Speeding Road Construction: Efficient Contract Design Can Lead to Faster Repairs, Fewer Delays, and Lower Commuter Costs

by Patrick Bajari and Greg Lewis

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Road closures due to construction not only cause travel delays, but also produce stress and frustration for motorists, and rob commuters of time that could be spent on work or leisure activities.

Residents of Minnesota often joke that the state has two seasons, winter and road construction. The joke has more than a grain of truth: Harsh winters take a high toll on our state's highways, and the warm months are consequently filled with an intense burst of road construction and repair. This second season also exacts a high toll, and the price is paid by Minnesota motorists who suffer painful delays as lanes are closed, stretches of highway are shut down, and detours are endured. The delays not only cause stress and frustration, they also rob commuters of time that could be spent on other things, such as work or leisure activities with family and friends.

Economists refer to the cost of such delays as "user costs." Careful empirical research by the Minnesota Department of Transportation (MnDOT) computes the individual user cost of construction delays at $12 per hour, which is approximately half the mean hourly wage in Minnesota.[1] These user costs can mount quickly. Suppose, for example, that MnDOT awards a $1 million contract for repair of Interstate 35W and gives the contractor 15 days to complete the repair. On an average day, Interstate 35W carries about 175,000 motorists in the Twin Cities metropolitan area. If we assume this construction project delays the typical driver by 15 minutes each trip, total driver delay time amounts to 43,750 hours every day, and at $12 an hour, that equals a daily user cost of $525,000. Over the 15-day project, then, user costs amount to nearly $8 million—almost eight times the fee paid to the contractor. Clearly, if MnDOT could persuade contractors to complete projects faster, even by a day or so, considerable savings would be generated in the form of lower user costs.

[1] From Office of Investment Management, MnDOT.

Unfortunately, in most instances MnDOT does not account for user costs when it awards its projects. Instead, as with most government agencies, MnDOT evaluates construction contracts using competitive bidding, just as most homeowners do when they hire a contractor. Both economic theory and data suggest that competitive bidding minimizes final payments to contractors. Because the state's bidding system is open to any prequalified contractor and MnDOT normally awards projects to the lowest bidder, contractors do not raise bids far above costs so as to avoid being undercut by a competitor. In fact, empirical evidence indicates that contractors' markups are quite modest, typically on the order of 1 to 3%.

However, economic theory also suggests that contractors typically have little or no incentive to minimize commuter delays, as doing so typically involves additional expenses for them, such as overtime pay, working on weekends, or forgoing opportunities to bid on alternative projects. In the face of tight profit margins, contractors are unlikely to incur these additional costs just to complete a job more quickly.

To avoid commuter delays, government agencies such as MnDOT usually retain the right to penalize contractors for late project completion. Typically, the agency sets a deadline and can impose penalties for every day the project extends beyond that deadline. In practice, however, the size of the penalty is usually quite small relative to both the user cost and total contract cost, and therefore may not provide any real incentive for completing the project on time. For a $1 million contract, as in our earlier example, MnDOT typically specifies a $1,500 daily "late fee," which is quite small compared with the contract amount and the $525,000 daily user cost. Moreover, MnDOT has discretion in imposing fines and frequently does not penalize contractors for exceeding deadlines. MnDOT's standard contracts also do not provide bonuses for early completion. The problems inherent in these standard practices suggest that a better process for awarding contracts could speed highway construction.

Fortunately, MnDOT and other state highway departments have begun to recognize this inefficiency and have started experimenting with alternative procedures designed to motivate contractors to complete projects earlier. One such method is *lane rentals*, which penalize contractors for each day they close a highway. A second procedure is *A+B bidding*, where contractors bid both on time and materials (the A-bid) and the number of days to complete the project (the B-bid). We discuss these experiments, in comparison with the use of standard contracts, later in this article.

Economics, to a substantial degree, is the science of achieving efficient resource use. A major goal of economic theory, therefore, is to design efficient mechanisms, that is, systems that will provide the right signals (through prices and rules) to everyone involved in a transaction so that the highest possible output is achieved with the least possible waste after all costs and benefits are considered. Given this efficiency focus, economic theory might help design better rules for awarding and paying contractors on state highway

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To avoid commuter delays, MnDOT retains the right to penalize contractors for late completion. However, the size of the penalty is usually too small to provide an incentive for completing the project on time.

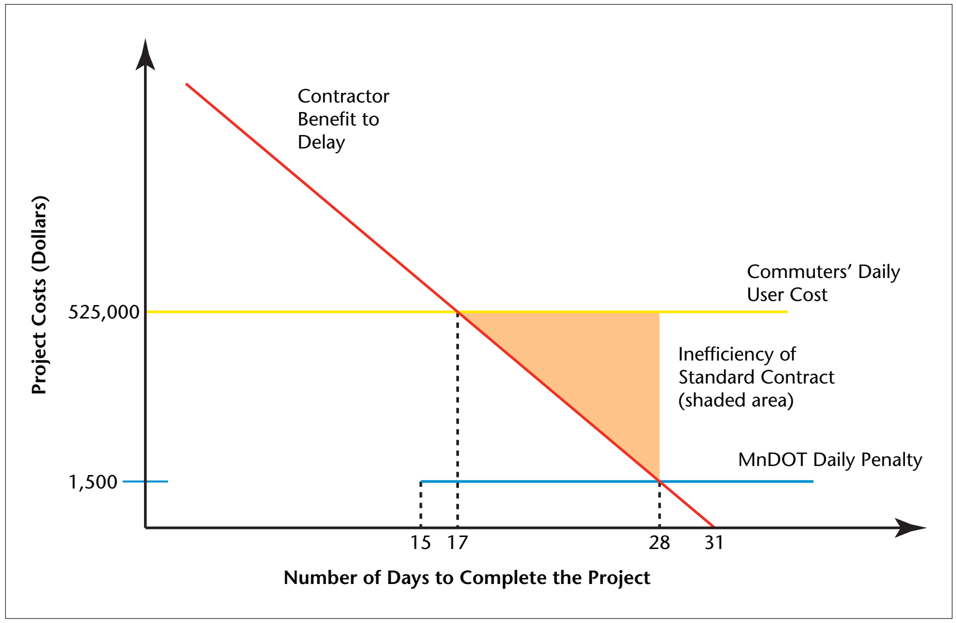
projects. In our earlier example, the substantial gap between the benefits for commuters of early project completion ($525,000 a day) and the costs paid by contractors for late completion ($1,500 at most for each one-day delay) suggests that the current method of evaluating and rewarding road construction contracts is inefficient and results in substantial waste; therefore, it may well be possible to design contract incentives that benefit both commuters and contractors.

For the past year, we have studied the economics of time incentives in road construction and efficient contract design, using MnDOT contracts as an empirical case study. We were motivated by two questions. First, how can we design efficient bidding systems for highway projects that could account for both direct construction costs and indirect commuter costs? Second, what are the potential gains from switching to a more efficient system? This article summarizes some of the key findings from our study. Our complete findings are reported in our working paper, "Procurement Contracting with Time Incentives: Theory and Evidence."[2] The research upon which this article is based was supported in part by a grant from CURA's Faculty Interactive Research Program. Additional support was provided by the Grant-in-Aid of Research, Artistry and Scholarship Program at the University of Minnesota and the National Science Foundation.

Some Basic Economics

The various costs and timelines associated with our earlier Interstate 35W repair project example can be graphically represented (Figure 1). The contractor's daily benefit from *not* completing the project ("benefit to delay"; the red line) is sizeable initially, as finishing the project in just one or two days would entail an enormous financial outlay for the contractor (hiring more workers immediately, paying overtime wages, incurring extra costs to expedite material delivery, and possibly renting or buying more equipment). From the contractor's perspective, then, delaying project completion has substantial financial benefits. For example, the first day of delay is worth a great deal to the contractor, well over $1 million in this hypothetical example, because postponing completion for a day avoids

Figure 1. Relationship between Completion Times and Project Costs for a Hypothetical Road Construction Project



Note: The red line represents the contractor's daily benefit from *not* completing the project. The yellow line represents the cost to commuters of a day of construction in our hypothetical example, $525,000—the total of 175,000 commuter delays of 15 minutes each valued at $12 an hour. The blue line is the daily penalty MnDOT charges to the contractor for exceeding the completion deadline.

enormous extra expenses. Another day's delay would still be worth a considerable amount, but not quite as much as the first day's delay. The benefits of delay diminish over time, because the extra costs of accelerating work will decrease—less overtime, fewer extra workers, and no rush delivery of materials. Eventually, no benefit is realized by delaying completion, and it is at that day (where the red line intersects the horizontal axis—day 31 in Figure 1 for our example) that economic theory predicts the contractor would choose to finish the job *if* no other costs were to be considered.

However, other costs *do* need to be considered, as demonstrated by two additional lines on the graph. In our example, the cost to commuters of a day of construction (yellow line) was $525,000 for each day the project continues. Therefore, from the very first day of construction until the last highway cone is removed, motorists as a whole will pay an aggregate daily cost (in delays, frustration, and inconvenience) of more than $500,000. The other cost is the daily penalty the hiring agency charges to the contractor for exceeding the completion deadline (blue line). Because MnDOT set the project deadline at 15 days in this hypothetical example, the penalties are zero if the contractor completes the project within that time frame. Starting at 15 days, though, MnDOT would charge the contractor $1,500 for every day the project continues (if MnDOT engineers actually choose to impose the penalty).

In economic theory, we assume that contractors are *self interested*—that is, they are concerned with maximizing their profits. As a result, they will only undertake costly efforts to reduce delays if such efforts prove profitable. Given that assumption and given that our hypothetical contract starts imposing a daily penalty of $1,500 after 15 days, theory predicts that the contractor will finish the project on the 28th day, as that is the day when benefits to delay no longer exceed penalties for delay. On day 27, the contractor could still save a bit by not speeding up the project, but on day 28 those benefits drop to $1,500—precisely the penalty that MnDOT imposes. Beyond that point, it will actually cost the contractor more to delay the project than to finish it. Therefore, economic theory predicts that the penalty *does* speed the project up a bit, because rather than the 31 days the contractor would take if no penalty were imposed, the contractor will instead finish in just four weeks.

Seeking Efficiency

Both economic theory and the graph in Figure 1 tell us that the *efficient* number of days to complete the project is 17, which is the point where the

[2] Available at www.cura.umn.edu/publications/Bajari_procurement.pdf.

contractor's benefits to delay exactly match the user costs of delay. Why is day 17 the efficient number of days? Consider day 28, the point where the contractor would ordinarily choose to end the project because benefits to delay equal the cost of delay (the $1,500 penalty). On that same day, the user cost for commuters is $525,000. Theoretically, the commuters (or MnDOT acting on their behalf) could band together and pay the contractor to complete the project in 27 days instead of 28 days. This action would benefit the commuters because they would not waste another day stuck in traffic. How much would the contractor have to be paid? The same as the contractor's benefit to delay on day 28, $1,500 (because the project will be completed, thus avoiding the $1,500 MnDOT penalty). The commuters benefit by $523,500 (= $525,000 – $1,500) and the contractor benefits by covering his costs.

By similar reasoning, every time the red line lies below the yellow, it is possible to make someone better off and no one worse off by arranging a similar deal. However, the ability to make people better off is limited, and that limit comes on day 17. At day 16, the contractor's benefit of delay is *greater* than the commuters' daily user cost of $525,000—in the graph, the red line lies above the yellow—and even if commuters could band together, they would not come up with enough to compensate the contractor.

This example, constructed using real-world figures, suggests that a large amount of waste may occur in how standard highway contracts are awarded. Even a one-day decrease in completion time could make society better off—in other words, improve social welfare—by a $523,500 savings in commuter costs. Summing the potential benefits between day 17 and day 28—the area of the shaded triangle—demonstrates the total inefficiency of standard construction contracts. These contracts are inefficient because they do not provide the contractor appropriate incentives to economize on the commuters' user costs of construction. By providing appropriate incentives, a better contract would reduce total costs of the project, taking into consideration both direct contractor costs and indirect commuter user costs.

Designing Mechanisms

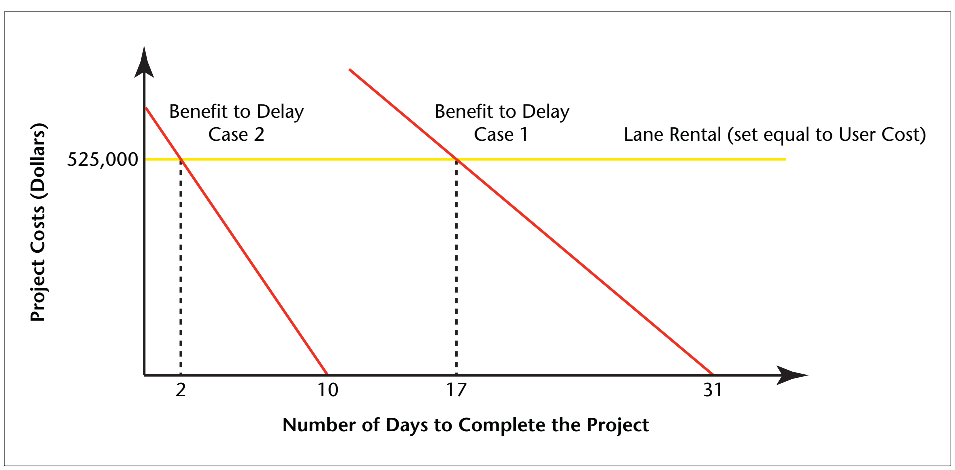
To design more efficient contracts, we used the tools of *mechanism design*. Our late colleague, University of Minnesota economist Leonid Hurwicz, was awarded the 2007 Nobel Prize in economics for his pioneering research in this field. Mechanism design is the idea of shaping systems and institutions to achieve desired goals, and one of Hurwicz's key insights was that such systems should be "incentive compatible," meaning that to work well, rules should take advantage of people's self-interest. If two people want to share a pie, one of them should cut it and the other should choose the first slice. That "incentive-compatible mechanism" will use the self-interest of both cutter and chooser to ensure that the pie is divided equally.

Governments have used mechanism design to auction timber-cutting rights, radio frequencies, and even carbon-emissions credits in ways that use profit-maximizing incentives to achieve efficient distribution and maximize revenue generation. Mechanism design is also the perfect tool for shaping an efficient highway contracting system, one that will use the contractor's desire to maximize profits to ensure that total costs (including user costs) are minimized.

Our earlier example suggests that standard construction contracts are highly inefficient for three reasons. First, contractors have poor incentives to economize on project completion time. Second, 175,000 commuters cannot "band together" to give the contractor correct incentives; only good public policy can act in the interests of commuters by providing appropriate incentives. Third, even if MnDOT wished to protect commuters' interests, it does not know whether the contractor has high or low benefits from delay—that is, it does not actually know where the red line lies—because compared with the contractor, MnDOT has less information about actual construction costs. This lack of knowledge makes it difficult for MnDOT to give appropriate incentives even if they had the contracting tools to do so.

Hurwicz was fascinated by this sort of problem and left an important legacy for economists and public-policy makers on how to better design incentives. In our study, we applied Hurwicz's toolbox to show how certain mechanisms can generate efficient outcomes. One such mechanism is called "lane rental," a tool that MnDOT has already tested. In lane rentals, highway departments charge contractors a rental fee for each day they obstruct traffic by working on a project. In one hypothetical example, the lane rental can be set exactly equal to the user cost (as illustrated by the yellow line in Figure 2). In this example (case 1), where the red line resembles that in Figure 1, theory predicts that the contractor will choose to complete the project in 17 days, when the benefits and the costs of delay are exactly offsetting (where the red line and yellow line cross). This outcome is the efficient—but unrealized—result we sought in Figure 1. However, what if the red line (that is, the contractor's benefits from delaying completion) is actually quite different,

Figure 2. Relationship between Completion Times and Project Costs for a Hypothetical Road Construction Project with a Lane Rental Incentive in the Contract



Note: The red line represents the contractor's daily benefit from *not* completing the project. The yellow line represents the lane rental, a fee that highway departments charge contractors for each day they obstruct traffic by working on a project. In this example, the lane rental fee is set equal to the cost to commuters of a day of construction in our hypothetical example, $525,000.

as represented by the red line for case 2 in Figure 2? In this case, theory predicts that the contractor would complete work in 10 days. Although that outcome is better than 17 or 31 days, the yellow line demonstrates that the efficient completion time is 2 days. So even here—when benefits to delay are low and MnDOT penalties for exceeding the completion time are not a consideration—theory predicts that a standard contract will not achieve an efficient solution.

Fortunately, lane rentals provide an efficient solution to this issue. An elegant feature of a lane rental contract is that it works even in the presence of what economists call "private information." Hurwicz knew that one party to a contract (such as a road contractor) often has information that is unknown to the other party. A properly designed mechanism (one that is incentive compatible) will account for the presence of this private information and the fact that parties to a contract will act in ways that are self-interested.

These considerations are certainly relevant in our example. Contractors on tight profit margins need to economize on costs whenever possible. In addition, MnDOT does not know in advance of bidding whether contractors have a high or low benefit to delay (i.e., whether case 1 or case 2 in Figure 2 is relevant). The advantage of using lane rentals is that MnDOT does not need to know where contractors' red lines are. By correctly pricing the commuters' user cost and setting lane rentals equal to that cost, MnDOT gives contractors appropriate incentives to choose the efficient completion time. Whether a contractor's benefit to delay is high (case 1) or low (case 2), theory predicts that an efficient solution can be achieved: at 17 days in case 1 or 2 days in case 2.

In our study, we showed that another technique, A+B bidding, can also be used to avoid inefficiencies in road contracts. With this system, agencies select contractors on the basis of both an A-bid (time and materials) and a B-bid (completion time). The agency pays a bonus if the contractor completes the project before the bid completion time, or assesses a penalty if the contractor does not complete the project until after the bid completion time. MnDOT has used A+B bidding for a number of time-sensitive construction projects, including the 2008 reconstruction of the Interstate 35W bridge that collapsed in Minneapolis in August 2007.[3]

The rules for awarding the project under this bidding system are crucial. They must be designed with great care to achieve efficiency. First, the contracting agency needs to score the bids using both the B-bid (the user cost; in our example, \$525,000 per day) times the number of days bid and the A-bid (time and materials). Second, the agency should also provide contractors rewards (or assess penalties) for every day they complete the project early (or late), and those (dis)incentives should be set equal to the user cost. For example, if the contractor bids 14 days to complete the project, but it takes 16 days, the agency should impose a penalty of \$1.05 million (=2 x \$525,000). A potential drawback of A+B bidding is that a poorly designed set of rules will give contractors the potential to "game the system," that is, use the rules to achieve unintended goals. In our study, we used economic theory to characterize how contractors could indeed strategically set bids to maximize their profits.

Study Findings: Applying Economic Theory to Real-World Contract Bidding

The graphs and mathematical formulas we work with are imperfect representations of contractor incentives, government procedures, and commuter behavior. In our study, we applied our theoretical models to the "real world" of highway contract bidding. With the assistance of the Innovative Contracting Unit at MnDOT, we compiled data on contractor bids, project completion times, and user costs from MnDOT projects awarded between 1997 and 2007. Our database included 3,702 contracts; of these, only 29 were generated through A+B bidding, and the remainder were standard contracts. For 248 of the standard contracts, MnDOT provided us access to project engineer data, including comprehensive information on daily traffic counts and completion times; these data formed the bedrock of our data analysis.

A+B Bidding. We first examined the A+B contracts to see how well they conformed to the predictions of our theoretical model. We found that the data fit the theory quite well. First, our theory predicts that bidders should bid fewer days when the positive incentives offered for finishing early are lower than the disincentives associated with exceeding the project completion time, so they can "lock in" the gains for finishing early. When we analyzed the data we found a clear pattern in support of the theory: the lower the incentives for finishing early in the contract, the lower the days that contractors bid. Second, theory predicts that the dollar bid should be relatively higher in contracts with zero or small positive incentives for finishing early, because the winning contractor will receive no bonus for finishing early. We ran a statistical test to gauge the relationship between dollar bids and incentive structures and found that, as predicted, bids were higher in contracts with no positive incentives for finishing early and with high user costs. Third, theory suggests that when positive incentives for finishing early are lower than disincentives for exceeding completion times, actual completion times should be "sticky" around the bid completion date, meaning that they will tend to bunch around that point. When we graphed the completion times for the 29 A+B contracts, we observed this predicted "stickiness."

Overall, the predictions of theory stand up well: based on descriptive analysis of an admittedly small sample, the data on A+B bidding for MnDOT contracts over a 10-year period appear to conform quite closely to our model. However, it is important to note that the theory has weaknesses in its application to the real world of bidding. For instance, an important deviation from the theory is that bidders do not in reality bid zero or even an unreasonably low number of days when no positive incentives for finishing early are offered—a strategy that theory says is optimal. Whereas it is possible that contractors do not understand the A+B "game," it is more likely that they reasonably anticipate that their bid will be rejected as "irregular" if they claim they will finish a project in zero days.

Standard Contracts. We next examined the 248 standard contracts for which complete data were available to see how well they conformed to the predictions of our theoretical model. Again, the theory matched the

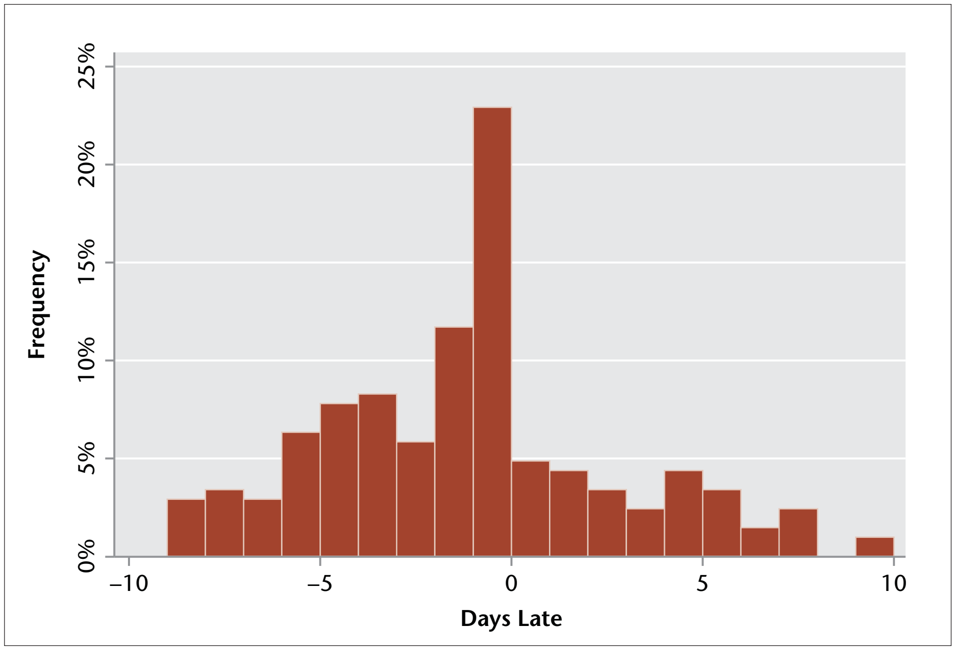
[3] This contract was awarded to Flatiron Construction on the basis of an A+B bid. Flatiron and MnDOT agreed to a December 24, 2008, deadline (the B-bid), and the contract stipulated that the company would receive incentive payments of \$200,000 for each day the project was completed ahead of schedule. By all accounts, Flatiron and its subcontractors worked at a furious pace, with workers on the project site between 16 and 24 hours per day to maximize incentive payments. The bridge was completed on September 18, more than three months before the deadline.

data well. In brief, the mean standard contract for this 248-project subsample had a winning bid of approximately $1 million, while the mean for the full sample was approximately $2 million. This means that our subsample was not representative of the whole. We corrected for this sampling issue in our subsequent policy analysis. The mean number of working days allowed before penalties would be assessed was 34.1. The mean time required to actually complete the project was 33.4 days. Most of the 248 contracts were completed on time (70.5%), but when they were completed late, damages were assessed in only 29% of cases (as project engineers have discretion over whether to impose penalties).

We categorized the 248 projects based on their "days late"—that is, the difference between the actual and specified project completion time (Figure 3). The figure illustrates a striking feature of the data—contractors were likely to use all of the allotted time to complete their projects. Nearly one-quarter of the standard contract projects (23%) we studied were completed just one day before they were potentially liable for penalties from MnDOT. By comparison, almost 5% of the projects were completed one day late. These data indicate that a contractor is about five times more likely to complete a project one day early than one day late. This evidence of the incentive effects of penalties on project completion time is one of our theory's strongest predictions.

To understand these data, it is important to note that the penalties assessed by MnDOT are small compared with the project value. For example, damages on a $50,000 contract (if imposed) are just $300 for each day of delay past the deadline. However, even though the penalties are small, Figure 3 indicates that the desire to avoid damages can have a strong effect on project completion times. To complete our analysis, we also performed a more careful statistical comparison of theory and data on standard contracts to assess the "fit" between predictions for and the actual sample data for completion times. For the sample contracts, 29.5% finished late, and if late, they finished an average of 15.7% over the allotted days. Our model matched these data well, predicting that 34% of contracts will finish late, and those that will finish late will be 15.7% late.

Figure 3. Completion Times for Road Construction Projects Awarded under Standard Contracts by MnDOT between 1997 and 2007



Note: Data are presented for 248 standard contracts for which we had access to comprehensive project engineer data. Project completion times were categorized based on the difference between the actual and specified project completion date. If a project's deadline is day 15 and the contractor takes 17 days, the project is included in the "2" days late category on the horizontal axis. If the contractor takes just 13 days, the project is included on the graph in the "-2" days late category to indicate that the project was completed early.

Saving Time and Money

Good theory is one thing, but if it has no real dollars and cents significance, it will remain just that: a theory. Therefore, our second main goal in this project was to estimate the gains that might be achieved if government agencies improved their bidding process by using procedures that account for completion time when procuring contractor bids. To do this, we computed user costs for 167 road-repair projects in our sample of 248 standard contract projects, employing procedures used internally by MnDOT (the necessary data for this analysis were not available for all 248 projects). For each of these projects, we used Google Maps to find a detour around the project and computed the implied change in commuting time if drivers used the detour. We then computed the mean construction delay in this set of projects (4 minutes) and, using the project engineer data, we found that nearly 20,000 daily commuters would be subjected to delay due to the 167 projects. Assuming that commuters value their time at $12 per hour, this yielded a mean user cost of $15,626 per day of construction.

We also developed some new statistical tools to estimate the impact of lane rentals on contractors' completion times. From Figure 3, we see that projects are likely to be completed just before deadlines rather than just after deadlines. By controlling for the size of the penalties and other factors, we estimated the effect of imposing lane rentals by looking at the efforts firms exert to complete projects a bit early rather than a bit late. Using these estimates, we then calculated the potential impact of three different contract policy changes, and compared them with no policy change at all. To do so fairly, we weighted our figures to ensure that our subsample of contracts (those for which we had complete data) better resembled the full set of Minnesota highway contracts.

First, we examined a very small policy change: setting lane rentals at the same daily rate at which MnDOT currently assesses delay penalties. We estimated that this would shorten project times by almost 1.5 days, increase contractor costs $1,287 per contract, and decrease commuter costs by $27,842 (Table 1). By subtracting the additional contractor costs from the lower commuter costs, we calculated the net gain in overall social welfare at $26,555, which is 1.3% of the mean Minnesota highway construction project costs of $2 million.

Second, we considered a stronger policy change: charging contractors a lane rental fee of 10% of total user cost. We estimated that this policy would shorten mean project time to just 34.7 days (down from 36.9), cost contractors $6,844 more per contract, and increase commuter welfare by $170,651. On net,

Table 1. Three Road Construction Contract Policy Options: Estimated Impact per Construction Project

Policy	Average (Mean) Project Completion Time	Additional Contractor Costs	Increase in Commuter Welfare	Net Increase in Social Welfare	Additional Costs to MnDOT
No change	36.9 days	—	—	—	—
Lane rental set at current MnDOT daily penalties	35.4 days	$1,287	$27,842	$26,555	$12,636
Lane rental set at 10% of user cost (10% of $12/hour)	34.7 days	$6,844	$170,651	$163,807	$17,573
Lane rental set at full user cost ($12/hour)	21.6 days	$144,613	$533,266	$388,653	$199,001

Note: The increase in commuter welfare represents the decrease in commuter costs associated with the use of a policy option. The net increase in social welfare represents the increase in commuter welfare less the additional contractor costs for a policy option.

then, the 10% policy would increase social welfare by $163,807, or 8.2% of mean contract cost.

Finally, we considered a third option: the economically efficient policy that would charge a lane rental fee exactly equal to the user cost of $12 an hour. As indicated in Table 1, the result of such a policy would be striking. Projects would be completed in 21.6 days, at additional contractor costs of $144,613. Commuters would benefit by $533,266 in saved costs. The net social welfare increase would be $388,653, which is 19.4% of the mean contract cost.

Despite the potential advantages associated with implementing changes to contract processes, this approach also has some disadvantages. The decrease in user costs that could be realized through new policy stems from projects being completed earlier, which requires contractors to incur higher expenses. Recognizing this, contractors will submit higher bids to MnDOT and, through the bidding process, a fraction of these higher costs will be passed on to MnDOT. For the three policies we evaluated—lane rentals at current penalties, 10% of user cost, and full user cost—the estimated additional MnDOT costs were, respectively, $12,636, $17,573, and $199,001. Because of these higher MnDOT costs, the economically efficient policy might not be politically practical, even though it would result in the largest net welfare gain. Implementing this policy for a year's worth of construction projects (about 370 on average) would require an additional $74 million in MnDOT expenditure, a 4.4% jump in the department's annual budget, which is a tough sell in a recession.

The intermediate policy—lane rentals at 10% of user cost—may represent a more pragmatic proposal, by increasing per project net social welfare by approximately $164,000 at additional MnDOT costs of approximately $17,600 per project. At a total cost of approximately $6.5 million for 370 road projects—just 0.4% of the 2008–09 MnDOT budget—it would yield enormous net social benefit (of more than $60 million). In addition, rather than focusing MnDOT incentives or penalties on a few high-profile projects, such as the Interstate 35W bridge reconstruction, this policy would take effect throughout the state, so that commuters at other bottlenecks would also benefit from the judicious use of state budget dollars.

Conclusion

Road construction results in substantial costs to commuters in Minnesota and elsewhere, and these costs are usually ignored because they are hard to quantify and are dispersed among thousands of commuters every day. Standard contracts used by MnDOT and other highway departments do not take these costs into account, and provide road construction firms with little if any incentive to minimize the delays that construction imposes on motorists.

A more intelligent approach to contract design, such as lane rentals or A+B bidding processes, offers great potential to speed highway repair and enhance overall social welfare. An economically efficient contract award procedure sets incentives such that contractors equate their benefit to delaying completion to the cost imposed by those delays on commuters. After developing a theoretical model of efficient contract design and analyzing a unique data set of highway contracts awarded by MnDOT between 1997 and 2007, we conclude that substantial increases in social welfare relative to commuter costs are possible at quite moderate costs. As the nation contemplates increased spending on infrastructure improvements, such efficiencies in contract design should be a central consideration.

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