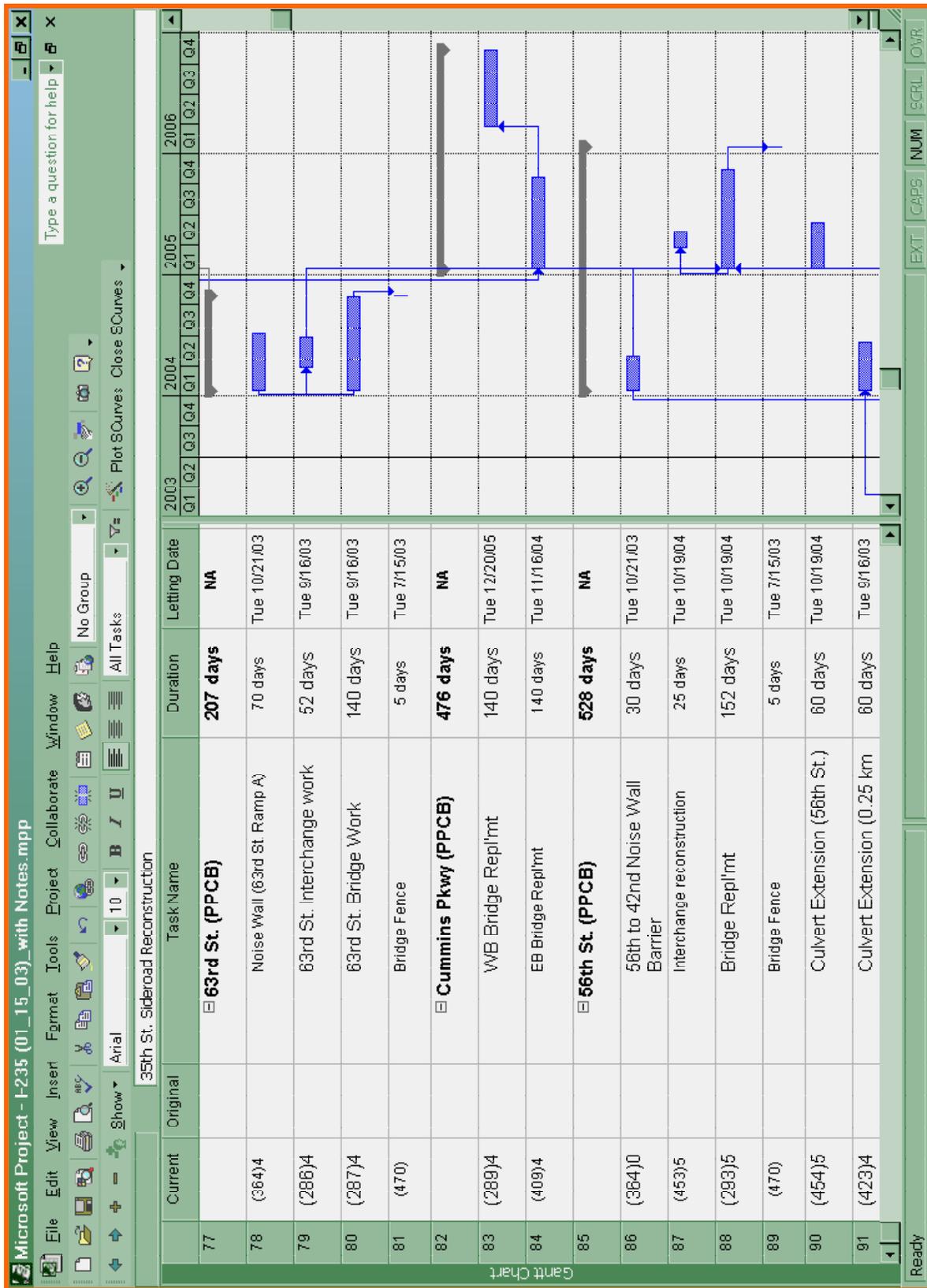


FIGURE 3. I-235 Corridor Schedule—Gantt Chart View

Updating the Corridor Schedule

In order to make the I-235 schedule an effective and valuable managing tool, it was updated every week since March 2002, a total of 63 times as of June 30, 2003. Relevant information about actual project progress is collected and recorded in the schedule file.

In a large project like I-235, it is difficult to collect information on project progress. Researchers developed a method of collecting information that involved reviewing Iowa DOT documentation, attending construction coordination meetings, and obtaining information from key people who have direct knowledge of the work.

From this weekly information collection effort, the following is abstracted: letting date changes; actual start/finish dates; and notes about changes and construction progress. Then milestones and logical relationships are updated, not only as data format, but also as construction notes recorded into the schedule's database (see Figure 4). If the comparison against the programmed schedule shows resource conflicts that can potentially affect meeting deadlines, users are informed.

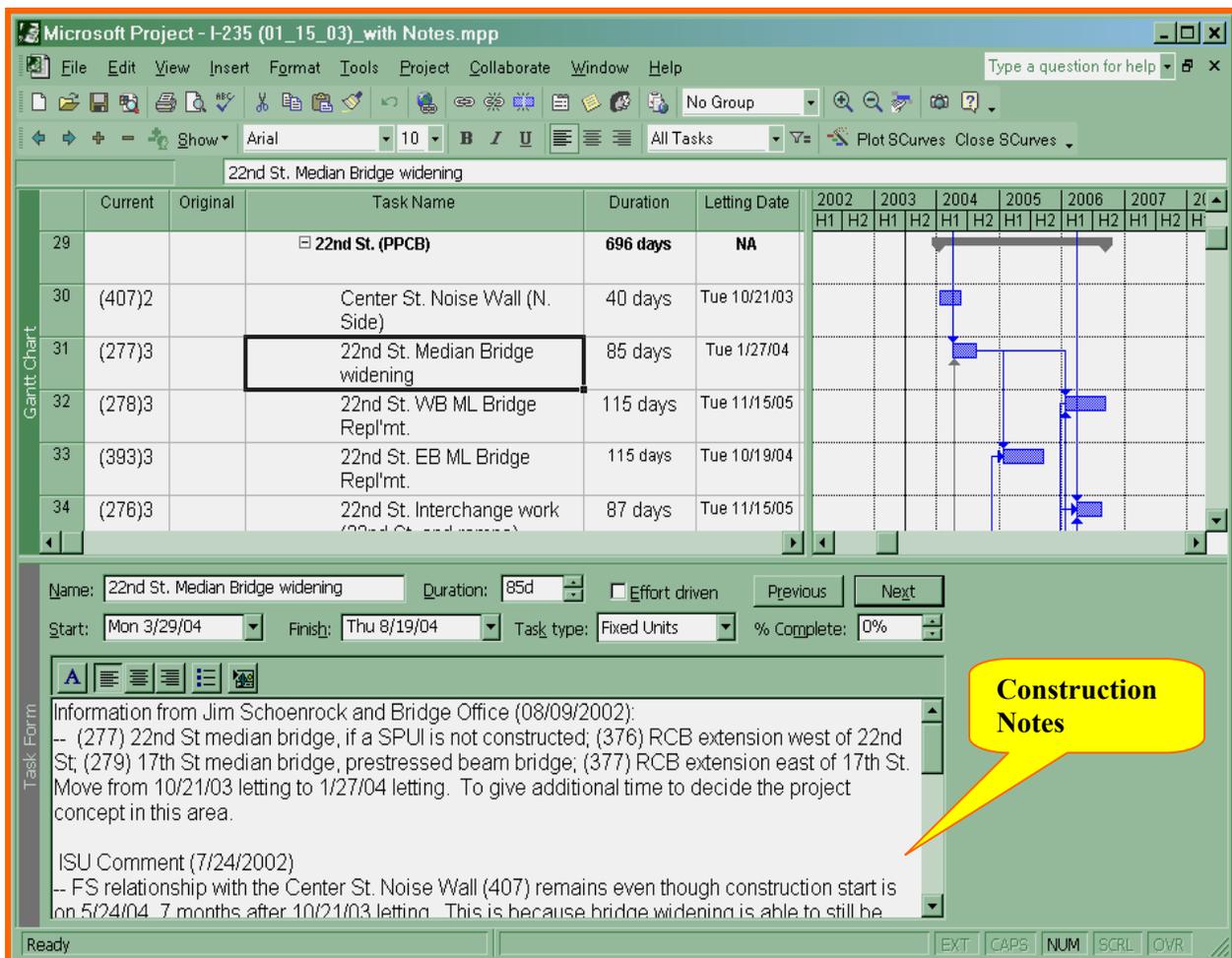


FIGURE 4. Updating the Corridor Schedule

Customizing the Corridor Schedule

Before distributing the schedule to users, it is important to customize the schedule according to the needs and expectations of various users:

- The Iowa DOT management team needs to view summary information, unencumbered with detail.
- Other project participants require detailed information concerning their areas of interest.

Using the many tools Microsoft Project provides, the research team is able to customize the corridor schedule to show the information that needs to be presented. For example, the schedule was customized so it could be used by Iowa DOT Office of Design for personnel management purposes (see Figure 5).

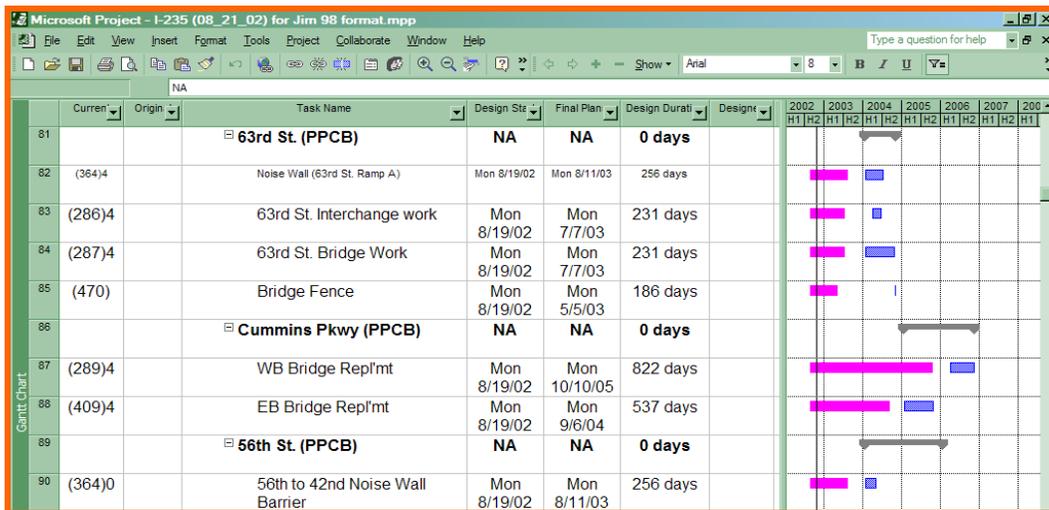


FIGURE 5. Customized Corridor Schedule for Iowa DOT Office of Design

Distributing the Corridor Schedule

When the success of the project depends on a group working together and interdependently, it may be vital that each user is able to communicate with one another in a timely manner. Users can waste valuable time when schedule distribution systems are slow or restrictive (e.g., if the schedule is not published as expected), or they don't know how to use the software, which is required to access the schedule.

Recognizing this, researchers publish the schedule via a website on a weekly basis (see Figure 6), publish schedule booklets (Figure 7) every three months, and provide training to users from time to time, as follows:

- *Corridor Schedule Publication.* Every Wednesday, the corridor schedule is updated and posted on the website (<http://erl.cce.iastate.edu/I235>). Notification of the update is sent out to every user via mail. Non-public information is protected by a user name and password.
- *Corridor Schedule Booklet.* The schedule booklet is a collection of summarized information from the scheduling work. It is published every three months (or less if there is a major change) and includes the following:
 - projects sorted by letting dates and project numbers (see Figure 8)
 - construction contact list (Iowa DOT and contractor contact information from ongoing projects)

- corridor schedule
- summary map (MicroStation map graphically shows project location, letting dates, plan turn-in dates, design numbers, etc.) (see Figure 9)
- *Client Training.* In order to make users of the schedule, researchers presented workshops to users regarding how to use the above products.

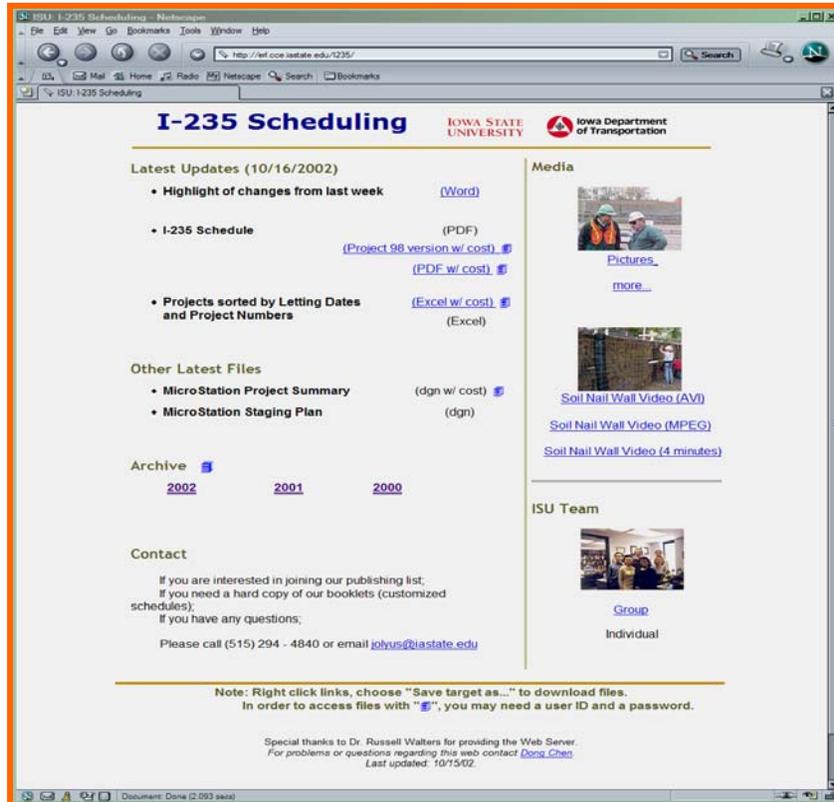


FIGURE 6. I-235 Scheduling Website

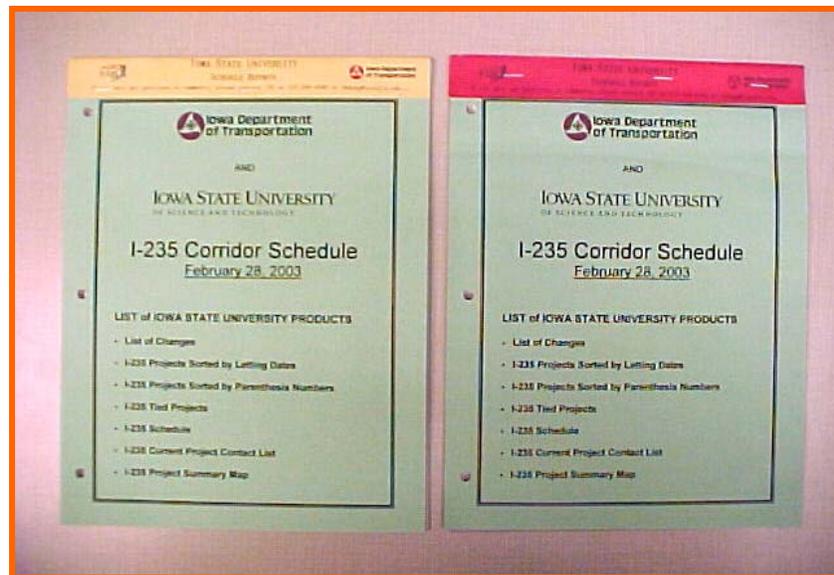


FIGURE 7. I-235 Scheduling Booklet

Microsoft Excel - I-235 Sorted by Letting Dates and Paren(06-25-2003)_with cost.xls

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Notes:

1. Projects are color-grouped by Letting Date.
2. Original Project #: Project No. before project is tied.
3. Current Project #: Project No. after project is tied.

*** If one project has both Current Project # and Original Project #, this project is tied w/ other project(s) ***

Original Project # ②	Current Project # ③	Task	Letting Date	Award Cost	Remarks
2003 Letting					
(470)		Bridge Fence (63rd St., 56th St., 31st St, 9th St., 7th St., 6th Ave., E14th St.)	07/15/03		
(530)2		Lighting- 35th St Interchange (Sec. 1-3)	07/15/03		
(531)9		Lighting- 2nd Ave. & 3rd St interchange	07/15/03		
(532)13		Lighting- Euclid Ave. Interchange (Sec. 9)	07/15/03		
(533)8		Lighting- 19th St & MLK Jr. Pkwy. Interchange (Sec 5.)	07/15/03		
(534)9		Lighting- E. 6th St & Penn. Ave. Interchnage (Sec 6.)	07/15/03		
(376)3		Culvert Extension (28th St. to 22nd St. WDSM)	09/16/03		
(377)3		Culvert Extension (E of 17th WDSM)	09/16/03		
(423)5		Culvert Extension (0.25 km W of 56th)	09/16/03		
(505)6		Traffic signals - 42nd St (sec4)	10/21/03		

Sorted by letting dates | Sorted by pame number | Tied projects

FIGURE 8. I-235 Scheduling Booklet—Project Sorted by Letting Dates

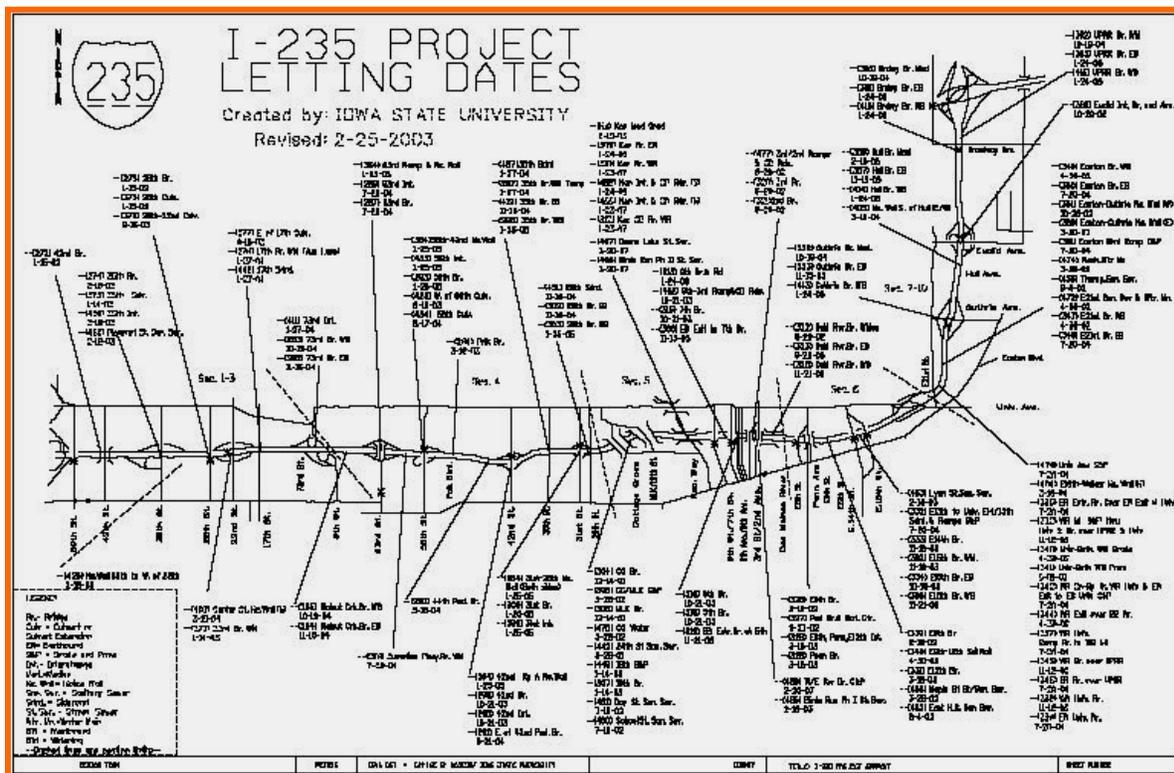


FIGURE 9. I-235 Scheduling Booklet—Summary Map

RESEARCH RESULTS

Over the past three years, the scheduling assistance to the Iowa DOT for the reconstruction of I-235 has been provided through a variety of activities. The following was accomplished:

- Assistance was rendered to the Iowa DOT personnel as they made management decisions and fine-tuned the I-235 project. Iowa DOT personnel are facing challenges in managing this project. Various assumptions are made after the review of limited information. Selections need to be made among options quickly. Such challenges are typical for an urban freeway renewal project. Detailed schedule reviews have resulted in significant savings. For example, according to researchers' advice, the Iowa DOT and the contractor adjusted the staging plan for Martin Luther King area, reducing detour construction and ensuring project completion in one construction season (3).
- Researchers helped fill in the gap between the Iowa DOT conceptual plans and contractors' detailed schedules (see Figure 10). Iowa DOT personnel develop conceptual plans that define the construction sequence and funding requirements. Contractors develop detailed schedules for each of their specific projects. How should the gap be filled between the Iowa DOT's conceptual plans and the contractor's detailed schedule? The flow of information is more efficient when there is a central repository to which information can be fed and extracted. The I-235 corridor schedule is designed to be such a repository, or database, which has an appropriate level of detail to bridge the gap between conceptual plans and detailed schedules. For instance, the logical relationships shown in the schedule connect corridor-level projects and can be used to show how several detailed contractors' detailed schedules fit together. Historical milestones of each task can be recorded as notes to the schedule; this helps both parties remember what happened without an extensive review of their own documents.

RECOMMENDATIONS

On the basis of research conducted by ISU, the following sets forth researchers' recommendations:

- In similar situations, the corridor scheduling system can be used on nationwide urban freeway renewal projects. America has been seriously under-investing in needed freeway and bridge repairs, and has failed to even maintain the substandard conditions it currently has (4). Substantial increases of urban freeway preservation and system expansion investment would be required to prevent both average physical conditions and operational performance from becoming severely degraded (5). The system developed by ISU provides a protocol for scheduling an urban renewal project. When analyzed individually, it can be easily applied to other urban projects.
- Productivity analysis of recent urban freeway projects should be performed. Production rates that the Iowa DOT currently has are more than 5 years old. Some of them came from rural projects. Researchers found that they are not always compatible with the I-235 corridor. From the beginning of this project, 12 bridges (including ramps) have been finished, four bridges are being constructed, and one paving project is underway. Historical data of these projects should be analyzed to obtain the latest production rates, which can then be used to provide more accurate scheduling services for the rest of the projects on I-235. Furthermore, these production rates can be standardized and thus be applied to other freeway reconstruction projects.

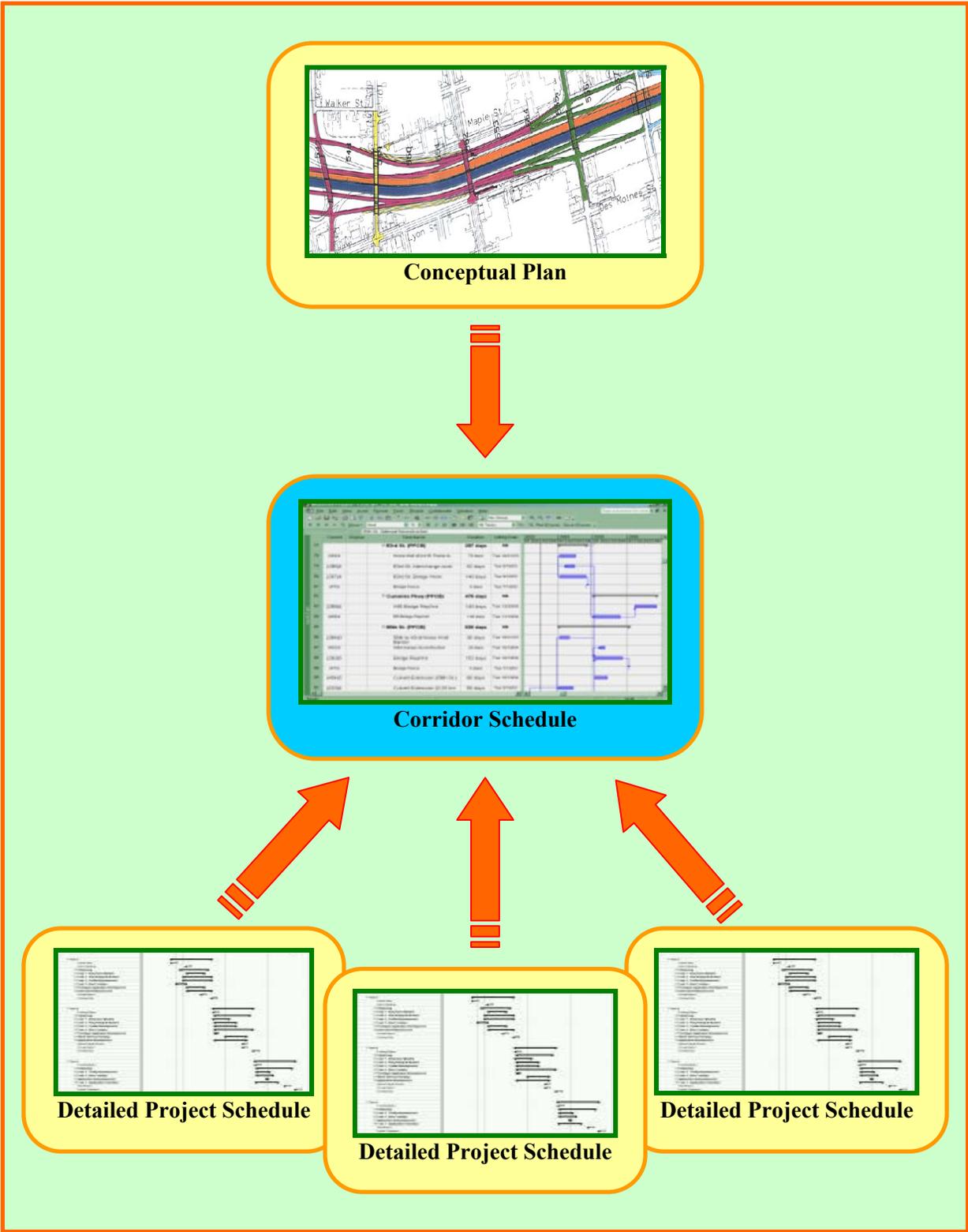


FIGURE 10. Function of the I-235 Corridor Schedule

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